Vision for the Northeastern Illinois Expressway System

Integrated Corridor Management Framework
I-90 Jane Addams Memorial Tollway

Prepared for
Chicago Metropolitan Agency for Planning

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CH2M HILL Engineers, Inc.
8735 W Higgins Road, Suite 400
Chicago, Illinois 60631

Contents

Acronyms and Abbreviations

ATMS	Advanced Traffic/Transportation Management System
CAD	Computer-Aided Dispatch
CMAP	Chicago Metropolitan Agency for Planning
CTA	Chicago Transit Authority
DMS	Dynamic Message Sign
DSS	Decision Support System
ICM	Integrated Corridor Management
IDOT	Illinois Department of Transportation
ITS	Intelligent Transportation System
MaaS	Mobility as a Service
REVLAC	Reversible Lanes Control System
RMIS	Ramp Meter Information System
RTMS	Regional Transit Management System
USDOT	U.S. Department of Transportation

Integrated Corridor Management

Introduction

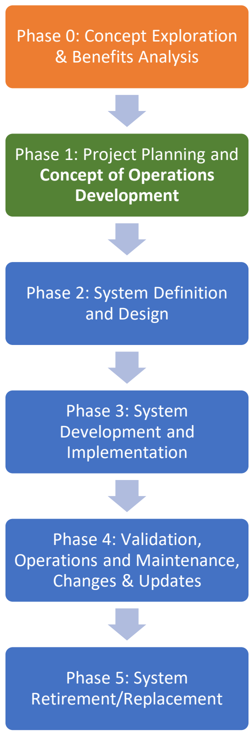
This technical memorandum presents a sketch-level framework for integrated corridor management (ICM) along Interstate 90 (I-90) Jane Addams Memorial Tollway from Hoffman Estates to River Road toll plaza in the northwest suburbs of Chicago (Figure 1). In addition to the I-90 corridor operated by the Illinois Tollway, other key transportation facilities in the corridor include transit systems operated by Metra and Pace and regional arterial systems managed by local jurisdictions along the I-90 corridor. Operators of these facilities are key stakeholders in the ICM framework discussed in this document.

The purpose of the framework is to illustrate on a very high level how ICM could function in the Chicago metropolitan area, if implemented, and how the region's transportation agencies and their respective systems would interface, communicate, and operate in a coordinated manner. The next step is to expand the framework to a concept for operations for the Integrated Corridor Management System that will focus on the details of these multi-jurisdictional operating procedures and protocols under different operational scenarios.

The memorandum begins with a description of ICM, a summary of current practices, an overview of interfaces and information exchanges that develop the *connectivity* between the various transportation, operational and incident management systems in a region, and a discussion of the proposed sketch-level framework for the I-90 Jane Addams Memorial Tollway as the illustrative corridor. The memorandum concludes with an example of how ICM could improve mobility, safety, and information dissemination within the I-90 corridor, when there is an incident on the Jane Addams Memorial Tollway, such as an accident, and identifies next steps for deployment of ICM. Although the I-90 Jane Addams Memorial Tollway corridor was selected for the purposes of an illustrative example given the existing ITS elements and infrastructure along the corridor, an important next step will be for stakeholders to confirm the pilot corridor for the initial deployment of ICM system in the region.

Figure 1. I-90 ICM Corridor

Figure 2. Overview of ICM Development Process



Source: Summarized from *Systems Engineering Guidebook for Intelligent Transportation Systems*

The Joint Agency team discussed the draft ICM framework at its meeting on September 11, 2018. During the meeting partner agencies discussed the process for development and deployment of an ICM system. Figure 2 illustrates in orange that the following framework is reflective of Phase 0: Concept Exploration and Benefits Analysis. The next step denoted in green is Phase 1: Project Planning and Concept of Operations Development. The ICM development process is discussed in greater detail in section *Project Planning and Implementation*. See Joint Agency #6 meeting minutes and presentation for more information.

What It Is

Historically, each transportation agency within the I-90 corridor has handled its operations independent of other agencies operating along the corridor.[1] ICM is the integrated and coordinated operation of existing freeway, transit, arterial systems, incident management, maintenance and parking systems within a corridor using Intelligent Transportation System (ITS) infrastructure, fault-tolerant communications systems, and advanced decision support systems, to manage a corridor as a coordinated system rather than the management of the individual localized transportation networks/systems (for example, transit, arterials, freeways, incident/security, etc.). The goal of the ICM system is to coordinate, monitor, and manage multiple transportation networks and respective operation management systems across jurisdictions within a corridor, with the objective of operating these individual transportation networks as a coordinated unit, to improve mobility, safety, operations, and support a connected and integrated transportation system. A successful implementation of ICM requires a real-time system status of the entire network across all mode operations and interconnectivity between the individual systems within a corridor. A successful ICM would also promote cross-network shifts, modal shifts, change in time of departures, and manage both capacity and demand.

ICM focuses on improving the transportation network by encouraging the efficient movement of people and goods through institutional collaboration, proactive communication, and integration of operations along major corridors (including interstates, arterials, and transit services). Through an ICM approach, transportation agencies manage the corridor as a multimodal system and make operational decisions using real-time data to optimize performance across the corridor.

Current Practices

Through its ICM Initiative, the U.S. Department of Transportation (USDOT) is providing guidance to transportation agencies in implementing ICM and creating supporting tools and standards.[2] US 75 in Dallas and I-15 in San Diego were selected by USDOT in 2013 to be “Pioneer Demonstration Sites”—the nation’s first ICM systems. Separate efforts are also underway in San Francisco on the

[1] A “corridor” is defined as a largely linear geographic band characterized by existing and forecasted travel patterns involving both people and goods (FHWA 2006).

[2] https://www.its.dot.gov/research_archives/icms/index.htm

"I-80 Integrated Corridor Mobility Project" and Virginia "I-95/I-395 Integrated Corridor Management Initiative" to apply ICM concepts to improve corridor performance.

While ICM programs are too new to provide comprehensive data on the impacts, study modeling of ICM in Dallas and San Diego demonstrates several expected benefits, including savings in person hours, fuel, mobile emissions, reduced travel time, and cost and benefit information (Table 1). Expected ICM benefits at these two Pioneer Demonstration Sites indicated projected benefit/cost ratios for combined strategies of 10.1:1 to 20:1.

Table 1. Expected Annual Benefits of ICM in USDOT Demonstration Sites

	San Diego	Dallas
Person Hours Saved	246,000	740,000
Improvement in Travel Time Reliability	10.6%	3%
Gallons of Fuel Saved	323,000	981,000
Tons of Mobile Emissions Saved	3,100	9,400
10-Year Net Benefit	$104 million	$264 million
10-Year Cost	$12 million	$14 million
Benefit-Cost Ratio	10:1	20:1

Source: USDOT. 2017. Integrated Corridor Management (ICM).

The USDOT has developed an implementation guide based on the successes and lessons learned thus far in Dallas and San Diego. The guide can be found on the USDOT National Transportation Library website at: https://rosap.ntl.bts.gov/view/dot/30929.

Interfaces and Information Exchanges

As a starting point for developing the I-90 ICM sketch-level framework, the project team reviewed the *Northeastern Illinois Regional Intelligent Transportation System (ITS) Architecture* (CMAP 2015). As discussed in the document, a primary purpose of the proposed ICM architecture is to facilitate *connectivity* and *operational data/information exchange* between different individual transportation systems in the region and, where appropriate, outside the region. How these systems interface with each other is an integral part of the overall ICM system. A list of ITS elements in the region and opportunities for interfacing elements can be found on CMAP's website.[3] Interfaces have been defined for each element in the proposed architecture, and in some cases interface with several elements. For example, the IDOT District 1 Traffic Systems Center has existing and planned interfaces with several regional ITS networks ranging from *999 Cellular Express Line, to County traffic management centers, arterials signal management systems and future transit management centers.

There are 312 different elements, including city, county, and state traffic operations centers, transit centers, transit vehicles, public safety dispatch centers, media outlets, and others, identified as part of the Northeastern Illinois Regional ITS Architecture. As indicated in the document, these systems include essentially all the existing and planned components that contribute to the regional ITS network.[4]

The project team has developed a matrix of the existing ITS infrastructure that would support deployment of an ICM system in the I-90 corridor (see Appendix A.) The initial evaluation of this ITS infrastructure encompassed a 40-mile stretch of the I-90 corridor from Randall Road in Kane County to the Jane Byrne interchange in downtown Chicago. Based on further review, the I-90 Jane Addams Memorial Tollway between Barrington Road and the River Road toll plaza was identified for

3 http://data.cmap.illinois.gov/its_arch_v30/interfaces.htm

4 http://data.cmap.illinois.gov/its_arch_v30/inventory.htm.

development of a high level illustrative framework to depict how an ICM system could function in the Chicago metropolitan area. Through recent capital improvement program, the Illinois Tollway has deployed multiple ITS elements and supporting infrastructure in this 17-mile section of the I-90 corridor, such as the Illinois Tollway's SmartRoad traffic management system, Pace's I-90 Express Bus service, a fault tolerant fiber optic communication network and a network of modernized, interconnected signals on the adjacent arterial network. These existing system thus offer a good opportunity to illustrate how the ICM system, built on advanced technology platforms, would integrate and facilitate these existing ITS elements to interface, communicate and operate in a coordinated manner. The length of this corridor is comparable to the USDOT pilot programs in San Diego and Dallas.

I-90 Jane Addams Memorial Tollway ICM System Architecture

Figure 3 illustrates a preliminary high-level system architecture for the proposed I-90 Jane Addams Memorial Tollway ICM system. It is composed of a system core that supports continuous and real-time data exchange through system interfaces with various stakeholder systems, ITS field infrastructure, and third-party entities (such as media) to actively manage the corridor operations and disseminate relevant information to the system users (operators and public). The figure illustrates the key stakeholder systems relevant to the I-90 corridor (highlighted in yellow), as well as new or upgraded systems that would optimize ICM system response along the I-90 corridor. The proposed architecture also highlights systems, both existing and future, that can be developed and tailored further towards a Mobility as a Service (MaaS)[5] platform.

The ICM system core is composed of the following:

- A central data hub component, labeled in Figure 3 as "DATA HUB", serving as the back-end database of all data processed through the core. This data hub serves as the physical infrastructure for the system core, supporting data storage and application servers executing the system software.
- A Decision Support System (DSS) component, labeled as such in Figure 3, is the key component in the ICM system operations. Using advanced technology platforms of artificial intelligence (AI) and machine learning, coupled with defined business rules developed by all system stakeholders, the DSS is supported by the following three key subsystems:
  - Business Process Rules Management System, which allows stakeholders (based on inter-jurisdictional agreements) to actively manage and update business rules and protocols to meet the overall operational requirements of the ICM system.
  - Real-Time Simulation Subsystem calculating the key corridor performance metrics.
  - Network Prediction Subsystem providing predicative traffic responses to pre-defined operational scenarios.

  These core subsystems provide a comprehensive view of current and predicted operational conditions of the corridor as a multi-system multi-modal composite and allows the DSS to process and evaluate real-time data inputs from different stakeholder system interfaces. Based on the evaluations, the DSS initiates responses back to the stakeholder systems and provides automated change requests to mitigate and optimize corridor performance. While the AI and machine-learning platforms of the DSS allow it to evolve and fine-tune its responses based on past outcomes, a graphical user interface is always available to stakeholder system operators and incident managers to interact directly with the ICM system core, allowing manual overrides

[5] MaaS is essentially the next step in the progression from isolated agency-by-agency information and operations to a one-call/one-click/one-pay transportation network. The philosophy behind MaaS is to direct people to their most appropriate mobility options, in real time, through a single, unified trip planning and payment application (National Center for Mobility Management 2018).

based on established protocols to fine tune and update the automated responses and procedures from the DSS.

- A System Services component, performing the support functions for the ICM system and specifically the DSS component. For example, the Road Asset Condition Database provides the required inputs to the DSS to consider infrastructure condition and performance when formulating responses. Similarly, the Response Strategy Database provides the DSS with the repository of the latest response strategies and protocols for network issue mitigation, across the stakeholder jurisdictions and systems, which are then continuously fine-tuned and updated by the DSS.

As illustrated in the system architecture diagram, it is critical to affirm that the automated responses from the ICM/DSS do not supersede the authority of the various stakeholders in operating their respective systems. Responses from the ICM/DSS are *requests* to the different stakeholder systems, providing the applicable system with recommended changes to optimize corridor operations based on historical and current conditions. System operators, especially for stakeholders managing sensitive public safety and regional traffic systems, will continue active monitoring of the relevant systems, including the ICM and, as needed, override ICM DSS requests and responses. In addition, the Business Rules Management system of the ICM Core is specifically tailored to accommodate agency policies and protocols in its predictions and simulations, assuring individual stakeholder protocols and business rules are always adhered to in the DSS responses.

The following key systems have been preliminarily identified to interface with the ICM system core in the I-90 corridor. Relevant stakeholders for each of these systems have been identified in Figure 3.

- Advanced Traffic/Transportation Management System (ATMS)
- Regional Events Management System
- Regional Transit Management System (RTMS)
- Smart Parking System
- Ramp Meter Information System (RMIS)
- Weather Information System
- Computer-Aided Dispatch (CAD)
- *Arterial Travel Time System (new system)*
- Regional Arterial Management System
- Lane Closure System
- Reversible Lanes Control System (REVLAC)
- *Corridor Performance Monitoring Systems (new system)*
- *Managed Lanes Control System/Congestion Pricing System (new system)*
- *511 System (new system)*

Integrated Corridor Management Operation: Expressway Incident

Figure 4 provides an overview of how the ICM would operate in the instance of an incident on the I-90 corridor. Input and response for various stakeholder systems are based on the type, location, and severity of the incident. It is important to note that not all systems interfacing with the ICM will be activated for every given event. As an example, the following list illustrates ICM operation for a crash on eastbound I-90 near the Arlington Heights Road exit ramp and how the stakeholders of the I-90 ICM system would communicate and coordinate a response to manage and mitigate the impacts of the incident on the network.

1. A call is made to 911 to report an incident on the expressway. Based upon location, the call is routed to Northwest Central Dispatch System (NCDS), the Public Safety Access Point providing computer-aided dispatch services for many northwest suburban communities, including Arlington Heights. Due to the incident being on the mainline, NCDS routes the call to Illinois State Police District 15 operators who has overall jurisdiction and incident management responsibilities on all Illinois

Tollway routes. In addition, the NCDS notifies emergency services and (in the instance of fatalities) the medical examiner's office.

2. Incident information data is transmitted from the CAD to the ICM Core, initiating the ICM system response. As has been implemented in Lake County, the information is transmitted to the ICM Core without the need for special action by public safety telecommunicators – policies and procedures are established for automatic transmittal of highway incident data to the corridor management system.

3. The ICM exchanges operational data with the Tollway's ATMS. Messages and operational requests are pushed out from the DSS to the ATMS. Incident information and response procedures are disseminated to drivers on the expressway via gantry-mounted Dynamic Message Signs (DMS) and lane control signs (LCS). This may include lane closures, opening the flex lane for either buses or as an auxiliary lane (or reserving it for use by emergency responders), travel-time updates, and suggestions and travel times for alternate routes and modes, as well as parking availability at transit stations.

   – In the future, requests to update the ramp metering or a control plan will be passed along to via the ATMS, reducing the rate at which traffic enters the expressway in the vicinity of the incident. (The Expressway Vision recommend a traffic control system to a greater part of the system, which will allow for a dynamically managed system, more responsive to traffic conditions.)

   – Also in the future, depending on the severity of the incident, maintenance units can be dispatched to close barrier gates at selected expressway entrances.

4. In the future, if a dynamic pricing system is implemented along an expressway (either as managed lanes or a managed expressway), the DSS can request a change to the pricing scheme to either encourage the use of lane(s) for additional capacity (pricing decrease) or reduce the demand for a lane or the entire expressway (pricing increase). Updated pricing information will be disseminated to drivers in real-time via DMS upstream of the incident.

5. Real-time operational data obtained from Closed-circuit Television Cameras and Vehicle Detection Systems in the vicinity of the incident are exchanged between the Regional Arterial Monitoring System and the ICM Core, along with travel times from the Arterial Travel Time System. Signal timing plans are updated to optimize interchanges and parallel arterial corridors near the incident. Arterial re-routing information along interchanges near the incident are disseminated to drivers via upstream DMS on I-90 and depending on the severity of the incident, drivers on adjacent arterial routes are notified via arterial DMSs of the incident, along with recommended alternate routes.

6. Depending on the severity of the incident and the duration (especially if the eastbound I-90 lanes are required to be shut down), to provide multimodal travel alternatives, the ICM may send service change requests to the transit management systems (RTMS), requesting transit agency actions including updated schedule and service frequency, reroutes and customer notifications.

7. Advisory information and response procedures are automatically disseminated to travel information sites such as www.travelmidwest.com via the Gateway Traveler Information System through its interface with the ICM. Similar advisory notifications are also available to the media through the Gateway.

8. Throughout steps 1 through 7 above, the Corridor Performance Monitoring Systems continues live monitoring and evaluation of the overall network performance and provides the DSS with live feedback regarding the system performance, as the incident is being managed, specifically flagging any spillovers. This live feedback loop allows the DSS to tweak the predictions and response plans, thereby providing real-time optimization.

Integrated Corridor Management System Upgrades

Suggested Short Term Improvements

The following is a brief discussion on some ITS elements that have been identified for upgrades as part of past studies and system inventories. The next step is to develop a concept of operations framework for ICM system deployment in the selected corridor, where these preliminary recommendations can be further evaluated and updated to meet the stakeholders' needs and requirements.

General Improvements. The proposed general improvements are designed to address existing communication architecture needs for collecting and storing data from each major corridor. The key improvements include the following:

- Development and approval of interoperability policies and procedures among the various agencies, consistent with a concept of operations also to be developed.
- Establishment of central communications and control for highway traffic signal systems along these corridors, a key component for the overall operation of the ICM system.
- Installation of a physically and logically redundant fiber-optic cable network, and fill in gaps in the existing physical fiber optic network between agencies, to provide a fault-tolerant fiber-optic communication backbone in the region.
- Enhancements to the existing ITS data storage and analysis capabilities, including but not limited to installation of advanced data analytics for data processing and applicable back-end system infrastructure for improved motorist communications and information dissemination.

Active Traffic Management (ATM). ATM system has been recently implemented on the I-90 Jane Addams corridor through the Tollway's Move Illinois capital program, for real-time traveler information dissemination, based on changing dynamic traffic conditions. The Expressway Vision proposes to extend a variation of this traveler information system, using arterial DMS to the adjacent arterial system, integrated into the ICM Core. Improvements will need to be prioritized based on specific needs and goals of the arterial corridor, to support the ICM system functionalities and the requirements to improve regional travel-time reliability and safety. Examples include, but are not limited to, the following:

- Arterial roadside improvements, including arterial dynamic message signs, interconnected central traffic signal control and monitoring systems.
- Improvements at expressway access points, including possible consideration of expressway suitable control systems for managing demand.
- Back office improvements, including centralized data collection and processing and advanced data analytics platforms.

Integrated Corridor Management System Core: One of the key initial investments required is development, integration and commissioning the ICM system core, which would serve as the foundation of all recommended improvements to regional operations, noted herein. These include but are not limited to:

- Decision Support System and all related components noted in the system architecture
- System services and all related components noted in the system architecture
- Required interfaces with existing stakeholder systems
- Communication infrastructure and format

***Illinois Highway Traffic Signal Inventory**:* CMAP maintains the northeastern Illinois Highway Traffic Signal Inventory. A review of the Illinois Highway Traffic Signal Inventory database identified that there are additional locations where signal interconnect system would be beneficial.

Figure 5 illustrates in red the locations of interconnected traffic signals adjacent to I-90.

Suggested Long Term Improvements

Trip Planning/Mobility Marketplace. One of the long-term improvements from the initial deployment of the ICM system is the migration towards a mobility marketplace, to further enhance the motorist experience. Improvements in this category include interface with third party and private vendors to provide real-time pre-trip and in-trip congestion, travel time, incident, multi-modal and alternate routing information to the public on a subscription basis.

Staged System Implementation. Ideally, ICM optimizes travel through a corridor in real-time, by integrating various ITS systems and automating much of the decision-making process that improves outcomes for the various modal networks within the corridor. However, the capital and infrastructure investments required to commission a full ICM system with all required and recommended functionalities at one time could be challenging for the stakeholders involved, specifically in terms of disruptions to existing operational protocols, and inter-jurisdictional agreements and policies.

The modular nature of the proposed ICM architecture allows for a logical phased approach to integration and implementation. With careful consideration and stakeholder concurrence, even initial improvements, noted herein, to existing systems can measurably improve travel reliability within a corridor. The principal focus of upfront implementation should be on reducing inter-jurisdictional barriers to communication and exchange between stakeholders, allowing each system operator to understand current conditions on adjacent systems and how those conditions may affect their operations and decision-making process. Once these channels and protocols are established, the more advanced sub-systems and components as shown, can be added and integrated over time allowing for a smoother transition for the agency system operators and supporting decision making processes that maximize outcomes for the region and the corridor. Additionally, once stakeholders have been through the process, the second implementation process should be easier.

Alternate Locations for Initial Implementation

In northeastern Illinois, as part of the Circle Interchange Project, the I-290 Eisenhower Environmental Impact Statement, and Blue Line Environmental Impact Statement, IDOT worked in partnership with CTA to address regional mobility issues. As part of this collaborative approach, the agencies identified and implemented the following:

- New approach for revamping parallel roads to handle construction-phase/post-construction traffic flow
- New traffic management systems/technology for corridor operations
- Treatments for reconnecting bisected communities
- Transit service enhancements
- Identification of funding sources and future collaboration opportunities

While the Circle Interchange Project was initiated with a focus on addressing the construction phase and post-construction mobility, the collaboration could serve as a foundation for building an ICM in the I-290 Eisenhower corridor.

Integrated Corridor Management as Maintenance of Traffic

Based on the recommendations of the I-290 Eisenhower Environmental Impact Statement, IDOT anticipates reconstructing the I-290 corridor between the I-294/I-88 interchange and the Jane Byrne interchange within the next ten years. Given the volume of traffic using this expressway segment (an average AADT of approximately 195,000 in 2017), a multi-year program will have an adverse impact on congestion and travel time reliability during construction, even with effective conventional maintenance of traffic. While IDOT has made a point to prioritize alternate routes like the Kennedy Expressway and Stevenson Expressway during construction, the local arterial network surrounding I-290 will inevitably absorb some of the effects of construction-related congestion. Having a strategy to effectively manage this demand will be imperative to providing reliable travel to and from the city via the west side.

The Cook-DuPage Corridor Study evaluated the transportation network centered around 30 miles of I-290 and I-88 between the west DuPage County and downtown Chicago, with a goal of improving multi-modal service in this area. As a result of the study, three east-west arterial corridors (along with Harlem Avenue) were recommended for evaluation as smart corridors, with ITS implementation as a main driver. These three corridors – Roosevelt Road, North Avenue, and Cermak/22nd/Butterfield Road – happen to be the three regional arterials in closest proximity running parallel to the Eisenhower segment of the I-290 corridor. These corridors run well into DuPage County, providing vehicles with an alternate route in advance of the construction zone beyond the I-290/I-294/I-88 interchange. Deploying ITS along these arterials would allow for the prioritization of traffic displaced from I-290, while also providing drivers on the expressway system with real-time information on the viability of these alternate routes via existing dynamic message sign locations.

The I-290 corridor also features several transit lines to serve displaced vehicles. Three CTA L lines are within two miles of the corridor (Blue, Green, and Pink), along with the two Metra lines (UP-W, BNSF), providing opportunities for travelers to change modes. Existing infrastructure like expressway dynamic message signs and highway advisory radio can provide drivers with real-time transit information like travel time, train frequency, route delays, and availability of parking at Park n’ Ride facilities.

The I-290 Eisenhower reconstruction project presents a unique opportunity to evaluate an ICM implementation within the region with minimal additional upfront infrastructure investment. Given that construction activity is a planned with known operations and impacts, it would also provide regional stakeholders the chance to test and refine ICM use in a more controlled environment than serving primarily as an incident response system, which is subject to more variability and unpredictability.

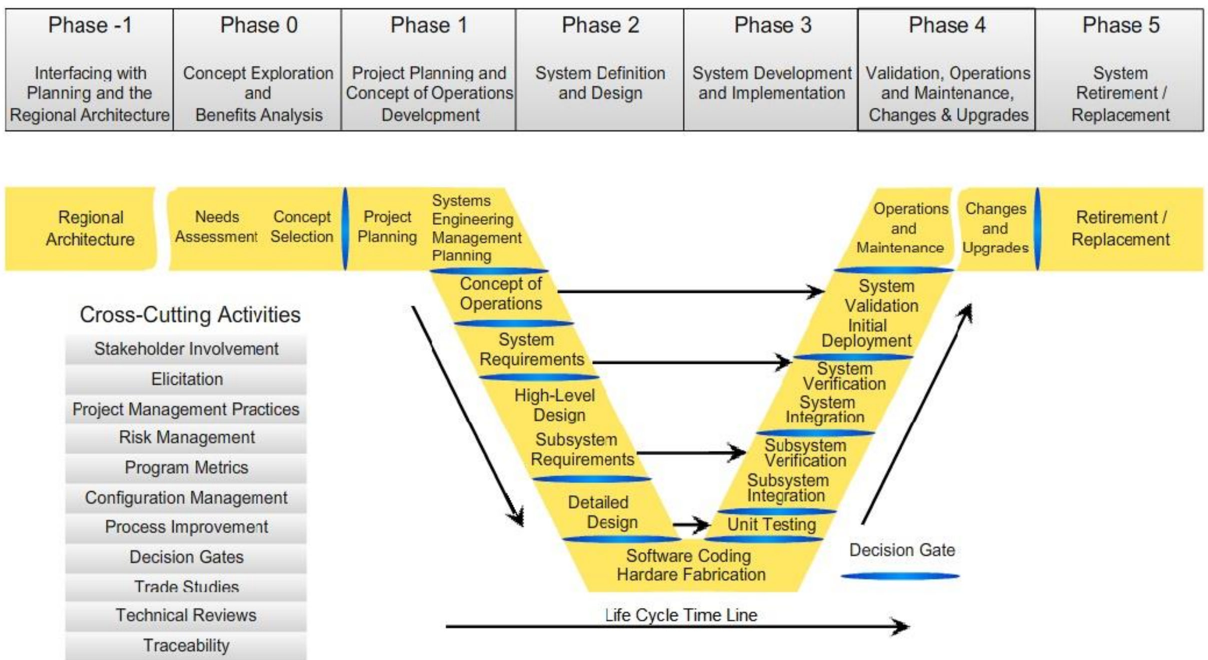
Recommendation

As the next step in the process, the Vision for the Northeastern Illinois Expressway System recommends development of a detailed Concept of Operations to facilitate deployment of Integrated Corridor Management System in the selected corridor.

Project Planning and Implementation

This section provides a high-level overview of the process of developing and implementing an ICM system. The extensive and ongoing collaboration necessary from ICM stakeholders requires a thorough and thoughtful approach when establishing project roles and responsibilities, drafting operational documents and agreements, and constructing necessary infrastructure. Fortunately, a number of resources provide guidance for these tasks, helping stakeholders develop an ICM system that achieves their mobility goals.

Figure 6. Vee Technical Development Model



Source: *Systems Engineering Guidebook for Intelligent Transportation Systems*

Planning Process

At its core, ICM implementation is a system engineering process. In developing the ICM system, it is recommended the project follow the process laid out in FHWA's *Systems Engineering Guidebook for Intelligent Transportation Systems*[6]. Often referred to as the Vee Technical Development Model (Figure 6), the systems engineering life cycle process shows the development of the technical systems and documentation in the context of the project planning and implementation timeline. As the systems hierarchy is designed from the top down (de-composition and definition) and assembled from the bottom up (integration and re-composition). Despite this relative complexity, the general timeline for project development is phased in a manner similar to most infrastructure projects – featuring concept exploration, project planning and concept design, system definition and design, system development and implementation, and validation.

Stakeholders

A precursor to the project initiation is the identification of ICM system stakeholders. This list should not be limited to the owner/operators of the physical facilities on which the ICM will operate. Candidates for consideration as ICM stakeholders should include:

[6] https://www.fhwa.dot.gov/cadiv/segb/files/segbversion3.pdf

- **Transportation agencies**: state DOT, local agency (city and county) transportation and public works departments, Federal Highway Administration, state motor carrier agencies, and toll authorities
- **Transit/multi-modal agencies**: local transit (city/county/regional), Federal Transit Administration, paratransit operators, rail services (e.g. Amtrak), Federal Rail Administration, port authorities, seaport authorities/terminal operators, and department of aviation or airport authority
- **Fleet operators**: commercial vehicle operators (long-haul trucking and local delivery services), courier fleets (e.g. USPS, FedEx, UPS, etc.), and taxi companies
- **Public safety agencies**: law enforcement (including state police/highway patrol, county sheriff department, city/local police, and transit/port police), fire departments/first responders, emergency medical services, hazardous materials teams, 911 services, and Department of Homeland Security/FEMA
- **Travelers**: commuters, residents, tourists/visitors, motorists and their passengers, transit riders, commercial vehicle operators, and bicyclists/pedestrians
- **Private sector**: traffic reporting services/information service providers, local TV/radio stations, travel demand management industry, telecommunications industry, automotive industry, and private towing/recovery businesses
- **Planning organizations**: metropolitan planning organizations, council of governments, and regional transportation planning agencies
- **Activity centers**: event centers (e.g. sports, concerts, festivals, casinos, etc.)
- **Other agencies**: tourism boards/visitors associations, school districts, local business leagues/associations, local Chambers of Commerce, National Weather Service, air and water quality coalitions, Bureau of Land Management, academia interests, local universities, military (including Coast Guard), and US Army Corps of Engineers
- **Other agency departments**: information technology, planning, telecommunications, and legal/contracts

This list, while not exhaustive, represents those with a vested interest in regional mobility. From this group, a governance structure for the project should be established, to guide the project through the planning and implementation process.

Agreements

Key to the development of the ICM system are the agreements between stakeholders, governing the protocols for cooperation and exchange between of the entities in their effort to improve corridor mobility. The agreements should cover the following topics:

- **Participants and Geographic Coverage**: An agreement must identify each party to the agreement and the geographic area it covers. The number of parties to an agreement varies according to limitations established by state law, the purpose of the agreement, and the geographic area involved.
- **Purpose, Need, and Authority**: The purpose and need section of the agreement should indicate the activity or activities to be handled through the agreement, any standards that the activity should meet, and any exceptions to those standards. Statutes and regulations appropriate to the agreement should be cited.
- **Roles and Responsibilities**: The discussion of roles and responsibilities is often the lengthiest and most detailed part of a cooperative agreement. However, the level of detail varies depending on the subject of the agreement.
- **Adoption, Duration, Amendment, and Termination**: This element may include such information as the effective date, the period covered by the agreement measured in time or completion, terms for renewal or amendment, and termination requirements.

- **Funding and Financial Arrangements**: A crucial element of any agreement that involves shared financial obligations is a detailed statement about which party (or parties) is responsible for bearing the cost of various portions of the agreement. Such arrangements may encompass personnel, service, funds, equipment, property, or facilities.
- **Appendices**: Corridor management agreements are often accompanied by appendices that contain management plans or other technical supporting documents. One potential benefit of separating agreements from technical support documents is that it enables authors to negotiate specific details of an agreement or plan separately in small groups or committees. Then, the detailed plan may be adopted as a separate document or appendix to an agreement through one of the methods as described, such as a resolution, MOU, or intergovernmental agreement.

Agreements between agencies can take many forms, such as a resolution, a memorandum of understanding (MOU), intergovernmental agreement, or some combination of these methods. In *Integrated Corridor Management, Phase 1 – Concept Development and Foundational Research*, these agreements are defined as follows:

- A **resolution** can be generally defined as the formal expression of an opinion or the will of a governing body on a given policy at a particular point in time. As such, resolutions are not legally binding and are subject to change. However, a resolution in support of corridor management may serve as an initial step toward a more formal and legally binding cooperative agreement.
- A **memorandum of understanding (MOU)** goes beyond a resolution to document the desire of involved parties to engage in a particular course of action. For corridor management, an MOU is generally used to define roles and responsibilities of participating entities, as well as to establish common direction on a particular course of action. An MOU could serve as an intermediate step toward more extensive cooperation or it may be the only form of declaration in those places where a more formal or binding agreement cannot be attained or is not necessary given the ICM approaches to be deployed.
- An **intergovernmental agreement (IGA)** may be defined as "a legal pact authorized by state law between two or more units of government, in which the parties contract for or agree on the performance of a specific activity through either mutual or delegated provision" Because they are tantamount to contracts, intergovernmental agreements work best when responsibilities, financial obligations, and procedures are detailed. They also are the most binding, from a legal perspective.

When developing the framework for the project description and project governance framework for the ICM system deployment, it is recommended that stakeholders enter into **Memorandum of Understanding (MOU)** as the preliminary agreement in lieu of an IGA. The less formal MOU would permit stakeholders to develop the project's goals and objectives without the legal obligations of an intergovernmental agreement. As identified in the Appendix C of *Elements of Business Rules and Decision Support Systems within Integrated Corridor Management: Understanding the Intersection of These Three Components* the MOU serves the following purposes:

- Confirm support from all project partners, particularly local support for expressway ITS elements
- Articulate key operations and maintenance principles for continuing project development
- Clarify ownership, operations and maintenance, and management responsibilities
- Clarify the distribution of costs and funding sources
- Outline the framework for multi-agency cooperation, collaboration, and conflict resolution
- Identify which Smart Corridor system and elements will be part of the ICM project
- Signify the ongoing commitment of the project partners to deliver the project and make it a success

Once stakeholders have defined and designed the ICM system to the satisfaction of each party, formal intergovernmental agreements based on the terms developed under the MOU would provide the stakeholders with a legal structure for defining roles and responsibilities. The project's IGA(s) may take one of several forms based on stakeholder needs – a single agreement between all parties to govern the entirety of the project, a series of two-party agreements between stakeholders, or a series of agreements between select stakeholders for specific aspects of the project. However, the simplest approach practicable is recommended when developing agreements, as the legal process for an IGA approval may take upwards of 12 months. NCHRP Synthesis 337, *Cooperative Agreements for Corridor Management*, identifies the state of current practice in developing and implementing cooperative agreements for corridor management, elements of such agreements, and best practices or lessons learned.

Documentation

Based on guidance from FHWA's *Elements of Business Rules and Decision Support Systems within Integrated Corridor Management: Understanding the Intersection of These Three Components*[7], the following documentation is recommended for ICM implementation.

To design the project:

- **Project Report**: Defines the purpose and need for the project, identifies the alternative selected, describes how that alternative was decided upon, and describes how consensus was reached among stakeholders.
- **Environmental Document**: For a capital project to proceed, it must receive official federal, state, and environmental approvals as well as consensus from all the stakeholders and the public.
- **Corridor Systems Management Plan (CSMP)**: Overall corridor operational conditions, existing and future conditions, list of future projects, and recommendations.
- **Concept of Operations Report (Con Ops)**: Concept operations for the proposed system including user-oriented operational needs and requirements, operational descriptions, system overview including operational and support environment, operational requirements, typical operational scenarios based on the requirements and summary of response protocols and impacts.
- **Traffic Operations Analysis Report (TOAR)**: Existing traffic conditions, proposed alternatives, traffic forecasts, modeling results.

To govern the implementation of the project discussed herein:

- **Project Implementation Plan**: Document identifying the staging and commissioning of each ICM project element.
- **Operations and Maintenance (O&M) Plan**: Operational scenarios and cost of operations, lifecycle maintenance and management cost for each subsystem along the corridor proposed to be interfacing and integrated into the ICM.
- **Incident Response Plan (IRP)**: Overall incident response plan that defines various incident scenarios and procedures for managing traffic congestion during incidents, including signal flush plans.
- **System Integration Plan**: Specifies the procedures, methods and strategies to implement the required project elements based on project documents and system requirements.
- **Configuration Management Plan**: Details the process to establish and maintain the integrity and control of software and hardware products.
- **Outreach Plan**: Outlines strategies to disseminate periodic project information and updates to various stakeholders.

[7] https://ops.fhwa.dot.gov/publications/fhwahop17027/app_c.htm

Funding Opportunities

In the past, the USDOT has awarded ICM grants to highly congested urban areas to expand real-time traveler information. In 2015, $2.6 million was awarded to 13 cities to combine numerous information technologies and real-time travel information from highway, rail, and transit operations. Additionally, the ICM system pilot project may be a good candidate for the Congestion Mitigation and Air Quality program (CMAQ). CMAQ provides a flexible funding source to State and local governments for transportation projects and programs to help the region meet the requirements of the Clean Air Act. Funding is available to reduce congestion and improve air quality for areas that do not meet the National Ambient Air Quality Standards for ozone, carbon monoxide, or particulate matter (nonattainment areas).

Summary

Due to jurisdictional and technical complexities, a phased approach to ICM deployment is recommended. Some of the initial system upgrades towards ICM implementation include:

- Priority existing system upgrades
  - Physically and logically redundant fiber-optic network to support a fault-tolerant communication network between agencies and to signal systems along key arterial corridors.
  - Upgrades and interconnection of traffic signals along principal arterial corridors within a 2 to 5 mile buffer of the I-90 corridor, with specific emphasis on corridors that run parallel to the corridor, including deployment of coordinated and centralized signal system control system software.
- Priority future systems
  - Traffic Control System at expressway access points, which could include enhanced ramp metering system infrastructure control system software.
  - ICM system, including the following:
    - Decision Support System and all related components noted in the system architecture
    - System Services and all related components noted in the system architecture
  - Corridor Performance Monitoring System
  - Arterial Travel Time System

Given the jurisdictional and technical complexities of this proposed system, stakeholder engagement, communication, and clear understanding of needs, goals, visions, and objectives of the ICM system is critical to its success. It is recommended that stakeholder operations staff be interviewed to identify other gaps in the existing I-90 corridor ITS architecture, and to identify other needs and issues within the corridor that can be addressed towards the deployment of the ICM system. Barriers to data sharing, both institutional and technical, and strategies to overcome the barriers, should be clearly discussed.

Taking into consideration the design and development of the ICM system and the numerous interface requirements as noted herein, a strict adherence to the systems engineering approach is critical.

Following the establishment of project governance structure, key next steps would include development of the Concept of Operations (ConOps) for the proposed ICM system which would include elements discussed herein and key stakeholder interviews to define the system requirements and operational scenarios. This key system engineering document should, at a minimum, document and address the following items:

- Existing conditions and systems

- System stakeholders – key and related
- Needs
- Vision, goals, and objectives
- ICM system overview
- Operational and support environment – what enhancements are required to existing systems, and what new systems / components are required to make ICM system work
- Operational scenarios – describe what happens (with diagrams) and who / what is responsible for making operational changes for a variety of different scenarios
- Implementation plan – a staged approach for implementing the ICM system, budget estimates, and which stakeholders are responsible for each implementation activity

Once the Concept for Operations document is approved, the next steps are to develop the following:

- Policies and inter-governmental agreements
- System Requirement Specifications document
- Interface Control document to define the various system interfaces depicted in the system architecture
- Staged implementation plan

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