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Guide to Integrating Business Processes to Improve Travel Time Reliability

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Accelerating solutions for highway safety, renewal, reliability, and capacity

Guide to Integrating Business Processes to Improve Travel Time Reliability

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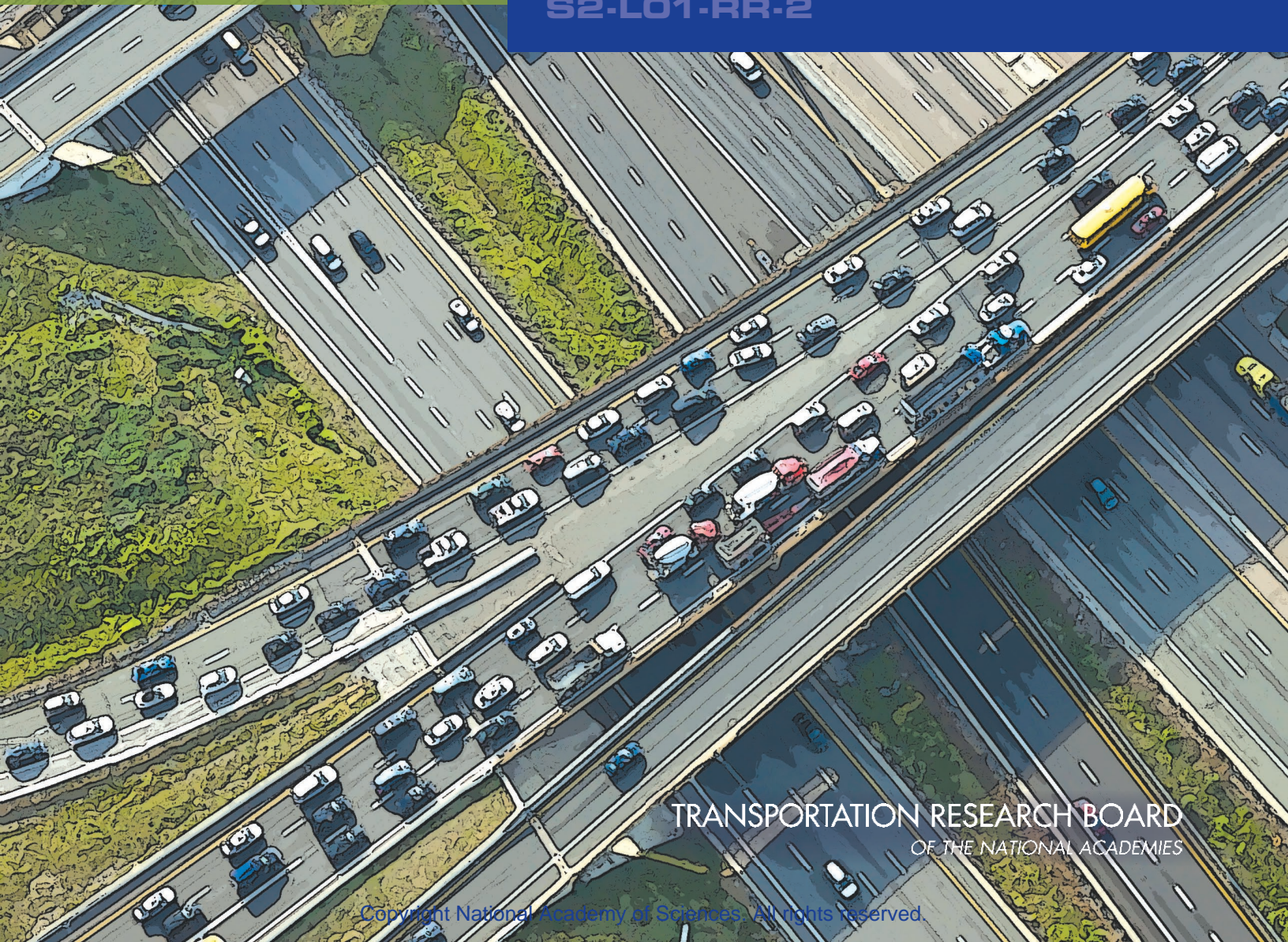
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Guide to Integrating Business Processes to Improve Travel Time Reliability

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The need for SHRP 2 was identified in *TRB Special Report 260: Strategic Highway Research: Saving Lives, Reducing Congestion, Improving Quality of Life*, published in 2001 and based on a study sponsored by Congress through the Transportation Equity Act for the 21st Century (TEA-21). SHRP 2, modeled after the first Strategic Highway Research Program, is a focused, time-constrained, management-driven program designed to complement existing highway research programs. SHRP 2 focuses on applied research in four areas: Safety, to prevent or reduce the severity of highway crashes by understanding driver behavior; Renewal, to address the aging infrastructure through rapid design and construction methods that cause minimal disruptions and produce lasting facilities; Reliability, to reduce congestion through incident reduction, management, response, and mitigation; and Capacity, to integrate mobility, economic, environmental, and community needs in the planning and designing of new transportation capacity.

SHRP 2 was authorized in August 2005 as part of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). The program is managed by the Transportation Research Board (TRB) on behalf of the National Research Council (NRC). SHRP 2 is conducted under a memorandum of understanding among the American Association of State Highway and Transportation Officials (AASHTO), the Federal Highway Administration (FHWA), and the National Academy of Sciences, parent organization of TRB and NRC. The program provides for competitive, merit-based selection of research contractors; independent research project oversight; and dissemination of research results.

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The SHRP 2 Reliability Project L01 workshop Integrating Business Processes to Improve Travel Time Reliability was held in Phoenix, Ariz., from May 5 to 6, 2009. Attendees were Natalie Bettger, Senior Program Manager, North Central Texas Council of Governments; Mark Bush, PE, PTOE, Program Manager for Operations, American Association of State Highway and Transportation Officials; John Corbin, PE, PTOE, State Traffic Engineer, Wisconsin Department of Transportation; John Conrad, PE, CH2M Hill; Leslie Spencer-Fowler, ITS Program Manager, Kansas Department of Transportation; Catharine Jensen, Transportation Planner, Michigan Department of Transportation; Galen McGill, PE, Intelligent Transportation Systems Manager, Oregon Department of Transportation; Terry Mullins, Bureau Chief, Bureau of Emergency Medical Services and Trauma Systems, Arizona Department of Health Services; Rick Nelson, PE, Assistant Director of Operations, Nevada Department of Transportation; David Plazak, Senior Program Officer, SHRP 2; Faisal Saleem, ITS Program Manager, Maricopa County Department of Transportation/AZTech; Battle Whitley, PE, Division Operations Engineer, North Carolina Department of Transportation; Lisa M. Burgess, Vice President, KHA; Jeffery W. Dale, PE, Project Engineer, KHA; Thomas M. Fowler, PE, PTOE, Vice President, KHA; Amanda R. Good, Analyst, KHA; and Pierre Pretorius, PE, Senior Vice President, KHA.

FOREWORD

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SHRP 2 Senior Program Officer, Capacity and Reliability

Improving travel time reliability is an emerging business activity for transportation agencies in the United States. To improve the reliability of travel times on their roadway networks, transportation agencies must advance on a number of fronts. These include collecting and analyzing data; integrating travel time reliability considerations into planning, programming, and project delivery; adopting innovative operational strategies and technologies; and modifying their institutional structures and business practices surrounding traffic operations. The report and accompanying guide explore various ways that transportation agencies can reengineer their day-to-day business practices to improve traffic operations, address nonrecurring traffic congestion, and improve the reliability of travel times delivered to roadway system users.

The report for this project (2) is based on a series of case studies that describe successful business processes. The case studies show how business processes were successfully reengineered in operational areas such as traffic incident management (TIM), work zone management, planned special event management, road weather management, and traffic control system management. Students of traffic operations will recognize these subject areas as corresponding to five of the seven causes of nonrecurring traffic congestion. (The two omissions concern inadequate base roadway capacity and fluctuations in travel demand.)

The research report and guide also provide a detailed introduction to one of the most useful tools for business process reengineering: business process mapping. An approach to business process mapping developed by the IBM Corporation for use in automating business processes, called Business Process Modeling Notation (BPMN), is used in the report and guide. This approach proved highly adaptable to business processes related to traffic operations. BPMN uses a straightforward graphical approach to business processes, illustrating them with objects, flows, pools, and lanes. Business processes diagrammed using BPMN are simple to comprehend and communicate.

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This guide, which focuses on showing how to use BPMN for mapping traffic operations business processes, the report, and other SHRP 2 Reliability products related to institutional structures and business process reengineering are intended to help transportation agencies move forward in addressing nonrecurring traffic congestion and delivering more reliable travel times on their highway networks.

PREFACE

The purpose of the SHRP 2 Reliability Project L01, Integrating Business Processes to Improve Travel Time Reliability, is to assist transportation agency and authority managers in assessing their business processes for transportation system operations and in developing and integrating key business processes to improve travel time reliability. Reliability of the transportation network, which can be defined as the consistency of travel time for a particular trip, is dependent on many agencies and many processes; often these independent business processes must work together to achieve reliability objectives. Travel conditions on streets and highways are significantly affected by congestion triggers such as incidents, work zones, special events, and weather. The impact of each of these events on reliability can be minimized to some extent by processes put in place by various agencies. Furthermore, where there are opportunities to implement improved processes or enhance current procedures by integrating processes from one or more agencies, there can be a significant reduction in the impact of congestion triggers. For example, the impact of an incident on reliability will be influenced by fire and emergency medical service (EMS) response to aid victims, police response to investigate and clear the incident, and transportation's response to provide detours and advance traveler information. Reliability may be improved when the various processes are integrated with common goals, such as improved reliability built into each of the different processes.

Information for this project was gathered through literature reviews; a workshop conducted with representatives from federal, state, and local planning and operations agencies (*1*); and a series of 10 case studies. Information from the research is presented in *Integrating Business Processes to Improve Travel Time Reliability* (*2*).

The case studies provided the primary basis for the project's recommendations and guidance. The case studies looked at successful examples in which business process integration resulted in improved reliability. The following are the case studies and the agencies that participated in them:

• Washington State Joint Operations Policy Statement (JOPS) and Instant Tow Dispatch Program— Washington State Department of Transportation (WSDOT);

• Florida Road Rangers Freeway Service Patrol Program—Florida Department of Transportation (FDOT);

• United Kingdom (UK) Active Traffic Management—UK Highways Agency;

• North Carolina Department of Transportation (NCDOT) Traffic and Safety Operations Committee—NCDOT;

• Michigan Department of Transportation (MDOT) Work Zone Traffic Control Modeling—MDOT;

• Kansas Speedway Special Event Traffic Management—Kansas Department of Transportation (KDOT) and Kansas Highway Patrol (KHP);

• The Palace at Auburn Hills Special Event Traffic Management—Road Commission of Oakland County and Auburn Hills Police Department;

• I-80 Winter State-Line Closures—Nevada Department of Transportation (NDOT);

• AZTech Regional Archived Data Server—Maricopa County Department of Transportation (MCDOT)/AZTech; and

• San Pablo Avenue Signal Retiming—Metropolitan Transportation Commission (MTC).

As the case studies evolved, it was found that there were two distinct aspects to process integration that were critical to support reliability-focused operations: process integration at the operations level and process integration at the institutional or programmatic level. At the operations level, various processes and activities evolve and are coordinated among those who are responsible for overseeing or carrying out operational initiatives. There is often a direct link between the process and the outcome. These processes are often detailed and unique for each application and typically do not require major changes within organizations at the programmatic, administrative, or legislative level.

Process integration at the programmatic level is a much more complex undertaking. Not only are there different constraints to be worked through at the institutional level, there is also a much less direct relationship between those programmatic processes and their contribution to travel time reliability, although institutionalizing certain processes may be an important enabler of operations processes. Process integration at the programmatic level may require more formal adoption of the changes and will generally take longer and involve higher levels of decision makers within one or more agencies.

This guide identifies influences that lead to process integration, common obstacles faced when implementing process integration, and an outline of the steps that can be referenced to implement and institutionalize processes. The steps reflect the need to define specific reliability goals, document current business processes and recommended changes, implement a process, measure outcomes against reliability goals, and institutionalize the process. The guide is not specific to any one process. Its purpose is to assist any agency that is seeking to improve travel time reliability through improved coordination and integration of multiple processes and agencies.

CONTENTS

Color versions of the figures in this guide are available online:
www.trb.org/Main/Blurbs/165284.aspx.

1 PURPOSE

INTRODUCTION AND BACKGROUND

Travel time reliability marks an increasingly important measure for travelers; any traveler who uses the transportation system—by car, bus, freight vehicle, and even emergency response vehicle—can relate to the frustration of having a trip take longer than expected. Travelers tend to develop assumptions of how long a trip will take and plan accordingly on the basis of their personal historical experience, time of day, or day of the week, among other parameters. A traveler who routinely takes a specific route at a specific time of day may expect some level of congestion; typically, this is a reliable assumption. When factors such as a crash, work zone restricting travel lanes, special event, hazardous weather, or other anomaly unexpectedly affect the network, the reliability diminishes. Unforeseen delays account for almost half of the congestion on the nation's roadways.

Effective traffic management and operations are the result of a number of different business processes working together. Business processes comprise two general types of activities: operational processes and institutional or programmatic processes. At the operations level, various processes evolve and are coordinated among those who are responsible for overseeing or carrying out operational initiatives. Processes at the programmatic level involve higher levels of decision makers and often more than one department or agency.

Within a transportation agency, there is a range of operational processes aimed at maintaining safe and efficient network operations even when unforeseen events affect overall network reliability. Transportation management agencies plan their standard operational strategies on the basis of assumed "typical" travel conditions, which vary with time of day, day of week, and route. These procedures may be modified occasionally to sustain current operations and improve efficiency as roadway conditions and technologies change. Event-specific processes are set in motion by different triggers

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or events that affect typical conditions. When an event-specific process is found to be effective, an agency may incorporate it into its program for use during a similar future event. Both standard and event-specific operational processes are designed to provide specific responses or actions to improve conditions for users of the transportation network.

This guide examines the integration of business processes at the two key levels: operational and programmatic.

At a broader, institutional level, there also are important processes that work toward improving the reliability of the network. These institutional or programmatic processes are often more challenging to implement, but they have the potential to yield tremendous benefit. Institutional processes may include policies, training, interagency agreements, and reporting strategies. Managing a transportation network is a collaborative endeavor that relies on equally effective business processes of key partners, such as law enforcement, emergency responders, and adjacent jurisdiction transportation operations and management agencies, and even participants from the private sector, among others.

This guide examines the integration of business processes at the two key levels: operational and programmatic. It provides a step-by-step guide for agencies to assess their operational processes and identify opportunities to change or develop new processes. This guide also provides agencies with recommendations related to documenting and institutionalizing operational processes to improve their sustainability within the organization once they are effectively implemented. Finally, it summarizes the benefits and challenges associated with integrating and institutionalizing processes related to travel time reliability. Additional information from the research is presented in the SHRP 2 L01 report, *Integrating Business Processes to Improve Travel Time Reliability* (2).

CONTENTS AND ORGANIZATION

Chapter 2 provides an introduction to business processes and an overview of process integration concepts. It gives the reader context for subsequent discussions that focus on operational and programmatic processes. The chapter also includes a brief discussion on business process modeling as a tool for agencies to assess and document their processes.

Chapter 3 presents the proposed seven-step integration approach for analyzing, implementing, documenting, and institutionalizing business processes. This methodology is illustrated through two case studies, detailed in Chapter 4, that show how different steps in the business process development and integration approach are applied using real-world operational examples. Chapter 5 presents some of the typical benefits and challenges of process integration and strategies for aligning the process for integration with other established planning activities (including regional intelligent transportation system [ITS] architectures and the congestion management process). Last, Chapter 6 provides a brief summary of the guide and the material presented.

INTENDED READERSHIP

The intended readership of this guide includes managers within state and local agencies that are responsible for overseeing operations programs for traffic management, maintenance, traveler information, and incident response and management. The content and context of operational processes described here are focused on managers who develop programs, who liaise with internal and external departments within a department of transportation (DOT) or law enforcement agency, and who can influence programmatic components. Their responsibilities would include recommending training needs, recommending or developing policy, or requesting funding through programming processes.

2 TRAVEL TIME RELIABILITY AND OPERATIONS

WHAT IS TRAVEL TIME RELIABILITY?

Travel time reliability moves beyond typical congestion management strategies, which often are associated with urban area freeways during peak travel periods. Travel time reliability is a measure of the consistency of a trip duration based on a specific time of day and route. Reliability typically is discussed for weekday peak-hour travel, and it is measured as the percentage of trips that are within an acceptable variation of the expected trip duration. However, reliability also is a factor for nonurban and non-peak-hour travel, where incidents or other anomalies can cause significant impacts.

As DOTs move toward more customer-based performance metrics, network reliability and travel time reliability assume more importance among potential measures on which a transportation system is rated. Reliability is an important day-to-day measure for the traveler, who must make route decisions on the basis of his or her personal experience with previous or similar trips, make assumptions about how long a particular journey will take, and factor in elements such as time of day, weather conditions, or other variables. Reliability-focused performance measures are emerging for transportation agencies, although most agencies rely on measures such as delay, level of service, or typical congestion levels during a specific time of the day on a specific segment as an indicator of network performance. The concept of travel time reliability goes beyond day-to-day congestion or urban area versus rural area, and it focuses on those inconsistencies that result in unexpected delays. Incidents, work zones, special events, hazardous weather, and bottlenecks all contribute to diminished travel time reliability.

The SHRP 2 Reliability L01 research effort takes a specific look at the operational and programmatic processes that directly influence network reliability and travel time reliability. More specifically, this project analyzes the steps agencies would take to change or develop processes that improve travel time reliability.

FOCUS ON BUSINESS PROCESSES AND PROCESS INTEGRATION

There are several interpretations of a business process, and the term may have a different connotation depending on the context or focus. Business process management and mapping are used regularly in the systems engineering and information technology arenas, where they take a quantitative approach. In those fields, efforts are under way to standardize how processes are shown and integrated to provide a detailed road map of events, actors, inputs, outputs, activity sequences, and outcomes.

This guide's approach for business process modeling for transportation operations is based on the systems engineering mapping model. The transportation arena comprises a variety of different processes with a range of complexity and detail, often executed by more than one entity or agency. Business processes can range from the steps a DOT maintenance supervisor takes to schedule a snowplowing activity for the division in advance of a winter storm, to the steps and actions involved in a multiagency response to a major incident on an urban freeway. There are two levels of business processes that support travel time reliability: operational and programmatic.

> **Operational processes are those that are typically sequential, well defined, and outcome oriented.**

Operational processes are those that are typically sequential, well defined, and outcome oriented. These are the types of processes that may be associated with very specific steps of operational functions, often performed in accordance with a standard operating procedure. They are typically quantifiable and measurable in terms of a time-based sequence. For example, a 911 call to a dispatch center about a roadway incident will set in motion a certain sequence of actions within the 911 call center, and it often will extend to external entities, such as law enforcement, emergency responders, transportation agencies, and potential others. Because these steps are well defined, operational processes are often easier to measure, either by time, completion, activity (number of events or actions), or other means, than are programmatic processes. Operational processes typically are developed and integrated on the basis of need and may be initiated by personnel most closely connected with the problem.

Programmatic processes represent broader agency programs or services. Long-range planning, divisional program development, training needs and programs, formal agreements, or performance management activities are just a few examples of programmatic processes within transportation agencies. These are often important enablers of operational processes, but they may require more formal adoption or even legislative action before they can be implemented. Programmatic processes can often be somewhat removed from day-to-day operational activities; because these processes are not typically linked to sequential activities or to a timeline, measuring the impact and effectiveness of programmatic processes or process integration can be difficult. Programmatic processes often represent those values or requirements that have been institutionalized; that is, they have become formally engrained into the overall agency business culture.

Both operational processes and programmatic processes are necessary to ensure the maximum benefits of the new programs. Figure 2.1 shows the relationship of operational processes to programmatic processes.

Process integration is the course of action by which a new or changed process is incorporated into an agency's business practice. As shown in Figure 2.1, integration occurs within both operational and programmatic processes and also is used by agencies to transition a new or changed process from a daily operational activity to higher-level institutional policies and programs.

Integration can occur either through deliberate efforts or as a result of evolution over time. In order for a process to become part of day-to-day operations or to justify a change in current processes, there needs to be a demonstration of tangible benefits. Within a single division of an agency, benefits of integrating an operational process may quickly be realized, either through improved efficiency, streamlining of steps, or improved product or output. The impetus and the input to operational process integration often come from individuals who are directly involved in either carrying out or overseeing those specific operational processes.
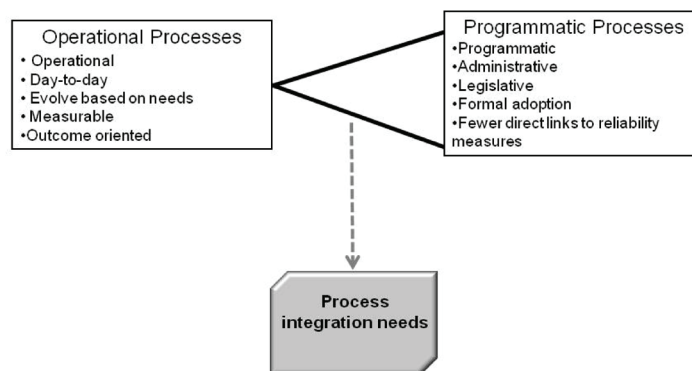
Figure 2.1. *Relationship between operational and programmatic business processes.*

Michigan Department of Transportation Work Zone Traffic Control Modeling

MDOT has developed a tool for work zone modeling for use by construction engineers. Although translation of the output is still being formatted, once complete, the tool will allow construction engineers to make modifications based on changing work zone configurations or schedule. This relationship between the planners and construction engineers is an example of a successful integration point.

Operational process integration could take several forms, such as the following:

• Updating or modifying a standard operating procedure;

• Formally documenting steps in a process through a procedural manual and making that process available to others or implementing a training program to provide a level of consistency among personnel who are responsible for that process; or

• Implementing a system, software, or reporting mechanism that improves or streamlines a process.

When processes need to be integrated between multiple divisions or agencies, a much more formal process probably needs to be followed. Such a process typically requires a more collaborative approach to identifying a need to change how things are currently done and may require justifications of time and resources. If effectively

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bringing processes together requires personnel, costs, or substantial changes to one or more agency policies, higher-level support will be necessary. As seen in the case study interviews in Chapter 4, a top-down directive was often the primary impetus for implementing significant interagency process integration efforts.

Strategies that can address more complex process integration efforts include the following:

• Formalizing roles and responsibilities through an agreement, such as a memorandum of understanding, intergovernmental agreement, or other binding vehicle.

• Establishing justification by identifying a common goal, particularly between two agencies or divisions. If there is no direct link to an agency's core function, its role in the process might not be easily understood, and the agency might not support making a significant change.

• Identifying impacts and outcomes that are expected to result from a new process or collaborative approach. Any additional training, procurement of additional systems, or new reporting procedures that will be required should be identified early. Making a direct link to expected outcomes and benefits also will help with justification.

It is important to recognize that different agencies operate on different timelines. Significant changes to policies or procedures, or processes that might require procurement, may require consideration of planning and programming schedules and departmentwide reviews of procedural activities. Major changes or updates to training programs also might require additional time for development, review, and implementation. Although this additional time helps establish a foundation for change, it also can affect the timeliness of implementation.

MODELING AND ANALYZING BUSINESS PROCESSES

In this project, it was important to select a consistent method of process modeling to assist in comparing similarities across several dissimilar processes. Business process modeling provides a visual representation of the steps included within a process and makes a connection between those who create the process, those who implement the process, and those who will perform the process. Research was undertaken to determine the most applicable business process modeling approach, and the Business Process Modeling Notation (BPMN) was identified as a viable standard to use.

BPMN uses a visual representation consisting of several terms and phrases that provide consistency to help guide a process's flow of events. It allows activities with a workflow to be mapped on the basis of their relationship to time and to each other. The flow of a process begins with an event. The process then moves through the necessary tasks or subprocesses to a result or an end event. Along the workflow, decisions may be required; these decisions or integration points are modeled using "gateways." These gateways also can represent a diverging or merging of workflows or processes. The gateways are an important aspect of the overall process and can influence the flow of a process or the operation of an agency. Another important aspect of BPMN

Business process modeling provides a visual representation of the steps included within a process and makes a connection between those who create the process, those who implement the process, and those who will perform the process.

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Figure 2.2. *Example of BPMN business process for WSDOT incident response.*
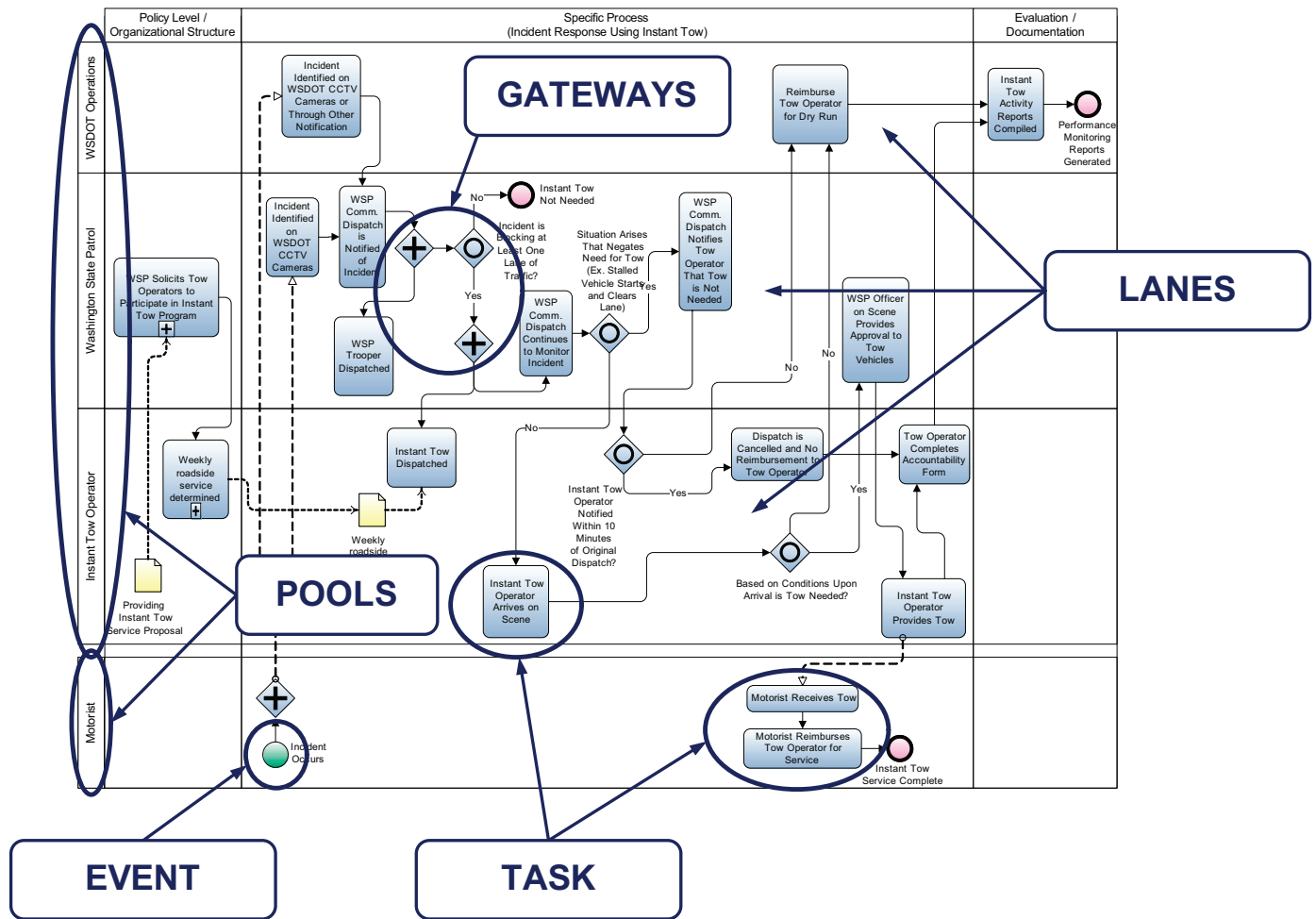
modeling is the use of "pools" and "lanes." Pools represent stakeholders with aligned responsibilities for each process, and a lane represents a department or person within that stakeholder group who is actually performing a specific task within each pool.

As seen in the SHRP 2 L01 report, *Integrating Business Processes to Improve Travel Time Reliability*, each of the cases studies presented in the analysis has been mapped using BPMN (*2*). Figure 2.2 is an example of the mapping process for an incident in the Instant Tow Program at the Washington State Department of Transportation (WSDOT). This example also is described in more detail in Chapter 4.

As seen in Figure 2.2, one pool for this process includes operators and the State Patrol, who work together to respond to incidents. The motorist is in a second pool. Within each pool, horizontal "swim lanes" are used to represent each of the agencies or working groups involved within the process: WSDOT Operations, Washington State Patrol, and Instant Tow Operator. The analysis used vertical "swim lanes" to divide the overall process into three core areas: Policy Level/Organizational Structure, Specific Process, and Evaluation/Documentation.

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The agencies involved in the case studies had not formally mapped their business processes before this research project. After interviews were conducted, the processes were mapped and then reviewed by the agencies for accuracy.

Although mapping had not been performed, the integration of the processes had been successful. The documentation of a business process, however, allows an organization to evaluate its details. Mapping can highlight resource needs (personnel or technological) within the process. It also can help identify additional support needs, such as for training, formal agreements, or policy requirements. The BPMN documentation allowed the team to identify crucial integration points within each case study so that real-world examples of how these processes are affecting travel time reliability could be extracted and summarized.

Mapping operational processes is not without its challenges. Although it does provide a representation of the sequential activities and who is responsible for carrying them out, it is difficult to represent specific outcomes within the context of the process modeling.

3

METHODOLOGY FOR ANALYZING AND INTEGRATING BUSINESS PROCESSES

Operational processes and the level to which they can influence programmatic needs vary widely from agency to agency. The L01 effort looked at a total of 10 case studies that included locations throughout the United States and United Kingdom. The case studies were selected to provide an in-depth review of how processes were integrated to improve reliability related to challenges in four areas: Incident Management, Work Zone Management, Special Event Management, and Weather Operations and Management.

Although each of the case studies and its processes were unique, the research discovered a common pattern in each case study's process integration. Each case could be followed through the same seven-step process, which is shown in Figure 3.1. There also were other similar elements:

- The influences that initially caused the integration of the processes could be grouped in three broad categories;

- The importance of performance measures and the need to clearly document benefits were evident in each case study; and

- The obstacles to process integration were similar in nearly all case studies.

Although all agencies do not follow each step shown in Figure 3.1, this flowchart presents the seven potential steps that may be taken to develop or change a process. Below are brief descriptions of each of the process development and integration steps, which are discussed in more detail in the subsections that follow.

Step 1: Influences. At some point, it becomes apparent that a business process needs to be improved. The catalyst for action can be top down, event driven, or needs based. Examples of such influences for action are directives from senior management or elected officials, a significant natural disaster that exposes gaps in current agency processes or response plans, or just a recognized need for the improvement.

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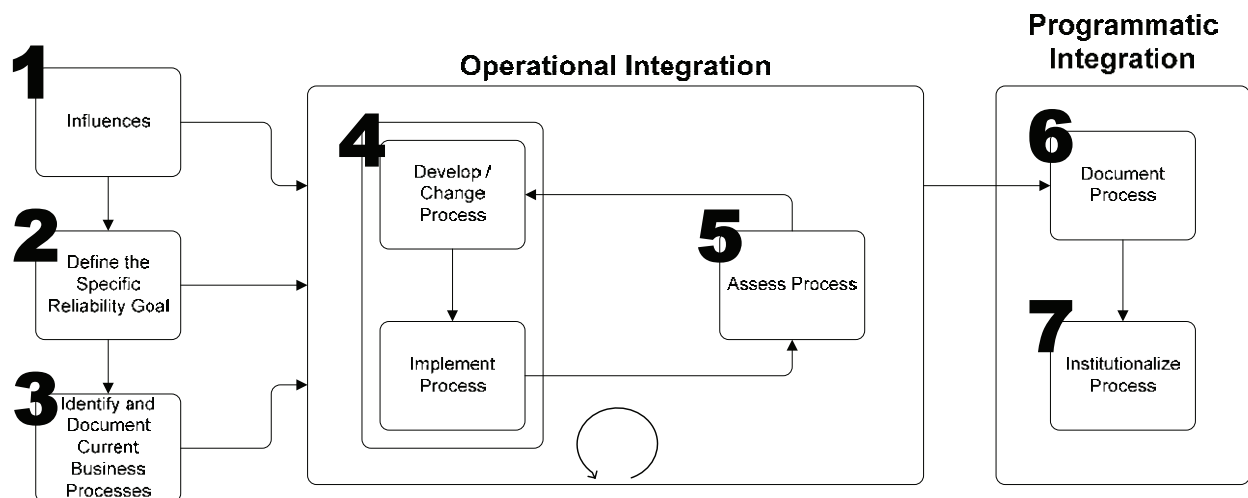
Figure 3.1. *Overview of integration approach.*

Step 2: Define the Specific Reliability Goal. Goals focus the agency's efforts on the problem at hand regardless of any specific process. Defined goals help to develop benchmarks that an agency can use to determine how well the process is meeting the need. Goals such as reducing incident clearance time, providing 24/7 operations, or improving resource efficiency often require multiple processes to work together. Although an agency may not document the goal of a new process, it must define a goal or target for addressing a need before a decision can be made or an action taken.

Step 3: Identify and Document Current Business Processes. Agencies considering changes in business processes often skip the step of thinking through current business processes in a systematic way to identify and document potential gaps or issues. This third step helps the agency identify key components or enablers that can promote a more efficient process. By using the BPMN modeling notation template (or similar process modeling tool) to document and represent the agency's process, stakeholders can see the connections between the different components of the process more easily.

Step 4: Develop/Change and Implement Process. This step is driven by a particular influence identified in the first step. This step is usually initiated at the grassroots level of an organization by staff or advocates who are at the center of the activities involved. The implementation can be formal or informal, depending on the complexity of the process and the agencies involved. This is the core step toward process integration.

Step 5: Assess Process. Once the new process has been implemented, it is assessed or evaluated against the identified goals. In an iterative approach with Step 4 (Develop/Change and Implement Process), the process continues to be refined on the basis of performance against the goals.

Step 6: Document Process. Agencies document their processes with varying degrees of complexity. Documentation can be as simple as an interagency agreement or as complex as a multivolume operations manual. Regardless of the type of documentation,

it should capture the roles, responsibilities, objectives, and expected outcomes of the process.

Step 7: Institutionalize Process. The seventh step of business process integration may consist of adopting operational activities and processes, implementing formal traffic policies, establishing training, or other actions. Institutionalization requires the buy-in and support of upper management, as well as additional stakeholders who have a vested interest in the outcomes of the business process. This step will have a direct impact on the long-term survival of a process within an organization.

STEP 1: INFLUENCES

Analysis of the case studies presented in *Integrating Business Processes to Improve Travel Time Reliability* (*2*) and feedback from participants at the L01 project workshop (*1*) suggested that influences on business processes can be grouped into three broad categories, depending on the event or directive that initiated the process change or process development (Table 3.1).

TABLE 3.1. TIER LEVELS FOR PROCESS INFLUENCES

Tier	Description of Influence	Case Studies
Tier 1: Big Directive (Top Down)	Big-directive influences are typically legislative requirements or management-level directives. Broad external factors such as safety concerns, economic parameters, or larger governmental accountability initiatives also may drive the influence. Big-directive influences tend to greatly accelerate process development, integration, and change and also increase accountability of those responsible for implementing.	• WSDOT Joint Operations Policy Statement and Instant Tow Program • NCDOT Traffic and Safety Operations Committee • Kansas Speedway Special Event Traffic Management
Tier 2: Event Driven	Event-driven influences are caused by a specific event or hazard that prompts a need for improving process integration. The initial event can prompt change, but if the event does not recur, momentum or support for the change can erode over time.	• MDOT Work Zone Traffic Control Modeling • NDOT I-80 Winter State-Line Closures
Tier 3: Needs Based/ Opportunity Based (Grassroots)	Needs-based/opportunity-based influences evolve over time according to recurring needs. These types of changes typically affect day-to-day operations and begin at the grassroots level of an organization.	• Florida Road Rangers Freeway Service Patrol Program • The Palace at Auburn Hills Special Event Traffic Management • San Pablo Avenue Signal Retiming • AZTech Regional Archived Data Server • United Kingdom Active Traffic Management

Nevada Department of Transportation I-80 Corridor

Local staff members from NDOT were encouraged to investigate alternative solutions to disseminating road condition information based on a serious crash in eastern California that created significant delays and stranded travelers for several hours in locations where amenities were not available.

It is difficult to relate a specific influence—top down, event driven, or needs based—to a specific impact on travel time reliability. However, the types of influences can have a direct impact on the timeline and resources dedicated to process change. There is no single right way to start process integration, and the selected case studies provide examples of successful process integration using all three types of influences. Figure 3.2 shows the influence as the first step in the development or modification of a business process.

STEP 2: DEFINE THE SPECIFIC RELIABILITY GOAL

Clearly defined goals provide benchmarks by which an agency can measure its success, particularly in the case of specific reliability goals. Goals can be established throughout process development, implementation, assessment, and documentation. Most important, performance against the established goals can support institutionalization of the process.

In recent years, agencies have begun to adopt more performance measures and goals to demonstrate the need for projects and the effectiveness or impact of completed projects. Performance measures also apply to evaluating the employees of the organization.

Figure 3.2. *Step 1: Influences.*
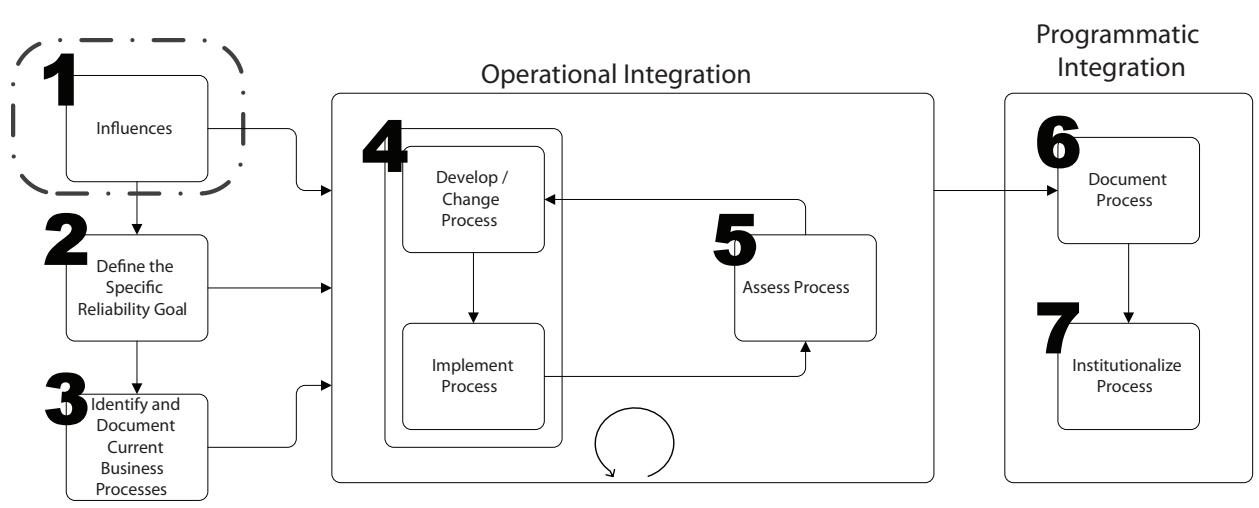
> ### North Carolina Department of Transportation Traffic and Safety Operations Committee
>
> The NCDOT Work Zone Traffic Control (WZTC) section regularly establishes goals, objectives, and strategies for all projects. A committee is formed for projects defined as significant so the impacts and effectiveness of the work zone plans can be continuously monitored throughout construction. Strategies are developed in response to some of the issues observed.

Establishing goals that align with the agency's mission can drive the development of effective processes to improve the performance of the employees, projects, programs, and ultimately the agency. Figure 3.3 illustrates that defining a specific reliability goal is done after the process is initiated by an influence.

STEP 3: IDENTIFY AND DOCUMENT CURRENT BUSINESS PROCESSES

Even in the absence of formal documentation of existing processes, typically existing conditions and processes are known to some extent. However, more often than not, the documentation step is overlooked in assessing current operational processes.

There are risks in not documenting the existing or baseline processes. Without documentation, an agency runs a higher risk of overlooking critical roles, available resources, or operational activities that may be essential enablers of a more efficient process. Although this information may be known by staff members, documentation ensures that the knowledge will remain available as staff changes. Figure 3.4 represents the step for identifying and documenting existing business processes.

Figure 3.3. *Step 2: Define the specific reliability goal.*
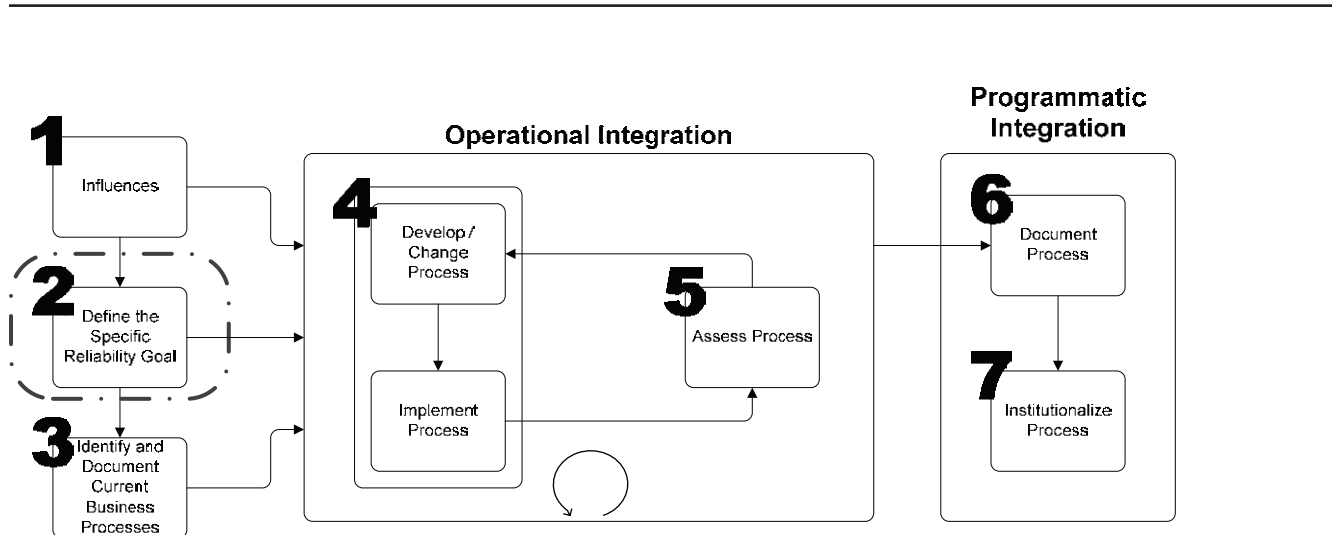
> ### The Palace of Auburn Hills
>
> Before determining a new event management plan for the facility, the Auburn Hills Police Department, The Palace of Auburn Hills, the Road Commission for Oakland County, and MDOT assessed the current traffic management plans and road network in the vicinity of the facility.

STEP 4: DEVELOP/CHANGE AND IMPLEMENT PROCESS

Operational integration includes developing or changing a process (Step 4), implementing it (Step 4), and then assessing its effectiveness (Step 5). This sequence of activities can begin after any of the first three steps. The develop/change, implement, and assess activity cycle is iterative and will be repeated until the process successfully meets the predetermined goal.

The research suggests that some of the most successful and innovative solutions focused on specific needs have been designed and implemented at the grassroots level, although the motivation for a process change can come from any of the influences discussed in Step 1. The personnel most closely connected to the need have the strongest incentive to develop an effective solution to meet the need. Their proximity to the operations often drives a continuous refinement of processes to improve the daily functions and appropriately address the defined need.

Figure 3.4. *Step 3: Identify and document current business processes.*
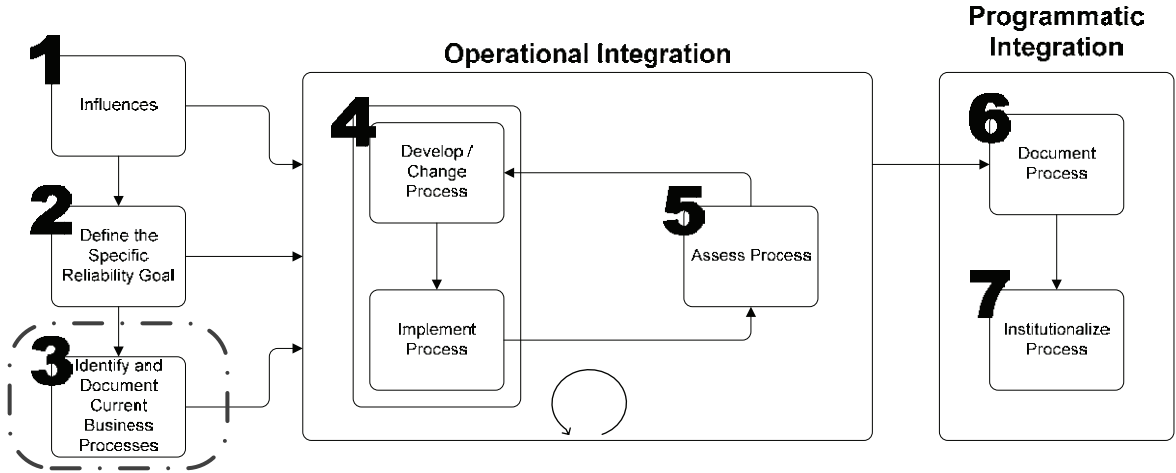
Implementing or modifying current practices, coordinating with other agencies, and recommending more efficient systems to support operations are all elements of operational process integration. Often, certain processes become ingrained into a broader operations strategy. Processes that need to be implemented upstream, or are dependent on management from one or more divisions or agencies for support, call for a more formal approach to implementation.

It is important during process integration to involve all of the appropriate stakeholders. Buy-in is important from those who will provide inputs into the process and those who are affected by the process. All stakeholders are critical, whether they are in the field or in a central office, and their input should be an integrated part of the overall process. Figure 3.5 illustrates the location of the process development and change, as well as process implementation activities within the business process integration flowchart.

North Carolina Department of Transportation Traffic and Safety Operations Committee

The NCDOT Committee looks at processes continuously throughout the life of a construction project. Each issue that arises within the construction project is analyzed by the committee, and a strategy is proposed to mitigate the issue. Solutions are monitored and adjusted as needed until an effective result is achieved.

Figure 3.5. *Step 4: Develop/change and implement process.*
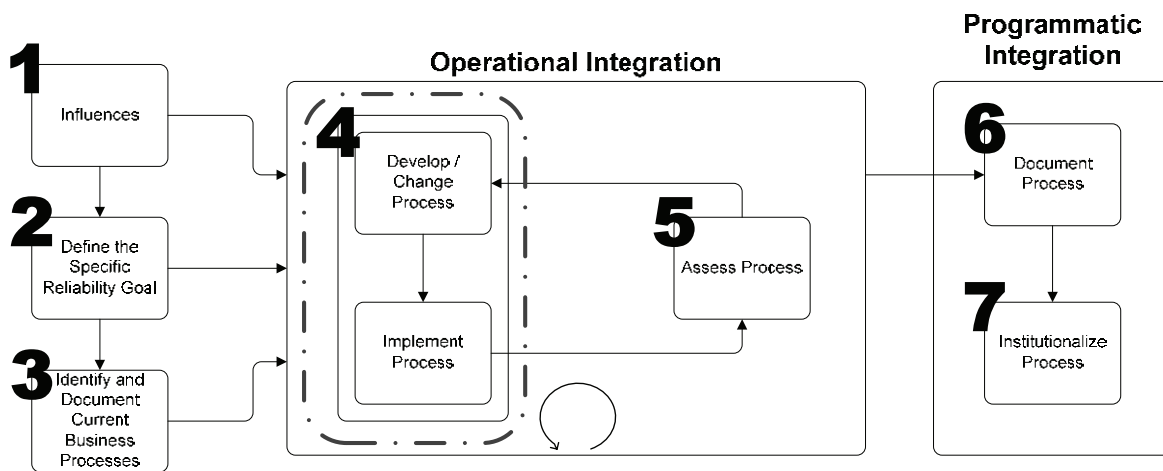
STEP 5: ASSESS PROCESS

Some level of assessment is important to determine the effectiveness of a process. This step is one element of the three-part operational integration loop that continuously adapts and evaluates business processes, along with developing/changing and implementing the process (Step 4).

UK Active Traffic Management
In the United Kingdom, the Highways Agency monitored the impacts of an Active Traffic Management (ATM) deployment on the roadway network. A survey was conducted to evaluate the effectiveness of the ATM measures and the overall use of the corridor. The results showed an improved journey time and decreased accident rate. Such benefits have helped to gain support of Government Ministers and industry.

The assessment often is commensurate with the complexity of the process and may occur with limited documentation or formality. However, it is important to determine a measure of success, a method for continuous evaluation, and the data needed for the evaluation. The evaluation and measured benefits will provide a means of communicating the effectiveness of the process in question with senior managers.

Measuring effectiveness or outcomes also provides an opportunity to periodically evaluate the effectiveness of various business processes and modify or change elements of the process if needed. Figure 3.6 shows that the assessment step is within the iterative operational integration stage.

Figure 3.6. *Step 5: Assess process.*
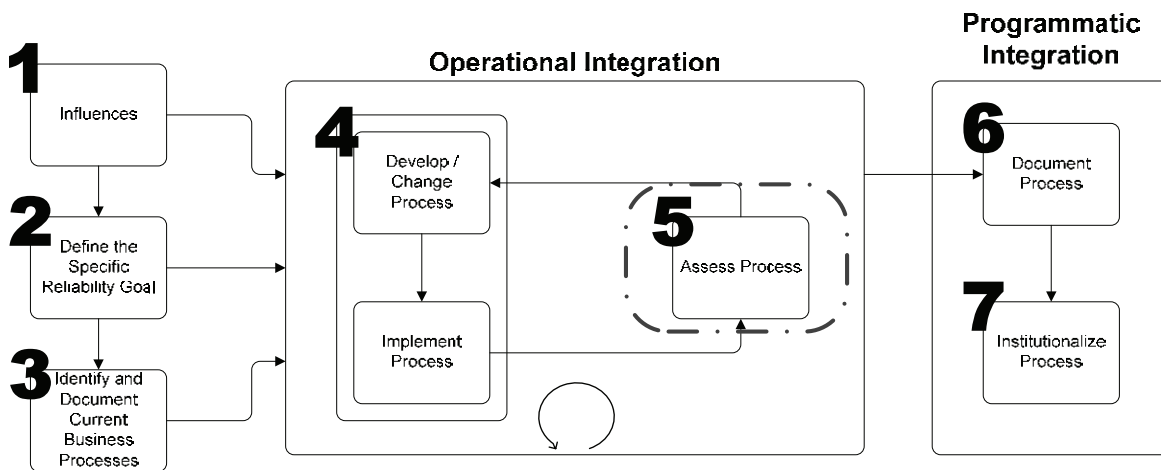
It is important that quantifiable benefits are identified and measured against pre-implementation conditions. Mapping the process also can prove to be a valuable tool for assessing effectiveness. Process mapping forces the participants to think through each step and the way agencies and staff members interact with each other. Through this project, the BPMN approach proved to be a reliable method for developing consistent diagrams of each case study.

STEP 6: DOCUMENT PROCESS

Once a process is established and refined, it is important to document and accurately capture the steps involved. Documentation typically occurs once the process has been implemented and proved effective. It provides detailed steps of the business process, the evaluation process, and the stated benefits and lessons learned. It also should include the roles and responsibilities of the stakeholders involved. The documentation includes the performance measures associated with the overall process. Documentation of these elements assists the agency in demonstrating performance against the goals established as part of Step 2.

The documentation process also assists with updates and future modifications to a process. Changes can be due to technological, political, infrastructure, or organizational influences; all of these influences need to be captured. Complete documentation of the established procedural steps and evaluation methods makes maintenance of the process easier for the agency and stakeholders. Not documenting a new or changed process involves the same risks as noted in Step 3 (Identify and Document Current Business Processes), including an increased possibility of overlooking critical elements and the risk of losing information when staff leaves.

Documentation Examples

The Palace of Auburn Hills documents its processes through evaluation meetings.

WSDOT and the UK Highways Agency produce performance monitoring reports that state the benefits and lessons learned from the process. The WSDOT JOPS Agreement documents the performance measures developed as a result of the agreement as a way to assist the agency in defining how data are collected and reported.

The MTC produces a report at the end of the process that is then incorporated into an annual report provided to the Federal Highway Administration (FHWA).

Not all agencies want to invest the time required to prepare detailed process models for all of their operational activities. They would prefer to document only the key steps, relationships, information exchanges, and other factors when there is a need to do so. This can be achieved through developing internal memorandums, informal memorandums of understanding (MOU), or more formal intergovernmental agreements to document roles, responsibilities, objectives, and expected outcomes.
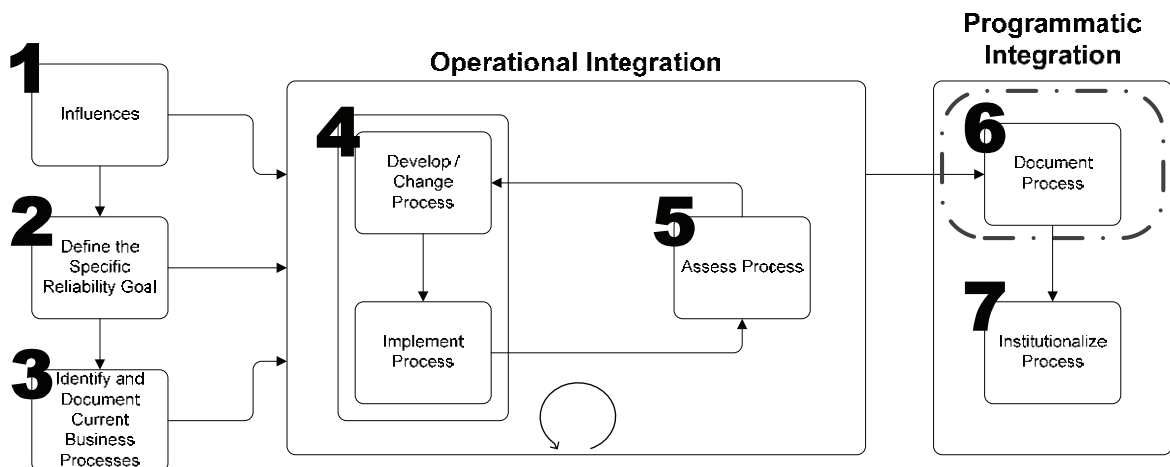
Figure 3.7. *Step 6: Document process.*

Operational manuals can provide another mechanism for capturing details of the process without involving too much investment. Figure 3.7 illustrates that documentation occurs after a process has been implemented and determined to be acceptable.

STEP 7: INSTITUTIONALIZE PROCESS

Institutionalization is the final step in the successful integration of business processes. It is the way in which a new or changed process is incorporated into existing policies or management programs. It typically starts from higher levels in an organization and often requires a certain level of senior-management support.

Washington State Joint Operations Policy Statement

The governor's office requested that WSDOT and the Washington State Patrol (WSP) report jointly on performance monitoring and accountability goals related to incident response and clearance time. These reports were compiled and incorporated into the Government Management Accountability Performance program being implemented in Washington State. This joint reporting and responsibility enabled Washington State to deliver an effective Incident Response Program.

Institutionalizing the process translates it into a core process in the organization that can survive changes in management and personnel. The most successful examples of business processes rely on linking them to firmly established agency goals, objectives, or mission-critical activities; this helps establish the priority among multiple operational entities.

Institutionalization requires more than adopting operational activities or processes and is very dependent on buy-in and ongoing support by agency leaders. In some instances, policy or legislative action might be required, such as to implement formal traffic policies (i.e., "move over" laws) or divisional reporting strategies. Other divisions or departments not directly involved in operations, such as procurement, information technology, human resources, communications/public information, or others, depending on the specific objective, also might need to become involved. For processes to transcend individual divisions and operating units or to be solidified across multiple agencies requires that benefits and outcomes be tangible and directly related to each agency and the individual operating unit.

To become ingrained in the institutional culture, whether through resource management, training, procurement practices, or other programmatic functions, processes must demonstrate continued and sustained benefit over time rather than a one-time successful outcome. This establishes a need for a strong and well-communicated performance management program that goes beyond merely reporting on performance and incorporates outcomes into regularly scheduled policy and process reviews.

A process can be institutionalized—or institutionalized further—at any time, not just when it is first developed and implemented. Strategies and considerations for successfully institutionalizing an integrated process include the following:

- Formal documentation that is available and accessible. A signed MOU is a good start, but if it is hidden in a file cabinet, it is likely to be forgotten. It is important that agreements be based on operational need and that those agreement terms are made known to key individuals and groups that are directly affected. Advocates (or "champions") change, and through formal shared documentation, the process is less likely to be lost if an advocate moves out of a position.

- Sustainability of the process is key, and so is the sustainability of agreements or documentation that might have been developed in support of it. MOUs, interagency agreements, or other documents that require more formal approval have a better chance of outlasting informal agreements.

- Performance management programs can provide an important back-check and justification for continued support of integrated and institutionalized processes. A performance management approach goes beyond monitoring and reporting on key performance indicators. It uses those outcomes to better inform management and programmatic decisions.

Figure 3.8 shows that institutionalization is the final step in the integration of business processes.

The most successful examples of business processes rely on linking them to firmly established agency goals, objectives, or mission-critical activities.
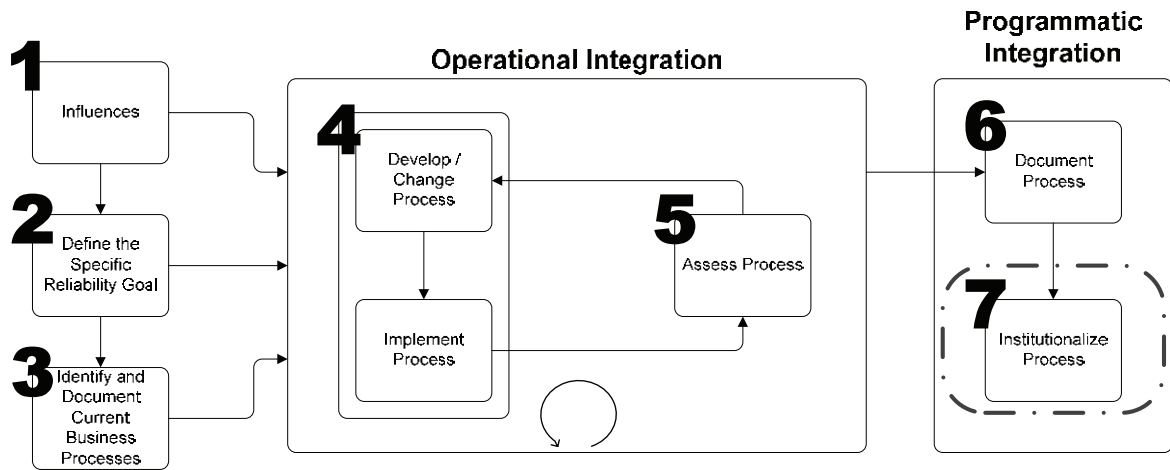
Figure 3.8. *Step 7: Institutionalize process.*

4

APPLYING PROCESS INTEGRATION ANALYSIS

The previous chapters of this guide have identified the various steps in process analysis and process mapping whereby transportation agencies can identify important integration points or process integration needs. This chapter considers two case study sites where reliability-focused processes have been implemented, and it maps the process analysis steps to operational programs and activities.

Case studies help illustrate how processes can be initiated and evaluated, as well as show some of the institutional issues encountered when processes are integrated, either within an agency or across multiple agencies. It is important to note that the analysis presented for these case studies was not performed during the initiation of the operational activities; instead, the analysis discusses process development and integration using the framework described in previous chapters.

The following case studies are featured in this section:

- Washington State Instant Tow Dispatch Program, which describes one element of a broader incident management program focused on reducing incident clearance time through the collaborative efforts of the Washington State Department of Transportation (WSDOT) and the Washington State Patrol (WSP); and

- I-80 Winter Operations, which details the actions and strategies that are initiated as a result of a closure or a restriction on I-80 at the Nevada/California state line during hazardous winter storm conditions.

WSDOT INSTANT TOW

Introduction and Background

The State of Washington has a comprehensive and effective incident response program. The two primary agencies that are responsible for response on highways, WSDOT and WSP, have a long history of working together to improve incident response and reduce

incident clearance times in Washington. In 2002, WSDOT and WSP developed a Joint Operations Policy Statement (JOPS) Agreement that formalized each agency's role and responsibilities for freeway operations, including incident response. The JOPS Agreement covers 13 areas of operations, including, among other functions, traffic incident management, enforcement, winter operations, work zone safety, and transportation safety/security.

In 2006, the Washington governor's office directed both agencies to collaborate on performance monitoring and accountability goals related to incident response and traffic incident clearance times. By making both WSDOT and WSP jointly responsible for performance monitoring and accountability goals, the governor's office promoted an even closer working relationship and increased cooperation between the two agencies to achieve these objectives. The agencies used the JOPS Agreement to enhance their collaborative relationship and refine performance measures, as well as to identify strategies that would support meeting those objectives. Through the JOPS Agreement, the agencies were able to document new programs and policies that were designed to improve incident response and decrease incident clearance times.

The request by the governor's office is an example of a big-directive, or top-down, type of influence (Tier 1) that is presented in *Integrating Business Processes to Improve Travel Time Reliability* (*2*). Even though WSDOT and WSP were currently working together, the request added a new level of accountability and led to increased cooperation between the agencies.

One example of a new program implemented after the governor's directive is the Instant Tow Dispatch Program. This case study looks at how the seven steps for analyzing and integrating business processes apply to the development of the Instant Tow Dispatch Program. Again, it is important to note that the following discussion is a retroactive analysis of the steps; these process modeling steps were not intentionally followed or documented by WSDOT or WSP during the course of the program's development, evaluation, or implementation.

Application of Methodology for Analyzing and Integrating Business Processes

The Instant Tow Dispatch Program initially began as a program on the Tacoma Narrows Bridge to provide for quick removal of disabled vehicles from travel lanes, thereby reducing the potential impact on mobility on the corridor. When a disabled vehicle was reported or spotted by WSDOT Traffic Operations Center operators using the WSDOT CCTV cameras, a WSP trooper was dispatched and, on arriving at the scene, would verify that a tow was needed; only then would a tow operator on the WSP list be contacted. Under the Instant Tow Dispatch Program, as soon as an incident is verified on the CCTV cameras, a tow truck can be dispatched without prior verification of need from a WSP trooper. In the initial program used on the Tacoma Narrows Bridge, tow operators on each side of the bridge participated and were dispatched according to how quickly they could reach the disabled vehicle(s). An evaluation of the program by the University of Washington Transportation Research Center found that the Instant Tow Dispatch Program saved an average of 15 min for clearance, compared with having an officer first respond to the incident.

Through the JOPS Agreement, the agencies were able to document new programs and policies that were designed to improve incident response and decrease incident clearance times.

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A challenge with this program was how to reimburse tow drivers for dry runs. Dry runs occurred when tow truck drivers were dispatched, but, before they arrived, the disabled vehicle was able to move out of the traffic lanes. This might happen if the driver was able to get his or her car restarted or if a passing motorist provided assistance. When this occurred, tow operators may have wasted as much as 30 min. Tow truckers thus did not want to participate in the program unless they could be reimbursed for this lost time.

To address this concern, WSDOT implemented a pilot program over a larger area that reimburses tow operators $25 for each dry run. When a disabled vehicle that is blocking at least one lane of traffic is identified by WSDOT CCTV cameras in an area with the Instant Tow Dispatch Program, WSP will dispatch a WSP trooper and an Instant Tow Dispatch Program tow operator at the same time. WSDOT Incident Response monitors the dispatch of the WSP and will deploy a WSDOT Incident Response unit to the incident as well. WSP has up to 10 min to cancel the call before the Instant Tow Dispatch Program tow operator is eligible for a dry-run reimbursement. If the WSDOT Incident Response unit arrives on scene first and can clear the incident, the Instant Tow Dispatch Program tow operator is entitled only to a dry-run reimbursement. If the Instant Tow Dispatch Program tow operator does tow the vehicle, then the tow operator is reimbursed by the driver of the vehicle.

In 2008, there were 597 calls for Instant Tow Dispatch that resulted in 347 tows, 192 cancellations, and 58 dry runs. WSDOT was not billed for every dry run, and the program resulted in total direct costs of less than $1,000 for WSDOT. Results in 2007 were similar, with 235 calls for Instant Tow Dispatch resulting in tows and total direct costs to WSDOT amounting to less than $1,000.

The Instant Tow Dispatch Program works well because of the trust between WSDOT and WSP and the formalized program established in the JOPS Agreement. It is one of several strategies implemented in response to a clear directive from the governor's office to reduce the impacts of incidents on mobility on Washington's freeways; because it has shown demonstrable benefits, the processes have been able to be sustained, integrated, and even expanded. WSP dispatches Instant Tow Dispatch tow vehicles and determines whether the call should be canceled, but WSDOT is responsible for paying for dry runs. Even though WSDOT is essentially paying for a program run by WSP, there have been no issues with the program or payment procedures thus far. The program is providing a tremendous benefit to motorists by clearing traffic lanes an average of 15 min faster and is doing so at a cost of less than $1,000 per year to WSDOT.

The process used for the WSDOT Instant Tow Dispatch Program is displayed using the BPMN method in Figure 4.1.

The methodology for analyzing and integrating business processes defined above describes a seven-step process that is typically used for the integration of business processes. Although these steps are not always followed by agencies, most follow a process that is very similar. In the sections below, the seven steps and how they relate to development and integration of the Instant Tow Dispatch Program process are described.

The Instant Tow Dispatch Program works well because of the trust between WSDOT and WSP and the formalized program established in the JOPS Agreement.
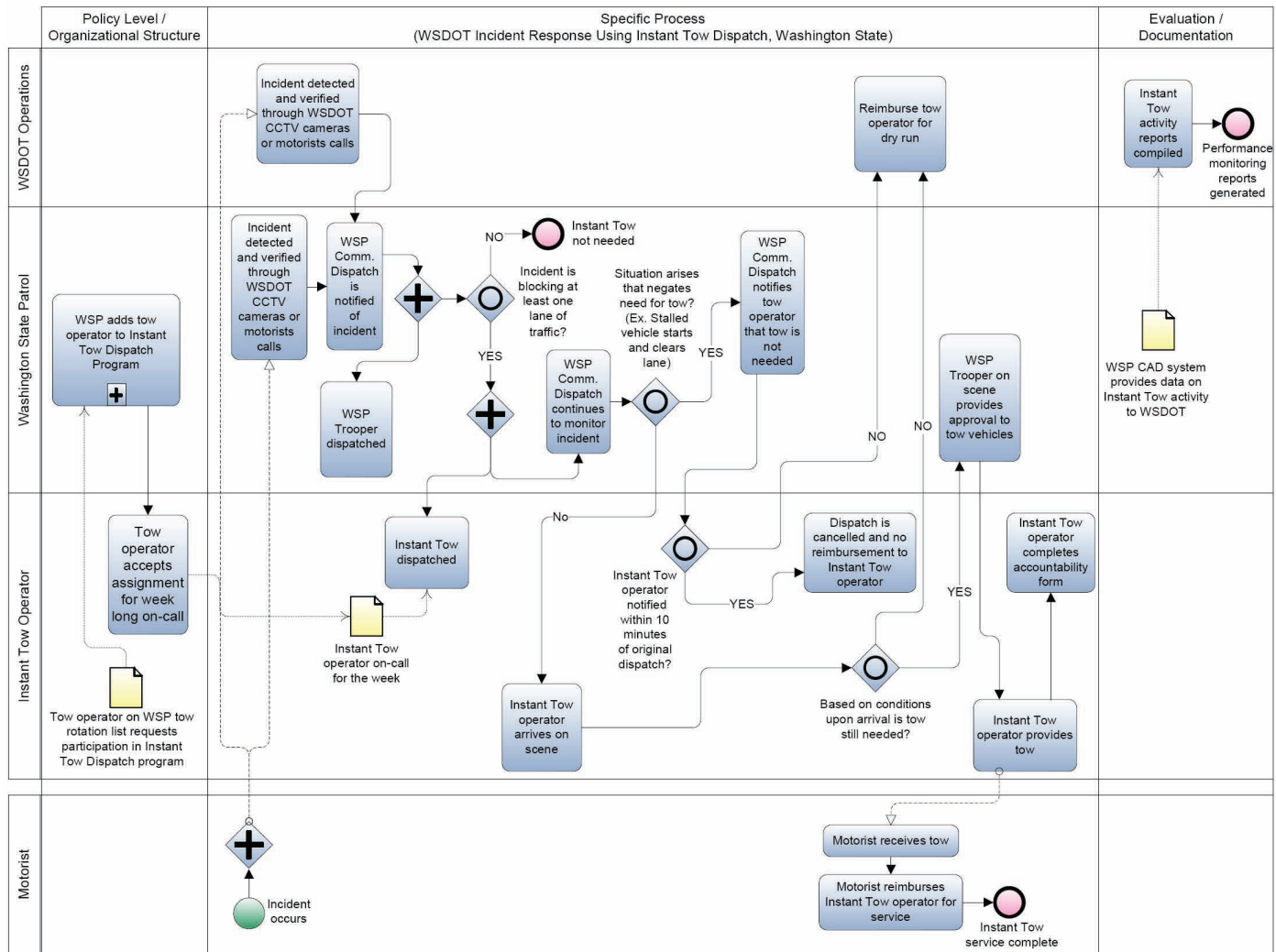
Figure 4.1. *Detailed business process diagram of WSDOT incident response.*

Step 1: Influences

Influences are described as the catalysts that initiate the need for an improved business process. The request from the governor's office that WSDOT and WSP collaborate on performance monitoring and accountability goals for incident response and traffic incident clearance times was very important. It made an already strong working relationship between WSDOT and WSP even stronger and increased the accountability placed on both agencies to meet the 90-min clearance time. WSDOT and WSP were required to jointly report the progress toward the 90-min incident clearance goal specified in the Government Management Accountability Performance program. This requirement led to the focus on developing strategies and practices to reduce incident clearance time and minimize the impacts of incidents on freeway mobility.

Step 2: Reliability Goals

The primary reliability goal that WSDOT was trying to achieve was the 90-min incident clearance time; the Instant Tow Dispatch was one of several strategies that were developed and implemented to work toward achieving that overarching clearance time goal. During the initial pilot test of the Instant Tow Dispatch Program, it was not clear how well the program would contribute to meeting that goal, so there were no specific goals established for the program other than monitoring the impact of the program on reduced incident clearance. WSDOT planned to evaluate the program after the initial pilot test to determine the costs and benefits of the program.

It is also important to note that goals and performance for WSDOT's transportation system and transportation program are very closely tracked and reported in the *Gray Notebook*, a quarterly publication of WSDOT. The *Gray Notebook* covers a variety of measures, ranging from project delivery, infrastructure condition, and safety statistics, and it addresses mobility as a key measure. Among the mobility measures that are publicly reported are freeway travel times and incident response times.

Step 3: Current Business Practices

In the methodology for analyzing and integrating business processes, it was noted that documenting current business practices can identify potential gaps or issues and also identify key components or enablers that are significant in developing a more efficient process. Although the Business Process Modeling Notation (BPMN) was not used to document other similar tow programs in existence at the time, the JOPS Agreement did clearly document each of the incident management programs that did exist.

The JOPS Agreement is unique in that it not only clearly defines how incident management programs will be done in Washington, but it also identifies specific employees from both WSDOT and WSP who are responsible for each program and sets performance measures for the programs. The document is signed by the Washington State secretary of transportation and the chief of the Washington State Patrol and is collectively reviewed and updated each year by WSDOT and WSP.

Step 4: Develop/Change and Implement Process

Developing or changing the process typically occurs at the grassroots level of an organization by staff or advocates who are at the center of the activities. In Washington, the Instant Tow Dispatch Program initially began as a program on the Tacoma Narrows Bridge. Although it was successful in reducing clearance times, it was not sustainable because tow operators were not reimbursed for dry runs, which occurred when they were dispatched to tow a vehicle and the vehicle had been removed from the lanes before the tow operator arrived. Without a reimbursement program, tow operators did not want to continue participating in the Instant Tow Dispatch Program. Through the reimbursement program that WSDOT initiated, WSDOT found it could maintain active participation by tow operators and yet still provide the Instant Tow Dispatch Program at a very low cost. WSDOT has several examples of changes that were made to the initial program to improve the process, better meet performance measures, and satisfy all of its partners.

Developing or changing the process typically occurs at the grassroots level of an organization by staff or advocates who are at the center of the activities.

Step 5: Assess Process

Assessment and evaluation of implemented processes is critical to determine whether the desired goals are being met and to identify whether changes to processes are necessary to improve performance. WSDOT and WSP had several measures, such as response time, number of tows, and cost of the program, to monitor the impact and effectiveness of the program. The University of Washington Transportation Research Center was also asked to study the initial pilot program. The study found that without the Instant Tow Dispatch Program it would take an average of 18 min to dispatch a tow truck after an incident was detected and verified. With the Instant Tow Dispatch Program, it takes an average of 3 min to dispatch a tow truck. The program has reduced the time for a tow truck to arrive at an incident by approximately 15 min for most incidents. WSDOT looked at the saving this created in terms of lost time and wasted fuel resulting from congestion and estimated that for less than $1,000 per year to operate the program, WSDOT would see annual benefits of approximately $6.5 million to $11.1 million.

Step 6: Document Process

The JOPS Agreement includes the Instant Tow Dispatch Program objective; roles and responsibilities, including those of lead staff from WSDOT and WSP; performance measures; and reporting requirements. Annual updates of the JOPS Agreement ensure that any changes to any of the joint programs included in the agreement can be captured and require the signature of the Washington secretary of transportation and the chief of the Washington State Patrol.

Step 7: Institutionalize Process

Institutionalization may include adoption of operational activities and processes, implementation of formal policies, or establishment of a training program. The JOPS Agreement provides the higher level policy for the Instant Tow Dispatch Program by establishing roles and responsibilities and lead staff. A set of standard operating guidelines was developed for the Instant Tow Dispatch Program, which was rolled out in several urban areas around the state over time. With specific staff assigned from both WSDOT and WSP in the JOPS Agreement, accountability for continuing the program is clearly defined; the annual update of the JOPS Agreement reinforces the continued desire of WSDOT and WSP leadership to keep the program.

Conclusions

The Washington State Instant Tow Dispatch Program provides a good case study of how a top-down directive led to the implementation and integration of a new business process for WSDOT and WSP. The process that was used to develop, implement, and institutionalize the Instant Tow Dispatch Program can be mapped to the seven-step process defined in Chapter 3. Through the JOPS Agreement, WSDOT and WSP established a method of taking a new process and documenting objectives, performance measures, and reporting requirements and, perhaps most important, assigning responsibility to individuals for the success of the program. The Instant Tow Dispatch Program demonstrates the importance of support from all levels within an agency for

Assessment and evaluation of implemented processes is critical to determine whether the desired goals are being met and to identify whether changes to processes are necessary to improve performance.

a business process to be integrated and successfully contribute to improved reliability. The Instant Tow Dispatch Program was developed at the staff level, but the JOPS Agreement, which contributed to the successful integration of the program, can be tied to the governor's top-down request for WSDOT and WSP to collaborate on performance monitoring and accountability goals related to incident response and traffic incident clearance times.

I-80 WINTER OPERATIONS AND MOBILITY IN NEVADA

Introduction and Background

Heavy freight traffic heading westbound on I-80 toward the Nevada/California state line needs advance warning about closures at Donner Summit (7,000 ft), which frequently occur during hazardous winter storms. During extreme winter snowstorms, conditions pose a significant hazard for freight and passenger vehicles, and Caltrans will often restrict I-80 for westbound traffic if weather conditions warrant. Although state-line restrictions and closures and associated notifications are initiated through Caltrans, if freight and other traffic are not notified in enough time to find suitable and safe parking or to alter their route to avoid the closure, the impacts on Nevada DOT (NDOT) roadway facilities as well as local streets in Nevada cities and towns can be significant.

Freight parking on I-80 during winter weather events not only affects freight drivers who are trying to maintain their schedules but also affects NDOT's winter plowing operations, restricts lane usage by emergency vehicles, and creates hazardous driving conditions for passenger vehicles.

The notifications and response activities on I-80 represent an event-driven influence (Tier 2), as presented in *Integrating Business Processes to Improve Travel Time Reliability* (*2*). This set of processes has evolved over time and in collaboration with multiple partners, including DOT and the police and highway patrol in California and Nevada, although the impacts of these processes also reach as far east as Utah and Wyoming.

Application of Methodology for Analyzing and Integrating Business Processes

Coordination for I-80 operations, and in particular for incident management or winter weather operations, extends beyond NDOT operations and maintenance to also include law enforcement and neighboring states. The Nevada Highway Patrol (NHP) is responsible for law enforcement and incident management coordination and response on the corridor and is a key partner in overall corridor operations, including implementing truck turnarounds whereby trucks are turned away from the state line and not allowed to obstruct the I-80 shoulders.

Because of the significance of I-80 as a major east–west freight corridor, there is increased importance for multistate coordination during major events; NDOT's efforts to notify state DOTs in Utah and even Wyoming provide for even more advance notice to freight traffic about upcoming closures, even though drivers might be several hundred miles east of the Nevada/California state line.

The Instant Tow Dispatch Program demonstrates the importance of support from all levels within an agency for a business process to be integrated and successfully contribute to improved reliability.

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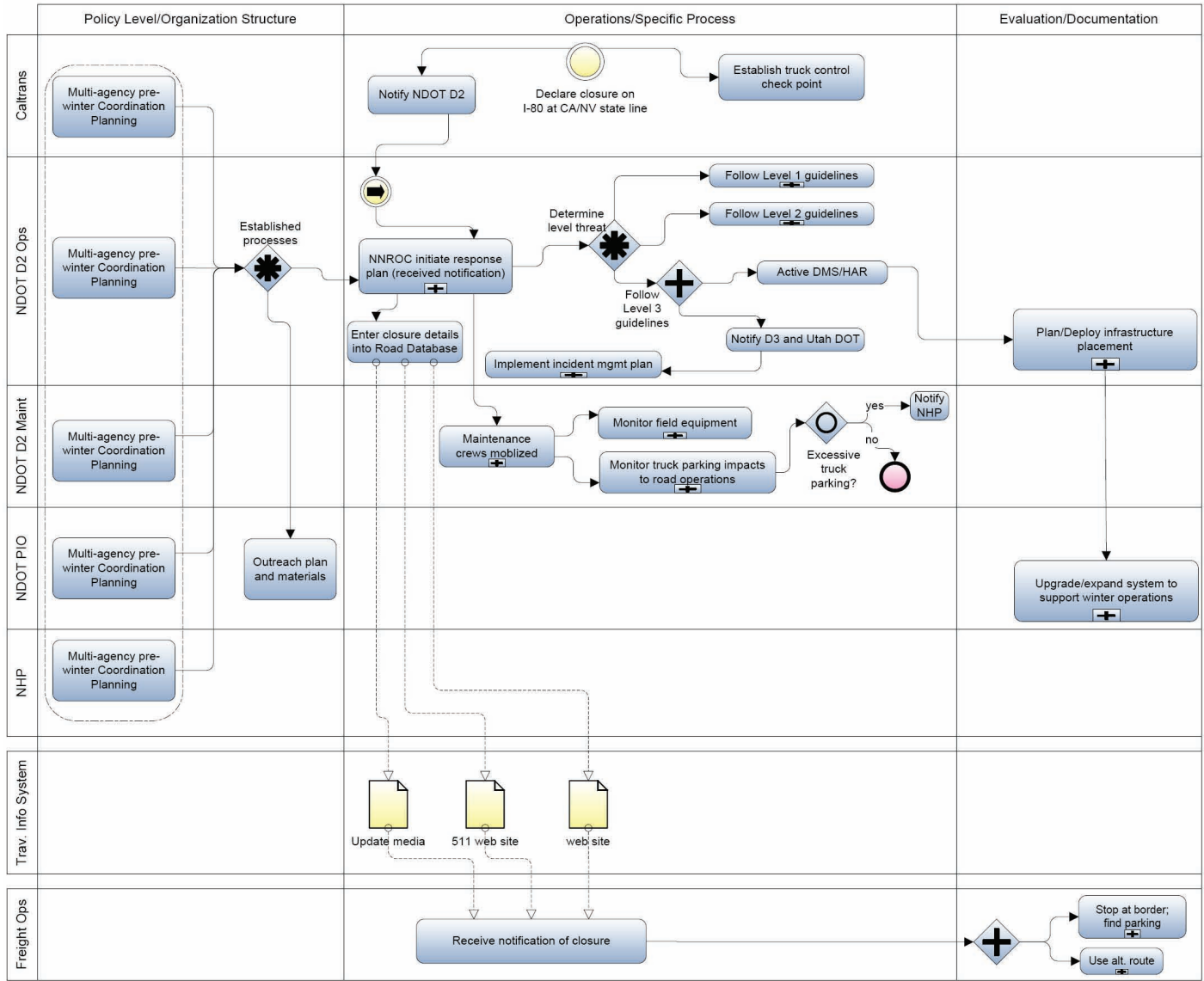
Figure 4.2. *Detailed process diagram of I-80 winter closure notifications.*

The process used by NDOT and other partners to initiate notifications of restrictions at the Nevada/California state line using the BPMN method is shown in Figure 4.2. This figure shows the sequence of events and key decision points for implementing specific responses and strategies.

This section describes the seven steps of business process development and integration and how they relate to the I-80 winter operations and management activities.

Step 1: Influences

During the 5-year period between 2002 and 2007, NDOT observed 23 closures on I-80 at the Nevada/California state line and an additional 31 truck prohibitions resulting from severe winter weather. There was a definite need to address on-site restriction issues, as well as the need to provide advance notification to westbound I-80 freight traffic of the state-line closure and the limited to no parking options in Reno (just east of the Nevada/California state line). NDOT estimates daily truck traffic of 2,500 vehicles per day on I-80 on a typical winter day. Although the majority of I-80 within Nevada and near the state line with California is considered rural (with the exception of the Reno/Sparks metropolitan area), winter weather impacts have the potential to cause significant congestion if trucks and other vehicles are held in Nevada.

A recent closure of a 400-space truck stop has further exacerbated the parking shortage for freight vehicles near Reno. In some instances, NDOT indicated that trucks will sometimes park on the shoulder, or they will exit the freeway and park on arterials until they are able to cross the state line. The resulting lengthy truck queues create obvious safety hazards because they inhibit winter maintenance activities and limit the ability of emergency responders to navigate through the congested corridor.

Step 2: Reliability Goals

NDOT currently has limited quantitative goals related to reducing truck queues and idling near the state line as a result of a closure or restriction. On a broader level, NDOT's focus is to limit the number of trucks that are parked and idling on the shoulders and to provide as much advance notification as possible to westbound travelers on I-80 that travel may be restricted beyond the state line. Notification is particularly important for freight because there are significant economic impacts to missing or delaying deliveries.

Step 3: Current Business Practices

When NDOT's Road Operations Center in Reno/Sparks receives the notification from Caltrans regarding the expected duration of a closure or restriction at the state line, it sets in motion a series of actions for NDOT to mobilize according to the stage level (predetermined by the duration). Previously established agreements between NDOT and Caltrans allow for Caltrans to operate equipment (dynamic message signs) in Nevada to post warnings or alerts about state-line restrictions. Furthermore, these agreements also make provisions for Caltrans and the California Highway Patrol to establish truck turnarounds on the Nevada side of I-80 to restrict or prohibit trucks or other vehicles from crossing the state line.

Caltrans, NDOT, and associated partner agencies (including state and local law enforcement) hold a meeting annually in September in advance of the snow season to discuss strategies, roles and responsibilities, and extraneous circumstances that could affect strategies and to establish overall lines of communication. This meeting is also used as an opportunity to fine-tune processes based on prior years' experiences during winter closures. Transportation operations, maintenance, law enforcement, emergency services, public information officers, and local agencies participate in this annual meeting.

NDOT and other western states that operate and manage the I-80 corridor have implemented tools and systems that can provide traveler information; monitor weather conditions and weather sensors; and issue notifications to DOT, police, and the public about travel conditions. This effort typically employs a combination of manual (phone calls) and automated activities in response to rapidly changing winter weather conditions.

Step 4: Develop/Change and Implement Process

Although there are good working relationships among the state and local agencies that are routinely involved in winter operations and management on the I-80 corridor, agencies have recognized that they could do more to mitigate the impacts of closures or restrictions at the state line.

At one of the prewinter coordination meetings, a hierarchy of closure activities was established and agreed on by the primary partners (DOT and law enforcement). This hierarchy is based on the expected duration of the closure or restriction; depending on the duration, additional strategies may be implemented. These different levels and associated durations are as follows:

- Level 1: Assumed duration less than 3 hours;
- Level 2: Up to 6 hours;
- Level 3: 6 to 12 hours;
- Level 4: 12 to 24 hours; and
- Level 5: 24 hours or longer.

For closures or restrictions up to 12 hours, controls are primarily implemented by Caltrans for the state-line closure or restriction, and NDOT initiates notifications to other agencies and travelers for westbound traffic. For a Level 3 closure, NDOT dynamic message signs (DMSs) further east on I-80 are activated by District 2 or 3. For a Level 4 and Level 5 closure, NDOT and NHP implement Nevada controls and turn trucks away before they reached the Reno area, while the Caltrans controls are in effect at the state line. For closures or restrictions of 12 hours or longer, NDOT also notifies the Utah and Wyoming DOTs of the conditions at the Nevada/California state line, and these states would also initiate notifications using their respective systems and infrastructure.

Step 5: Assess Process

The recurring nature of these winter events and the long-standing collaboration of the agencies involved, particularly California and Nevada, allow for ongoing assessment of how various steps in the I-80 winter operations and management are working. On an event-by-event basis, NDOT examines how its internal processes have worked, and, on at least an annual basis, agencies are able to meet and discuss the prior year's activities and identify opportunities to modify or enhance plans and procedures. The duration hierarchy is a direct result of a need to provide specific guidelines to indicate when certain strategies should be implemented.

Nevada and California can measure public usage of their information tools (including web-based and phone-based traveler information systems) during these major winter events and can also track the number of notifications issued and the number of truck stops on their distribution list. Highway patrols can track the number of incidents or callouts through their dispatch systems. NDOT does monitor queue length of trucks on I-80 when there is a closure or restriction on the state line, although as yet there are no formal performance monitoring processes to enable comparing queue lengths with queues in prior closures or restrictions.

Step 6: Document Process

Processes for I-80 winter operations and management are well documented. The outcomes of the planning meetings are shared with affected agencies, and the established duration levels allow agencies to tailor operational procedures to meet the needs of those specific closure or restriction durations. Moreover, a more formal agreement that has been in place for many years between Caltrans and NDOT allows for joint operations of equipment and for Caltrans personnel to activate restrictions and turnarounds on Nevada's portion of I-80. Operational procedures within NDOT at the Road Operations Centers also capture the steps required to initiate various notifications, update traveler information systems, or involve other divisions or agencies.

Step 7: Institutionalize Process

The need to effectively operate and manage the I-80 corridor during winter has been the impetus for ongoing collaboration among multiple state DOTs, interagency cooperation, and the establishment of operational procedures that expedite notifications of corridor conditions. Partners on the I-80 corridor work cooperatively and have made a focused effort at implementing and integrating processes within and outside their agencies in order to achieve the broader objective of reducing truck queues and idling during state-line restrictions.

A long-standing agreement between Caltrans and NDOT established the initial framework for cooperative management strategies and enabled Caltrans to set up checkpoints and truck turnaround points in Nevada. A cooperative venture between Caltrans and NDOT installed three DMSs on I-80 just east of the state line. Caltrans has remote access to these signs in Nevada to be able to post messages about state-line closures or restrictions for westbound traffic. It is the ongoing collaboration throughout the prewinter strategies that allows agencies in both states to continually review and refine these processes and procedures.

The operations and management needs on this corridor have extended to planning and programmatic processes and have been the primary justification for enhanced communications and infrastructure in Nevada on I-80. Corridor information needs along I-80 have resulted in NDOT Districts 2 and 3 installing permanent DMSs and highway advisory radio on westbound I-80, with an increased number of flashing beacons that are activated during state-line closures on the segment of I-80 in District 2 approaching the Reno area. The need to provide more comprehensive and timely information to freight traffic has also inspired some key enhancements to NDOT's 511 and web traveler information system.

It is the ongoing collaboration throughout the prewinter strategies that allows agencies in both states to continually review and refine these processes and procedures.

Conclusions

The evolution of the I-80 processes and strategies has been driven by several factors. At the core, there is a high priority on traveler safety during hazardous winter conditions, particularly given the steep elevation changes on this segment of I-80. There is also a need to minimize (or eliminate) the number of trucks parking on I-80 because these trucks affect other traffic, pose a hazard to emergency access, and impede NDOT's winter maintenance activities.

Process integration begins well in advance of any specific weather event. It takes the form of planning for response strategies among those agencies responsible for traffic management, maintenance, enforcement, and notification along I-80. At a higher level, there are overarching interstate coordination processes for winter maintenance and road closure operations that are also not necessarily specific to an event but provide the framework for which specific processes and activities are carried out and coordinated in response to winter closures in this region. Because these processes must be drawn upon repeatedly during the winter driving season, ongoing opportunities exist to refine the process and achieve efficiencies.

5

PROCESS INTEGRATION BENEFITS AND CHALLENGES

BENEFITS OF PROCESS INTEGRATION

The case study examination revealed common benefits realized by agencies that were able to successfully integrate new or changed processes. Travel time reliability was the primary benefit sought by the research team, although few agencies have actually integrated reliability as a formal measure. Elements that contribute to reliability, including reduced delay, improved incident response times, improved event egress, and others, were tangible benefits that were recognized to have important links with overall travel reliability. Additional benefits included increased efficiency in use of staff, saving of financial and staff resources as a result of improved cooperation and reduced capital expenditures, and increased scalability and flexibility of systems. Process integration can allow agencies to plan for a system that can be implemented in a scalable format, with growth commensurate with needs. By integrating agencies and processes early in the planning process, agencies are less likely to miss opportunities for integration of future processes and more likely to build systems that can expand to meet future needs.

For any process to remain beneficial, it should be developed in such a way that it allows for innovation or some level of flexibility to integrate with established processes or institutional cultures. Processes that are not flexible and remain static may be effective initially in improving travel time reliability, but as travel conditions, travel patterns, and other factors that affect reliability change over time, a static process may lose its effectiveness and impact. Case studies where processes have successfully been integrated for a number of years often indicate that the processes changed, expanded, or evolved over time to meet ever-changing challenges faced by the agencies in delivering reliable transportation systems.

OBSTACLES TO PROCESS INTEGRATION

Regardless of how an integrated process is influenced, nearly all the agencies involved in the study encounter similar obstacles and challenges when they begin to evaluate, implement, and further modify a process. Some of the obstacles can be overcome through modifications to operational processes or approaches. Many of the most challenging (and yet effective) process endeavors, however, require changes at the institutional level; such changes pose challenges for adopting, implementing, and integrating a new or expanded business process. When more than one institution is involved, such as a transportation department and a police or public safety agency, institutional changes tend to become even more complicated.

An overarching challenge is that reliability is not yet part of the common operations lexicon, even among departments of transportation. Only a few agencies have formally adopted a reliability focus, although many transportation operations agencies would likely agree that reducing congestion, improving response to congested conditions, and maintaining reliable travel times are among their core objectives. Mobility and safety are much more tangible and recognizable to operations-focused staff and agency managerial staff. A further challenge is that reliability does not easily translate to a maintenance division, a law enforcement agency, or an adjacent jurisdiction. Adopting a formal reliability focus, with an emphasis on the core components that make up reliability (such as response times, reducing delay caused by incidents, more efficient responses to weather hazards, or improved detours to support work zones), can greatly help in articulating how multiple business processes can support a broader reliability-focused objective. Only then can partners begin to assess process change and integration through their links to a larger reliability goal.

A number of other common obstacles to process integration were identified. For instance, departments of transportation are historically construction and maintenance focused and not operations focused. Agencies must clearly identify benefits of improved operations and reliability to get support for process change.

Another issue is that, although reliability is emerging as an important metric among agencies, that new level of importance does not often translate into new or changed business processes. Agencies need to show a line between a process and its impact on reliability. This can be achieved through performance monitoring and reporting and by articulating benefits that have been achieved, such as safety, reduced crashes, improved response times, resource efficiency, or other metrics. Building support and recognition of the positive impacts will help to foster greater awareness of agency efforts among management, elected officials, and the public, which will in turn lead to further support for more improvements.

Then there is a range of agency stakeholders or partners that often contribute to reliability-focused strategies, and each will likely have a different motivation and approach to process implementation and process change. Furthermore, processes will evolve within divisions or agencies at a varying pace, so aligning processes to support a larger objective is not always easily instituted. The challenge is showing how

> **An overarching challenge is that reliability is not yet part of the common operations lexicon, even among departments of transportation.**

improving transportation reliability will benefit all agencies that need to be involved in process change.

Another significant challenge to integrating processes is that agencies may have different goals and objectives. Although a transportation agency might be focused on mobility or reliability, law enforcement and emergency response may be operating under different goals and objectives. For example, although incident clearance time may be identified as an important goal for both, the individual agency procedures may not be well aligned, so the transportation system overall fails to see as many benefits as it otherwise would.

Finally, detailed process modeling is typically not done by transportation agencies before, during, or after process integration. The lack of documentation can make it challenging for any one agency to identify critical gaps or breakdowns within specific processes, and the final processes that are established may not be fully documented. Improving documentation practices can lead to more efficient and effective processes and policies.

Institutionalizing processes is perhaps one of the most challenging aspects of implementing reliability-focused processes.

ALIGNING WITH OTHER INSTITUTIONALIZED PROCESSES

Institutionalizing processes is perhaps one of the most challenging aspects of implementing reliability-focused processes. Integrating processes across different operational divisions or agencies, as well as solidifying support for that integration, can be difficult to articulate and accomplish.

Current planning and programming activities offer many opportunities to identify important integration opportunities or gaps, as well as opportunities to articulate the need for integrating reliability-focused processes. Applying the process integration steps into other planning activities will provide even more opportunities to improve processes and take advantage of existing planning efforts that involve multiple agencies and key stakeholders.

Table 5.1 identifies three operations-focused planning efforts that can be used to identify opportunities for process integration. These are examples of processes that are already institutionalized, to varying degrees, within many transportation agencies. Each of these planning efforts brings together multiple stakeholders and involves a close review of current operations related to areas that affect reliability, such as incident management, traffic operations, and congestion management. They demonstrate the link between assessing business processes and integrating this approach with already established planning efforts.

TABLE 5.1. OPPORTUNITIES FOR ALIGNING WITH OTHER OPERATIONS-FOCUSED PLANNING EFFORTS

	Planning Efforts		
	Regional ITS Architectures	**Concepts of Operations**	**Congestion Management Process**
Relationship to Reliability-Focused Business Processes	• Identification of existing and development of desired operational concepts of processes related to reliability • Identification of all relevant stakeholder agencies involved in operations • Identification of specific functional connections between systems and agencies • Opportunity for development of agency agreements, such as to share infrastructure, share data, or collaborate on operational activities	• Development of operational activities, goals, and outcomes • Identification of current and future roles and responsibilities of all stakeholders	• Development of congestion management objectives • Development of performance measures • Identification and evaluation of strategies for congestion management
Level of Adoption and Federal Requirements	Widely adopted: Required in regions deploying ITS. There is a set of requirements established for what an ITS architecture needs to capture, so there will be consistency in how ITS architectures are developed from region to region.	Gaining widespread adoption: Not yet required.	Widely adopted: Required as part of the metropolitan planning process in transportation management areas. Likely led by organizations that, by nature, have interest in multiple operations.
Opportunities for Process Integration	Development of operational concepts and integration of multiple systems that affect travel reliability	Development of concepts of operations including operations that directly affect reliability	Development, implementation, and evaluation of strategies to reduce congestion

6 SUMMARY

A seven-step methodology has been developed for analyzing and implementing business processes. Integration of new or changed processes can be divided into two distinct aspects in supporting reliability-focused operations: process integration at the operations level and process integration at the institutional or programmatic level. Each has different challenges in terms of process implementation, execution, and overall integration.

At the operations level, various processes and activities evolve and are coordinated among those who are responsible for overseeing or carrying out operational initiatives (such as steps a traffic management center operator takes to initiate notification to travelers). There is often a direct link between the process and the outcome (although it might take a collective set of processes to result in a significant outcome). Process integration at the programmatic level is a much more complex undertaking. Not only are there different constraints to be worked through at the institutional level, there is also a much less direct relationship between those programmatic processes and their contribution to travel time reliability. Yet, institutionalizing processes so that they influence training, staffing and resource management, planning, programming, and policy is an essential enabler to effective business process integration.

Process integration needs to occur at the operations level (in the field, in the center) as well as within the institution, so that it extends to planning, programming, training, procurement, and other organization-level activities. Creating positive impacts on travel time reliability (i.e., minimizing the negative impacts of variability on travel times) is rarely the result of operational processes from one source or one agency. Multiple entities carry out one or more steps in each process, and each individual step is an enabler of the success of the overall process.

The overarching objective behind the need for integrated processes is improved travel time reliability, although this is not yet widely measured or reported on by most transportation agencies. Furthermore, the fact that external agency partners or entities are not likely to have reliability-focused metrics makes it challenging to articulate such a goal that spans multiple partners. To extrapolate impacts on reliability, agencies need to capture those operational and response metrics that contribute to an overall reliability strategy: reduced delay, increased use of traveler information systems, number of automated information exchanges with key partners, and proactive preventive maintenance activities, among others. Such metrics can help show how incremental process enhancements and integration efforts provide a cumulative impact on network operations and reliability.

The benefits that result from process integration at both the operations level and the programmatic and institutional levels can include increased efficiency, saving of financial and staff resources, increased scalability and flexibility of systems, and, ultimately, processes that are more integrated into an institution. For any process to remain beneficial, it should be developed in such a way that it allows for innovation. Processes that are not flexible and remain static may be effective initially in improving travel time reliability, but as travel conditions, travel patterns, and other factors that affect reliability change over time, a process that is static may lose its effectiveness.

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RELATED RESEARCH

Institutional Architectures to Advance Operational Strategies (L06)
Evaluating Alternative Operations Strategies to Improve Travel Time Reliability (L11)
Improving Traffic Incident Scene Management (L12)
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