HIGHWAY CONSTRUCTION COORDINATION TO MINIMIZE TRAFFIC IMPACTS

REQUESTED BY:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

STANDING COMMITTEE ON PLANNING

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UNDER SUBCONTRACT TO ICF INTERNATIONAL

August 2006

The information contained in this report was prepared as part of NCHRP Project 08-36, Task 56, National Cooperative Highway Research Program, Transportation Research Board.

ACKNOWLEDGEMENTS

This study was requested by the American Association of State Highway and Transportation Officials (AASHTO), and conducted as part of National Cooperative Highway Research Program (NCHRP) Project 08-36. The NCHRP is supported by annual voluntary contributions from the state Departments of Transportation. Project 08-36 is intended to fund quick response studies on behalf of the AASHTO Standing Committee on Planning. The report was prepared by Timothy Luttrell (SAIC) and Kevin Duffy (SAIC). The work was guided by a task group chaired by Tim Henkel (Minnesota DOT) which included Robert Vockrodt (Minnesota DOT), Donald Miller (Wisconsin DOT), Will Mathies (Michigan DOT), David Rush (Virginia DOT), John Leonard (Utah DOT), Daniel Shamo (URS Corp.), Jacqui Ghezzi (Caltrans), Celso Izquierdo (Caltrans), Amr Jabr (Minnesota DOT), and Terry Zollar (Minnesota DOT). The project was managed by Ronald D. McCready, NCHRP Senior Program Officer.

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EXECUTIVE SUMMARY

Highway construction programs are implemented to maintain and expand infrastructure, with many projects typically carried out under maintenance of traffic. Agencies often experience difficulty in maintaining safety and mobility for motorists while completing projects in a timely fashion without sacrificing quality. A construction or maintenance zone may experience traffic safety issues created by a reduction in mainline mobility. Additionally, alternate routes that would normally be viable options for motorists may also have degraded conditions due to similar capacity restrictions (e.g., lane closures).

Strategies are available to practitioners to assist them in overcoming many of these issues. One such strategy involves enhanced coordination among agencies and entities to avoid large-scale impacts across multiple routes and jurisdictions. Inter-agency and intraagency construction program coordination can help avoid traffic impacts on two parallel routes at the same time. The planning process plays an important role in successfully implementing construction programs, especially when a project has the potential to cause corridor-wide impacts. There is a need for a solid understanding of the potential impacts from a project at a wider scope than just the mainline route — an understanding that is most useful in determining the best maintenance of traffic plan.

Modeling and simulation tools, capacity analysis, and other analyses often require not only familiarity with the tool itself but also quality data that may not be readily available. Sometimes exacerbated by short timelines for planning and design, the lack of appropriate time needed early in the process to develop a full understanding of the mainline impacts may exist — making it difficult to perform analysis of potential corridor-level impacts that may occur. This may ultimately require that responsibility for coordination between and among projects be vested in a 'Regional Mobility Coordinator'. That is, a "Program" as opposed to a "Project" level approach is needed.

Good modeling and simulation tools along with improved intra-agency coordination may not be enough to resolve conflicts between and among projects if there are process conflicts embedded within the agency. This often occurs where authority for various aspects of the agency's program is fragmented, and/or where a multitude of exogenous pressures (utility locations, steel deliveries, local coordination, etc.) exert conflicting demands on project managers. A top-to-bottom process improvement may be needed to identify and remove "pinch points" in the process and to empower an appointed "Regional Mobility Coordinator".

This document outlines several examples of various approaches to overcome traditional institutional barriers to coordination of highway construction projects for the benefit of traffic mobility along a corridor or network. Additionally, the report provides recommendations for a process that can benefit agencies responsible for implementing construction and maintenance programs while maintaining reasonable levels of traffic flow.

STUDY SITES AND INTERVIEWS

The project study team performed interviews with representatives from six states and analyzed construction coordination processes, management plans, communication strategies, and technologies used to improve corridor mobility during construction. While many agencies were involved in the coordination at each site, this report often describes the state and also the state department of transportation (DOT) for ease of reference. The six study sites are Utah, Ohio, Oregon, the Gary Chicago Milwaukee Corridor Working Group (GCM), Massachusetts, and New York / New Jersey TRANSCOM.

After reviewing program- and project-level practices at each site, the team developed descriptions for distinct levels of inter-agency coordination, including:

- *Communication* sharing information on planned construction activities and making information available for intra-agency and inter-agency viewing (using technology or otherwise)
- *Collaboration* forming inter-agency groups to develop plans for construction and maintenance activities across jurisdictional boundaries (may also be for intra-agency groups)
- *Consultation* seeking buy-in from within an organization (construction to maintenance, inter-agency, etc.) or across organizations for planned activities
- *Command* a specific structure that enables control of activities within and across jurisdictional boundaries and changes to plans and schedules.

Table 1 highlights each type of coordination strategy employed by site.

Location	Type of Coordination Strategy						
Location	Communication	Collaboration	Consultation	Command/Control			
Utah	Х	Х	Х	Х			
Ohio	Х	Х	Х				
Oregon	Х	Х	Х	Х			
GCM Corridor	Х	Х	Х				
TRANSCOM	Х	Х	Х	Х			
Boston CA/T	Х	Х	Х	Х			

Table 1. Coordination Strategies in Use by Site

The team observed some common issues, needs, and trends, including the following main points:

• Each organization or agency has its own mission and charter. Because of personnel and resource constraints, agencies may find it difficult to coordinate at a level higher than local or intra-agency. There may also be no direct incentives (at certain levels

within the agency) to do so. Buy-in from top-level decision makers is important in overcoming this challenge.

- Because of their structure and alignment, agency groups may have difficulty communicating and coordinating both internally (construction, traffic, etc.) and externally. Regional mobility coordinators are one way to improve communication within and across agencies.
- Project Managers are looking for "ammunition" to sell strategies that can improve mobility to decision makers. Lessons learned with associated costs from other successful efforts can help.
- State DOTs often experience resistance from local agencies to the idea of diverting traffic from a freeway onto a parallel arterial due to infrastructure impacts in neighboring jurisdictions. However, for events such as catastrophic incidents, a large number of motorists may divert on their own. It is better to have performed some type of analysis and to have a plan for this type of diversion to allow agencies to be prepared for management of traffic during times of congestion. Agencies can benefit from processes and procedures for coordinating construction so that parallel routes along the same corridor are not experiencing capacity restrictions at the same time.
- Freight mobility considerations are very important when managing traffic along heavily traveled routes, especially Interstate corridors, due to potential economic impacts.

One of the recommendations developed from this study is for state-level agencies to appoint a corridor- or regional-level traffic mobility coordinator. This position has been shown to enhance cross-jurisdictional communication when planning for projects that have significant potential impacts to traffic mobility and safety. In California, District Traffic Managers (DTM) provide the coordination link across entities responsible for construction, maintenance, and utility work. The goals of the District Traffic Managers are first to insure the safety of the traveler and those who work on the state highways. They also keep travelers informed of lane closures so that they can make informed decisions about their trips. The DTMs actively improve mobility and accessibility of the state highway system by coordinating the lane closure process and tracking and reporting on lane restrictions.

INTRODUCTION

The Intermodal Surface Transportation Efficiency Act (ISTEA), signed into law in 1991 by President George H. Bush, is often referred to as the first post-Interstate highway national authorizing legislation in the United States. The implementation of this act signaled a shift in emphasis away from the building of Interstates, the focus of the preceding thirty-plus-year period, and toward the continuing need to maintain, rehabilitate, and occasionally reconstructing not only the Interstate System but also other major roads of national significance later designated the National Highway System (NHS). This historic change in priorities, which had actually begun "on the ground" in the mid-1980s, led quickly to a new era of conducting most maintenance and construction operations in close proximity to the traveling public; i.e., in "work zones," a phenomenon which has grown and will only continue to grow for the foreseeable future.

Work zones present two fundamental potential problems: a reduction in mobility through lower capacities, degraded geometrics, and reduced speeds; and an increase in the potential for crashes due to these factors and the presence of workers and nearby construction equipment. Dealing with these problems has been the focus of a large number of conferences, research projects, and other efforts aimed at improving work zone operations. The Federal Highway Administration has been particularly active in this area, producing a variety of tools and recommended procedures for use by transportation agencies. FHWA also has regulatory responsibility in this area and recently began implementation of a major rulemaking effort.

The new regulation for work zone mobility and safety requires the use of public outreach plans, transportation management plans, and work zone impacts analysis on federally funded projects. In addition, it encourages the use of innovation by owner-agencies throughout the project development process and promotes a coordinated approach to considerations of traffic impacts from construction. As State Departments of Transportation and local highway agencies look to innovative techniques to mitigate the impacts caused by work zones, they also must be cognizant of the potential impacts to surrounding jurisdictions as strategies are implemented. For example, traveler information systems may directly or indirectly divert a large percentage of traffic around a work zone and onto local roadways.

Adequate planning, quantitative estimation of impacts from diversion, and high levels of interagency coordination can alleviate traffic impacts to surrounding areas. Mitigation efforts should begin long before the first barrel is in place. A corridor-wide approach to planning for construction projects can alleviate impacts at a larger than normal scale and can optimize traffic flow on the mainline and alternate routes during construction. This approach requires adequate coordination and communication between federal, state, and local agencies – coordination across boundaries that may require extra effort outside the normal mission and associated procedures within each agency.

Management of construction impacts at the "Program" level as opposed to the "Project" level introduces coordination and communication needs early into the process. Typically, sensationally large projects often attract attention and require enhanced coordination with agencies in adjacent jurisdictions due to a high probability of impacts. Generally, DOTs may share information through state-level coordinators (such as MPO coordinators) on large, potentially high impact projects, but centralized construction program information repositories are less common.

The following sections highlight examples of successful practices, programs, and strategies that have been used to alleviate issues that arise due to impacts outside the local work zone area on the route under construction.

The team outlined the key components of coordination practices from the states shown in the figure below. While the DOT is listed in some cases as the lead agency for each site for illustration purposes, multiple agencies were normally involved in coordinating construction activities across jurisdictional boundaries.



Figure 1. Map of the United States Highlighting Key Components of Coordination Practices in Selected States

In addition to the sites studied for this project, several other initiatives provide useful insight into the issue at hand. The American Association of State Highway and Transportation Officials (AASHTO) has recently been active in workshops designed to brainstorm new ideas on how to accelerate construction to minimize exposure to potential impacts. Workshops held in Minnesota, Montana, New Jersey, and Texas all included discussion on the need for enhanced coordination and recommended specific actions.

The results call attention in particular to the need to update schedule information on a specific basis to identify milestones and prioritize the schedule of activities. Development of a flowchart for relationships and responsibilities was also recommended.

The following sections highlight practices and procedures in use by each interviewed agency and organization as they relate to coordination to minimize impacts from construction and maintenance projects.

Some highlights from each section include:

- *Utah* Analyses for mega projects; scheduled coordination meetings; integration of systems across jurisdictions
- *Ohio* Maintenance of Traffic Policy; Maintenance of Traffic Alternatives Analysis; corridor-wide capacity analysis for projects with large anticipated impacts
- Oregon Structured hierarchy for resolving potential conflicts; designated statewide mobility manager and regional mobility liaisons
- *GCM* Advanced technologies for sharing data; integrated systems that foster communication and coordination; concept of operations for coordination
- Boston Traffic Milestone Matrix; Traffic Advisories; Traffic Management Implementation Plan
- *TRANSCOM* (*NY/NJ/CT*) voluntary consortia / working group; enhanced coordination across agency boundaries; shared database for storing construction information.

UTAH DEPARTMENT OF TRANSPORTATION COORDINATION PRACTICES

The Utah Department of Transportation (UDOT) coordinates construction and maintenance activities at the project and program level while implementing strategies to eliminate impacts to other jurisdictions due to mainline construction. Strategies such as scheduling lane closures outside of peak hours and working at night keep impacts at a minimum to avoid burden on local agency routes. UDOT also establishes advisory groups consisting of key stakeholders and implements heavy public relations campaigns for larger impact projects.

"A traffic management system shall be designed to allow safe, efficient, and effective integration and additions of highways and intersections under county and city administrative jurisdiction. The department shall enter into an agreement or contract...with a county or municipality to share costs incurred under this section." - Utah Criminal and Traffic Code (2001)

In 2001, the Utah State Legislature introduced legislation to establish a Traffic Management Committee, made up of the following stakeholders:

- UDOT
- Utah Association of Counties
- Department of Environmental Quality
- Wasatch Front Regional Council
- Department of Public Safety

- Mountainland Association of Governments
- Utah League of Cities and Towns
- Utah Transit Authority
- Others as designated

The legislation mandated implementation and administration of a traffic management system to improve regional mobility and to allow for information sharing across agency boundaries. The committee is tasked with making recommendations and providing guidance to UDOT, counties, and municipalities on enhancing safety and efficiency of highways using strategies such as traffic signal coordination, monitoring, ramp metering, variable message signing, and incident management — especially during periods of congestion.

Weekly construction coordination meetings are held from April through October. Typical participants include the six resident construction engineers for the region, the two regional public information coordinators, Traffic Operations Center (TOC) control room supervisors, the signal coordination engineer, a meteorologist, two regional traffic engineers, a permits office representative and the regional maintenance area supervisors. The meetings are held on Thursday mornings and the discussion focuses on the upcoming construction-related traffic impacts for the weekend through the next week. Major traffic control changes and upcoming closures are discussed 2 to 3 weeks out so that any coordination between projects can take place.

From this meeting, conflicting traffic control plans, estimated impacts, and potential detour routes are identified and adjusted as needed. Weather impacts are anticipated and addressed, the public information coordinators identify important information to disseminate to the public, signal timing issues are identified, and the TOCs have the information they need for outlining VMS, HAR, 511 and other messages. For major incidents, UDOT Intelligent Transportation System (ITS) elements allow for control of parallel route signal systems to flush traffic from a detour route. Several state and local agencies have workstations that function as a node on the UDOT ITS network and have access to camera images and traffic data in real-time. These strategies allow UDOT to enhance mobility through major corridors and foster coordination and communication.

CASE STUDY: UDOT I-15 RECONSTRUCTION PROJECT

UDOT formed the I-15 dedicated project team to enhance coordination through regular meetings with each agency that had operational responsibilities within the corridor. The team was created in 1995 and consisted of 8 UDOT representatives and 25 consultants including a private program manager who coordinated 8-10 simultaneous contracts. UDOT also programmed \$50 million in funding for alternate route improvements prior to the I-15 freeway reconstruction project. UDOT chose 11 projects with environmental clearance that could be completed in a short timeframe. Each Regional Office designed the projects within their jurisdiction, and each project had to be completed prior to starting the I-15 work. The I-15 project was valued at \$1.3 billion, with \$1.6 billion for program costs overall.

UDOT implemented full freeway closures at night due to a requirement to keep some lanes open during the day (MOT plans reduced three lanes to two in each direction). With 225,000 annual average daily traffic (AADT) prior to construction, analysis showed that motorists used the alternates and that demand was well distributed across each alternate route. These routes included I-215, State Street, 700E, Redwood Road, Bangerter Highway.

Several alternate route improvement projects were planned prior to mainline construction to reduce the number of bottlenecks on each route and provide enhanced capacity. UDOT filled in medians in some locations to add extra lanes, restriped additional lanes, removed on-street parking, performed signalized intersection improvements, and added lanes in some locations to expand capacity (two-lane to six-lane sections).

Alternate route projects were chosen based on what could begin in a timely manner and be completed by summer 1996. UDOT performed an analysis using traffic modeling techniques to understand the delay and impacts to get the "biggest bang for the buck." Parallel street projects (\$50 million total) were constructed using I-15 program funds. Additionally, \$50 million was used for a combination of ITS hardware and software, the

Traffic Operations Center structure, right-of-way acquisition, and a contractor award fee contingent upon established criteria for overall quality.

The I-15 team performed visual alternate route inspection with local agency partners to determine the most appropriate projects for completion prior to mainline construction. UDOT used resources from regional offices for alternate route improvement projects. While UDOT owns many of the alternate routes, local agencies were involved and consulted. Ownership of a route was not a factor in selecting the alternate route projects, and local jurisdiction routes were included in the analysis. Throughout the project, UDOT held weekly traffic, maintenance, and incident management coordination meetings. UDOT coordinated informational updates with the media, utility companies, trucking associations, the Utah Highway Patrol, the local police, and city agencies after each meeting.

For the corridor, capacity improvements were mainly targeted at expanding capacity at "choke points" along the routes. The project team coordinated operations during construction to ensure no other work would be scheduled for the 5-year period. Meetings were held with cities, and consensus was reached to accelerate projects such as utility work along the corridor prior to I-15 work.

UDOT implemented extensive outreach strategies to local communities, elected officials, and other stakeholders (e.g., mayor, public works director, city engineer). Another key aspect was to mitigate impacts to local businesses — alternate route traffic increases led to increased business for some

UDOT originally estimated the I-15 reconstruction project would take 8 to 10 years to complete; however, hosting the Winter Olympics in Salt Lake City in 2002 created a need to complete the entire reconstruction project in 4 ½ to 5 years prior to the start of games.

UDOT began work on the I-15 corridor in 1982 with an I-15 Corridor Major Investment Study that included two major components: increased capacity and additional transit options. In 1990, the Utah Transit Authority (UTA) started concept development for a light rail system along the corridor and constructed the rail system. By the mid-1990s, major congestion was prevalent along the corridor along with serious infrastructure deterioration. UDOT made the decision to upgrade I-15 using Design-Build, and began construction in 1997.

Because of the enhanced coordination across agencies and the corridor wide alternate route improvements, UDOT was able to complete the I-15 reconstruction with significantly fewer impacts to traffic mobility along the corridor. All lanes on I-15 were open to traffic ahead of schedule in summer 2001. While the I-15 program overall was a special case for a large, focused project, it highlights the importance of using a process to coordinate across jurisdictional boundaries and analyze potential construction impacts to traffic. While dedicated funding may not be available in many cases for alternate routes improvements, a formal process for estimating the potential impacts will help form

alternative plans, such as changes in scheduling, enhancements to alternate route signal timing plans, or enhanced public outreach to affect change in travel patterns.

OHIO DEPARTMENT OF TRANSPORTATION PROGRAM

The Ohio Department of Transportation mitigates traffic impacts from adjacent construction projects by utilizing processes that identify work zone capacity needs and potential constraints to accommodate the needed capacity during construction.

Ohio is currently implementing a 10-year, \$5 billion "Jobs and Progress" program that includes major projects in addition to a \$1.2 billion annual construction program. Most projects are in urban areas where heavy congestion already exists — congested areas experience higher crash rates and work zones magnify the problem — and where there is heavy truck traffic.

ODOT implemented a Maintenance of Traffic Policy, and a Maintenance of Traffic Alternatives Analysis (MOTAA) process for all projects. ODOT uses field observations, crash data, and operational information to manage corridor-level networks where a mainline is under construction. Agency employees, consultants, and contractors are trained on the policy and MOTAA process.

The MOT Policy – What does it do?

The purpose is to systematically determine required mainline work zone capacity needed during MOT. It provides a process for ensuring adequate work zone capacity is provided whenever feasible.

The MOT Policy – When does it happen?

Efforts take place during Preliminary Engineering – before detailed plans are created.

The goal of the MOTAA is to identify potential traffic safety and mobility problems prior to detailed design so that a solution can be engineered into the design. When an engineering fix isn't possible or practical, innovative contracting and construction techniques may be used to minimize the duration of the problem (sub-phases).

Extensive Traffic Management Plans are not usually required (only a Maintenance of Traffic Plan is required) when the impacts are identified early and designed out of the project. When impacts analysis shows that local jurisdictions will be affected, ODOT coordinates with other agencies to determine the most appropriate treatment. Some examples of strategies to mitigate impacts are shown in the following list, ordered from the most frequently used to the least frequently used:

- Web Cams w/dedicated work zone info web pages.
- Intelligent Transportation System technologies for monitoring and surveillance.
- Alternate route improvements (especially signal operations).
- Ramp closures to constrain traffic in the work zone.
- A ban on commercial trucks for a particular route.

- Moveable barrier systems for directional capacity by time of day.
- Pay for increased bus service.

ODOT sets maximum allowable queue thresholds to help determine the appropriate MOT design and uses a queue calculation spreadsheet to analyze whether queues will exceed the maximum threshold and whether delays will be excessive. The analysis is based upon work zone capacity calculations (using QUEWZ-98) and known traffic data, including volume, percent trucks, and terrain type.

ODOT also sets pre-defined times when the contractor can reduced the number of lanes available to traffic on any section of the mainline route. A web-based system is used to catalogue and archive pre-determined times when lane closures are permitted for each route.

If a proposed project violates lane closure time restrictions for a highway, an analysis must be performed to determine the expected impacts and resulting queue lengths. If estimated queue lengths are greater than the policy threshold, an exception request must be submitted to the Maintenance of Traffic Executive Committee. The committee then decides if and how the project will be carried out. The procedures are applicable to both contract construction and maintenance work.

The ODOT policies and practices listed are important in fostering inter-agency coordination based on enhanced knowledge of potential impacts and traffic characteristics during construction. The procedures allow for a corridor-level analysis to determine the effects of mainline capacity restrictions along with alternate route capacity and traffic diversion (directed or voluntary) that may affect local agencies. A solid understanding of the potential impacts can lead to the development of optimal solutions and enhance the planning process.

The MOTAA identifies work zone problems (constraints) early enough in the project development process that there is time to determine the appropriate mitigation techniques. By necessity, the analysis happens early enough so that constraint fixes can be incorporated into the environmental, right-of-way, pavement selection, and bridge structure scoping processes. Safety, mobility, constructability and access issues are explicitly studied. ODOT measures performance by constantly analyzing historical work zone crash data along with historical qualitative mobility performance.

OHIO PROJECT-LEVEL CASE STUDIES

Coordination is performed for major projects throughout project planning and design, and ODOT involves all stakeholders in the process. The amount of coordination is commensurate with the specifics of the project. For example, ODOT is currently planning the reconstruction of I-70 and I-71 in downtown Columbus, and major impacts are anticipated. The alternatives analysis is ongoing and, when it is complete, ODOT will have a series of workshops with local agencies and other stakeholders to discuss

traffic management through the corridor. At that point the potential impacts will be known and the key stakeholders will jointly develop solutions and mitigation strategies.

For a separate project on the East Freeway in Columbus, the only feasible way to maintain traffic was to close all of the on-ramps inside the project. ODOT worked with the city to develop new timing plans on three adequate parallel surface streets to accommodate the diverted traffic.

Utility work on adjacent routes is coordinated between agencies during mainline maintenance of traffic implementation. Utility permits are granted by the local agency for work performed within a local agency jurisdiction. Generally, ODOT tries to provide sufficient capacity in mainline work zones so that the local streets are not overly stressed by traffic diversion.

Where necessary, ODOT considers capacity enhancement projects on alternate routes prior to mainline construction. For example, ODOT is planning the reconstruction of I-75 through Dayton, and bridge work on the Interstate is expected to have a significant impact on Main Street in Dayton (a local road). ODOT analyzed the diverting traffic patterns and the most likely alternate routes that would be used to bypass Main Street and is making improvements (mostly signal changes and intersection layout improvements) along the diversion routes to aid in traffic flow.

An important factor in ODOT's interactions with local agencies is that Ohio is a "home rule" state, which means that local agencies are not bound by ODOT requirements, even on state and US routes inside city boundaries; however, local agencies have historically been cooperative when approached by ODOT. For example, design consultants develop new timing plans so as to avoid inconvenience to the local agency's operations. With the "home rule" in effect, local agencies could decide not to use the proposed signal timing plans developed by ODOT, but generally that does not happen.

Agencies in Ohio use ITS technologies to help manage traffic statewide during construction. The Columbus TMC is co-staffed by the City of Columbus and ODOT. In Cincinnati, the TMC is staffed fully by ODOT, where staffers monitor the Interstate system. ODOT maintains and operates all Interstate routes (even inside of cities). The planned Cleveland TMC will be an important part of managing traffic for the planned I-90 reconstruction through the heart of downtown. ODOT is making provisions to give camera feed access to local agencies for monitoring and surveillance.

OREGON DEPARTMENT OF TRANSPORTATION PROGRAMS

The Oregon Department of Transportation (ODOT) uses corridor management strategies to minimize negative impacts on businesses and the public. ODOT regions deliver the Statewide Transportation Improvement Program and Oregon Transportation Investment Act III (OTIA) bridge projects plus other state projects, maintenance work, city and county projects, rail projects, and major planned utility projects. An unprecedented era of road and bridge work is underway throughout the state, and maintaining mobility across corridors, regions, and throughout the state is a high priority for ODOT.

With mobility as a primary concern, ODOT designated a statewide traffic mobility manager and regional mobility liaisons as well as forming a Statewide Traffic Mobility Committee. The statewide mobility manager is the point person for project restrictions, closures, and detours. The position resides in the Highway Division, reporting to the DOT Director and chairing the Statewide Traffic Mobility Committee. A corridor mobility committee, regional mobility committees, ODOT motor carrier division, five ODOT regions, and Oregon Bridge Delivery Partners are also major players in the process. The structure will be expanded to include representatives from other divisions, representatives from the trucking industry, and the public. The steering committee meets monthly or more often as needed. ODOT monitors traffic within Oregon and also in neighboring states when it might impact Oregon using probe vehicles. ODOT is also evaluating other technologies for traffic monitoring.

The statewide Traffic Mobility Manager is empowered to change the timeline of a project or projects if it is in the best interest of freight and traffic mobility.

A Traffic Mobility Operations Room houses a mobility tracking database and web-based mobility tracking system. The system provides access to real-time regional traffic information, including bridge weight limits, lane restrictions, detours, estimated delays, and detailed information on all current and planned bridge and road projects at the state and local level. The Sequel database has all the query and report generation features of a typical database. The technology helps facilitate traffic monitoring, traffic rerouting, and a staggered construction scheduling to keep traffic moving. Additionally, maintenance activities are scheduled in Microsoft Outlook in some regions to store information on the timeline and anticipated delays. This has proven to be a useful tool in scheduling maintenance activities around construction and vice versa.

At the program level, the overall objective is to make sure there is always an unrestricted freight route for both north-south and east-west traffic through the state; four major corridors have been identified in an effort to meet this need. At the corridor level, the objective is to monitor delay throughout each corridor to make sure it does not exceed maximum acceptable thresholds and determine how many projects can be underway at any one time. ODOT's Work Zone Traffic Analysis methodology provides windows of

time during which lanes can be closed throughout the year without causing significant negative impacts to traffic operations. The estimated delay, measured delay, as well as the delay threshold, all refer to the average delay for all vehicles during a given time period.

The ODOT Work Zone Traffic Analysis methodology has been recently augmented to allow for estimating average delays based on various staging strategies and schedules. At the project level, the objective is to make sure that each project observes the minimum mobility requirements for maintaining unrestricted freight routes. For a project on I-5, the team adjusted the staging to increase the number of lanes available to traffic during construction as one strategy to avoid delays. The delay estimates showed a slight violation of the threshold, so a delay exception was submitted and approved in that case. Another project on I-5 was planned for a holiday weekend and an exception was granted after an intensive public information campaign was proposed.

ODOT has a process in place that allows adequate time for communication and coordination prior to restrictions. For example, commercial vehicle restrictions through work zones require a 28-day notice to the ODOT Motor Carrier Division and a 21-day notice to the trucking industry. Additionally, leadership within ODOT provided guidance that conclusions on traffic patterns and detours must be made with earnest conversation and coordination with industry stakeholders.

ODOT Communication Checklist

- Contacted Motor Carrier Technical Coordinator and Trucking Industry representatives.
- ✓ Provided project information to Region Mobility Liaison.
- ✓ Worked with the following entities to identify and resolve any potential conflicts:
 - ✓ District Maintenance staff.
 - ✓ Oregon Bridge Delivery Partners.
 - ✓ Local road authorities.
 - ✓ Local utilities.
 - ✓ Rail Authorities.
- Provided 28 day written notice to Motor Carrier Division prior to start date of restriction.
- ✓ Considered impacts of local events and special travel days prior to start of restriction.
- ✓ Collaborated with community members (provided community outreach).

ODOT published the Highway Mobility Operations Manual, a document that outlines policies and procedures for coordination within and among agencies and strategies to enhance multi-modal mobility across the state. The manual describes the process for development of corridor-level Traffic Management Plans - similar to the FHWA

requirement for Transportation Management Plans that include public outreach, traditional traffic control plans, and work zone impacts analysis. The manual requires coordination of all projects along designated corridors in an effort to meet the statewide mobility goals.

The Oregon example highlights the importance of fostering communication within and across agencies and the utility of understanding the key impacts given a particular maintenance of traffic plan. The formal chain of command allows ODOT to manage the multiple construction projects while minimizing impacts to traffic.

GARY / CHICAGO / MILWAUKEE CORRIDOR ACTION TEAM PROGRAM

The Gary Chicago Milwaukee (GCM) ITS Priority Corridor was founded in the 1990s as a key area for deployment of ITS technologies for managing traffic conditions. The GCM group has formed a subcommittee known as the Corridor Action Team (CAT) to coordinate construction information between four cooperating transportation agencies in Indiana and Illinois. This group is composed of members of the various participating agencies and their goal is to promote a very high level of interagency cooperation during periods of extensive construction.

Key stakeholders include:

- Illinois DOT.
- Indiana DOT.
- Wisconsin DOT.
- Chicago DOT.
- Illinois State Toll Highway Authority.
- Indiana Toll Road.
- Chicago Skyway.
- FHWA.

The GCM CAT identified a need to use ITS technology to support the major construction/reconstruction projects in 2004 on the Borman Expressway (I-80), Tri-State Tollway (I-294), Dan Ryan Expressway (I-94), and Chicago Skyway (I-90). Several ITS components were already in place to support these major construction/reconstruction activities. The CAT also developed a Concept of Operations (ConOps) to identify and prioritize the coordination required to make full use of these systems. By agreeing on a mutually acceptable ConOps, the agencies responsible for specific components were able to identify the necessary actions to maximize the support capability of the ITS technologies and to prioritize those actions on a timeline that would assure the integration and mutually beneficial use of these systems. The GCM ConOps document defines the specific details for planned construction projects, the data that is needed by the Gateway System from each agency, the role each agency plays in the process, and the methods that can be used to share data and information (automatic, semi-automatic, or manual). The GCM CAT developed interagency notification list so agencies can quickly contact

A Concept of Operations is an important step in documenting how a system will support decision-making for minimizing impacts from construction activities. With enough detail it can also play an important role by highlighting the roles and responsibilities of each participating agency.

appropriate personnel in case major incidents affect neighboring jurisdictions. Updated construction and travel time information, including video snapshots, can be found at the GCM Travel website at <u>www.gcmtravel.com</u>. This website currently averages about 4

million hits per month. The CAT added web site "hot links" connecting participating agencies' websites with the <u>www.gcmtravel.com</u> website. Additionally, the team promoted the Chicago Area Transit Study's (CATS) "Share the Drive" program. Currently they have recruited approximately 4,000 ride-share subscribers.

The GCM CAT is also coordinating public information releases between various agencies. Additionally, development is underway for an automated interface between the

Borman System in Indiana and www.gcmtravel.com to update Indiana's traffic information postings every few minutes. Traffic detection equipment and video monitoring and surveillance systems are being integrated across agencies to link information and provide a platform for sharing and coordination. The GCM CAT is also promoting enhanced interagency coordination between Indiana's Hoosier Helpers and the Illinois Minute Men motorist assistance services.



Figure 2. GCM Routes with Construction

Several agencies and organizational units have operational and/or support roles during the major construction/reconstruction activities along the corridors. For example, the Illinois Department of Transportation (IDOT) Bureau of Electrical Operations (ComCenter) distributes information and coordinates response between maintenance, IDOT, Illinois State Police, Tollway, and local fire and law enforcement. The IDOT Bureau of Traffic oversees and coordinates traffic management on IDOT metro area expressways, and the IDOT Traffic Systems Center (TSC) monitors and manages traffic on IDOT metro area expressways. The operational linkages between age ncy representatives helped foster communication channels and develop relationships that helped agencies adequately plan for construction activities and minimize impacts at the corridor level.

The Gateway Traveler Information System (Gateway TIS) provides the mechanism for agencies to share traveler information and help ensure that operators and travelers receive timely, accurate information. The Gateway collects transportation-related information from geographically dispersed systems, validates and fuses the information collected, and disseminates it to transportation operators, public and private partners, and the traveling public. Multiple agencies (Chicago DOT, state DOT partners, etc.) feed traffic and construction scheduling information into the Gateway TIS for processing. Other agencies can access the data to help understand potential impacts and plan accordingly.

ITS technology is one way that the GCM CAT has enhanced coordination across agencies at the corridor and regional level. The technology provides an interface to store

information, analyze data, share scheduling and phasing details across agency boundaries, and coordinate the effective management of traffic within the region.

NEW YORK, NEW JERSEY TRANSCOM PROGRAM

Recognizing the need for information sharing and coordination in a number of areas, 14 agencies (transportation, public safety, and transit) formed the Transportation Operations Coordinating Committee in 1986. TRANSCOM currently has 18 member agencies and is a public-private partnership with the characteristics of both a government agency and a business. As a 501C3 corporation, TRANSCOM has greater flexibility than a large governmental organization while still maintaining an authority and leadership role similar to that of a government agency. The type of organizational culture needed to accomplish the goals and objectives set forth was an important factor in developing the identity and structure for TRANSCOM.

The idea for the TRANSCOM program was conceived due to the very issue at the center of this research project. During the mid-1980s, construction issues were prevalent due to the fact that major corridors are in extremely close proximity to each other. The two-level George Washington Bridge (GWB) carries more than 100,000 vehicles per day and crosses the Hudson River between upper Manhattan and Fort Lee, NJ, forming part of Interstate 95. The GWB, Holland tunnel, and Lincoln tunnel are major routes across the Hudson River, making the routes extremely important in moving freight and traffic through the local area and region.

The Port Authority of New York and New Jersey decided to form TRANSCOM to bring agencies together for discussion about planned construction and maintenance projects so that corridors are not under construction in parallel.

Early on, TRANSCOM procedures were relatively 'low-tech' and labor intensive, while improvements were been made in parallel with evolving technology. As discussions between member organizations progressed, a need arose to actively manage large volumes of information and details about planned projects and projected impacts. A unified database was developed to store information and was made available to each member agency. Each agency populates the database with information and submits the detail to TRANSCOM, where specialists review the information. The planned projects are then discussed in an annual construction meeting held during the spring of each year. The meetings are strategically held just prior to the start of construction season so that member agencies can discuss plans in detail. The Construction Management Office from each organization sends a representative to the annual meetings.

The input screen for the TRANSCOM database system is shown in Figure 3. Currently, agencies populate a copy of the database input file on CDROM through an executable program. The agency then sends the updates directly to TRANSCOM for incorporation into the master version. Data fields include lane restriction dates and times, number of lanes closed, location of the project, affected direction of travel, and duration of the

closure. TRANSCOM personnel analyze the master database to identify potential impacts to parallel routes for discussion at the construction meetings.

Each agency has an opportunity for discussion about projects and impacts, while TRANSCOM employees facilitate the discussion to avoid potential conflicts. Once details are discussed, smaller task forces are formed for projects to develop ideas to mitigate impacts. Such mitigation techniques can include changing overall schedules and planning for lane closures and capacity restrictions to avoid impacting both directions at the same time. The local Traffic Management Center provides technical support at the operational level for traffic and incident management and provides any traffic data needed to perform detailed analysis of the potential impacts.

While TRANSCOM is a structured group, each agency participates voluntarily. There is no hierarchy or mandate that sets forth the authority for final decisions; however, each agency is committed to minimizing impacts to the end user with one objective in mind; to adequately analyze impacts and schedule projects accordingly. Agencies accommodate each other on a cooperative basis — they know

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Figure 3. TRANSCOM Database Input Screen

that their own future activities will require the cooperation of others, and they act accordingly to minimize impacts.

The TRANSCOM process allows for improved coordination and consultation with stakeholders when higher levels of impact are anticipated from construction. When parallel impacts are anticipated, the projects will be scheduled to avoid the situation. However, some projects may be scheduled and work may begin after an analysis is performed and impacts appear to be minimal. For example, all three corridors were recently under construction concurrently, but the construction was scheduled to avoid major impacts. Once construction commenced, a conflict arose due to schedule delays from weather. Due to built-in penalties in the construction contracts for delayed completion, cancelling any project or rescheduling the work for a later time became issues of dispute.

In this example, the process worked to avoid parallel impacts but unforeseen circumstances arose. TRANSCOM specialists then looked to operational strategies to better manage the construction projects along the corridor. Public Information Officers were called in to discuss potential mitigation techniques. Plans were developed for mitigation and included information on real-time message signs, highway advisory radio, and press releases. Additionally, police agencies were used to patrol the area and other operational strategies were put into place including traffic monitoring from the TMC.

In planning and design, traffic engineers analyze and predict average and maximum queue lengths and delays based on options for traffic control plans. Some projects are at the design stage when potential impacts are assessed. TRANSCOM is also charged on a year-to-year basis with coordinating and investigating operational impacts from construction (operations planning). One key component is the use of integrated information for operational strategy development as part of the TRANSCOM regional operations information center. When incidents occur, the correct actions can be taken and decision-makers can act appropriately. Additionally, the Port Authority can cancel a project if a large incident occurs so that adequate integration exists within the operational realm of project implementation.

All projects from all member agencies are included in the analysis process, and each agency talks about its program in the annual meeting. Further discussion takes place on any projects that have the potential for multiple impacts along the corridor. Stakeholders agree to meet as often as needed depending on the project and anticipated impacts. If conflicts arise, additional meetings will take place, especially if major impacts are expected. TRANSCOM also allows for coordination "on the fly" for potential construction conflicts, and a project may be cancelled due to anticipated greater-than-acceptable traffic mobility impacts.

A new system is currently under development to enhance the coordination and planning process. A newly designed website will be available in the future for enhanced data input, with stakeholder login and update functions tied to a centralized database available to all stakeholders. Additionally, TRANSCOM has added a Weekly Traffic and Transit Advisory listing the construction activities planned for the week. The construction planning and coordination component of TRANSCOM continues to enhance the efficiency and mobility of the regional network.

BOSTON, MASSACHUSETTS "BIG DIG" TRAFFIC CONSTRUCTION IMPACTS

The Boston Central Artery Tunnel (CA/T) Project (the "Big Dig") had 161 lane miles under construction through a major urban area with 4 tunnels, 1 cable stay bridge, and 4 major interchanges along with 29 miles of relocated utilities. The overall project value was \$14.65 billon dollars over a period of more than 10 years. In the early 1980s, one elevated artery carried more than 190,000 vehicles per day with significant congestion. Construction of the new Central Artery Tunnel required advanced planning and coordination among many stakeholders for a successful implementation.

During the planning stages, restricted traffic flow and traffic disruptions were predicted to be the single most public event for the project, and also the single greatest source of complaint by the public. In fact, 35% of all complaints received by Big Dig project management concerned traffic mobility and safety. The CA/T recognized that not all traffic disruptions would be planned; many emanated from collisions or constructions mishaps. To minimize the severity of these incident- and accident-related disruptions, they were handled under the purview of the emergency management department. This guaranteed rapid response actions to mitigate traffic disruptions as they occurred in real-time.

Planned traffic disruptions to capacity or alterations to traffic patterns were conducted under the umbrella of a working group composed of project departments, including traffic, construction, community mitigation, and emergency management, as well as representatives of the affected local or state jurisdiction.

All lane alterations were scripted, using a three-phase sign-off involving the contractor, the traffic engineering section, and state/local authorities. Enhanced coordination among all involved parties and extensive public outreach were two important components of the project.

The CA/T leadership decided that capacity should remain at pre-construction levels throughout the construction period. To reconcile the two periods, stakeholders developed a comprehensive program of planning and approvals concerning traffic impacts.

Two areas of concentration for management of the Central Artery Tunnel Project were managing traffic and minimizing construction impacts to traffic (including freight traffic). The \$15 billion urban infrastructure redevelopment project created a new infrastructure above, below, near, and around the existing traffic footprint while upholding a pledge to the community to maintain or expand capacity. To accomplish the mission of minimizing or eliminating impact to the traveler, the Big Dig needed to deploy proactive, creative measures.

The scope of construction activities provided the potential for worksites and lane restrictions to overlap, severely restricting the capacity of traffic through the footprint. The CA/T leadership decided that capacity should remain at pre-construction levels throughout the construction period. To reconcile the two periods, stakeholders developed a comprehensive program of planning and approvals concerning traffic impacts. This program included:

- A traffic set up and advisory document for routine construction activities affecting traffic capacity. This document is shown in Figure 4.
- A traffic management implementation plan to manage facility openings and closings and large-scope actions.
- A series of traffic planning products designed to allow participation by stakeholders and maximum information dissemination to the public. These products included:
 - Traffic Milestone Implementation Plan.
 - o Traffic Advisory.
 - Public Outreach Plan.
 - Active Notification.
 - Abutter Impact—Community Liaison contacts specific impacted abutters.
 - Enforcement Deployment Plan.

All work would occur within delineated jurisdiction boundaries. Assumptions of the traffic program included a definition of the jurisdictions impacted, of which there were three: Massachusetts Turnpike Authority, Massachusetts Highway Department, and the City of Boston. The Traffic Management Council had the authority to halt contractor plans by not approving the proposed traffic adjustments.

All contractors were trained on the traffic approval process, and all had to make their work schedules conform. In addition, contractor traffic plans were required to include detour route information. Because utility companies were on a force account to the CA/T, the CA/T retained a high degree of control over their traffic interruption practices. The benefits of this approach included:

- The ability to avoid adverse construction traffic impacts from multiple lane restrictions on the same corridor at the same time.
- The ability to force contractors to plan their work well in advance so as to coordinate the need for traffic restrictions and capacity reductions.
- The ability to provide the earliest possible notice of traffic pattern change or closure to any person who would use or cross the affected footprint.

The CA/T used an Operations Center to coordinate all pending and active construction work and planned traffic shifts and lane restrictions. The CA/T Operations Center operated around the clock due to construction demands. Establishment of a full time Operations Center with full data accountability provided a sense of security to the community that they could be heard at any time, day or night. This idea strengthened support for the project within the community.

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Figure 4. CA/T Traffic Set Up Approval Document

THE TRAFFIC MILESTONE MATRIX

The CA/T developed plans and templates to handle any type of traffic disruption lasting from one hour to several months. The plans were scalable to match the level of anticipated disruption to the community and the amount of construction that needed to be accomplished. The Traffic Milestone Matrix that appears as Table 2 provides a sample of the templates that would be deployed. The CA/T deployed a Traffic Plan for all events that would cause a potential shift or disruption to traffic patterns or capacity. This included minor construction moves to major events, including roadway or ramp closures or openings. This process was much more complex as the actions involved likely included a temporary capacity restriction as facilities were brought on or off line.

The least complicated traffic planning occurred tactically at the level of the Resident Engineer and Traffic Engineer. They scheduled temporary traffic pattern shifts to accommodate a construction activity. As shown in the Traffic Milestone Matrix, the products were composed of a routine traffic advisory and public information release.

The script was reviewed with affected jurisdictions and their concurrence was required. This step was frequently beneficial since assets or personnel of the jurisdiction often had roles in the script.

If the Traffic Milestone	And the Characteristics/	Then the Planning Elements
Classification Is:	Criteria Are:	Required Are:
 Example A: Short deviation to accommodate construction activity NO STREET CLOSURES 	 Signal Impacts - None Roadway Classifications - local, arterial Pedestrian Impacts - Detours Access to Adjacent Properties - None Parking Impacts - Minor Agencies Involved -Project, City Duration of Traffic Change implementation - less than 30 minutes Time of Day - non-rush implementation 	 Task Force – None Planning Lead – Resident Engineer Office Time Frame – 1 Hour PRODUCTS Traffic Milestone Implementation Plan – No Traffic Advisory – Yes Public Outreach Plan – No Active Notification – No Active Notification – No Abutter Impact – Community Liaison contacts specific impacted abutters Enforcement Deployment Plan – No, regular details posted PARTICIPANTS RE, Traffic Engineer Meeting Fax Sketch

 Table 2. Example Traffic Milestone Matrix

If the Traffic Milestone	And the Characteristics/	Then the Planning Elements
Classification Is:	Criteria Are:	Required Are:
 Example B: Close East St. for 2 Weeks Days Only STREET CLOSURES FOR DURATION LESS THAN 6 DAYS 	 Signalization Impacts – less than 2 Intersection Roadway Classification –All Pedestrian Impacts – Minor Access to Adjacent Properties – Alternate Entrances installed Parking impacts – Minor, capacity expanded in other areas to achieve same Agencies Involved – Project, City Duration of Traffic Change implementation –greater than 2 hours Time of Day – non rush implementation 	 Planning Task Force – None Planning Lead – Area Construction Manager, Traffic Engineer. Planning Time Frame – 4 hours to One Day PRODUCTS Traffic Milestone Implementation Plan – No Traffic Advisory – Yes Public Outreach Plan – Partial, targeted at abutters and transportation companies. Community Liaison schedules public neighborhood meeting. Active Notification – Yes, emergency services Abutter Impact – Alternative access/parking provided Enforcement Deployment Plan – Yes
		 PARTICIPANTS Members – Resident Engineer and Traffic Engineer
	 Signalization Impacts – Significant Roadway Classification – All Pedestrian Impacts – Rerouting Access to Adjacent Properties – Restricted Parking Impacts – Loss of space capacity Agencies Involved – Local, State Duration of Traffic Change implementation –greater than 2 hours Time of Day – non rush implementation 	 Task Force – Multi Agency Task force recommended Planning Lead – Resident Engineer Planning Time Frame – six weeks PRODUCTS Traffic Milestone Implementation Plan – Yes Traffic Advisory – Yes Public Outreach Plan – Partial, targeted at abutters and transportation companies. Community Liaison schedules public neighborhood meeting Active Notification – Yes, emergency services, traffic reporting agencies Abutter Impact – Yes, alternative parking/access provided Enforcement Deployment Plan – Yes

If the Traffic Milestone	And the Characteristics/	Then the Planning Elements
Classification Is:	Criteria Are:	Required Are:
 Example D: Ramp E closure Ramps A1/N1 opening COMBINING MULTIPLE MAJOR ADJACENT EVENTS IN ONE JOINT, SEAMLESS OPERATION 	 Signalization Impacts – Major, including disabling automatic controls Roadway/Classification – All Pedestrian Access Impacts – Access To Adjacent Properties – restricted Loss of parking/mobility capacity Multiple Agencies Involved Duration of Traffic Change – All Time of Day – Any 	 PARTICIPANTS Task Force – Full Task Force Planning Lead – Area Const. Manager Planning Time Frame – 10 to16 Weeks PRODUCTS Traffic Milestone Implementation Plan – Yes, highly choreographed time schedule of activity Traffic Advisory – Yes, published widely Public Outreach Plan – Full, targeted at abutters and transportation companies. Public Information designs and implements a campaign to inform the public using all media forms, Project abutter lists and community meetings Active Notification – Yes, emergency services, traffic reporting agencies Abutter Impact – Yes , alternative parking/access provided Enforcement Deployment Plan – Yes, detailed choreograph of closing and openings

THE TRAFFIC SET UP AND ADVISORY PLAN

The CA/T utilized a 3 step traffic set up plan:

Step One

• The contractor determined his own construction activity schedule and need for lane restrictions that impact capacity. These actions were taken in the course of routine construction and maintenance activities.

Step Two

• The contractor submitted his plans to the client traffic manager for the CA/T, who was a member of the project traffic engineering team. The traffic manager would assess the traffic capacity alteration or reduction with the knowledge of traffic and construction activities occurring nearby, including known utility work and other efforts of the state and local governments.

Step Three

- The client traffic manager met with traffic representatives of all affected jurisdictions and coordinated schedules. Large scale traffic moves involving multiple contract areas or multiple legal jurisdictions were referred to a working interagency committee, which met on a regular schedule. The committee assessed the requested traffic move against all known conditions and planned activities, which may not all have been traffic-related; the committee considered religious festivals, community celebrations, and sporting events in addition to traffic-related activities.
- The interagency committee ensured that traffic moves did not counter one another. This proactive coordination allowed for capacity to remain undiminished, allowed each contractor to plan his work schedule, and allowed travelers to have a hassle-free experience.

Following Traffic Set Up and Advisory Document approval, shown in Figure 4, the information was written into a plain language press release, shown in Figure 5. The public release was then cleared by the project's public relations office and then rapidly broadcast using a notification system operated by the project emergency management department. The rapid systems of advisories would extend to a set list of over 1200 abutters, agencies, and interested parties, including:

- All state agencies.
- All local agencies.
- All emergency services within 10 miles.
- All transportation agencies (transit, bus, rail).
- All hospitals.
- All transportation facilities (airport, rail stations, bridges, HOV lanes, etc.).
- All cab companies.
- All tow companies.

- All trucking companies.
- All media outlets (TV, radio).
- All traffic reporting services (511, commercial radio services, etc).
- All adjacent abutters.
- Any interested party.

Particularly crucial were notifications made to emergency services and to transportation companies such as truck delivery (FedEx, UPS) and commercial delivery. The advance notice to them allowed them enough time to alter route choices and schedules as appropriate. These high volume road users could then eliminate the construction-impacted area, decreasing the potential for congestion.



Figure 5. Public Release Traffic Advisory

THE TRAFFIC MANAGEMENT IMPLEMENTATION PLAN (TMIP)

The most involved planning process called for a full Traffic Management Implementation Plan (TMIP), which required a long lead time for planning among the affected jurisdictions. This long lead time was directly related to the scope of the planned traffic move. The TMIP required the assembly of a detailed script noting the specific actions required to open or close the transportation asset, the time the action would occur, the person responsible for the activity, and the cell phone number of that person.

The TMIP entailed full activation of all task forces and products called for in the Traffic Milestone Matrix. This substantial planning effort occurred for major traffic moves and facility openings that occurred at the Project. The planning lead time, 10 to 16 weeks, allowed plenty of time for stakeholders to agree to the terms of a major opening or closing and maximized time for transportation companies and commuters to plan their commute and make route choices based on solid information.

The range of actions represented in the Traffic Milestone Matrix provided a scalable model to plan all traffic moves and impacts. The construction efforts needed to continue, and the capacity of existing roads needed to be maintained. The careful, inclusive planning allowed both goals to coexist.

WHAT'S NEW AND DIFFERENT: AN IN-DEPTH LOOK AND PROPOSED PROCESS

This section provides additional detail from the study sites relative to an overall process that can be beneficial to agencies interested in implementation of enhanced construction coordination. The proposed process was developed for consideration by state and local agencies based on research, interviews, and in-depth examination of current practices and lessons learned. For example, the Oregon approach involves a specific hierarchy at the state level while the TRANSCOM example is one of a voluntary nature for each agency involved. Many states will face the issue of how to gain momentum for implementation of an initiative such as construction coordination, especially if it adds to existing workloads and requires financial support for systems, data integration, and analysis tools.

The proposed process will provide interested agencies with a framework for beginning dialogue and discussion with key stakeholders, leadership, practitioners, and state and local officials. Figure 6 outlines the overall process and the following text provides a detailed description of what can be done to enhance coordination across agency boundaries.



Figure 6. Example Construction Coordination Process

Step 1 – Identify the Need: Many states have major construction programs planned for the future and could benefit from a process that includes consideration of impacts and coordination across agencies. What might differ across states is the magnitude of such a program. The coordination activities should be designed around planned large-scale projects and multi-year programs. Based on the magnitude of the construction program and the geographical layout of a state or sub-area, agencies can determine whether coordination can be handled at a corridor, regional, or state or inter-state level. For Boston, Utah, and Ohio, coordination occurs at the corridor level based on large projects with potential to impact multiple jurisdictions. Within Oregon DOT, the GCM Corridor, and TRANSCOM, coordination occurs at a program level to ensure that impacts to statewide mobility are considered.

Step 2 – Identify the Stakeholders and Communicate Ideas To Affected Groups :

Enhanced coordination benefits many stakeholders, including state and local transportation agencies, the public, landowners, air quality boards, commercial motor

carriers, shippers, receivers, contractors, suppliers and vendors, consultants, all levels within FHWA, public safety agencies, and transit operators. For example, Oregon Bridge Delivery Partners (a public/private partnership between ODOT and a consultant) was an important stakeholder in the process due to the large scale bridge rehabilitation program going on in the state. For I-15 in Utah and the Central Artery Tunnel in Boston, interaction with potentially affected local jurisdictions and the public were also key activities for the group. Stakeholders should be identified early in the planning process to allow adequate opportunity for input and review – especially in the establishment of the overall coordination and communication structure.

Step 3 – Develop a Concept of Operations For Coordination: A ConOps document identifies the roles and responsibilities of each agency and stakeholder. Figure 7 outlines the Oregon concept of operations for coordination across boundaries and within the DOT. ODOT established the concept of operations and formal structure while working to solve as many mobility issues as possible at the local or regional level. The statewide mobility manager is consulted as needed on issues that are unresolved at the local level, while each region has a mobility liaison that chairs the regional mobility committee and works to resolve mobility issues as they arise within the region. For the Big Dig Project, the concept of operations defined approval procedures across jurisdictional boundaries for scheduling restrictions that would impact traffic. Practitioners should develop their concept of operations with consideration for how mobility issues can be solved most efficiently based on the structure of the lead agency.



Figure 7. Oregon Coordination Structure

Step 4 – Identify Data Needs: Capacity analysis is important in understanding the potential impacts from multiple construction projects along a corridor. Data needed for analysis include overall facility characteristics, such as the total number of lanes, the number of available lanes during each phase of construction, facility type, an estimate of capacity per lane, percent trucks, vertical clearance, and size and weight restrictions. Several study sites have databases of this type of information and allow practitioners to

input additional data. For example, the Ohio DOT uses a pre-populated permitted lane closure spreadsheet to determine when demand would exceed capacity, as shown in Figure 8.

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Figure 8. Ohio Permitted Lane Closure Spreadsheet Tool

Capacity is determined based on Highway Capacity Manual Principles and formulas for work zones that include adjustments for heavy vehicles, intensity of work activities, ramps, and number of lanes open through the work zone. ODOT also has an electronic tool for monitoring safety performance of highway construction projects and assessing crash rates for individual projects for additional future enhancements and lessons learned.

Step 5 – Develop Decision Support Tools and Provide Training: Tools such as the Ohio Permitted Lane Cbsure Spreadsheet are important in understanding the potential impacts and understanding the specific information needed to enhance coordination. Tools should be developed at a program level so that they can be used across many different types of projects. Agencies may have difficulty developing and implementing tools primarily in response to the needs of a mega project due to the need for lead time for development and testing. Also, if used on only major projects, the effort may lose momentum and gaps in familiarity may be introduced, leading to the need for additional training.

TRANSCOM is also currently testing a web-based system to coordinate construction project information across agencies, as shown in the screen shot in Figure 9. The TRANSCOM tool allows member agencies to input lane closure and restriction information in a centralized location. Potentially affected agencies can access the system and view specific project-level information. Agencies should use tools such as these to enhance coordination and decision-making processes to avoid impacts from multiple projects along the same corridor or network.

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Figure 9. TRANSCOM Planned Construction Input Tool

Once tools and systems are developed, training programs (large or small scale) should be designed and implemented. ODOT provides internal training to staff, a "traffic academy" training course for consultants, and "worksite traffic supervisor" training for contractor personnel, with each class tailored to the specific functions of the target group. ODOT is currently undertaking the largest internal training initiative in the state's history, and two of the many required classes (for 2500 ODOT highway workers, project inspectors, etc.) involve work zone management. Testing and certification are part of many of these training classes; in fact, consultants are required to undergo testing and certification in ODOT's design training class as part of their pre-qualification. ODOT offers mobility workshops to train all personnel whose work may affect mobility or who coordinate construction activities across the state.

Step 6 – Implementation and Assessment: Once a coordination program is in place and operating, evaluation and independent assessment of the coordination efforts can produce lessons learned that can benefit responsible agencies. Assessment should occur at two levels: one to test the success of mobility management across corridors, and the other to test the success in meeting goals, the effectiveness of the structure, and effectiveness of the coordination process overall. To this end, data needed for assessments include quantitative information such as crash records and delay and travel time information, and qualitative information including feedback from participating agencies, the public, and any customer satisfaction information from surveys or other means that can be obtained. Development of the ConOps should include at least high level plans for data collection that will allow agencies to assess their operations.

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The site studies for this project share some similarities that are important for other entities and groups interested in enhancing their coordination practices to minimize the impacts to traffic and freight mobility. Importantly, enhanced coordination can include a largerthan-local area so that corridor-level or regional impacts can be better understood and managed. There are areas where coordination initiatives can enhance the process throughout the course of project development. For example, in the planning stages, agencies may use their historical knowledge to identify anticipated traffic impacts based on the magnitude of projects and brainstorm ideas for treatments and strategies to mitigate impacts. In the preliminary and final design stages of a project, agencies may have performed some type of analysis (e.g., capacity, simulation, etc.) based on more detailed data and have developed a better understanding of how traffic control plans and lane restrictions may impact traffic. Combined with a coordination group, both strategies can be beneficial.

At any stage in the process, the types of coordinating entities and bodies highlighted in this report can be extremely useful in integrating and scheduling construction and maintenance projects. For agencies that lack the support to form an internal/external working group to reach out to stakeholders, momentum will need to be generated to form a voluntary consortium to meet regularly to discuss potential impacts and, overall, provide enhanced communication and coordination. This course of action will minimize the possibility of large-scale impacts along a corridor if project scheduling consensus can be met among stakeholders. One barrier to this approach may be difficulty in creating change within individual organizations to parallel the approach and make it successful. In any case, buy-in from senior management, decision makers, and appointed officials, along with marketing to each group, is important. The Oregon DOT site example presented gained momentum from a policy-level decision by the director to make freight and traffic mobility considerations a key priority for the agency.

A specific, proposed process formed from this research includes the following key elements:

- Define the scope of the project and understand the magnitude and effect it could have on a corridor or region.
- Begin looking at the potential impacts to maintaining traffic and the potential scheduling conflicts with other key routes through the corridor or region.
- Designate individuals who will be responsible for consideration, coordination, and communication on mobility within the corridor.
- Designate a formal mobility coordinator if possible.
- Form a working group of potentially affected stakeholders.
- Communicate the expectations of all affected parties and the desired goals, objectives, and potential end results of the process.

- Use data and tools like traffic simulation to enhance the understanding of traffic patterns along the corridor and alternate routes (baseline and construction).
- Analyze and discuss the impacts of traffic diversion to other jurisdictions and communities.
- Determine the final strategy for maintaining traffic based on the process.
- Look for solutions at both the planning and operational level (including scheduling changes, alternate route improvements, signal timing changes, incident management plans, etc.).
- Provide training for staff, consultants, contractors, and other stakeholders on the defined process and elements such as analysis, coordination responsibilities, and communication needs.
- Make use of technologies including ITS communication and databases; catalogue, organize, and routinely input information on routes, pre-determined peak periods to avoid lane closures, project restrictions, traffic data, and other known data elements.
- Make use of available tools for both analysis and for fostering dialogue, including spreadsheets, modeling tools, computer programs for analyzing the effects of lane closures, MOT plans, restrictions, lane width reductions, and anything else that affects capacity.
- Make use of the analysis for determining if the proposed plans will work and also to predict, if capacity reduction occurs, what the impacts will be (e.g., average and maximum queue lengths, related delays, etc.).

Future research on this topic will be useful if tailored to better understand, in-depth, the issues and constraints (e.g., resources, staff, policies, etc.) to forming voluntary consortia, designating a person as "mobility czar" within an agency, and obtaining consensus on issues and buy-in on the importance of the topic. Additionally, focus groups, conferences, workshops, and brainstorming sessions are beneficial in providing a better understanding of how to gain the momentum for the proposed approach to enhancing coordination.

In the appropriate setting, a field operational test of this concept along with a formal evaluation and supporting documentation and development of promotional materials could enhance the awareness and use of such a strategy for minimizing impacts from construction. For agencies faced with great challenges to implementing this approach, examining and analyzing the culture within the agency, the structure, and the hierarchy and decision-making process will be an important step in identifying the necessary changes to make it work.

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ADDITIONAL ACKNOWLEDGEMENTS

The authors greatly appreciate the insights, information, and time investment from the following interviewees:

W.D. Baldwin, P.E., Oregon Bridge Delivery Partners Tom Batz, TRANSCOM
Bryan Chamberlain, Utah Department of Transportation Tom Cowan, TRANSCOM
Dave Holstein, P.E., Ohio Department of Transportation
John Leonard, P.E., Utah Department of Transportation
Sanjay Patel, TRANSCOM
Dan Shamo, P.E., GCM Corridor Group / URS Corporation
Smith Siromaskul, P.E., Oregon Bridge Delivery Partners
Randal Thomas, Oregon Department of Transportation