PBOT

PORTLAND BUREAU OF TRANSPORTATION

Utility Coordination Scoping Project

City of Portland – Portland Bureau of Transportation

Portland, OR

Phase 1 White Paper

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Executive Summary

This document is the product of Phase One of a 4-Phase project to improve coordination opportunities in the transportation right-of-way (ROW) for the City of Portland. This first phase was comprised of two elements.

1. An inventory and analysis of existing systems, and
2. A benchmarking of other cities' best practices

The inventory of existing systems and processes identified three areas where Portland Bureau of Transportation (PBOT) and its partners could most effectively realize cost savings and improved coordination:

1. Strategically leveraging the paving program
2. Optimizing time and location-based coordination
3. Implementing intelligent information systems.

In a quantitative comparison of five peer cities and their ROW management practices, Portland consistently scored lower in all eight functional categories that comprise it. Conducting a "gap analysis" that looks at the maturity of the process, PBOT scored best in its Engineering and Communications, but significantly lagged against best practices in its Business Processes and supporting Information Technology. The business practices in use are not mature, transparent, or repeatable, and the deficiencies prevent good planning. Effectively, PBOT is executing its work through the efforts of committed professionals who develop ad hoc processes in order to meet PBOT's commitments.

The next phase is to evaluate options that would best address those gaps that are most hindering PBOT, and to advance the process maturity closer to best practices.

Subsequent phases of this project, due to be completed in 2015, include an Alternatives Assessment; an Evaluation and Selection of Preferred Alternative, and culminate with Recommendations and Scope-of-Work for the Preferred Alternative.

1 Document Overview

This document is the product of Phase One of the Utility Coordination Scoping Project that is examining the coordination of projects in the City of Portland transportation Right-of-Way (ROW). Phase One is, itself, comprised of two elements; both will be summarized in this document, and will cover goals, process, and results.

To assist the reader in navigating this document, it is broken down into the following sections:

Chapter 1 – The overview of the document.

Chapter 2 – The **Project Overview**, explaining the drivers of the project, its sponsors, and the participants.

Chapter 3 – The **Benchmarking** component of Phase One. This chapter explains how the best practices were derived, and from whom. These are methods that have led to successes for other ROW coordination across the country. They act as guidelines, allowing the City to develop strategies that would allow it to operate more efficiently and realize similar gains.

Chapter 4 – The **Inventory & Analysis** component of Phase One. This chapter presents the results the of stakeholders' individual roles in ROW coordination throughout the City. It also evaluated the tools and processes that support those groups.

Chapter 5 – The **Gap Analysis** directly compares PBOT against the best practices – a composite of the capabilities of the peer cities.

Chapter 6 – The **Next Steps** summarizes what will be the subsequent phases of the Utility Coordination Scoping Project. This chapter will look at the development of alternatives, their evaluation, and the recommendation of a solution that is achievable, realistic, and customized to PBOT and its partners.

2 Project Overview

2.1 Background

Portland City Council designated a $1 million Innovation Fund in fiscal year 2013-14 to support the City of Portland's (City) innovation efforts by funding promising ideas that have the potential to make City government more effective, responsive, and accountable to the public. PBOT was awarded $250,000 to fund the Utility Coordination Scoping Project (Project). PBOT contracted with HDR Engineering, Inc. to produce a scope of work and performance criteria that will guide the selection of technology, coordination opportunities with stakeholders in ROW, and organizational protocols that enable cost savings and road preservation.

PBOT is the steward of ROW and the City's transportation system and a community partner in shaping a livable city. PBOT plans, builds, manages, maintains, and advocates for an effective and safe transportation system that provides access and mobility to all citizens and stakeholders.

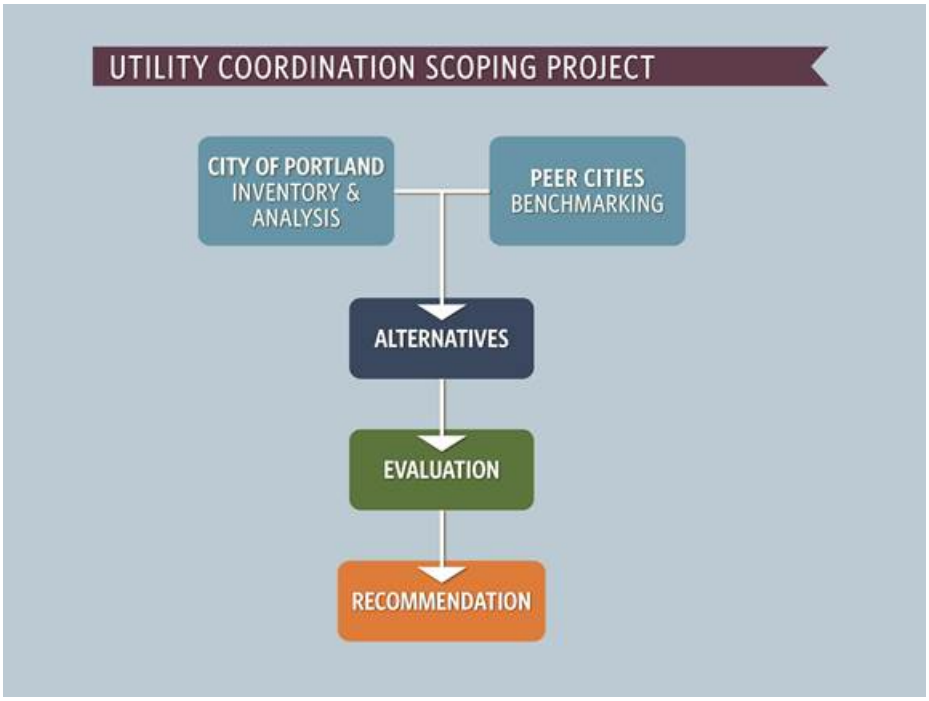
2.1.1 Project Structure

The primary objectives for the Project are to identify opportunities to reduce project costs for PBOT and its partners; better coordinate work in ROW; better maintain city streets; and improve public information and communications on current and proposed projects in ROW.

The Project has four phases (see Figure 1):

1. **Inventory Analysis and Benchmarking** is foundational – providing the quantitative information needed in the later phases. This includes the identification of "gaps" that will be addressed (discussed in Section 5)
2. **Alternatives** will explore three strategies that would best advance PBOT's maturity and address gaps from the previous stage.
3. **Evaluation** will explore the real impacts and the feasibility of each of the alternatives.
4. **Recommendation** is the culmination phase of this Project, and represents the development of a scope to implement the best of the evaluated alternatives.

Figure 1: Project Structure



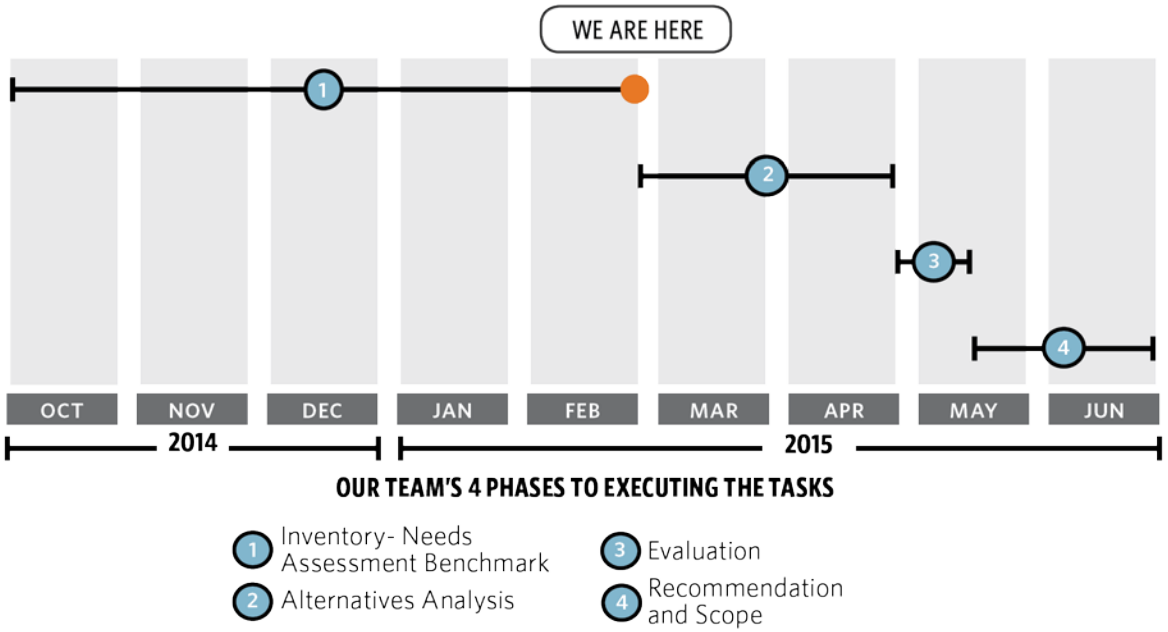
As you can see from the graphic, each phase builds upon the previous, progressively developing a more refined vision for the City.

This report combines the two elements of Phase One: benchmarking and inventory and analysis. These are brought together in the gap analysis. The goal is to discover the current state of coordination at PBOT, and between PBOT and its partners, in order to set the direction for subsequent phases of this project. No recommendations are presented here.

2.1.2 Timeline, Phasing, and Status

The Project timeline (Figure 2) shows the current status and the current schedule of the subsequent phases. Final recommendations will be submitted to the City Council after the Project concludes later in 2015.

Figure 2. Project Time and Current Status



2.2 Approach

The Project team benchmarked against five cities that have a reputation for innovative practices in coordinating work in ROW. Benchmarking was used to establish best practices in a gap analysis that measured PBOT in seven major areas with thirty-six sub-areas (see Section 3.1.3). The Project team performed phone interviews with the benchmark cities and followed the interviews with web-based research in an effort to fully understand each organization's business processes in ROW coordination.

During the inventory and analysis portion of Phase One, the Project team conducted over 30 interviews with stakeholders who perform activities in ROW. Information gathered from the interviews was used to score PBOT against best practices established in the benchmarking phase. The results were charted and gaps were identified using a matrix gap analysis tool (see Appendix A). These gaps allowed the Project team to quantitatively identify key findings to be used for the remainder of the project.

2.3 Key Findings

Through the analysis, the Project team identified several areas for improvement related to ROW coordination across the City Bureaus, based upon the best practices found in benchmarked cities. During the course of the inventory and analysis, it became clear that the benefits of a coordination system could be identified in three areas where PBOT and its partners could realize cost savings and improve coordination. This type of Pareto Analysis is a technique in decision-making used for the selection of a limited number of tasks that produce the greatest overall effect for the least amount of input. Commonly known as “the 80/20 Rule,” these identified areas will be the starting point for examining alternatives and developing recommendations, which will be informed by the themes from the benchmarking process. The top areas where benefits could be realized are listed below:

The Project team identified the following three major themes that most contribute to the success of ROW coordination programs in the cities selected for benchmarking.

Authority and Policy to Incentivize Project Coordination

- Each city used in benchmarking had an influential leader that made ROW coordination a mandate.

Organizational Structure Designed for Project Coordination

- Every city that the Project team benchmarked against had a dedicated office or board that was designed for coordination.

Leverage Information Systems and Asset Management Best Practices

- Cities that leveraged information technology best had the most mature ROW coordination processes.

Strategically Leveraging the Paving Program

By utilizing the benchmarking themes of authority and policy, organizational structure, and leveraging information systems, PBOT and its partners could realize cost savings and improved coordination through strategically leveraging the paving program. The Project team has found:

- PBOT does not effectively leverage its paving program with coordination in mind, and policy and organizational structure are not aligned to support coordination.
- Some coordination occurs, but is localized, not documented, not strategic, and not standardized.
- Cost effective paving solutions that would increase the pavement asset value and life are not consistently leveraged.
- Fee structures do not protect newer pavement assets by penalizing for cuts in moratorium streets.

Optimizing Time and Location Based Coordination

Utilizing the benchmarking themes, PBOT and its partners could realize cost savings and improved coordination by optimizing time and location-based coordination. The Project team has found:

- Communication channels are built on strong relationships. However, planning and scheduling is siloed within PBOT and, more broadly, across the three major infrastructure bureaus at the City.
- Time- and location-based systems are not utilized to their fullest capacity, and are not integrated across the bureaus.
- Although the City is nationally known for having a strong asset management program, individual programs differ across departments. Enterprise (City Wide) Asset Management programs vary greatly and are not mature across City Bureaus.

Implementing Intelligent Information Systems

Utilizing the benchmarking themes, PBOT and its partners could realize cost savings and improved coordination by implementing intelligent information systems. The Project team has found:

- Performance measures are misaligned and do not address the underlying causes.
- The software composition is cumbersome – management overhead is increased though a large portfolio of disconnected software.
- Current desktop-centric software portfolio does not maximize Return-on-Investment (ROI).
- PBOT has a strong technical core, both in infrastructure and technical ability.
- Current IT initiatives (Information Technology Advancement Project [ITAP]) hold a lot of promise, but may need to be expanded.
- Location-based (GIS) capabilities are strong, but have high demand and need to be expanded.
- Information systems are not integrated across bureaus; each bureau has its own Computerized Maintenance Management System (CMMS), which is used differently, with different standards and protocols.
- Web-based applications, allowing wide-area and multi-stakeholder coordination, are not leveraged in the permitting process.
- PBOT is not realizing any benefits from mobile technologies.

3 Benchmarking

3.1 Capability Maturity Model

The Project team used a quantitative approach that leverages the Capability Maturity Model Integration (CMMI), a process improvement and appraisal program that was developed by Carnegie Mellon University. It is designed as a Quality program, emphasizing continuous improvement – the maturity assessment provides a baseline for the organization to effect.

The CMMI ranks business processes on a scale from 1 to 5. The scale indicates the rigor to which the organization can consistently execute, document, and reproduce its work. The premise is that the more structured – or "mature" – an organization, the greater its ability to improve its processes.

The Project team adapted the CMMI to local government engineering to evaluate the City.

3.1.1 Maturity Model Levels and Explanations:

CMMI uses a progressive scale of 1 to 5 for the different areas of the organization. Though an average can be taken, there is no single level for the entire organization. Instead, each area is evaluated and assigned a level. The following levels (see Figure 3.) are metrics, or definitions, of the organizational maturity evaluation criteria, which are the general classifications used during the assessment of processes:

Level 1 Ad-Hoc: At this level processes are poorly controlled and not standardized. Since the work processes are not standardized, it is the commitment and dedication of the staff that drive business processes. This level has a good deal of risk involved since business processes are not documented and work is performed using "tribal knowledge" and tradition.

Changes in staffing can cause significant disruption to the delivery of services, or alter them altogether. Organizations are reactive in nature, and projects often exceed the schedule and budget allotted to them. Management has little view into the current status of the organization without significant fact-finding efforts.

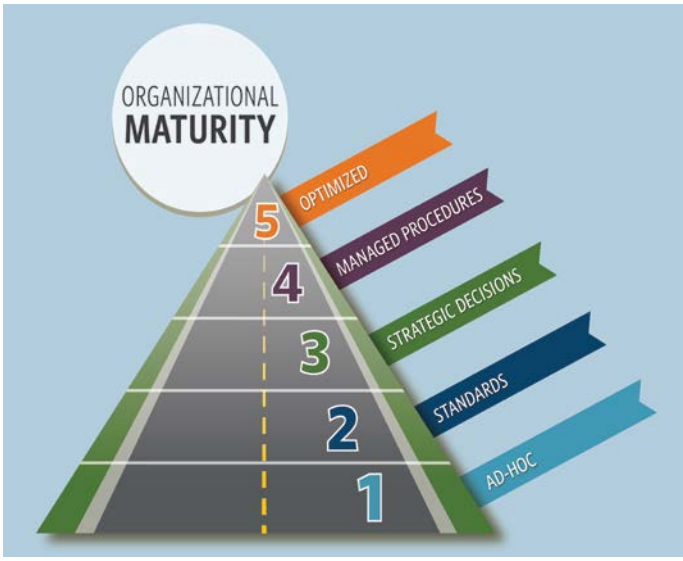
Level 2 Standards: A Level 2 organization is sometimes called "managed" or "repeatable." Standards are written, but are not rigorous, nor are they generally enforced by any designated authority. However, the documented processes guide the staff to execute projects. At this level, services are managed and the delivery is visible to management at set points or milestones.

Work and services are delivered on time and on budget, but there is no attempt at process improvement.

While information is available, it is fractured and difficult to compile in a timely manner. Standards and measures are not used to drive strategic decision making.

Level 3 Strategic Decisions: Level 3 is more commonly called "defined." At this level, organizations look at processes and procedures regularly to adjust and improve. Processes are used to create constant performance across an organization. They have established more defined goals than at level 2, and are managing their processes to meet those goals.

Figure 3. CMMI Levels Related to Organizations' Abilities to Effect Change



A critical distinction between level 2 and level 3 is the depth and rigor of standards, process descriptions, and procedures. At level 3, the standards, process descriptions, and procedures for a project are tailored from the organization's set of standard processes to suit a particular project or organizational unit. In other words, they are optimized for the organization. At level 2, the standards, process descriptions, and procedures may be more generic and not aligned with procedures from other departments.

The tailoring of standards between levels 2 and 3 signifies a shift from a departmental performance standard to an organizational performance standard.

Another critical distinction is that at maturity level 3, decision-making is strategic and performance measures drive business decisions.

Level 4 Managed Processes: At this level, it is the predictability of the delivery of services that is emphasized. Compared to the general assessment of levels 2 and 3, level 4 measures its delivery, and is looking beyond the goals to the sub-processes to improve those goals.

Level 4 organizations emphasize quantitative decision-making. Quantitative objectives are based on the needs of the customer and end users, not on the ease of the organization and process implementers themselves. Quality and process performance is understood in statistical terms and is managed throughout the life of the process. A managed processes level of maturity, measures and management can control business processes so that they do not lose the quality of the process that is being managed.

Information management is more sophisticated at this level. The depth and accessibility of information means that planning is based on improving sub-processes that will significantly contribute to performance.

Level 5 Optimized: At Level 5, processes are focused on addressing "common causes" of process variation. This level builds on the organization and process improvements of levels 2, 3, and 4. A continual process improvement methodology has been established in organizations at this level, and the effects of deployed process

improvements are regularly and rigorously measured and evaluated against the quantitative goals. At this level, the organization itself – not simply its processes – are the focus of improvement activities.

Information management is optimized here. Detailed data is readily available throughout the organization and planning is completely focused on organizational goals.

While both quantitative, a major difference between levels 4 and 5 is that while level 4 focuses on statistical predictability, level 5 looks to control the variation at all levels. This additional effort is exceptionally intensive and cost-burdensome and means that few level 5 service organizations exist. It is primarily reserved for highly detailed manufacturing.

3.1.2 The Discovery Process

There is a significant "discovery" process as part of establishing a maturity level. Structured interviews and supporting web research are the primary components. The goal is to utilize an organization's discipline-specific stakeholders to look for improvements in ROW, with the intent of evaluating PBOT's maturity level. In this process, engineering and technology are tightly coupled. A primary assumption in this process is the "clean slate": designing optimal project delivery without the legacy of existing PBOT processes. .

These process experts were selected for their:

- Participation in the ROW process
- Advanced delivery methods
- National experience
- Project successes
- Key knowledge

The primary goal of the interview stage is to gain the most accurate picture of how the staff operate in the organization today, providing a starting point for the process improvement effort. Interviews were conducted either individually or in small groups. The interview team asked simple questions and encouraged the person being interviewed to just talk about how they do their job. Questions centered on three basic areas:

1. Understanding the **Business Processes** involved
2. Capturing the **Technology** used, and
3. Understanding the stakeholders' definition of **Success**

The Project team then listened and captured the information. A key element was to remain as unbiased as possible and use no CMMI terminology that could influence the responses. The Project team performed over 30 interviews with stakeholders in ROW to gain a high level understanding of the current business processes. .

The Project team also performed web research to obtain a deeper understanding of each stakeholder and their role in ROW coordination. Organizations that scored highly in maturity during inventory, analysis, and benchmarking had business processes defined

on their website that reflected what they described in their interview. The organizations that emphasized continuous improvement of processes scored at the highest level.

3.1.3 Measures

For the Project, the team considered eight primary categories of measurement. Each primary category contained sub-areas, resulting in a total of 36 areas of measurement. These areas of measurement were used in each interview and helped to establish a standardized approach to performing a gap analysis.

Table 1. Gap Analysis – Functional Assessment Categories and Sub-areas

Business Strategy					Stakeholder Communication			Planning					Engineering						Communication				Governance Structure				Finance				Business Information Systems				
Unified Vision and Mission(Org Wide)	Defined Service Levels	Established Business Processes	Performance Metrics	Risk Mitigation Plan	Stakeholder Engagement	Stakeholder Process Understanding	Breadth of Stakeholder	Development Needs	Stakeholder Information	Scenario Planning	Funding Policy	Funding Plan	Enterprise Asset Management	Life Cycle Costing	Data Management	Design & Construction Requirements	System Evaluation and Inspection (after	Project Prioritization	Transparent Web Site	Citizen Engagement	Strategy Awareness	Staff Education	Architecture (Levels / Org Chart)	Clear Lines of Authority	Defined PPP MOU's / Ordinance	Legality	Financial Reporting	Auditing	Budgeting	Cost Forecasting	Information System Plan	Standards and Protocols	System Integration Plan	Data Standards	IT Policy

3.1.4 Peer Cities

To compare the City to others using best practices, it was first necessary to identify cities that were known to have mature and effective processes in managing and coordinating construction in ROW. Established best practices were used in comparison to get a manageable set of peer cities. These cities would then be used to create a composite benchmark of the CMMI – the best value of the maturity levels in the 36 sub-areas from the peer cities against which Portland practices could be compared.

After the evaluation process, the Project team narrowed the peer cities to the five below. These all had innovative and successful practices from which Portland could glean insights. In alphabetical order, they are:

- **Baltimore, MD** – The originator of a quantitative and transparent city management style called CitiStat, Baltimore required its agencies to report monthly against established performance metrics. The processes were regularly reviewed, and substandard performance areas were reviewed and revised. Equally important, the results of the City's performance were reported out in a timely manner to the public via a web dashboard, making it accountable to its constituents. This quantitative and goal-based approach represented a level 4 maturity level. CitiStat has operated successfully since 1999, and the process has been emulated at other city and state levels.
- **Bend, OR** – While much smaller than Portland, Bend has had to deal with an explosive growth – the population almost doubling over the last 20 years. Managing the associated infrastructure has required extensive effort from the

City. Working on a mandate from the City Manager, Bend instituted a department that was dedicated to coordinating ROW activity.

- **Boston, MA –** A major city with growing infrastructure costs, Boston has implemented citizen-based accountability, supporting a strict establishment of moratorium streets. Supported by strong information infrastructure, stakeholders can "reserve" streets for where their projects are planned. This yields the ability to view all current and future projects and coordinate their funding and execution.
- **Chicago, IL –** Another major city with infrastructure issues, Chicago streamlined its approach to all projects in ROW, including infrastructure improvement projects across all City departments. Rather than incurring the internal costs of the supporting IT infrastructure, Chicago took the progressive step of outsourcing the application, making it completely web-accessible for stakeholders and the public.
- **Las Vegas, NV –** Despite the recent economic downturn, the City of Las Vegas (CoLV) is dealing with major growth issues, both from the prior boom and from resurgence. With over 100,000 new residents since 2012, and an overwhelming dependence upon tourism as the primary economic driver, the need for coordination is at a premium. CoLV made major changes in policy, structural, and information technology to address complaints about repetitive roadway construction and lack of coordination.

3.2 Benchmarking Results and Key Indicators

A key element of the benchmarking process is to identify both strengths and weaknesses for each city. However, in establishing the best practices, the team identified the highest performing organizations and quantified their business processes in the coordination of utility cuts. These processes would be used for the gap analysis under the capability maturity model described in the methodologies in Section 2. An overview of some of the best practices is outlined in Table 2 below.

Table 2. Best Practices Overview – as compiled from the Peer Cities

Category of Evaluation	Best Practices Overview
Business Strategy	• Level-of-service used in business strategy • Measures were updated real-time and drove business decisions
Stakeholder Communication	• Stakeholders were engaged and had input in coordination • Coordination boards met regularly • ROW cuts were approved electronically by all stakeholders
Planning	• 5- and 10- year project lists were produced across utilities • Project lists were transparent, timely, and web based for easy access
Engineering	• Enterprise-wide asset management systems drove decision making • Projects were grouped and ranked across departments • Data standards were universal and IT Systems were integrated
Communication	• Near real-time measures were published online • Measures had cause and effect and processes were transparent and public

Category of Evaluation	Best Practices Overview
Governance Structure	• Single leader or group to coordinate efforts • Opportunities for coordination were sought after
Finance	• Fees and cost forecasting were performed with project list • Fee penalized cuts in moratorium street
Business Information Systems	• Data Standards, Systems Integrated, and applications improved business workflow • Technology allowed for electronic plan review and leveraged web-based tools

From the list above, the Project team identified the following three major themes that most contribute to the success of ROW management programs:

1. **Authority & Policy** to incentivize project coordination
2. **Organizational Structure** designed for project coordination
3. Leveraging **Information Systems & Asset Management Best Practices**

These are discussed in more detail below.

3.2.1 Authority and Policy

Significant organizational change requires difficult process change. Enacting systems, reorganizing power structures, and redesigning work processes are frequently resisted by established entities. In those peer cities that were successful in ROW management, each had an influential leader that made ROW coordination a mandate and established work processes to support it. Authority and policy adjustments that promoted increased coordination are as follows:

Baltimore:

- Mayor Martin O'Malley implemented CitiStat across the City to measure the performance of City functions. CitiStat was publicly accessible and functions as an internal audit program, as monthly CitiStat reports were reviewed by the Mayor and the CitiStat committee.

  "The Office of CitiStat is a performance-based management group responsible for continually improving the quality of services provided to the citizens of Baltimore. CitiStat evaluates policies and procedures practiced by City departments for delivering all manners of urban services from criminal investigation to pothole repair."[1]

- Baltimore gave all paving responsibilities to the Transportation Department. The Water, Storm, and Sewer Departments use the Transportation Department as their paving contractor.

[1] http://archive.baltimorecity.gov/Government/AgenciesDepartments/CitiStat.aspx

Bend:

- Responding to increased demands on the system, the City Manager and public criticism of inefficiencies related to ROW cuts, and duplicative efforts, the City Manager effected total organizational restructuring and established a new department dedicated to coordinating ROW.

Boston:

- In Spring 2011, the Boston Public Works Department initiated a new policy for patching procedures that required all utility companies, private contractors, City contractors, and other agencies that perform excavation work on the City's roadways or sidewalks to install a color-coded identification marker into the surface of their asphalt patches. Citizens can now place a complaint through a website and associate the complaint to the agency that performed the patch.
- Newly resurfaced streets have a 5-year “guarantee period”. No utility companies or private contractors are issued permits on "guaranteed streets", unless the work has first been approved by the City, due to accepted special circumstances.
- Work on a guaranteed street requires the repayment of the cost of full curb to curb repair of the street 25 feet beyond the limit of work on both sides.

Chicago:

- Mayor Rahm Emanuel ordered greater coordination of the construction schedules of Chicago’s infrastructure departments. With this charge, a Project Coordination Office (PCO) was developed within the Office of Underground Coordination (OUC). The sole purpose of the PCO is to coordinate all projects in ROW, including infrastructure improvement projects across all City departments.
- The OUC has the authority on all permit requests and is responsible for the review and approval of all work performed in ROW.
- Before permits are issued to open a city street for utility or department infrastructure improvement work, the construction schedule is brought to the PCO to determine if there are any conflicts or cost-sharing opportunities amongst construction schedules.

Las Vegas:

- Within the Las Vegas Public Works Department, an Engineering and Planning Department was established that is responsible for reviewing and coordinating projects in the public ROW.
- The Regional Transportation Commission of Southern Nevada was established by the State Legislature as part of a move towards mitigating complaints from the public about repetitive roadway construction and lack of coordination.

3.2.2 Organizational Structure

Every city that the Project team benchmarked against had a dedicated office or board that was designed for coordination. This type of centralization provided a single, clear

point of contact for all of the activities in the peer cities. Supported by high levels of communication and a simplified work process, this made ROW activities more efficient.

Baltimore:

- CitiStat is a dedicated audit group that reviews operations across the City. ROW coordination is reported upon and rolls up into a dashboard that is regularly reviewed by the CitiStat office. All City agencies must make presentations to the CitiStat group; these presentations are known to maximize internal accountability and coordination.

Bend:

- The Bend City Manager worked with the Bend City Engineer to create the Engineering and Infrastructure Planning Department (E&IP). This department was created specifically due to lack of coordination, not just amongst utilities, but all City projects, and was empowered as a single point of contact.
- A ROW manager position was created and was empowered to ensure all work in ROW abides by City standards and that the schedule is reviewed for construction conflicts and/or opportunities.
- Disconnected utility departments resulted in decision-making that was uncoordinated and nonessential. Bend combined all utility groups under one department, and pulled the Chief Engineer for each utility group to represent their department within the E&IP department. Utility department managers act as the conduit between their department and the E&IP. They are also responsible for overseeing coordination of their department specific projects with the overall E&IP master coordination schedule.

Boston:

- The City of Boston did not leverage organizational structure in coordination of ROW cuts. Instead Boston leveraged technology that allows 24 stakeholders in ROW to officially “clear” a street for construction. Hard policies assure that streets that are “cleared” will not be cut for a minimum of 5 years for resurfacing candidates and 10 years for full reconstruction.

Chicago:

- The City of Chicago’s Office of Underground Coordination (OUC) has a strict permitting process for all construction performed in ROW. In addition, the Project Coordination Office (a sub-department of the OUC) is solely focused on coordinating construction schedules for all City infrastructure improvement projects, and electric, gas, and telecommunication utilities.
- CDOT has weekly coordination meetings for stakeholders with projects planned for or affected by construction within the calendar year.

Las Vegas:

- The City of Las Vegas' (CoLV) Engineering and Planning Department provides a master coordination schedule for all City projects to the Regional Transportation Commission (RTC) for integration into the master transit planning schedule managed by the RTC. Regular coordination meetings are held with RTC, the CoLV Engineering and Planning coordination board, developers, and stakeholders to identify construction conflicts and opportunities.
- RTC and the City Coordination Board have the final say in how projects are coordinated.

3.2.3 Information Systems and Asset Management Best Practices

Timely access to information is a critical element of maturity levels – the more available information is to decision makers and tied to specific goals, the more efficient the organization. Gravitating toward full "enterprise" systems – systems that are created to share services and data across an organization to eliminate the problem of information fragmentation – improves efficiencies. The high initial cost of installation, and complex ongoing maintenance, can be a deterrent in implementing these systems, but they typically have a high Return on Investment (ROI). Those peer cities that leveraged information technology best had the most mature ROW coordination processes.

Baltimore:

- The most visible element of the CitiStat office is the electronic dashboard, a data-centric report that is given to the Mayor and his / or her cabinet, and that is published out to the public on the City's website. Reports and data are captured in agreed upon metrics called CitiStat Templates. Every 2 weeks, current performance is compared to past performances. These near real-time statistics create instant accountability with an eye on continuous improvement of City functions. This requires not only the establishment of workflows, but the sizeable investment of making sure the databases and information systems were interconnected.

Bend:

- Bend has made some significant enterprise investments in the IT infrastructure needed to support asset management and planning. These help guide data-supported decisions and provide options that would be time-prohibitive to research individually. Specifically, Bend has implemented:
    - Infor Software – a major asset management package used by the Office of Coordination that is capable of managing all of the processes across the City.
    - Optimatix Software – a predictive program that can run millions of scenarios to find the lowest cost scenario for project/repair and determine when the need will occur. This is a critical function in budgeting and finance.

Boston:

- City of Boston Utility Coordination Software (COBUCS)[2] software is a centralized database coordination tool. The City mandates it usage by all 24 major stakeholders in ROW. COBUCS acts as a "reservation system" where projects are planned out in advance. The ability to view all current and future projects in a "common operating picture" (COP), with a dynamic mapping component, provides a tremendous advantage in planning and executing projects.

Chicago:

- Chicago uses Autodesk's "Buzzsaw"[3], a software as a service (SaaS)[4], to accept electronic plan submittals for projects that require underground utility coordination. Buzzsaw is used to route plans to 24 different utility customers for approval before the project can proceed.
- Once projects are permitted, Chicago uses a real-time Google map application to share data across disparate agencies that have ROW interest. This Google application enabled the City to eliminate millions of dollars of duplicate work.

Las Vegas:

- RTC uses Mapit2C to integrate projects and optimize coordination with stakeholders in ROW, including Clark County and CoLV. Mapit2C is a custom-developed system originally developed by the Las Vegas Valley Water District, AM/FM/GIS[5] Division. The system uses a map-based interface and acts as an Automated Data Exchange (ADE) through which an agency can submit and manage their data. Users can also extract project data for further analysis and reporting. The project database extends out 5 years.

4 Inventory and Analysis

4.1 Process

During the inventory and analysis phase of this project, the Project team performed over 30 interviews with stakeholders in the City and external to the City. The Project team started the project by interviewing within four areas of PBOT – Utility Coordination, Maintenance, Capital Projects, and the Pavement Management Team. Each interview lasted 1.5 hours, and had the goal of gaining a general understanding of each group's role in ROW coordination. All interviews were geared towards the evaluation criteria outlined in section 3.1.3 of this paper. Interviews were followed by web research to gain

[2] http://www.cityofboston.gov/publicworks/construction/coordination.asp

[3] http://www.autodesk.com/products/buzzsaw/overview

[4] Software as a Service (SaaS) is a distribution model where applications are hosted by a vendor, and provided to the customers over the internet. Effectively, the service is rented without incurring the cost and maintenance of a computer system.

[5] Asset Management/Facilities Management/GIS

a better understanding of complete processes. Follow-up interviews were held if the Project team felt that business processes in a particular group were critical in making pavement coordination more efficient. The Project team was also able to obtain news articles and policy documents in order to complete the research.

While completing a thorough inventory of PBOT, the Project team also queried major stakeholders in ROW, such as the Bureau of Environmental Services (BES), the Water Bureau, Portland General Electric (PGE), and Northwest Natural Gas. Each of these interviews had a slightly different focus than those with PBOT. The Project team was looking to explore communication channels and coordination methodologies. Interviews with the Bureau of Technology Services (BTS) and the PBOT Asset Manager were focused on systems, processes and the uses of technology in ROW coordination.

All interviews in the inventory and analysis phase were recorded using the Capability Maturity Model (Section 3.1) and scored against best practices established in the benchmarking phase of this project. Interviews, web research, and policy documents were used to establish the “Current State” in the project gap analysis.

The Project team found that both the Water Bureau and BES have the structure and systems in place to interface with PBOT, as well as the capability to coordinate on larger and smaller projects. PBOT interviews validated that a coordination problem exists and that a management structure and systems need to be in place to support full implementation of a coordination system.

4.2 Findings Summary

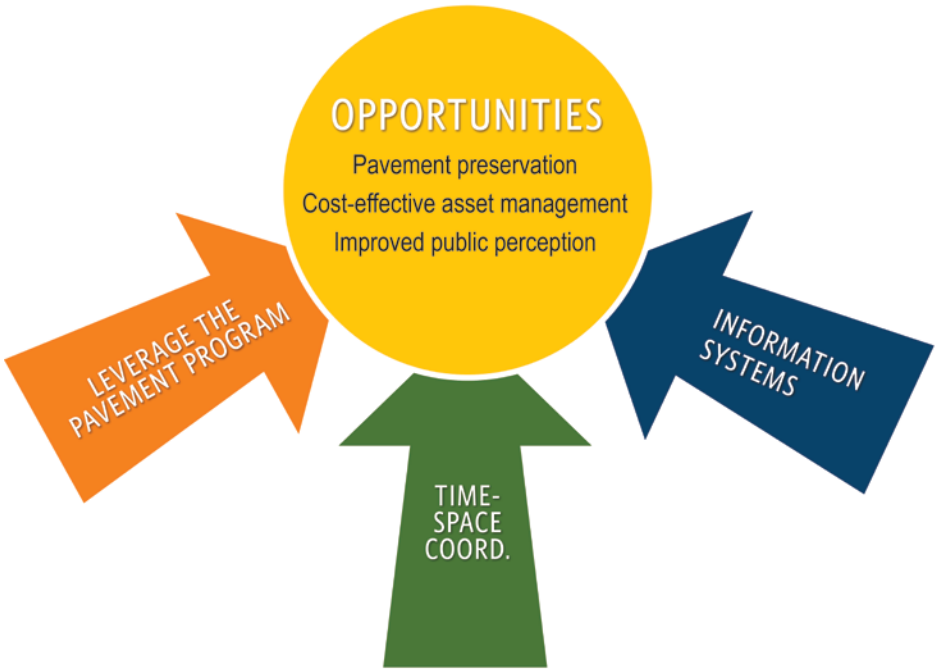
In the inventory and analysis phase of the Project, the team identified several areas for improvement related to ROW coordination across the City. The top three areas were identified in order to allow for the greatest improvement and cost savings in this analysis. The Project team based its recommendations on a Pareto Analysis – a technique in decision-making used for the selection of a limited number of tasks that produce the greatest overall effect for the least amount of input. Also known as the 80/20 Rule, the Pareto Analysis is a means of prioritizing initiatives.

With the goal set to better coordinate work in ROW; better maintain city streets; and improve public information and the ability to easily communicate current and proposed projects in ROW, the Project team found that large efficiencies can be gained by small improvements in the following areas:

1. Strategically leveraging the paving program
2. Optimizing time and location-based coordination
3. Implementing intelligent information systems.

The document goes into detail on each of the areas below.

Figure 4. Focal Points for ROW Improvement in PBOT



4.2.1 Leverage the Paving Program

The City has almost 5,000 lane miles of streets within its city limits; this asset is valued at over 5 billion dollars today. A more strategic approach to leveraging the paving program would result in the greatest cost savings with small changes to the current business processes. The Project team found that current business processes were informal and loose, but fundamentally sound. Although the processes are rated as Level 1 on the maturity model, people, and heroics make the coordination that occurs possible. Additionally, there is a failure to communicate as projects change and evolve. Formal coordination is not documented, strategic, or repeatable.

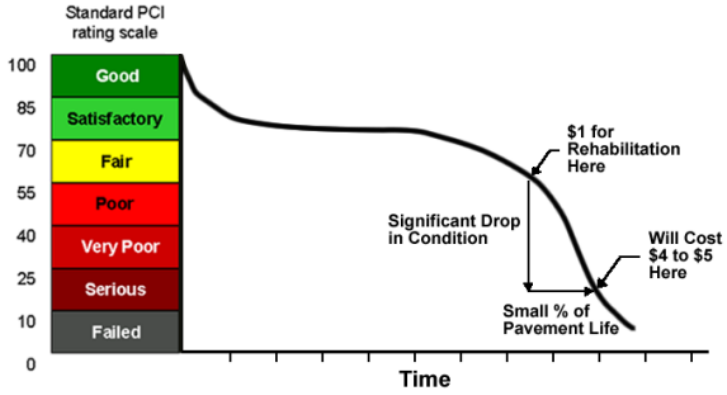
Quantity based paving policies make coordination more complex

Metrics to prove that the 100-mile paving policy is working do not exist. This is the biggest constraint that the paving program faces: the current policy outlines that 100 miles of “paving improvements” takes place in a fiscal year. While quantity-based, this measure makes coordination more complex, as taking the time to plan and coordinate is seen as a barrier to the need to maintain the roughly 2 miles per week of paving. In interviews, the Project team heard several times that “avoiding coordination is a coordination strategy”. Under the 100-mile policy, paving lists are in constant flux, as waiting to coordinate could potentially slow the paving schedule down. An area of further investigation would be to measure the effect of the paving policy on the overall Pavement Condition Index (PCI) rating of the City.

Lack of Support for Increasing the Pavement Asset Value

Paving solutions that are both cost effective and increase the value of the paving asset are not fully leveraged by stakeholders in ROW. As Figure 5 (below) shows, policies and standards for work in ROW should consider the asset value when determining restoration techniques and fees. The timing of maintenance can have tremendous impacts to its overall cost. And preserving existing pavement or rehabilitating it to a higher PCI will save money over the extended life of the pavement asset. Although there are moratoriums to avoid when cutting new streets in the City, informal negotiations are often made to get around the moratorium. It was also noted in the interview process that bureaus didn't fully respect the moratorium list when planning projects. It has become practice with stakeholders to cut moratorium streets as part of "doing business".

Figure 5: Extending Pavement Life has Potential to Save the City over the Life of the Asset



No Formalized Communication and Strategy

Both the Water Bureau and BES have a 5-year Capital Improvement Planning (CIP) List; these lists are very effective in coordinating projects since they give a look ahead that may enable coordination. A large constraint in potential coordination is that PBOT only produces a 1 to 2 year paving list that is focused on conflict avoidance. The timeliness and the access to the paving list make communication and coordination with stakeholders difficult. In lieu of timely paving lists, employees at PBOT have formed very informal process for coordinating projects. At the time of writing, a paving list is generated out of Street Saver software in the Engineering Department and exported to a Microsoft Excel spreadsheet. The spreadsheet is distributed at PBOT to identify conflicts or projects not to do, and with the Active Transportation Group, the list is color coded based on the likelihood the project can be coordinated with their initiatives. This process speaks highly of the employees at PBOT, since it is an attempt at coordinating, but the process is clearly Level 1 on the maturity model as it is not repeatable, documented, and is dependent on individuals for success.

What's Working

- Employees are committed to excellence
- Informal communication

Areas for Follow Up

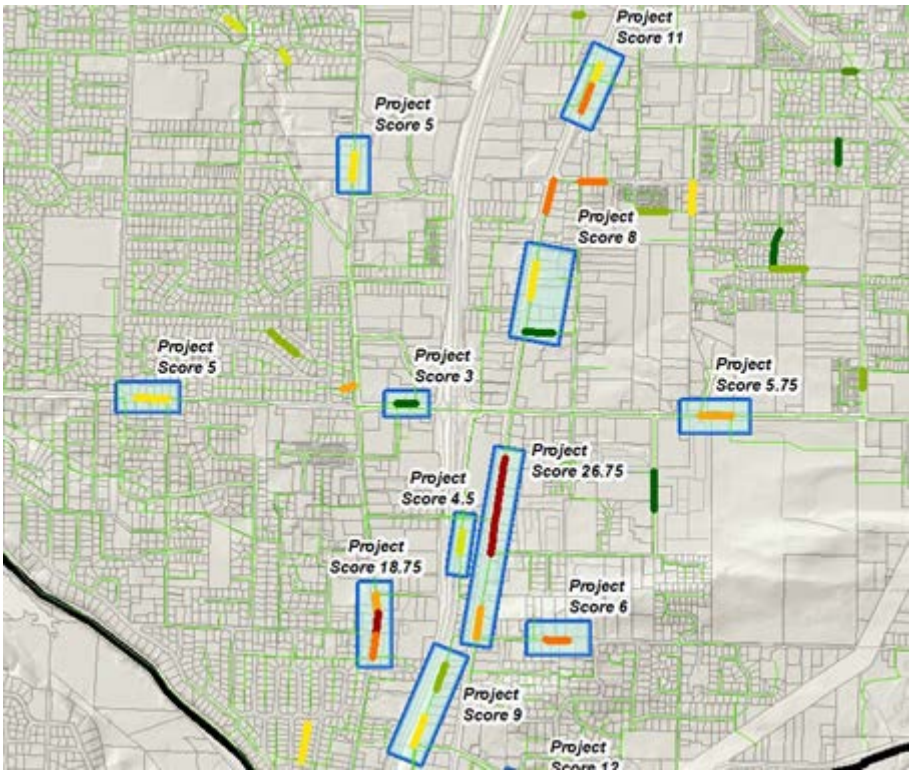
- Quantity-based paving policy makes coordination difficult
- Business processes are not formalized for coordination and communication of project lists
- BES and the Water Bureau cannot plan their 5-year CIP with paving coordination in mind
- Paving list does not seek coordination with BES and Water Bureau, but seeks to avoid confrontation

4.2.2 Timely, Location Based Coordination

Planning Scheduling

Siloed planning and scheduling leaves the maintenance division in PBOT in a reactive state of doing business, instead of utilizing long-term strategic planning. The Project team did not find a strategy in individual planning and scheduling groups within the maintenance division. Computerized Maintenance Management Systems (CMMS) are used as work logging systems to track equipment, labor, and materials once projects have been completed. It is essential in coordinating ROW cuts that CMMS software be used for work management, so that maintenance schedules are timely and posted to a coordination site. Currently, the timeliness of planning and scheduling, coupled with the breadth of CMMS systems across City Bureaus, do not allow for technology to aid in coordination. This problem does not just exist within PBOT; both BES and the Water Bureau plan and schedule projects within their own bureaus and do not interface with PBOT's planning and scheduling. It would be most effective to schedule work far in advance, so that stakeholders would have a COP of proposed work. This COP would allow for maps that would highlight project areas. If each bureau had proactive planning and scheduling, the City would be able to rank and score projects that overlapped. The Project team feels that this alone would result in tremendous cost savings and efficiencies city-wide.

Figure 6: Project-based Coordination across Utilities is a Proven Cost Savings Methodology



Enterprise Asset Management Too Limited

Enterprise Asset Management is not leveraged across the bureaus. Furthermore the current process is designed for use at the departmental level, when what is needed is Agency or Interagency coordination to maximize effectiveness.

Not Coordinated

During the inventory of software and systems, it was highlighted that each bureau had different asset management software systems that were not integrated on an enterprise level. Additionally, PBOT has several custom-developed systems of its own that are not leveraged fully, or adapted for use in asset management. Effectively, the City has a wealth of software, but not one has been fully implemented to maximize its effectiveness.

More Geospatial

In interviews with stakeholders, it was identified that the GIS system was consistently seen as the ideal integrator of asset condition. Existing GIS tools are viewed favorably, extensively used, and there is demand for more.

No Data-driven Decisions

The Project team did not see asset management techniques used in prioritizing or coordinating projects in ROW. Data driven decision making does not exist to create projects across bureaus.

What's Working

- Individual bureaus have strong asset programs

Areas for Follow Up

- Asset Management Scope only at bureau level, not city-wide
- Project Planning Strategies not leveraged between bureaus
- Planning and Scheduling are siloed within PBOT and also between bureaus
- Growing demand for GIS ~~geospatial~~
- Data elements aligning with Key Performance Indicators

4.2.3 Intelligent Information Systems

The information systems related to ROW management are in flux. Built on a strong information core, the system has evolved through the innovation and dedication of technologically savvy staff. With the foundations more than a decade old, the demands of City operations and the advances of technology have primed ROW management for a major overhaul. PBOT has already initiated a major IT project to address known issues; however, the current scope may not cover all of the initiatives presented in this report.

Meaningful Measures Not Aligned with Performance

One of the most important keys to successfully aligning Key Performance Indicators (KPIs) and performance measures is to ensure the strategy is measurable. A cause and effect relationship in KPIs is essential is understanding whether a strategy is effective. The Project team found that many of the measures are only loosely related to asset performance. To achieve higher levels of maturity – maturity level 4 and 5 - organizations emphasize quantitative decision-making based on the needs of the customer and end users, not on the ease of the organization and process implementers themselves. The Project team found that the current KPIs, while correlated, do not have a direct relationship to the overall performance of the transportation system.

Enterprise Management

Software Overhead

The system for coordinating projects (capital projects, utility, work, permits, maintenance, events, and street closures) in the Public ROW is complex. Given the breadth of activities, the number of software platforms and plugins is significant. An internal December 2014 software scan yielded 83[6] different software applications currently in "production" - the setting where applications are actually put into operation for their intended uses by end users. These applications are comprised of a mix of Commercial Off-The-Shelf (COTS) and internally (City of Portland) developed software.

[6] Innotas Export, December 23, 2014, PBOT.

Vendor Management

There are a significant number of vendors involved. While this is partially due to the unique nature of transportation software, this typically impedes an organization's ability to control costs, improve service excellence, and mitigate risks to gain increased value from their vendors throughout the software's lifecycle. This mix is complex and difficult to manage, resulting in a higher Total Cost of Ownership[7] (TCO).

Physical Infrastructure

The server infrastructure upon which these information systems sit is physically sound. PBOT is working in a mature virtualized environment with all of its servers that host major systems with industry best practices in management.

IT Development

PBOT has an exceptional technological knowledge base and internal resources. Advanced users act as development resources located throughout the departments. With access the to the Enterprise GIS team, PBOT has created a range of databases and applications to compensate for the lack of a unified process. In effect, they are actively moving to maintain delivery through initiative and subject matter expertise.

Departments lend each other technical support. A risk of this approach can be a lack of standardization, where not all staff are utilizing the same data and tools for their decision-making, and the possibility of creating "orphaned" information that is not able to be accessed by the rest of the organization.

ITAP Initiative and Expectations

The Information Technology Advancement Project (ITAP) is the City's technology initiative to move the development review process to a paperless system. The paperless process is intended to allow online access to the City Bureaus' permitting and case services. Built as a suite of software to manage the process, at the core of ITAP is the Infor software for the permit and case management system.

Many of the deficiencies identified in this effort were targeted as part of the ITAP initiative. However, CIP is not slated for inclusion in ITAP, missing an obvious avenue for interagency collaboration and cost savings.

There is a high degree of dependency placed upon the success of ITAP. While not slated to go online until late 2015 or early 2016, users have already placed high expectations on its deployment. Given the high risk associated with major implementations, a smooth rollout and early acceptance by stakeholders will be paramount to its success.

GIS is Integral in Providing a Common Operating Picture

Enterprise GIS is providing value throughout the process. Through the maintenance of the databases, development of ad hoc database queries, and process improvements,

[7] Phase 1 did not examine City financials to calculate exact ROI or TCO, but derived conclusions from industry standards and best practices.

GIS is in demand throughout the Agency. These data power the online maps and query tools used throughout PBOT. All processes look to GIS for assistance, and all ROW stakeholders are in need of a COP - a single identical display of relevant operational information shared by multiple departments and agencies.

Many groups have GIS user skills, but expanded resources are needed to maintain data, provide technical assistance, and speed data integration.

Web-based Applications and Processes

A significant number of critical processes are tied to desktop applications (e.g., Esri ArcGIS) and databases (e.g., Microsoft Excel and Microsoft Access). While not at risk for process failure, these practices are insufficient for the scale and accessibility demands that are put upon them, when compared to a service-oriented organization. For an organization of its size, PBOT has not fully adopted modern enterprise practices. The manual processes required by these software applications don't allow for the automation to help organizations become more effective. Reusability is critical, with the objective of creating a reusable architecture framework to facilitate initiatives across the enterprise by:

- Providing wider access of data to multiple groups, simultaneously
- Development of focused data services that can be mixed and matched to rapidly flex to business needs, without fundamentally changing the underlying data needs
- Emphasizing the reuse of architectural components over individual project requirements

Most importantly, web services are not being maximized in the communication and coordination of projects amongst stakeholders at all levels:

- Intra-Agency
- Inter-Agency
- General public

Some information is available online, internally provided by PBOT mapping, externally by Portland maps (www.portlandmaps.com), applications within it were built and are maintained by Corporate GIS (CGIS), and the Bureau of Technology Services (BTS) at the City, but it they are view-only. Other mapping support is provided via printed maps.

Mobile Strategy

By its own admission, the City is behind on its mobile strategy. With 60 percent of its users' primary access to the web coming via mobile, many organizations have already moved to a "Mobile First" strategy – designing interfaces for data consumption and (increasingly) data collection for mobile devices. With low cost of entry[8] and omnipresence in the workplace, these devices have an immediate ROI for their

[9] www.gartner.com

deployment. Technology advisor Gartner[9] predicts that penetration will grow as the benefits will be worth the additional management.

Internally, BTS has been pushing for accelerated mobile development, but this has not been prioritized. ITAP has a mobile component, but this will not be realized until its release.

What's Working

- GIS technology penetration
- Corporate GIS reach
- Staff technical skills
- Staff commitment
- IT architecture

Areas for Follow Up

- Software portfolio management
- Business System Integration
- System Interoperability
- Public web presence presenting City progress on KPIs
- Expanded mobile strategy

5 Gap Analysis

5.1 Overview

The gap analysis is an important method for an organization initiating a process improvement effort, because it facilitates the most effective plan based on the identified priorities for that particular organization. It does this by identifying areas of measurement. The goal for the organization is identified for each area, and then the current capabilities are measured. The difference – the "gap" – is then measured. Those areas where the gap is greatest are prioritized for process change.

The gap analysis is an ideal method to use in leading to a discussion of change, as it is a quantitative process, and not influenced by subjective assessments of capabilities or priorities. The method fosters consensus and expedites movement toward the development of strategies because, while there may be discrepancies in the attribution of values, there is transparency and standardization in the process. This helps move forward with a successful CMMI process maturity effort.

Rather than emphasizing process improvement across all processes, the CMMI process provides organizations prioritized areas in which to focus their efforts to align with goals.

[9] www.gartner.com

5.2 Process

For the Project, the team considered eight primary categories of measurement. Each primary category contained sub-areas, resulting in a total of 36 areas of measurement. These areas of measurement were used in both the peer cities interviews and in the inventory and analysis of the City resources. In this stage, the two values are brought together. In Table 3 (below), the quantified values are charted against each other; PBOT values are in red and the peer cities' values are shown in blue. The values can be seen in the cells below each subarea. The left axis shows the corresponding CMMI maturity levels.

To calculate the benchmark, the maximum value of the peer cities' subarea was used. Effectively this creates a composite – or best practices – of ROW management.

The "gaps" are the difference between the red maximum value and the blue maximum value in each subarea, and create a target against which PBOT can direct specific strategies to improve their values. Yellow values were sub-areas where PBOT was not evaluated as part of this project and against which no conclusions or strategies were developed.

Table 3. PBOT Gap Analysis – PBOT (red) and Peer Cities (blue)

Attribute	Score	Business Strategy					Stakeholder Communication			Planning					Engineering						Communication				Governance Structure				Finance				Business Information Systems				
		Unified Vision and Mission(Org Wide)	Defined Service Levels	Established Business Processes	Performance Metrics	Risk Mitigation Plan	Stakeholder Engagement	Stakeholder Process Understanding	Breadth of Stakeholder	Development Needs	Stakeholder Information	Scenario Planning	Funding Policy	Funding Plan	Enterprise Asset Management	Life Cycle Costing	Data Management	Design & Construction Requirements	System Evaluation and Inspection (after	Project Prioritization	Transparent Web Site	Citizen Engagement	Strategy Awareness	Staff Education	Architecture (Levels / Org Chart)	Clear Lines of Authority	Defined PPP MOU's / Ordinance	Legality	Financial Reporting	Auditing	Budgeting	Cost Forecasting	Information System Plan	Standards and Protocols	System Integration Plan	Data Standards	IT Policy
Optimizing	100																																			
	90																																			
	80																																			
Managed Procedures	70																																			
	60																																			
	50																																			
Strategic Decisions	40																																			
	30																																			
Standards	20																																			
Ad-Hoc	10																																			

Areas in yellow were not evaluated.

5.3 Findings Summary

Omitting the finance areas where no inventory was conducted, a quick visual analysis shows the greatest gaps in the areas of Business Information Systems and Governance Structure. Gaps were smallest in Engineering and Planning.

5.3.1 Agency Strengths

The main strengths for PBOT as seen in the gap analysis were in the following areas:

- **Engineering and Business Strategy:** The areas of engineering and business strategy were generally less mature than most agencies the Project team benchmarked against, but were still where PBOT was strongest. With some small changes in business practices, these areas could grow into real hallmarks for the City.
- **Communications:** PBOT has strong communication protocols with citizens. During the inventory and analysis, the Project team was impressed that PBOT's strategy was clearly defined, current policies were documented, and issues were addressed publicly. It was also apparent that PBOT leadership was very accessible; the commissioner and transportation director are active in community events and outreach. PBOT was ahead of most cities in communications and outreach.
- **Stakeholder Communication:** Stakeholder communication is another mature area for PBOT. Most stakeholders interviewed felt that communication was excellent with PBOT employees. ROW coordination could be more formalized, and most mature agencies the Project team benchmarked against had formal coordination boards with stakeholders.

5.3.2 Agency Improvements Needed

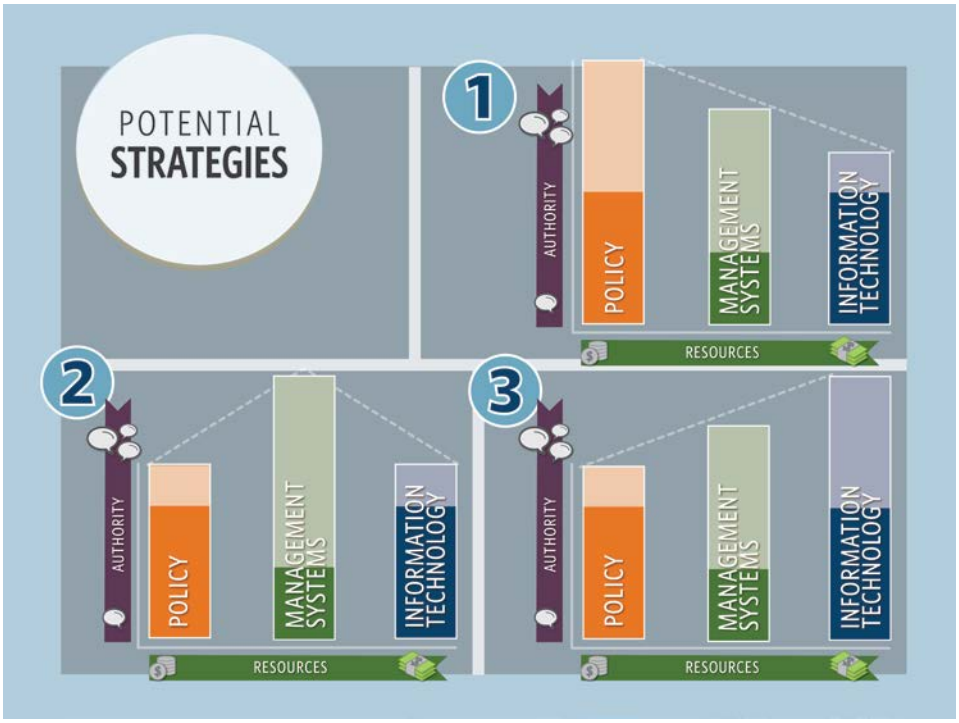
- **Governance Structure:** Compared to most of the peer cities, PBOT showed its largest gap in the area of governance structure. Every city benchmarked against had an office or department that was designed for coordination. PBOT struggles with silos in almost every department, and division that was explored during inventory and analysis. PBOT's management structure does not support full implementation. Lines of authority are not clear and there is no central position empowered to coordinate. While there is a desire for coordination, it has not been articulated fully, has not been mandated, and does not drive strategic decision making.
- **Information Technology:** Information technology was more localized and less integrated than the most mature agencies the Project team benchmarked against. Purchasing of technology was not done strategically or with the enterprise in mind. Many groups within have their own software tracking systems, are pursuing additional software, and many of the existing systems do not interface or communicate directly. This results in siloed decision-making, while still carrying a high TCO.

- **Planning:** Aligning development needs and trends with paving projects was a weakness for PBOT. Paving projects did not align well with quickly developing areas like Division Street, East Burnside, and Williams Avenue. The paving list gave a 1- to 2-year look ahead, while the more mature agencies the Project team benchmarked against had 5- to 10-year paving plans. PBOT's Capital group no longer has a project tracking system. PBOT's Permitting group attempts to identify coordination opportunities with external stakeholders, but is using outdated information due to current processes. The development of the paving list by Engineering Services is focused on conflict avoidance rather than coordination, and rigidly uses pavement score as the only factor in determining projects, not looking at opportunities to maximize investments.

6 Next Steps

In the next steps of the Utility Coordination and Scoping Project, the Project team will develop three alternatives for PBOT and its partners. Alternatives will cover policy modifications, organizational structures required for coordination, technology strategies, identifying cost saving opportunities, and providing recommendations for the implementation of each option. The Project team will carry alternatives into the evaluation and recommendation phases of this Project to develop a solution that is achievable, realistic, and customized to PBOT and its partners' unique needs.

Figure 7: Project Explores Solutions in Three Areas: Policy, Organizational Structure and Information Technology



The Project team believes that the right solution for the City will be realized by moving all three of these variables, as indicated by Figure 7. The right solution will create a "sweet spot" where moving policy, organizational changes, and information technology meet.

Each alternative will have a level of effort associated with it along with cost saving opportunities.

Along with these three alternatives, the Project team will do a case study on cost savings opportunities of machine-filling holes versus hand-trenching the same holes. The case study will explore the useful life of the road and the PCI score improvement by machine-filling trenches. The Project team believes that this case study will help in finding cost savings opportunities in coordinating ROW utility cuts.

Appendix A. Matrixed Gap Analysis Tool

Attribute	Score	Business Strategy					Stakeholder Communication			Planning					Engineering						Communication				Governance Structure				Finance				Business Information Systems				
		Unified Vision and Mission(Org Wide)	Defined Service Levels	Established Business Processes	Performance Metrics	Risk Mitigation Plan	Stakeholder Engagement	Stakeholder Process Understanding	Breadth of Stakeholder	Development Needs	Stakeholder Information	Scenario Planning	Funding Policy	Funding Plan	Enterprise Asset Management	Life Cycle Costing	Data Management	Design & Construction Requirements	System Evaluation and Inspection (after	Project Prioritization	Transparent Web Site	Citizen Engagement	Strategy Awareness	Staff Education	Architecture (Levels / Org Chart)	Clear Lines of Authority	Defined PPP MOU's / Ordinance	Legality	Financial Reporting	Auditing	Budgeting	Cost Forecasting	Information System Plan	Standards and Protocols	System Integration Plan	Data Standards	IT Policy
Optimizing	100																																			
	90																																			
	80																			■																
Managed Procedures	70																			■								■			■				■	
	60		■		■			■									■			■	■				■	■		■	■	■	■		■	■	■	
	50		■	■	■		■	■			■			■	■		■			■	■				■	■		■	■	■	■	■	■	■	■	■
Strategic Decisions	40	■	■	■	■	■	■	■	■	■	■	■		■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	30	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Standards	20	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Ad-Hoc	10	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Appendix B. Inventory and Analysis Interviewees

PacifiCorp

- Sheila Holden

NW Natural

- Gary Bauer
- Shanna Brownstein
- Two Staff Members

Portland General Electric

- Edward Groman
- Ross Cichosz
- John Watkins

Portland Bureau of Transportation

Asset Management

- Jamie Waltz

Paving Program

- Steve Townsen
- Brian Oberding
- Michael Magee

Capital Projects

- Dan Layden
- Peter Koonce
- Magi Bradway

Development/Utilities

- Kurt Krueger
- Alex Bejarano
- Ryan Mace

Maintenance Operations

- Suzanne Kahn
- Jody Yates
- Peter Wojcicki
- John Thomas

Portland Bureau of Environmental Services

- Scott Gibson
- Bill Ryan

Portland Water Bureau

- Jeff Winner
- David Peters

Portland Bureau of Technology Services

- Chris Cavanagh
- Kevin York (PBOT)

Appendix C. Benchmarking Point of Contact

Interviews included staff members at each organization. Listed below are the points of contract HDR used.

City of Las Vegas, NV & Regional Transportation Commission of Southern Nevada

Tim Parks
Engineering Project Manager
Public Works - Sanitary Sewer Planning
tparks@lasvegasnevada.gov

Paul Judd
Manager of Engineering Services
JuddP@rtcsnv.com

City of Bend, OR

Tom Hickman
Engineering and Infrastructure Planning Director
THickman@Bendoregon.gov

City of Boston, MA

Mark Cardarelli
Supervisor of Utility Coordination and Compliance
Boston Public Works
Mark.Cardarelli@boston.gov

City of Baltimore, MD

Richard M. Hooper
Operations Bureau Chief
Baltimore City Department of Transportation
Richard.Hooper@baltimorecity.gov

City of Chicago, IL

Jai Kalayil
Supervising Engineer at City of Chicago
jai.kalayil@cityofchicago.org