Case Study Developing Digital Project Management Systems to Streamline Project Delivery

INTRODUCTION

There is a growing movement among US State departments of transportation (DOTs) toward greater digitalization of their design and construction processes for delivery of capital projects. The use of digital project management systems can allow State DOTs to centralize project information fostering transparency, efficiency, and cost effectiveness throughout the lifecycle of a project. Project management systems include information on the budget, schedule, and documentation vital to project delivery of construction projects. The adoption of digital project management across the country has been hindered by high upfront costs, training needs for staff, and lack of expertise within departments. But, with champions and investment into the digital infrastructure, State DOT's can create a system that advances project delivery.

The Federal Highway Administration's (FHWA) Advanced Digital Construction Management Systems (ADCMS) program seeks to promote the application of advanced digital tools to mitigate discrepancies in schedules and budgets, create more sustainable infrastructure, and ease communications between project stakeholders. With the ADCMS program FHWA supports collaboration and investments in improved project delivery across all states by leveraging industry knowledge, providing incentives to use

KEY TAKEAWAYS

- Understanding key businesses practices for project delivery will allow for faster and easier implementation of digital systems.
- Releasing of minimal viable product allows real time feedback and fast turnover of improvements.
- Potential benefits of a digital project delivery system may include faster access to project information, improved communication between project staff, and improved transparency between stakeholders on project budget, schedule, and scope.

digital systems on projects, and encouraging investments in open data standards to create flexible and scalable project delivery methods.

This case study examines Connecticut DOT's (CTDOT) experience with their project management system, called COMPASS, and how it revitalized their project delivery for all construction projects. CTDOT was chosen because of the system's robust set of functionalities, early creation, and adoption of a digital system. The primary goals of this case study are to:

- 1. Examine the motivations behind CTDOT's COMPASS tool.
- 2. Detail the timeline in developing the functionalities of COMPASS and the integration of the GIS ATLAS system.
- 3. Give guidance to other State DOTs on how they can implement project management systems to make project delivery more efficient.



WHAT IS A PROJECT MANAGEMENT SYSTEM?

A project management system for state DOTs involves a series of interconnected processes that require documentation and communication between stakeholders during each stage of a capital project including project initiation, planning, design, construction, inspection, closeout, and post-project evaluation. Digital construction project management systems promote interdisciplinary collaboration among state DOT employees, contractors, and other stakeholders by providing a common platform for sharing information and coordinating activities in real-time. By breaking down silos and facilitating seamless communication, these systems mitigate errors, reduce rework, and accelerate project timelines. Furthermore, they empower project teams to optimize resource utilization, monitor progress, and adapt to changing conditions swiftly. Digital construction project management systems are increasingly becoming indispensable for State DOT's in optimizing their project delivery to enhance productivity, mitigate risks, and deliver superior-quality outcomes.

CTDOT COMPASS MOTIVATIONS

Starting in 2017 a directive from CTDOT's Engineering and Construction Leadership led the Architectural, Engineering, Construction (AEC) Applications Unit to implement a new project management system. Previously the department ran on a one-off standalone project management system framework for exclusively mega-construction projects that required constant new training for staff and large up-front efforts. Driven by the objective of increased efficiency, the AEC COMPASS team developed project goals and held peer exchanges with other state DOTs to determine system needs. From this initial work, key requirements came to light: cloud-based, flexible to customize, easy integration with other software and databases, cost efficient, scalable across project sizes, transparent, and accessible to all CTDOT partners. Additionally, the peer exchanges with other state DOTs helped CTDOT elude common pitfalls with digital systems, such as inflexibility and high knowledge bases required to run the system, that CTDOT could learn from. Guided by these principles, the team sought to implement a system that could serve as a one-stop-shop for all project staff, including department employees, consultants, and contractors, to manage the delivery of all CTDOT capital projects.

CTDOT COMPASS EXPERIENCE

Using the determined goals the AEC COMPASS team then conducted discovery sessions in collaboration with their consultant to get feedback from 144 CTDOT staff across disciplines and working levels to understand current project management capabilities and processes. A vital first step was deciding on using Microsoft 365 SharePoint platform for a commercial off-the-shelf solution (COTS) instead of a completely department-built system. The use of Microsoft applications provided the required flexibility and ease of modification that the Department needed, in addition to being a common platform that allows CTDOT to utilize external consultants in the development of new functionalities.

First Phase of Functionalities

The first phase of functionalities to be integrated into COMPASS was determined by finding the critical paths that are the basis of every capital project. The key element behind COMPASS's success is the decision to house each project on its own SharePoint site that shows vital project information in a digestible format. The site pages provide a one-stop-shop allowing staff, stakeholders, consultants, and contractors to access project information quickly and efficiently. While CTDOT maintains the Microsoft license, external consultants and contractors have free use of the COMPASS system to maximize transparency between project staff. The front page of each site is tailored to the most relevant information needed for project staff including right of way acquisition, budget, schedule, and permitting tracking. At its conception, COMPASS project sites contained information on the following:

- SharePoint sites for each project.
- Budget graphs for financial phases across project lifecycle including total overall, right of way, engineering, and construction budgets.
- Integration with MS Project.
- Environmental permitting tracking.
- Right of way property acquisition tracking.
- Staff data.
- Submittal/Transmittal functionality.

The COMPASS dashboard and detail tabs allow for users to quickly assess project information and deadlines to manage tasks efficiently. Staff management was a principal component of project sites as CTDOT realized the benefits of project staff and stakeholders having up to date contact information and organizational charts available in managing deliverables and streamlining communication. The staff section has been integrated with the Hyperfish application since November 2021, allowing flexible and autogenerated organizational charts, tracking staff with titles, unit, and contact information. Because of the success of Hyperfish within COMPASS, the system was adopted across the entire agency to manage staffing information on Office365 and automate organizational charts. CTDOT realized another benefit of using the Microsoft system in the ability to integrate COMPASS with MS Project. Schedules, project plans, and managing resources with pre-construction milestones are displayed on each page and a link to the MS Project schedule is provided. A large motivation behind COMPASS was a submittal/transmittal functionality providing ball-in-court features allowing users to route, review, sign, track, and archive documents. This functionality has been enhanced several times since the original output of COMPASS in 2019 to improve individual and team tracking for document transmittals by integrating with PDF applications, expanding attachment types, and ability to transfer ball-in-court workflow steps.

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Estimate No. 105 December 1 2023 to March 1	Internal Memorandum	Complete		03-07-2024		Construction	
ESTIMATE NO. 105 DECEMBER 1 2025 to March 1	Internal Memorandum	Complete		02-27-2024		Construction	
CEL Fee Swap	Internal Memorandum	Complete		02-16-2024		Construction	
Change Order No. 82	Correspondence to Contractor	Complete		02-02-2024		Construction	
Metal MultiDuct Conduit Surface Price Approv	Correspondence to Contractor	Complete		01-11-2024		Construction	
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Figure 1: Submittal and Transmittal Functionality. Image Source: CTDOT

Integration of ATLAS 2.0

As COMPASS has been rolled out the enhancement of functions and addition of new ones has allowed the system to grow with the agency and future projects. In parallel to COMPASS's development, CTDOT and a GIS developer constructed a new Esri Azure cloud-based GIS infrastructure called ATLAS 2.0. The Esri build out has developed a robust portal environment along with internal enterprise data governance, change management, and distributed subject matter experts across the agency. The collaboration between COMPASS and ATLAS 2.0 allowed for the Project Generation feature of COMPASS to be released in June 2023. The function creates projects from the conceptual phase, leveraging location and asset data to determine anticipated project needs and constraints. This eliminates the heavy lifts of gathering relevant data from internal and external resources. ATLAS is used to organize and manage the relationship between projects and assets. The interface provides a baseline map with a linear referencing system linked to agency data, such as daily traffic counts. Furthermore, the AEC team in collaboration with the Asset Management team developed the asset tab that displays selected project attributes from ATLAS 2.0 for simple access for relevant assets within the project area. The integration of ATLAS 2.0 within COMPASS has allowed CTDOT to capture information for each project in a common data environment, reducing errors caused by outdated or conflicting information when data is housed in different locations.



Figure 2: GIS Location Integration on COMPASS Dashboard. Image Source: CTDOT

Benefits

The success of COMPASS is tied to the foundation of housing projects on individual SharePoint sites. A cloud-based solution can be accessed by all members of the project team, keeping everyone up to date on current information. The COMPASS team prioritized integrating seamlessly with other software and databases including MS Project, PDF applications, CAD, and CTDOT databases to eliminate data silos and to obtain needed project data faster. Additionally, the system is flexible, able to expand and evolve with emerging technologies and over varied project sizes. COMPASS has allowed CTDOT to move away from previous practices of building costly, inefficient, one-off project management systems, that were typically only created for large projects during the construction phase and provided less functionality than

COMPASS. This not only created a standard procedure for project delivery across the agency but reduced training needs for staff over multiple project management systems. Users of COMPASS reported decreased processing time for documents from months/weeks to days/hours with the ball-in-court submittal/transmittal functionality.

NEXT STEPS

CTDOT is continuing to evolve and expand COMPASS to improve project delivery and transparency throughout the lifecycle of all transportation projects. All existing functionalities require continuous maintenance to address system bugs, adapt to changes in technology, and meet evolving business needs based on end user input. New functionalities are derived from gaps in the existing system or improvements to in-place functions that are requested by end users. A new function will enter the discovery phase of development after a thorough review period by the Offices of Engineering and Construction, Bureau of Engineering and Construction (BOEC), COMPASS Subject Matter Steering Committee, and finally AEC. The design and development of a function involves sprint cycles between AEC staff, IT, and the consultant to secure access to required authoritative data, preparing data maps, and test the new release before regression testing and an execution plan. The development of new functionalities always ties back to CTDOT's guiding principles of building the features around the existing business practices.

Future Functionalities

The COMPASS team is continually evaluating the use of the tool to improve current functionalities and expand to new ones. State funding has allowed several new functionalities to undergo development based off SME feedback. The next big stage in the development of COMPASS is creating a new architecture in conjunction with a long-term data storage plan that will allow all future projects to be housed in the system. In response to changing staff and rapid technology changes, the AEC team is developing an integrated COMPASS Help and Support tool which will allow new staff to get the help they need more efficiently. The Help and Support tool will work similar to support desks in other Microsoft software. Improvements to the financial reporting augment the current budget displays by reducing the need for manual updates with autogenerated budget reports, eliminating the time-consuming task for managers. Additionally, the COMPASS team plans to make improvements to the existing Right of Way system, enabling live interaction between Engineering and the Office of Right of Ways. The new feature will provide system generated warnings for required work tasks, increasing transparency from project inception. To aid in communications with consultants using COMPASS the AEC team is developing a Digital Invoicing Management Environment (DIME) to streamline invoice processes and management. This allows consultants to easily create and track invoices and other financial documents in their relationship with CTDOT. The Office of Engineering in partnership with the Office of Environmental Planning is helping to modernize the environmental site tracking page to create a single source for essential environmental scheduling information. The AEC team also has ongoing collaborations with CTDOT Finance, CTDOT IT, and external consultants in developing a narrative cost of allocation plan to provide project specific COMPASS usage reports for use by the Department for direct project cost reimbursement in using federal and state funds.

Use of ADCMS Funds

CTDOT received an ADCMS grant in August 2023 that supports development of new COMPASS Smart Communication and Reporting Solution (SCORS) functionalities including:

- Template management.
- Report of meeting generation.
- Project summary reports.
- Task pages on the user dashboard.

- Design and post construction review database.
- Expansion of the existing project generation functionality.

These functionalities focus on automated building out of reports and forms with project information that currently is inputted manually. The template management function integrates with the existing submittal/transmittal functionality to digitize the distribution process for letters and memos. The objective is to standardize digital forms to determine staff by their title as opposed to their email. Project summary reports are being developed in collaboration with the Capital Program Management Office to compile essential project data such as budget, schedule, and risk reports that will enhance internal project management, communication, and transparency. Based on user input to create a enhance individual use of the system, the COMPASS team is developing a new functionality to provide a digital dashboard specific to internal users that compiles action items to highlight essential project elements such as schedule adherence and deliverables. As the COMPASS system can be utilized at every stage of a project, new functions to facilitate maintain records of documents in the design and post-construction database and allow non-capital projects to be housed in the system are being developed in the expansion of the project generation functionality.

LESSONS LEARNED

CTDOT's development of their COMPASS project management system showcases the benefits to project delivery that digitizing project management can have to budget, schedule, and staff experience. This case study highlights lessons learned by CTDOT through the process of developing COMPASS for other agencies:

- Digital project management systems are not static; they require continuous improvement, updates, and adaptation to evolving technologies and business needs.
- Success of a digital system hinges on their ability to integrate seamlessly with existing software and databases.
- Considerations for user experience by providing adequate training and support for staff members are crucial aspects for successful system implementation.
- Use of end user's experience to drive functionalities better prepares the system for the day-to-day tasks of project management.
- State DOTs may achieve greater success using a flexible and scalable project management system.
- Small increments of changes to functionalities allow for faster roll out of features, as well as faster user input for needed changes.

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