When the Oregon Department of Transportation set out to repair and replace hundreds of bridges statewide, it developed the context-sensitive and sustainable solutions (CS³) decision-making framework. This approach combines the practices of context-sensitive design with the principles of sustainable design while improving transportation infrastructure and facilitating economic development.

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In 2003 the Oregon Department of Transportation (ODOT) was given responsibility for implementing the $1.3-billion State Bridge Delivery Program. Ultimately, this program will replace or repair hundreds of aging bridges on major highway corridors throughout Oregon and in so doing will improve mobility and stimulate economic development by enhancing the climate for business investment. Given the sheer size and scope of the bridge program, the ODOT established new ways for managing transportation infrastructure projects. In carrying out its work in the bridge program, the agency actively sought solutions that better reflect and account for the needs, values, and concerns of Oregon citizens. This new approach developed by the ODOT is referred to as context-sensitive and sustainable solutions, or CS³.

In response to legislative direction, the ODOT defined five primary goals for the bridge program:
- Stimulate Oregon’s economy;
- Employ efficient and cost-effective delivery practices;
A major test of the CS³ program involved the development of the Interstate 84 corridor strategy, which provided a framework for revamping infrastructure along a section of the interstate that passes through the Columbia River Gorge National Scenic Area. The bridge constructed over Moffett Creek was one of 16 spans updated as part of the strategy.

- Maintain freight mobility and keep traffic moving;
- Build projects that take a community’s needs, environment, and landscape into consideration;
- Capitalize on funding opportunities.

The ODOT contracted with Oregon Bridge Delivery Partners (OBDP), a joint venture formed by HDR Engineering, Inc., of Omaha, Nebraska, and Fluor Enterprises, Inc., of Irving, Texas. The OBDP supports the bridge program, ensures high-quality projects at the lowest possible cost, and manages engineering, environmental, financial, safety, and other aspects of operation.

CS³ adds a unique perspective to traditional transportation engineering in that it incorporates activities that foster workforce growth and development; reflect the community’s cultural and aesthetic interests; maintain mobility and safety; ensure sound stewardship of the environment; and promote cost-effective decision making. CS³ combines two innovative concepts emerging in the transportation industry: context-sensitive solutions (CSS) and the principles of sustainable design.

As defined by the Federal Highway Administration, CSS is “a collaborative interdisciplinary approach that involves all stakeholders in providing a transportation facility that fits its setting. It is an approach that leads to preserving and enhancing scenic, aesthetic, historic, community, and environmental resources while improving or maintaining safety, mobility, and infrastructure conditions.”

The steps called for in CSS are as follows: set a management structure; define the problem; create an evaluation framework; develop and compare alternatives; and evaluate, select, and implement solutions. The CSS approach considers the overall setting of a transportation improvement project.

Sustainability means using, developing, and protecting resources in such a way as to enable people to meet their current needs and ensure that the needs of future generations can be met. These needs are not just economic but also social and environmental; thus planners must meet what is called the triple bottom line.

The ODOT merged the concepts of CSS and sustainability, creating the CS³ approach for meeting the five primary goals of the State Bridge Delivery Program. The desired results of the program are an improved state transportation infrastructure that reduces transportation-based limitations on trade and economic progress while delivering projects that are socially and environmentally responsible.

Because the foundations of CS³ were innovative, the bridge program could not draw on existing models. In 1998 the Federal Highway Administration sponsored a conference entitled “Thinking Beyond the Pavement,” which provided a guiding structure for developing the CSS approach. Since then, the administration has sponsored pilot projects and information exchanges to further clarify the criteria and processes associated with CSS. While some of the goals underlying CS³ are not new to the ODOT, the methodology and evaluation process are unique. CS³ enhances traditional transportation management and represents an evolutionary process, not a radical change.

In 2004 and 2005, the OBDP developed the Context Sensitive and Sustainable Solutions (CS³) Guidebook to outline the new process. In addition to establishing expectations for the CS³ process as part of the bridge program, the book explains how the process evolved from the ODOT’s existing project delivery system and how CS³ can be applied to other projects.

The book’s three main sections describe the background of the program, its implementation, and the project delivery process. For example, the book details the development of the bridge program and how it was organized using CS³ as a framework. As for the project delivery process, it includes step-by-step explanations of the particular tools used in implementing the bridge program and describes processes for the two main contracting methods: design/bid/build and design/build. It also includes a companion document entitled “CS³ Performance Measures Framework,” which sets forth the measures used to evaluate the goals and objectives of the program. Used together, the guidebook and the framework thoroughly explain how data pertaining to each performance measure are collected and reviewed.

The tools and processes developed for the bridge program were designed to fit the needs of projects of any size. However, at the time the ODOT was developing CS³, the CSS approach had been used only on the largest, most complex projects. To help designers incorporate CS³ principles into their work, the ODOT and the OBDP developed guidelines for architecture and engineering consultants who would be working on the State Bridge Delivery Program. These guidelines provide additional background information and details about the tasks, activities, and results described in the scope of work for each project contract. The guidelines explain expectations regarding the level of effort for tasks to reduce uncertainty as architecture and engineering consultants prepare project scopes of work and fee estimates, and they provide directions on how to perform work within the program.

The design contracts specify what is to be delivered in connection with CS³. Using a template provided by the OBDP, the consulting engineer prepares a CS³ plan that outlines how the design firm and the construction contractor will achieve CS³ on the project and meet the program’s five goals. At key project milestones, the engineer submits summary reports to show progress toward meeting the goals.
During the early design process, the engineer completes a CS³ decision matrix. As part of this process, the consultant details the preferred bridge alternative and the principal factors underlying the final recommendation. The consultant also explains why other structural options, construction methods, structural types, and configurations were not selected.

CS³ is much more than a philosophy for managing the bridge program. It provides an adaptive management tool for evaluating the strategies being implemented. The performance measures used to evaluate the level of success serve to define the collective expectations for the bridge program. However, the program must be sufficiently flexible to weather unforeseen challenges and to evolve over time. Adaptive management relies on the experience and knowledge gained from monitoring key criteria and making the necessary adjustments. During the early stages of the program, the ODOT’s Major Projects Branch, the OBDP, and key stakeholders reviewed changes to the measures and proposed new measures annually.

Performance measures and their methodologies are identified in the document “CS³ Performance Measures Framework,” which, as mentioned above, forms part of the Context Sensitive and Sustainable Solutions (CS³) Guidebook. The document goes into considerable detail about the evaluation criteria, the performance measures, the reporting methodologies, the tools, and the resources that are to be used to achieve each stated goal on a programmatic and project-level basis. The design of the framework reflects insights from the ODOT’s Major Projects Branch, the OBDP, stakeholders, and experts on CSS and sustainability, as well as insights gained by the ODOT and several other states in using models based on practices generally regarded as highly effective (“best practices”). However, not all strategies can be quantified into a directly measurable outcome, and in some cases it may prove more valuable to track how goals are achieved on the basis of process and outcome measure in the annual report, the OBDP, stakeholders, and archive of all past reports are available on the OBDP’s website.

CS³ performance is measured in three ways: process, outcome, and indicator. Process measures of the evaluation criteria are qualitative; that is, they convey the way business is conducted. The annual report prepared in connection with CS³ details outcome and indicator measures. Outcome measures are quantitative and provide hard data on the effectiveness of strategies. Indicator measures are similar to outcome measures, but they do not have an established target.

Process measures and outcome measures are most useful when a barometer for expectations is established. For each process and outcome measure in the annual report, the OBDP assesses status on the basis of the following categories: meets criteria, below criteria, and needs immediate action. (See the illustration.) Meets criteria, shown in green, establishes a range with minimum expectations defining the baseline. Below criteria, in yellow, indicates that guidance is needed to improve situations that fall below the baseline. Needs immediate action, in red, indicates situations requiring significant corrective action.

CS³ effectively considers the possibility that the whole is greater than the sum of its parts. This philosophy suggests that examining any one measure separately from the others distorts the overall picture. At times the goals for the bridge program will prove compatible; at other times they may not. Sustainability calls for considering the balance between economic, social, and environmental interests, the key word here being “balance.” To illustrate the need for balance, the OBDP developed a tool, referred to as the CS³ bull’s-eye, for holistically evaluating performance measures with respect to the goals.

Like an archery target, this bull’s-eye is a circle, and it is divided into five equal wedges, each representing a program goal. In each wedge, an arrow marks the average performance reported for each goal. (However, goal 5, which refers to funding opportunities, has no arrow because no explicit goal exists for the category.) The process for calculating the average is similar to that used in calculating a grade point average. For each reported performance measure, “meets criteria” receives four points, “below criteria” receives two points, and “needs immediate action” receives zero points. The range used to evaluate overall performance for the bull’s-eye also is reminiscent of academic grading. An average score between 3.0 and 4.0 corresponds to “meets criteria,” 2.0 to 2.9 is “below criteria,” and 0 to 1.9 corresponds to “needs immediate action.”

The monthly progress report for the State Bridge Delivery Program provides current information on the program’s goals and the status of particular projects. This document includes program success stories, regularly reported metrics for each goal, details regarding project status, and an appendix of cost and schedule information for the bridge program. The State Bridge Delivery Program is the first ODOT program to regularly produce a report with this level of detailed information. The most current version of this report and an archive of all past reports are available on the OBDP’s website.

Because CS³ is a new way of approaching infrastructure projects, organizational challenges had to be overcome in implementing it. For example, conventional design and construction techniques do not require the knowledge and skills necessary for implementing the CS³ approach. Along these lines, standard design approaches did not always involve
investigating the best management practices for obtaining all five CS³ goals. Typical design approaches would account for economic considerations, whereas the CS³ approach accounts for all process requirements as well as those options most suitable for the surrounding area. In some cases designs were changed from standard designs to better suit the environment and to meet such objectives as those pertaining to environmental performance and mobility. CS³ sometimes requires “thinking outside the box” to create a project that addresses all five goals where appropriate. On occasion, established ODOT protocols conflicted with CS³-inspired ideas. Resistance to change, both internal and external, initially led to underestimating or overestimating cost and time commitments. With few initiatives to imitate, the CS³ approach needed to be flexible and to include careful monitoring of criteria and a disciplined response to fluctuations.

Because these challenges involved organizations and people, they were addressed with measures designed to increase collaboration and to help participants realize that they had common goals. The measures included partnering, training, adaptive management, and the formation of interdisciplinary teams. When the bridge program began, the ODOT and OBDP staff members held alignment meetings with personnel from the ODOT’s five geographic regions, as well as with representatives of those regions’ branches, to ensure that all parties would continue receiving the information they needed to do their jobs effectively. Bridge program staff members also met with each region’s public affairs staff to establish customized communication protocols and other guidelines for regional involvement. Altogether, the bridge program team held more than 60 meetings with resource agencies and other stakeholders. The alignment effort demonstrated the ODOT’s commitment to engaging all stakeholders through the CS³ process.

These alignment sessions culminated in a 13-step design/bid/build process and an 11-step design/build process. The processes are based on existing ODOT procedures and senior-level staff experience. They start with the most effective procurement and delivery steps and filter them through the CS³ lens. As part of this strategy, the OBDP developed a CS³ training program and reached out to the architecture and engineering community. Three formal training sessions were held in the early years of the bridge program, and altogether more than 600 bridge program participants from consulting firms, the ODOT, and the OBDP have been trained.

To facilitate collaboration, the ODOT named eight core areas that had to be represented in the program: economic stimulus, contractor and workforce diversity, cost-effectiveness, mobility, public information and involvement, environmental justice, environmental program management, and sustainability. Each of these areas had an OBDP task leader responsible for integrating it into the project delivery structure. What is more, a separate CS³ task leader was responsible for coordinating the actions of the task leaders for the eight key areas and managing the overall CS³ process to ensure that it was implemented at both the project and the program level. Collaboration prevented any decision from being made in a vacuum. These eight areas also addressed the bridge program’s five main goals, which are as important to the bridge program team as delivering projects on time and on budget.

CS³ provides an adaptive management tool that is of paramount importance in evaluating the strategies being implemented. The “CS³ Performance Measures Framework” is a living document that must be modified to reflect new situations or changing expectations as they arise. The framework guides decision making to reflect balanced and appropriate actions for a broad set of interests, including those of the ODOT, the OBDP, design and construction contractors, other stakeholders, and the public. The five program goals have been consistently met as measured through the “CS³ Performance Measures Framework” and depicted on the OBDP’s bull’s-eye tool.

A major test of the CS³ program involved the development of the strategy for the Interstate 84 corridor. Developed between 2004 and 2010, this strategy provides a framework to help the ODOT manage and improve infrastructure, including 16 bridges, located along a 79 mi stretch of I-84 that passes through the Columbia River Gorge National Scenic Area on the Oregon side of the Columbia River. The U.S. Congress established this scenic area to protect the scenic, cultural, recreational, and natural resources of the gorge. Embodying the principles of CS³, the I-84 corridor strategy reflects the input and suggestions offered by agency representatives and hundreds of interested stakeholders and citizens, and it has enabled the ODOT to meet public safety and transportation needs while conforming to provisions governing the national scenic area.

Since 2004 the ODOT has used the collaborative, long-term philosophy of CS³ to successfully deliver 11 design/build projects and was able to track their progress from design through construction. Like CS³, design/build contracting emphasizes a continual process of collaborative work toward mutually beneficial solutions, and it fosters innovation because engineers and contractors share information and ideas. Meanwhile, the ODOT is currently relying on CS³ to deliver one project by means of the construction manager/general contractor method.

Over the years Oregon’s State Bridge Delivery Program has received numerous awards, and the range of these awards highlights the success of the CS³ approach, which makes it possible to achieve a number of goals simultaneously and sustainably.

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