NCHRP PROJECT 15-32A

Facilitating Implementation of Guidelines for Quantifying the Benefits of Context Sensitive Solutions

PROJECT FINAL REPORT

By

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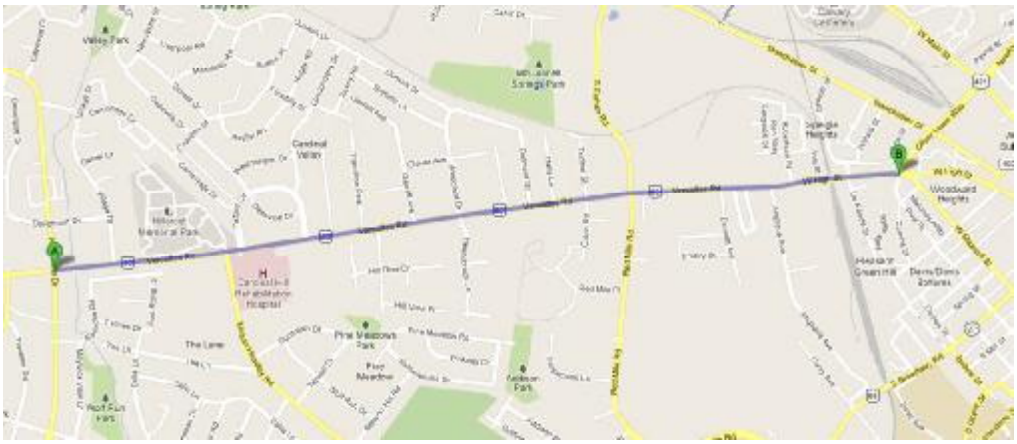
APPENDIX B

Case Studies

FINAL CASE STUDY DOCUMENTATION

Title	Versailles Road Multimodal Study
Location	Lexington, Kentucky
Lead Agency	Corridor Study—Lexington Area MPO Construction—Kentucky Transportation Cabinet (KYTC) Operations— Lexington Fayette Urban County Government (LFUCG)
Contact Person	Max Conyers, MPO Director
Phase completed	Construction; Project is in operation
Purpose and Need	The Versailles Road corridor is a major arterial into the heart of Lexington, KY, connecting the Bluegrass Airport, Keeneland Racetrack, and the Bluegrass Parkway with downtown Lexington. In addition, the corridor serves as the most heavily used transit route within the city. Heavy pedestrian and bicycle usage also exist on the corridor making it one of the most vibrant and diverse multimodal corridors in the city if not the state. However, few improvements have been made for either automobile or other modes of transportation in recent years leading to a poor condition of some facilities and the need for improved and expanded modal facilities on the corridor. There is a distinct need to develop alternatives that can improve multimodal uses on high volume roadways, and the Versailles Road corridor is a prime candidate for the development and evaluation of such measures. The objective of this study is to identify alternative roadway configurations that are capable of balancing multimodal uses including vehicular, pedestrian, bicycle and transit modes. Due to the high need and unmet funding needs, this project set out to identify short term improvements that could enhance the walkability of the corridor in the near term while laying the groundwork for long term investment and improvements. The limits of the study area on Versailles Road were from Alexandria Drive to Oliver Lewis Way (Figure 1).

Figure 1: Study Area



CSS Qualities

- Project Team (make up)

Discipline	Roles & Responsibilities
Project manager	- Develop and manage scope, schedule and budget; - Lead communications between LFUCG, LexAreaMPO, KYTC ad Consultant - Lead quality assurance
LexingtonArea MPO	- Lead Public Involvement Outreach and Efforts - Coordinate Public Communication and Social Media Outreach - Coordinate Transit Planning and Impacts - Coordinate Funding Needs
LFUCG Planning	- Coordinate/Review Pedestrian and Bike Activities - Contribute to planning-level cost estimates and pre-design level cost estimates - Contribute to evaluation of improvement options
LFUCG Traffic	- Review and Approve Operational Analysis Scenarios - Contribute to evaluation of improvement option
KYTC District Office	- Review and Approve Improvements Plans - Coordinate proposed improvements with various district programs including resurfacing program - Implement proposed construction improvements
KYTC Central Office	- Provide funding for evaluation study and improvement program - Coordinate proposed improvements with various programs including Highway Safety Improvement Program Provide policy review and approval of proposed improvements

- Stakeholders (make up, utilization, interaction)

  - Peggy Henson, 11th District Council Member – Project direction and outreach support
  - Friends of Versailles Road – Problem Identification and community coordination and partnering
  - LexTran (Transit Authority of Lexington)- Operational knowledge of transit operations and potential areas for improvement
  - Business representatives – connection to neighborhood/commercial plans and operations

- Public involvement (types, documentation)

  Public involvement activities were both used to gather information from the public as well as disseminate project information and status.

  The first major involvement activity was a user travel survey to determine mode choice and travel patterns for residents in the area. In addition, impediments to each modal alternative were identified to assist the project team in the prioritizing and addressing issues on the corridor. The travel survey was distributed in an online format through email addresses collected as part of the initial project outreach and through the assistance of the project stakeholders. In addition, hard copies were distributed at local businesses and at transit locations in both English and Spanish versions to capture local residents and/or business users who were not aware of the online survey or have access to the internet. In all, 244 English surveys were collected, and 17 in Spanish. The travel survey identified 19 percent of users exclusively used alternative modes on the corridor (9% walk, 10% transit). Several impediments to walking, biking and transit usage were also identified through the survey for each section of the corridor as well as the identification of suggested improvements.

  Following the initial travel survey and problem identification alternative solutions were developed as outlined below with the assistance of the stakeholders detailed above. Potential solutions were then presented at a public information meeting for review and comment. One of the primary results of this meeting was the discussion of the significant maintenance needs on the corridor regarding overgrown vegetation impeding full use of sidewalk widths. This led to agreements between neighborhoods and the city to establish a partnership in addressing these issues.

- Design solution (process, modes and alternatives examined).

  As identified in the purpose and need, this project focused on making improvements within the existing pavement section to minimize project costs so that improvements could be made in the short term (0-6 months). Therefore, the initial alternative considered for the project was a road diet which would reduce the cross-section from a 4-lane section to a 3-lane section. Representative cross sections of the existing conditions and alternative are shown in Figures 2 and 3.

Figure 2: Existing Conditions

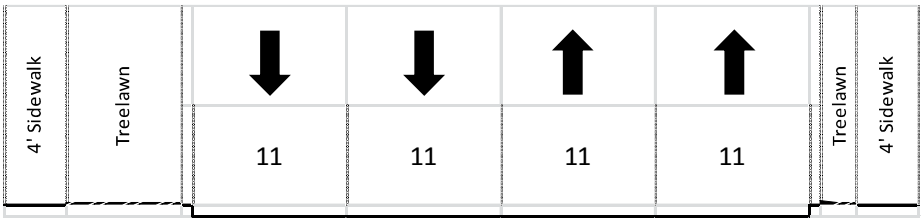
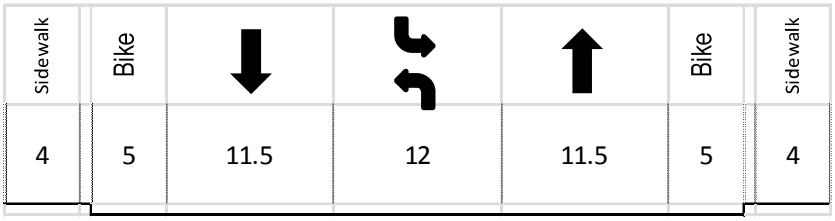


Figure 3: Road Diet Alternative



The impact of this alternative on the roadway capacity was evaluated through Synchro for the AM and PM peak periods. This alternative resulted in several movements operating at LOS E and F during the AM peak periods, but would then severely degrade during the PM period with major intersections operating under failing conditions. Additionally, significant queues would be created (traffic would have an average queue over ½ mile long in the PM rush at both intersections) which would impact upstream intersections and potentially further degrade operations at the major intersection.

In addition to the road diet concept, other miscellaneous minor improvements were explored that maintained the existing cross-section and layout of the corridor, but could address identified issues on the corridor. These improvements are corridor wide improvements as well as spot improvements that deal with very specific areas on the corridor.

The following are the corridor wide improvements identified for the study area.

Sidewalk repair and maintenance. Sidewalks throughout the corridor were in disrepair with cracks, missing sections, and displaced joints which cause hazardous walking and wheelchair accessibility issues. In addition, the majority of sidewalks are narrow (4 feet) and do not permit easy passing when pedestrians meet. Vegetation and grass adjacent to many sidewalks have encroached upon the sidewalks to further reduce the available width.

It was recommended that a corridor wide effort be undertaken to repair/maintain sidewalks to their 4 foot minimum width. This would include replacement of missing sections and displaced joints as well as clearing vegetation, with possible minor grading to reduce the chance of future encroachment. It is noted that sidewalk maintenance is the responsibility of the adjacent property owner. Therefore, targeted code enforcement activities may be used to achieve these improvements, or they may also be undertaken through joint city/neighborhood partnerships.

It is also recommended that, where feasible, sidewalks be widened to a minimum width of 5-6 feet. Due to sporadic retaining walls, short yard grades, or the placement of utility poles, this width is not available continuously; however, providing the widening with some intermittent narrow section would still significantly improve walkability on the corridor. *Vegetation and maintenance issues were addressed through partnerships with the community and LFUCG Public Works and division of Planning.*

Inlet Repair. The majority of drainage inlets on the corridor are in disrepair with sunken inlets and damaged grates. This creates a hazard to pedestrians as it creates holes in sidewalks and further narrows the sidewalks. These conditions also create a significant hazard to cyclists riding in the street as the sunken grates create a non-passable surface forcing cyclists to merge in with high speed traffic. It is recommended that all inlets on the corridor be reviewed and repaired/replaced where necessary to provide a smooth surface for pedestrians, bicycles and vehicles.

This improvement was completed by KYTC as part of resurfacing project completed immediately after completion of the study.

Pavement Milling /Curb Reconstruction. Over the previous cycles of pavement resurfacing the curb line has diminished in height as the pavement surface has been raised with overlays. Furthermore, curbs have deteriorated throughout the corridor and are crumbling in many areas. This creates a safety hazard for pedestrians as it diminishes the separation between vehicles and traffic and creates areas of ponding within the curb line that can cause splashing for the adjacent sidewalks.

It is recommended that any future resurfacing include adequate milling to reduce pavement height and restore proper curb height and drainage. In addition, corridor-wide repair/replacement of curbs is recommended to restore the sidewalk edge and improve safety for pedestrians.

This improvement was completed by KYTC as part of resurfacing project completed immediately after completion of the study.

Traffic Signal Pedestrian Accommodations. It is recommended that the city evaluate the use of shorter cycle lengths or 'half cycles' during off-peak periods of the day to reduce pedestrian wait times at signalized intersections. Pedestrian signal timing should also be reviewed to ensure minimum walk and flashing don't walk times are provided for crossing. It is recognized that all intersections on the corridor may not accommodate this strategy, but that others with heavy pedestrian activity such as those near Oxford Circle may benefit.

In addition, walking tours of the corridor identified several pedestrian buttons that did not readily activate and place a pedestrian call. It is recommended that pedestrian pushbuttons be reviewed and repaired/replaced as necessary to ensure that calls are placed.

Pedestrian pushbuttons and signal timing were reviewed and improved by LFUCG Traffic Engineering after coordination and service on the Project Team through regular maintenance activities.

Trash Pickup Practices. During walking tours and through submitted comments, it was identified that trash receptacles were placed on the sidewalk during pickup and blocked pedestrian access. It was recommended that receptacle placement and pickup procedures be modified to place trash receptacles on driveways or off of the sidewalk so as to not block the sidewalks.

This improvement was enacted by LFUCG public works after the issue was raised by LexAreaMPO staff through regular scheduled coordination meetings.

Pedestrian Buffer. One section of Versailles Road is significantly narrower (58 feet) than other sections. Lanes are narrower, 11-12 feet, and there is no space available for bike lanes or other facilities **(Figure 4)**. In addition, all sidewalks in this area are narrow (4 feet) and located directly at the back of curb. The narrow lanes on the roadway combined with the close and narrow sidewalk makes for an uncomfortable walking experience within this section of roadway. It is recommended that existing lane widths be narrowed to 10.5 feet to allow for a 2.5 foot buffer at the edge of the roadway between the travel way and sidewalk. It is noted that the cross-section may vary in this area and should the available width be reduced below 58 feet, that the lane width should held at 10.5 feet reducing the buffer zone in these limited instances. The proposed cross section is shown in **Figure 5.** The proposed cross section is anticipated to have 2 effects; 1) it will provide a buffer between pedestrians and vehicles and 2) the narrower lanes will have a minor traffic calming effect reducing high speed traffic through the residential pedestrian area.

Figure 4: Existing Cross Section Versailles Road (Oxford Circle to Red Mile Road)

↓	↓	↳	↑	↑		Total
11	12	12	12	11		58
		Existing				

Figure 5: Proposed Cross Section Versailles Road (Oxford Circle to Red Mile Road)

Shldr	↓	↓	↳	↑	↑	Shldr		Total
2.5	10.5	10.5	11	10.5	10.5	2.5		58
			Proposed					

This improvement was completed by KYTC as part of resurfacing project completed immediately after completion of the study.

Versailles Road at Red Mile Road/Forbes Road. The traffic signal at Red Mile Road is a box span wire with poor visibility of signals and insufficient pedestrian accommodations. No sidewalks exist at the intersection and pedestrian push buttons are located 10-15 feet from the paved edge making them inaccessible to anyone in a wheel chair or with other disabilities (See Picture). Several foot paths are evident at the intersection.

It is recommended that the intersection of Versailles Road at Red Mile road be reconstructed with appropriate ADA compliant pedestrian acocmodations. This includes 1) sidewalks with ADA ramps, 2) accessible pedestrian pushbuttons and 3) pedestrian signal heads.

This improvement has been completed through a Highway Safety Improvement Program (HSIP) project identified and funded by KYTC to rebuild the traffic signal at the intersection.

As can be seenf rom the above identified improvements and results, the majority of these issues were addressed through regularly scheduled projects or maintenance activities through the coordiantion afforded by the multidisciplinary team and the large stakeholder group.

- CSS concepts by phase

  As this project focused on short term solutions, the majority of improvements were able to be implemented without an extensive design process, limiting the project development process. However, the two most critical CSS concepts achived in the project was 1) the use of an interdisciplinary team within the planning and evaluation phase which led to immediately implementable solutions that were readily integrated into other programs and 2) continued stakeholder and public engagement and dialogue that led to increased opportunities for partnering between the project sponsors and community.

- Lessons learned

  Despite many initial complaints about the conditions on the corridor and lack of walkability from both stakeholders and the project team, definitive problem areas could not be identified. The extensive problem identification phase in the initial evaluation which included the travel survey discussed above as well as a walking, biking and transit tour by the project team enabled for definitive identification issues and locations as opposed to a general idea of problems. It is this extensive problem identification that allowed for the focused direction of the study and identification of spot improvements that lead to a successful project.

CSS principles

CSS Principle	Project Team
Use of interdisciplinary teams	3.3
Involve stakeholders	3.7
Seek broad-based public involvement	4.0
Use full range of communication methods	3.3
Achieve consensus on purpose and need	3
Utilize full range of design choices	2.7
Address alternatives and all modes	3.3
Maintain environmental harmony	3.0
Address community & social issues	3.0
Address aesthetic treatments & enhancements	3.0
Consider a safe facility for users & community	3.3
Document project decisions	3.0
Track and meet all commitments	2.0
Create a lasting value for the community	3.3
Use all resources effectively (time & budget)	3.3

Note: The project team and stakeholder scores are based on the survey results of a 4.0 scale (4: strongly agree; 3: agree; 2: disagree; and 1: strongly disagree).

- Project team's perspective

  There were 6 respondents that were considered as team members, including the responses of the person identified as the team leader. The project team indicated that in general all principles were marginally addressed, since all had a score greater than 2.0 (i.e. agreed that at least the principle was there). The principles with the lowest scores were "Track and Meet all commitments" (2.0) and "Utilize Full Range of Design Choices" (2.7). These scores may have been the result of the nature of the project which addressed only short term improvements and thus did not utilize formal commitment tracking typically used on long term major improvement and design studies.

  The project included an interdisciplinary team that covered all anticipated (required) areas and it seemed to have worked well. The responses received came from team members who identified themselves as design engineers, planners, community planners, construction engineers, and project managers. All were involved in the planning phase of the project and several were involved in the design phase of the project and construction as well. Al members were involved in all phases of the project. All respondents were new to CSS with 0-3 years of experience. Finally, most team members had more than 10 years of relevant experience.

CSS Benefits

CSS Benefit	Measured	
	Stakeh.	Team
Improved stakeholder/public feedback	NA	3.0
Increased stakeholder/public participation compared to other projects	NA	3.0
Increased stakeholder/public participation	3.0	3.0
Increased stakeholder/public ownership	3.5	3.0
Increased stakeholder/public trust	3.0	3.3
Decreased costs for overall project delivery	3.0	3.0
Decreased time for overall project delivery	3.0	3.0
Improved predictability of project delivery	3.0	3.0
Improved project scoping	NA	3.3
Improved project budgeting	NA	3.0
Increased opportunities for partnering or shared funding or in-kind resources	3.0	3.7
Improved opportunities for joint use and development	2.0	3.0
Improved sustainable decisions and investments	3.0	3.0
Improved environmental stewardship	N/A	N/A
Minimized overall impact to human environment	3.5	3.0
Minimized overall impact to natural environment	3.0	3.0
Improved mobility for all users	3.5	3.3
Improved walkability	3.5	3.3
Improved bikeability	2.5	3.0
Improved safety (vehicles, pedestrians, and bikes)	3.5	3.0
Improved multi-modal options	3.0	3.3
Improved community satisfaction	3.5	3.3
Improved quality of life for community	3.5	3.0
Improved speed management	2.5	3.0
Design features appropriate to context	3.0	3.0
Optimized maintenance and operations	3.0	3.0

Minimized disruption	3.0	4.0
Increased risk management and liability protection	NA	3.0
Fit with local government land use plan	3.5	3.0

- Semi-Quantitative Benefits

  Overall, both stakeholders and team members indicated that several benefits materialized as a result of the process followed. Almost all benefits have a score greater than 3.0 indicating that the survey participants at least agree that the benefit was achieved. Benefits that had high scores (equal or greater than 3.7, indicating that most of the participants strongly agree) include “Increased opportunities for partnering or shared funding or in-kind resources”, and “Minimized disruption. These benefits demonstrate the coordination and partnerships were able to achieve improvements without the need for additional projects beyond those already in progress.

  The project team did not rate any benefit under 3.0, but two benefits were rated lower by the stakeholders indicating that the respondents believe that the benefit was marginally materialized. These include “Improved bikeability,” “Improved opportunities for joint use and development” and “improved speed management”. These answers indicate that some of the principles may not be fully incorporated and similar answers were noted in the evaluation of the principle application by the team.

  An apparent trend of the benefits materialized is the consistent difference between the perspective of the team and the stakeholders, where for all common benefits the team scored them higher. In general, these differences are not large and it may be attributed to the fact that there were only three stakeholders that completed the survey. Therefore, any comparisons could be conducted cautiously.

- Quantitative Benefits

  In addition to the semi-quantitative scores obtained above, the following quantitative metrics were obtained for some of the benefits.

CSS Benefit	Metrics
Increased stakeholder/public participation	Through the course of the 6-month project, monthly travel survey responses increased from 43 responses in the first month to 138 during the 4th month when the survey was closed with a steady increase in responses as word spread about the project.
Decreased costs for overall project delivery	Through cooperation with stakeholder agencies, coordination with ongoing projects and partnerships with the community, the majority of improvements identified were completed without any designated funding.

Decreased time for overall project delivery	Projects delivered within 3 months of study completion due to coordination with repaving schedule
Improved predictability of project delivery	N/A
Improved project scoping	NA
Improved project budgeting	N/A
Increased opportunities for partnering or shared funding or in-kind resources	Increased partnership with community and city to address ongoing maintenance issues.
Improved environmental stewardship	No impacts
Minimized overall impact to human environment	No impacts
Minimized overall impact to natural environment	No impacts
Improved mobility for all users	N/A
Improved walkability	Improved/repaired sidewalk conditions through removal of vegetation, concrete repair; elimination of drainage issues and improved safety through lower operating speeds and introduction of on-street buffer from sidewalk.
Improved bikeability	Existing Bike lane facility extended 1500 feet to connect with cross street facility
Improved safety (vehicles, pedestrians, and bikes)	Improved pedestrian safety through the relocation of transit stops to discourage mid-block crossings and the introduction of the pedestrian buffer.
Improved multi-modal options	Improved walking and biking facilities
Improved speed management	Reduced lane widths reduced speeds on corridor.
Optimized maintenance and operations	NA
Minimized disruption	Night time construction to avoid full closures
Increased risk management and liability protection	NA

The project documentation provided by the study as well as the quick turn around and implementation of the project solutions shows that several benefits were achieved and are readily quantifiable for the project.

- Arnstein comparison

Arnstein Question Part 1	Stakeh.	Team
I am satisfied with the relationship we had with project team	3.0	NA
I am satisfied with the relationship I had with the stakeholders	NA	3.3
I am satisfied with the relationship I had with the interested public	NA	3.0
I am satisfied with the procedures and methods that allowed input to project decisions	3.0	2.7

Note: The project team and stakeholder scores are based on the survey results of a 4.0 scale (4: strongly agree; 3: agree; 2: disagree; and 1: strongly disagree).

This section evaluates the relative view and perceptions between the stakeholders and the team to determine whether both have the same experience and level of satisfaction. The team showed higher levels of satisfaction working with the stakeholders and lower with the public. The stakeholders also showed a high level of satisfaction working with the team.

Arnstein Question Part 2	Stakeh.	Team
My relationship with the project team was best described as	2.0	NA
My relationship with the stakeholders was best described as	NA	3.7
My relationship with the interested public was best described as	NA	2.3

Note: The project team and stakeholder rankings are based on the survey results of a 4.0 scale (4: They allowed us to provide direction; 3: We established a partnership; 2: We established a consultation relationship; and 1: We established an informational relationship).

The question on the level of relationship between team and stakeholders showed again a slightly different perspective. The team members indicated that they viewed that relationship between consultation and partnership, while the stakeholders noted that it was more informative, however, it is noted that overall the stakeholders were satisfied with the methods for input into the process. The difference noted here is similar to what one may expect where team members tend to view things slightly different and more optimistic than the stakeholders.

Overall Level of Success

The project is a successful use of CSS processes. Without the close cooperation of the project team with the stakeholders the project would not have been completed within the limited available time and limited resources. The cooperation between the team and stakeholders allowed for identification of critical problems and the immediate implementation of innovative and cost effective solutions to address them.

FINAL CASE STUDY DOCUMENTATION

Title	Interstate 5 / Bakerview Interchange Project
Location	Bellingham, Washington
Lead Agency	Value Planning Study - Washington DOT (WSDOT) Design & Construction – City of Bellingham
Contact Person	Todd Carlson, Planning and Engineering Services Mgr.
Phase completed	Construction; Project is in operation
Purpose and Need	The purpose of this project was to make better use of existing infrastructure by modifying existing channelization, signal systems, shoulder widths and adding minor improvements to optimize the vehicular and non-motorized elements. The Bakerview Value Planning Study (VPS) will determine the most effective way to improve the Interstate 5 interchange, city streets, and other multimodal facilities needed to improve livability and serve existing and future travel demand for this area. The VPS will: • Address all modes of travel – car, bus, bike and walk. • Review of how planned changes in transportation and land use will affect the corridor, and determine what this information tells us about how to prioritize improvements. • Enhance the understanding of existing operations at the I-5/Bakerview interchange by identifying existing areas of congestion and areas with geometric deficiencies. • Identify improvement options that reduce the societal cost of travel delay. • Develop a practical implementation plan that guides private and public investments at I-5/Bakerview. • Establish multi-jurisdictional partnerships necessary to implement strategic investments in transportation infrastructure.

CSS Qualities

- Project Team (make up)

Discipline	Roles & Responsibilities
Project manager	- Develop and manage scope, schedule and budget; - Lead communications between project team and management team; - Lead quality assurance
WSDOT Planning	- Lead public involvement process - Coordinate with federal and local elected officials - Lead evaluation and prioritization of improvement options - Lead analysis of risks, needs and opportunities - Lead development of planning-level cost estimates and pre-design level cost estimates - Lead development of text and graphics for final report
WSDOT Traffic	- Contribute to analysis of risks, needs and opportunities - Contribute to development of improvement options - Contribute to planning-level cost estimates and pre-design level cost estimates - Contribute to evaluation of improvement options - Contribute to text and graphics for final report
WSDOT Program Management	- Contribute to analysis of risks, needs and opportunities - Contribute to development of improvement options - Contribute to planning-level cost estimates and pre-design level cost estimates
WSDOT Design	- Contribute to analysis of risks, needs and opportunities - Contribute to planning-level cost estimates and pre-design level cost estimates
WSDOT Construction	- Provide construction review on improvement options - Contribute to analysis of risks, needs and opportunities
WSDOT Communications	Provide input at key project milestones
WSDOT Management Team	Provide input at key project milestones

- Stakeholders (make up, utilization, interaction)

  - Port of Bellingham/Bellingham International Airport - financial support
  - Whatcom Transit Authority - Transit ridership current and forecasted
  - Economic Development Association - Employment and tax revenue input to B/C process.
  - Lummi Nation – financial support
  - City of Ferndale – minimal
  - Non-motorized transportation interests – non-motorized plan coordination
  - Freight interests – auto turns analysis for all permitted carriers

- Neighborhood representatives – connection to neighborhood plans
- Chamber of Commerce – support
- Building Industry Association of Washington - support
- City of Bellingham elected officials – support/ city perspective and ultimate funding coordinator for design/construction of the project
- Whatcom County elected officials - support
- Whatcom Council of Governments policy board- support
- State patrol - support
- WSDOT Area 1 Maintenance – On the ground knowledge
- WCOG MPO/RTPO staff - Transportation modeling
- City of Bellingham Agency staff – signal engineering support
- Whatcom County agency staff – support for unincorporated area

♦ Public involvement (types, documentation)

Per the scope of work, we will work closely with our partners through three team workshops. The agenda for the first workshop includes time for stakeholder identification.

We'll contact stakeholders at two points during the process – once after we've evaluated improvement options and have a recommended improvement strategy (workshop 2); and again after we've completed the draft final report. Those communications will be accomplished with a phone call, one-page brochure or brief email newsletter/update. We may wish to contact the Bellingham Herald at key points in the process in the event they'd like to provide more information about the project on the blog.

Activity/ tool	**Description**
Briefing paper	This is a one-page (front and back) handout that will be updated to coincide with major project milestones. It will be distributed at the working group meetings, local agency workshops, targeted briefings, and as requested by members of the public. It will also be posted on the project website. Content will include purpose of the project; our partners; milestones and dates; anticipated outcomes.
Comment spreadsheet	We will track contacts and comments pertaining to the project, including name, contact info, comment and response.
Folio / "One-page glossy"	We'll develop a folio at the end of the project that will double as an executive summary.
Project website	A brief description of the project, the briefing paper and contact information will be available on the planning section of the MBA website.
Project workshops	The project team will meet with a small working group that includes city, county and WCOG. There will be three workshops during the course of the project.
Project update	A brief project update for interested audiences. May include a short email with a link to additional information. Might also include a phone call to a few individuals.
Briefings	The project team will provide briefings to WCOG TTAC, city council and MPO policy board at the end of the project to share key findings.

♦ Design solution (process, modes and alternatives examined).

Resources and Guiding Documents

- City of Bellingham Comprehensive Plan
- Whatcom County Comprehensive Plan
- WCOG Regional Transportation Plan
- Bellingham International Airport Master Plan
- Hidden Trails Traffic Impact Analysis
- Washington Transportation Plan
- WSDOT Highway System Plan
- WSDOT Moving Washington program materials
- WSDOT Reader-friendly Guidelines
- WSDOT Style Guide
- WSDOT Planning Guidelines

The VPS project team identified several improvement options (presumably lower-cost than the single-point urban interchange recommended in the Interstate 5 Master Plan) that may provide interim relief for the safety and congestion needs at the I-5/Bakerview Interchange. Our evaluation, described in greater detail in the summary report, included identification of risks and opportunities, a preliminary cost estimate, and a traffic analysis that compared each improvement option with projected no-build conditions in 2030. The options we evaluated are as follows:

1. Re-channelize Bakerview Road
2. New northbound on-ramp
3. Roundabouts
4. Additional lane over I-5
5. Re-align Pacific Highway to tie into Bakerview Road/I-5 northbound off-ramp
6. Diverging Diamond Interchange

Key findings:

- The two improvement options that increase capacity on the bridge over I-5 provide the greatest reduction in queues and delay on Bakerview.
- The effectiveness of roundabouts are limited by two key factors:
    - The high number of left turns at the Bakerview/I-5 southbound off-ramp/I-5 northbound on-ramp/Maplewood intersection
    - The close proximity of intersections in the corridor.
- The intersection of Bakerview and Pacific Highway shows a poor level of service in the no-build scenario as well as with each of the improvement options. However, it is important to note that the poor level-of-service is driven entirely by the few vehicles making the left turn from Pacific Highway onto Bakerview. Through traffic on Bakerview operates very well.
- Re-channelization of the bridge to four lanes (Option 1) appears to provide a great deal of benefit, addressing bottlenecks causing delays for westbound traffic. The addition of a new northbound on-ramp (Option 2) further reduces delays and queues, while the addition of a fifth lane on the bridge (Option 4) resolves the remaining bottlenecks causing delays for eastbound traffic. The question is whether the incremental benefit provided by options 2 and 4 are justified by the additional expense of constructing those

improvements. We will investigate that in the next phase of the VPS as we develop our recommendations and implementation plan.

- CSS concepts by phase

  The Value Planning Study process had 8 phases with 4 workshops:

  - Introduction
  - Corridor profile
  - Corridor needs, opportunities and risks
  - Evaluating the options
  - Recommendations
  - Corridor pre-design
  - Implementation strategy
  - Conclusion

  Each of these phases was conducted through interdisciplinary teams. At the conclusion of the VPS, the city of Bellingham and their consultant team implemented the findings of the VPS at a more detail design level. However, the decision made within the multidisciplinary VPS team held through design and construction. Only specific additional detail was added; for example the decision to use or not use impervious concrete for the bridge sidewalk and the need for a storm water vault

- Lessons learned

  - There is a lower-cost option. We can add a turn lane to the northbound on-ramp, do minor widening and complete other minor improvements to address bottlenecks and relieve congestion.
  - The fix isn't cheap – our estimate is $2.8 million – but seems very affordable when compared to the long-term plan of re-building the interchange. This lower-cost improvement can be broken down into even more affordable phases.

CSS Principles

CSS Principle	Project Team
Use of interdisciplinary teams	2.6
Involve stakeholders	2.4
Seek broad-based public involvement	1.7
Use full range of communication methods	2.0
Achieve consensus on purpose and need	2.4
Utilize full range of design choices	2.3
Address alternatives and all modes	2.7
Maintain environmental harmony	2.7
Address community & social issues	2.7
Address aesthetic treatments & enhancements	2.5
Consider a safe facility for users & community	1.8
Document project decisions	2.7
Track and meet all commitments	2.6
Create a lasting value for the community	2.3
Use all resources effectively (time & budget)	2.7

Note: The project team and stakeholder scores are based on the survey results of a 4.0 scale (4: strongly agree; 3: agree; 2: disagree; and 1: strongly disagree).

- Project team's perspective

  There were 7 respondents that were considered as team members, including the responses of the person identified as the team leader. The project team indicated that in general all principles were marginally addressed, since all had a score greater than 2.0 (i.e. agreed that at least the principle was there). The principles with the lowest scores were "Seek broad-based public involvement" (1.7) and "Consider a safe facility for all users and community" (1.8)

  The project included an interdisciplinary team that covered all anticipated (required) areas and it seemed to have worked well. The responses received came from team members who identified themselves as design engineers, planners, community planners, construction engineers, and project managers. All were involved in the planning phase of the project and several were involved in the design phase of the project and construction as well. There were one member that was involved in all phases of the project. All respondents were new to CSS with 0-3 years of experience. Finally, most team members had more than 10 years of relevant experience.

As noted above, there were three principles that had a low score (less than 2.0) that indicates that these principles were “barely” applied. A further review of the comments provided by the team members that scored these principles with the low score did not provide any additional information to clarify the reasons for their low score. On the issue of not providing a safe facility for all users, no additional insight could be provided, since there were no comments provided by the team members that could clarify this issue.

CSS Benefits

CSS Benefit	Measured	
	Stakeh.	Team
Improved stakeholder/public feedback	NA	3.0
Increased stakeholder/public participation compared to other projects	NA	3.3
Increased stakeholder/public participation	2.5	2.7
Increased stakeholder/public ownership	3.0	3.3
Increased stakeholder/public trust	3.5	3.6
Decreased costs for overall project delivery	NA	3.2
Decreased time for overall project delivery	3.5	3.0
Improved predictability of project delivery	3.5	3.7
Improved project scoping	NA	3.8
Improved project budgeting	NA	3.8
Increased opportunities for partnering or shared funding or in-kind resources	3.3	3.8
Improved opportunities for joint use and development	3.0	3.5
Improved sustainable decisions and investments	NA	3.2
Improved environmental stewardship	NA	3.2
Minimized overall impact to human environment	3.0	3.5
Minimized overall impact to natural environment	3.3	3.3
Improved mobility for all users	3.3	3.8
Improved walkability	3.5	3.5
Improved bikeability	3.0	3.2
Improved safety (vehicles, pedestrians, and bikes)	3.0	3.5
Improved multi-modal options	3.0	3.2
Improved community satisfaction	2.8	3.8
Improved quality of life for community	2.8	3.8

Improved speed management	2.8	3.4
Design features appropriate to context	3.5	3.7
Optimized maintenance and operations	NA	3.5
Minimized disruption	3.0	3.4
Increased risk management and liability protection	NA	2.8
Fit with local government land use plan	3.5	4.0

- Semi-Quantitative Benefits

  Overall, both stakeholders and team members indicated that several benefits materialized as a result of the process followed. Almost all benefits have a score greater than 3.0 indicating that the survey participants at least agree that the benefit was achieved. Benefits that had high scores (equal or greater than 3.7, indicating that most of the participants strongly agree) include “Improved predictability of project delivery”, “Improved project scoping”, “Improved project budgeting”, “Improved community satisfaction”, “Improved quality of life”, “Design features appropriate to context”, and “Fit with local government land use plan”. These benefits indicate that the project resulted in a better environment for the community and there is an agreement between team members and stakeholders on these issues.

  There are a few benefits that had a score below 3.0 that indicate that the respondents believe that the benefit was marginally materialized. These include “Increased stakeholder/public participation” and “Increased risk management and liability protection”, These answers indicate that some of the principles may not be fully incorporated and similar answers were noted in the evaluation of the principle application by the team.

  An apparent trend of the benefits materialized is the consistent difference between the perspective of the team and the stakeholders, where for all common benefits the team scored them higher. In general, these differences are not large and it may be attributed to the fact that there were only two stakeholders that completed the survey. Therefore, any comparisons could be conducted cautiously.

- Quantitative Benefits

  In addition to the semi-quantitative scores obtained above, the following quantitative metrics were obtained for some of the benefits.

CSS Benefit	Metrics
Increased stakeholder/public participation	NA
Decreased costs for overall project delivery	NA
Decreased time for overall project delivery	NA
Improved predictability of project delivery	Project delivered on time within a tight schedule
Improved project scoping	NA
Improved project budgeting	NA

Increased opportunities for partnering or shared funding or in-kind resources	Increased impervious surface required mitigation – considered pervious concrete but needed to build storm water vault
Improved environmental stewardship	Enhanced buffer area
Minimized overall impact to human environment	No impacts
Minimized overall impact to natural environment	No impacts
Improved mobility for all users	Added sidewalks, added bike lanes on shoulder,
Improved walkability	Added sidewalks
Improved bikeability	Added bike lane
Improved safety (vehicles, pedestrians, and bikes)	NA
Improved multi-modal options	Improved walking and biking facilities
Improved speed management	Speed reduced to 35 mph
Optimized maintenance and operations	NA
Minimized disruption	Night time construction to avoid full closures
Increased risk management and liability protection	NA

The data indicate that there were improvements for pedestrians and bicyclists as a result of the project. Even though there is quantifiable amount for the benefit of nighttime construction, the minimal disruption resulted from this construction approach was greatly appreciated by the stakeholders. The project was completed within a constrained time and there were no change orders and scope changes submitted for the project indicating that the budgeting and scoping of the project was appropriate. Therefore, the perceived notion of longer time and higher costs is not supported by the available data.

- Arnstein comparison

Arnstein Question Part 1	Stakeh.	Team
I am satisfied with the relationship we had with project team	3.0	NA
I am satisfied with the relationship I had with the stakeholders	NA	3.7
I am satisfied with the relationship I had with the interested public	NA	2.3
I am satisfied with the procedures and methods that allowed input to project decisions	3.0	2.7

Note: The project team and stakeholder scores are based on the survey results of a 4.0 scale (4: strongly agree; 3: agree; 2: disagree; and 1: strongly disagree).

This section evaluates the relative view and perceptions between the stakeholders and the team to determine whether both have the same experience and level of satisfaction. The team

showed higher levels of satisfaction working with the stakeholders and lower with the public. The stakeholders also showed a high level of satisfaction working with the team.

Arnstein Question Part 2	Stakeh.	Team
My relationship with the project team was best described as	2.8	NA
My relationship with the stakeholders was best described as	NA	2.5
My relationship with the interested public was best described as	NA	2.2

Note: The project team and stakeholder rankings are based on the survey results of a 4.0 scale (4: They allowed us to provide direction; 3: We established a partnership; 2: We established a consultation relationship; and 1: We established an informational relationship).

The question on the level of relationship between team and stakeholders showed again a slightly different perspective. The team members indicated that they viewed that relationship between consultation and partnership, while the stakeholders noted that it was more a partnership. The difference noted here is similar to what one may expect where team members tend to view things slightly different and more optimistic than the stakeholders.

Overall Level of Success

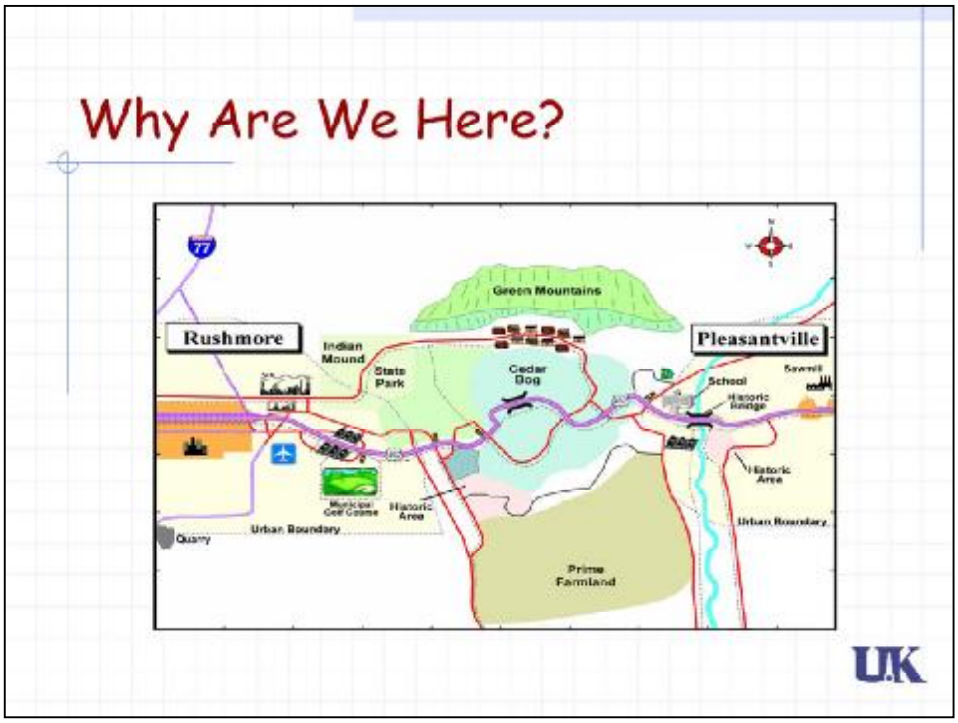
The project is a successful use of CSS processes. Without the close cooperation of the project team with the stakeholders the project would not have been completed within the limited available time. The cooperation between the team and stakeholders allowed for an appropriate solution without having to rebuild the interchange.

APPENDIX C

Workshop Presentations

Demonstrating benefits of context sensitive solutions (CSS) is of significant value to transportation agencies and stakeholders involved in project delivery. Benefit quantification allows agencies to determine the effectiveness of their efforts for a specific project and apply lessons learned to improve actions for future projects. Previous research and evaluation of CSS up to this point have not directly linked the project actions to outcomes and related benefits.

This presentation provides results from research that created a practical set of guidelines for use in assessing the benefits of CSS actions. The “Why, What, How and When” of benefit quantification will be addressed and explained. The process allows for continuous quality improvement that could be used to improve project delivery and apply agency resources more effectively. The workshop provides hands on experience in working the issues to be presented through a comprehensive case study. This allow for demonstrating concepts and applying the process presented.

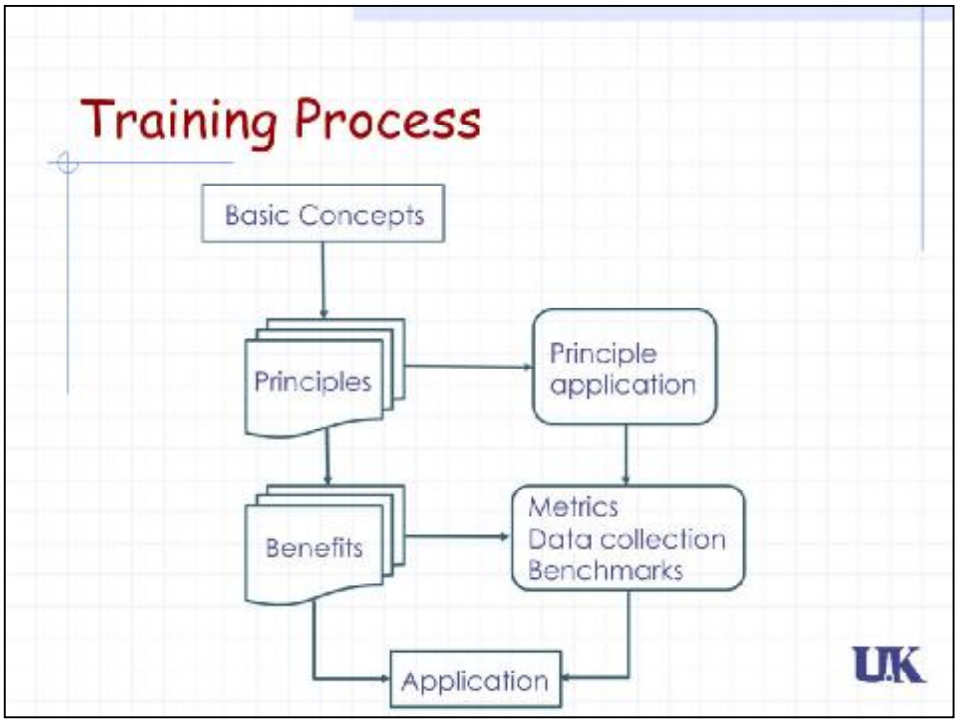


The case study to be used here is centered around the widening and realignment of US 462 in Happi County as was noted in the state's current six-year highway facilities improvement plan. The section of US 462 is a 10-mile segment between Rushmore and Pleasantville with a projected ADT of 20,000 vehicles per day.

Although only in its early stage of planning (funding availability was just announced), the project is already generating controversy and opposition. Critics of road construction express concern for the integrity and esthetic appeal of the region's rural character. Many opponents of the project attended the first meeting to study feasibility. So the press is closely following the controversy. For their part, supporters of the project point to the greater transportation needs arising from the economic growth and dynamism of the region. In addition, supporters, as well as, the Department of Highways are concerned about the potential safety and capacity shortcomings of not constructing a roadway as some roadway opponents demand. The Department of Highways is now in the middle of the debate between the contending parties. The search for consensus will undoubtedly call for much flexibility in the process.

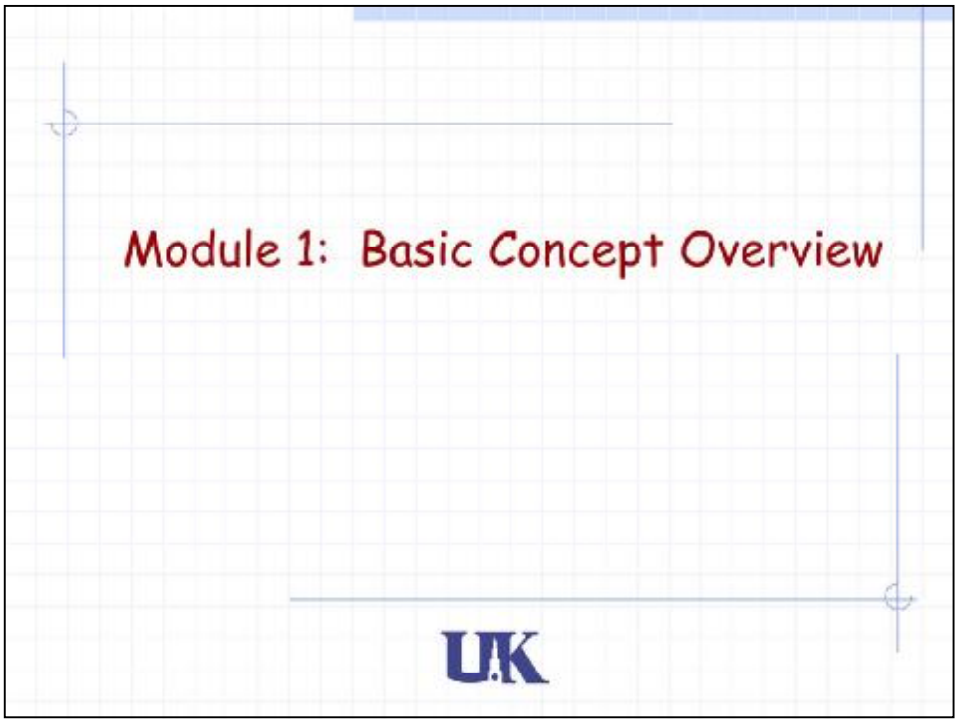
Major goals set for this project are the following:

- Quantify benefits;
- Justify expenses (team vs DOT);
- Define approach to be taken (principles, actions benefits)

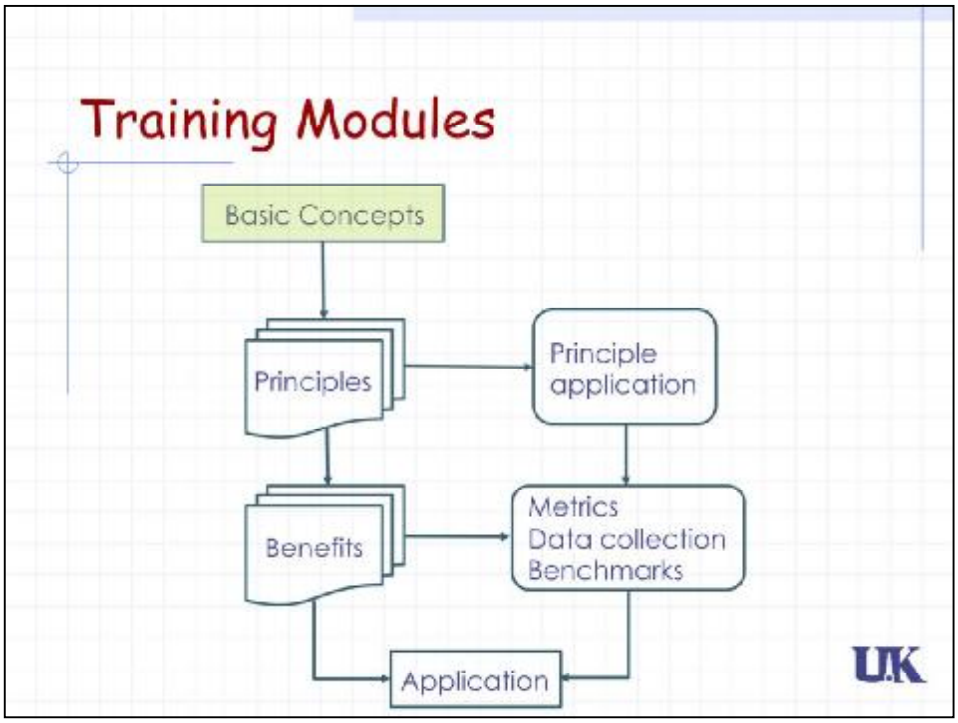


This diagram outlines the four modules of this training program. The first section introduces basic concepts and uses of benefit evaluation and the CSS approach in general terms. The following section goes into detail on how to apply CSS principles in order to direct the project approach and obtain desired outcomes. The next section discusses the benefits that can be gained through CSS application and how to set up an evaluation process to measure and monitor those benefits. The final module of the training to be completed at the end of the day will discuss how the evaluation will be applied. After each module, we will refer to an example of a composite case study that provides the opportunity to practice the concepts presented.

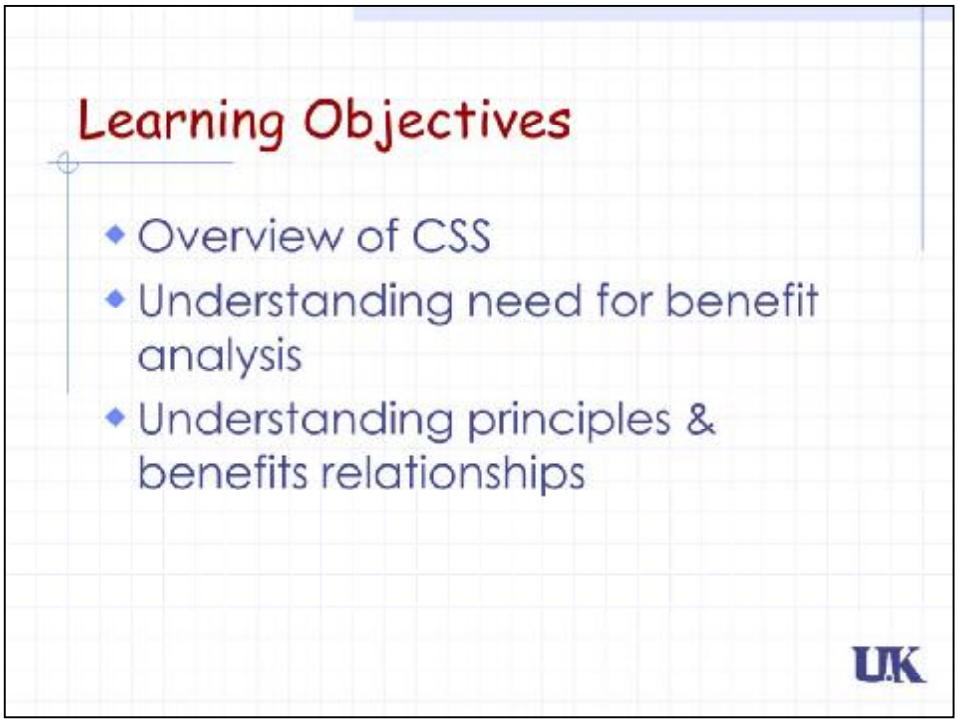
It is important to emphasize that there is a need to conduct such evaluations, since it provides the foundation for an agency to justify their actions and support their decisions. Such an approach will also allow for demonstrating the need for a systematic data collection and evaluation in order to improve agency resources. One should only consider projects that were stopped or went wrong to understand that we need to figure out a way that will allow us to avoid such errors and define a process to improve in the future.



Module 1 introduces basic concepts and uses of benefit evaluation and the CSS approach in general terms.



This module presents some of the basic concepts of the benefit quantification process and its uses. We will provide an overview of how the process will be used and the CSS principles interact to achieve the benefits or project outcomes. These components will be examined in detail in the following modules 2, 3, and 4.



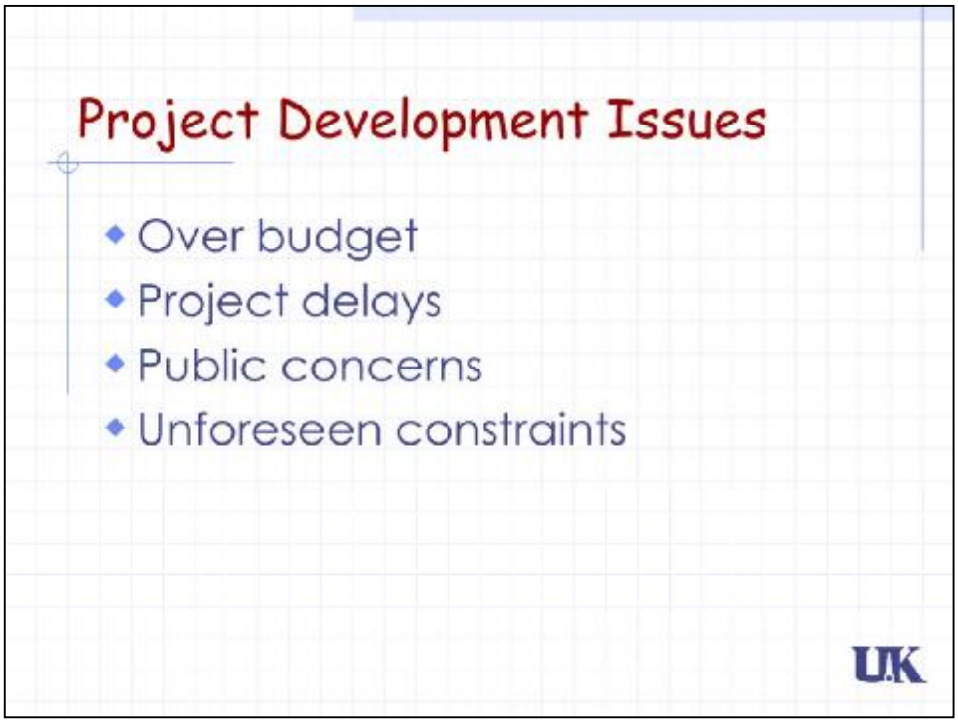
The objective of this module is to present the development of a process for quantifying benefits of the CSS process. A brief overview of the CSS process is first presented. Basic concepts on principles and benefits as they relate to the CSS process are presented and discussed. The linkage between principles and benefits, along with the metrics to be used to measure the magnitude of the benefits is introduced. In addition, the application process of the recommended guidelines to systematically quantify benefits is introduced. The use of the approach is outlined and the process required for implementing it is discussed.

At the end of this presentation a participant should be able to:

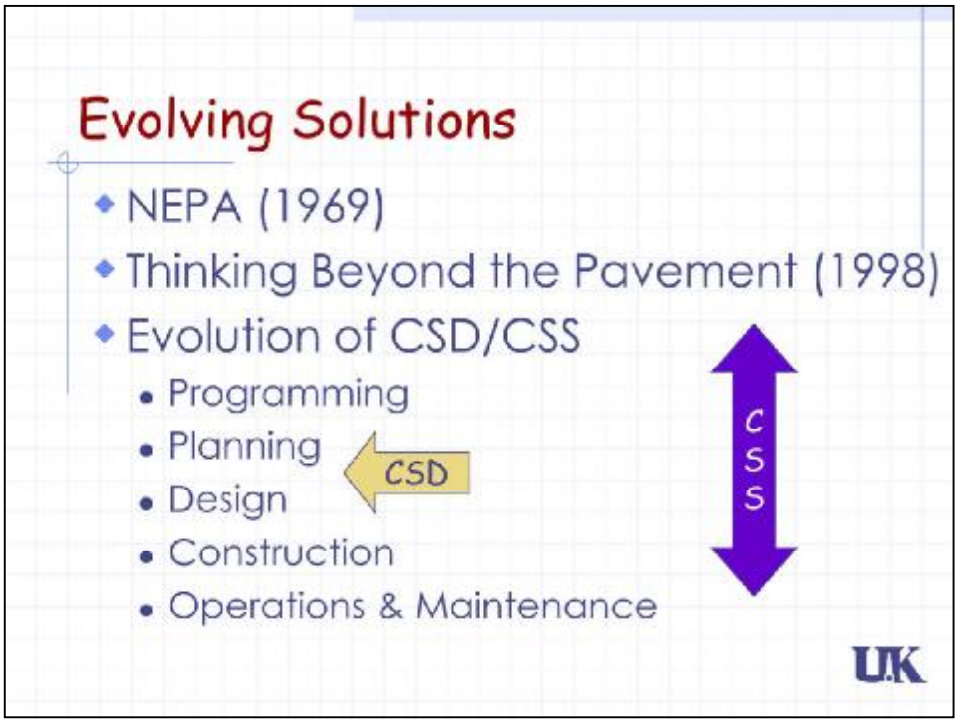
Understand the CSS principles, benefits and their interactions.

Comprehend how the benefit analysis may be used to assist in project delivery.

What are the typical issues you have during the projects development process? Take a minute to identify them and write them below.



Projects frequently must address issues that emerged during the various phases of the project development from stakeholders or having to rework project elements to address public concerns. Public concerns can result in significant delays, especially if decisions are challenged in court. Finally, lack of cooperation with stakeholders and public will result in unforeseen problems that will require additional resources (time, money and expertise) to be addressed. These issues often result in time delays and budget overruns holding up the project development process.



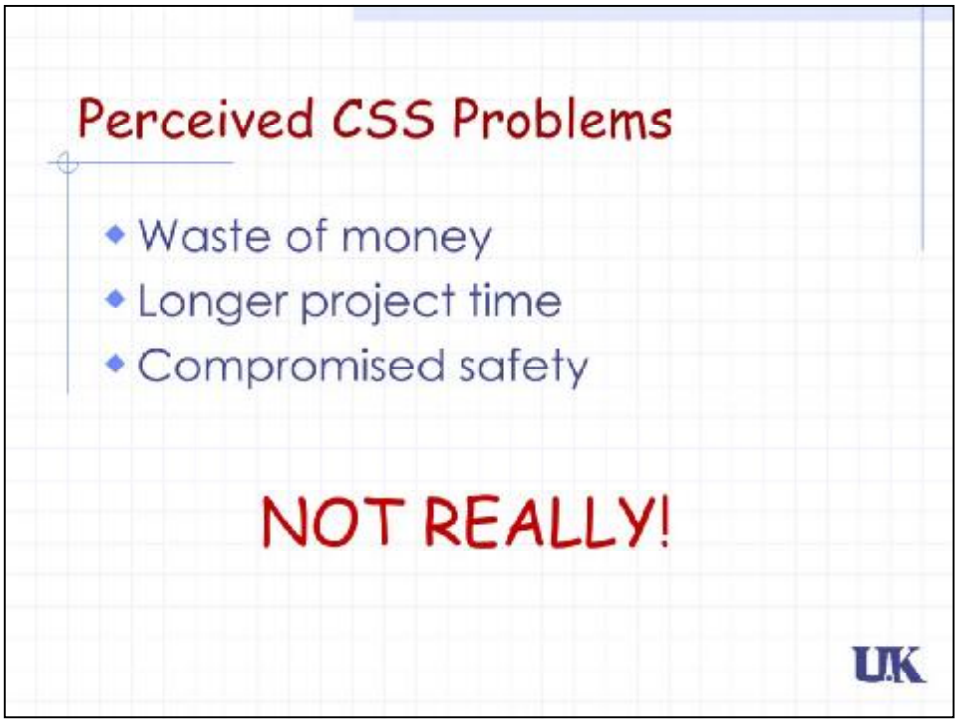
These issues were initially addressed by the National Environmental Policy Act of 1969 that was passed by Congress to regulate the environmental/community impacts of Federal actions.

In 1998, “Thinking Beyond the Pavement” workshop was held in Baltimore, MD sponsored by the Maryland DOT, the FHWA and AASHTO. The objective of that workshop was to bring together all of the beneficial practices employed by transportation agencies to make transportation projects fit better into communities and the natural environment.

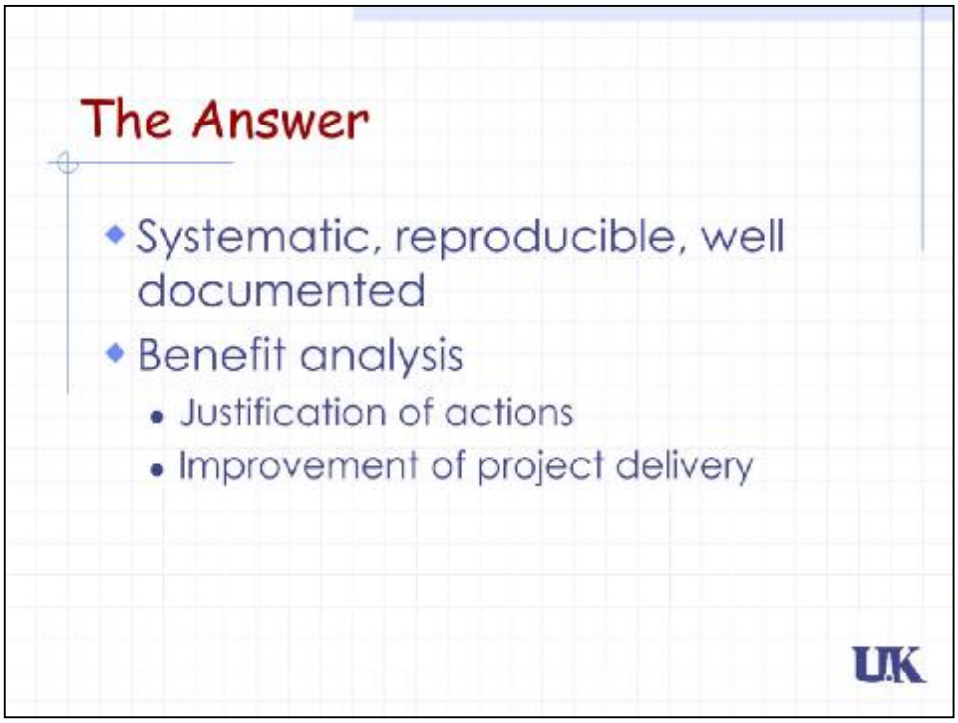
CSD grew out of the 1998 Conference in Maryland. The then-current focus was related to PD actions in Planning and Design in an effort to promote projects that were acceptable to the public and resource agencies focusing on public involvement and flexible design .

In the early 2000s, the term Context Sensitive Design began to be commonly replaced with a new one-Context Sensitive Solutions. The reasoning for this change was that the original parties that had coined “Context Sensitive Design” were focused on the early phases of project development (i.e. planning and design) and that other context sensitive activities occurred within the project development process that were vital and needed to be recognized. Context Sensitive Solutions was termed to address that perceived shortcoming. The current FHWA definition of CSS is: *Context sensitive solutions* (CSS)— is a collaborative, interdisciplinary approach that involves all stakeholders to develop a transportation facility that fits its physical setting preserves scenic, aesthetic, historic and environmental resources while maintaining safety and mobility. CSS considers the total context within which a transportation improvement project will exist.

The basic concept for the Context Sensitive Solutions is to develop a project that balances the mobility, safety, environmental, and social needs. Its goal is to achieve a project development process that provides an outcome harmonizing transportation requirements with community needs and values. The solution to be developed will address the agency expectations for deliver an on-time and within budget project along with the stakeholders expectations of addressing natural and human environment and community expectations of delivering a project that will improve the quality of life.

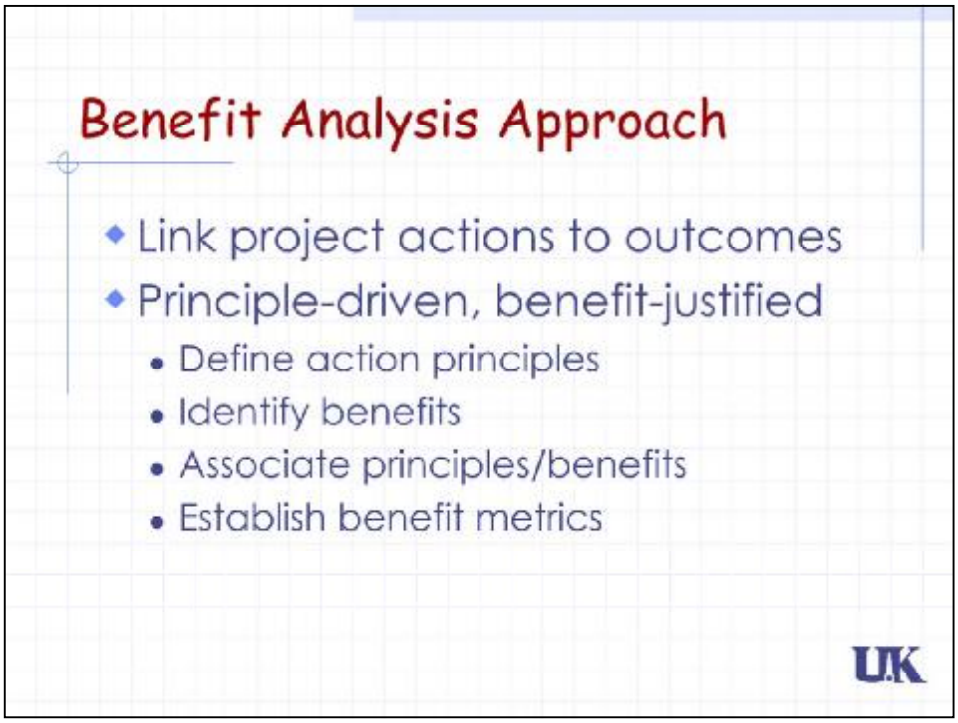


Efforts to apply the CSS process have been viewed negatively by some transportation agencies. Typical concerns are stated as a waste of money to include features that either are more expensive or unnecessary, the project takes longer to complete in order to accommodate more public involvement, and safety is compromised with the use of reduced standards or placement of obstacles (trees) in medians. However, these are often more of a perception than a reality based on anecdotal testimonies. For example, the project leader of sidewalk replacement project that used CSS in Georgetown, Washington DC stated that "working closely with stakeholders (utilities) and community (businesses) we were able to compress 15 years of construction work to four." Similarly, the project leader for the reconstruction of 12300 South in Draper and Riverton, UT stated that "the involvement of the community was instrumental in incorporating all landscape and aesthetic treatments that highlighted the natural, historical, and present characteristics of the cities of Draper and Riverton while achieving the safety and project delivery time targets."

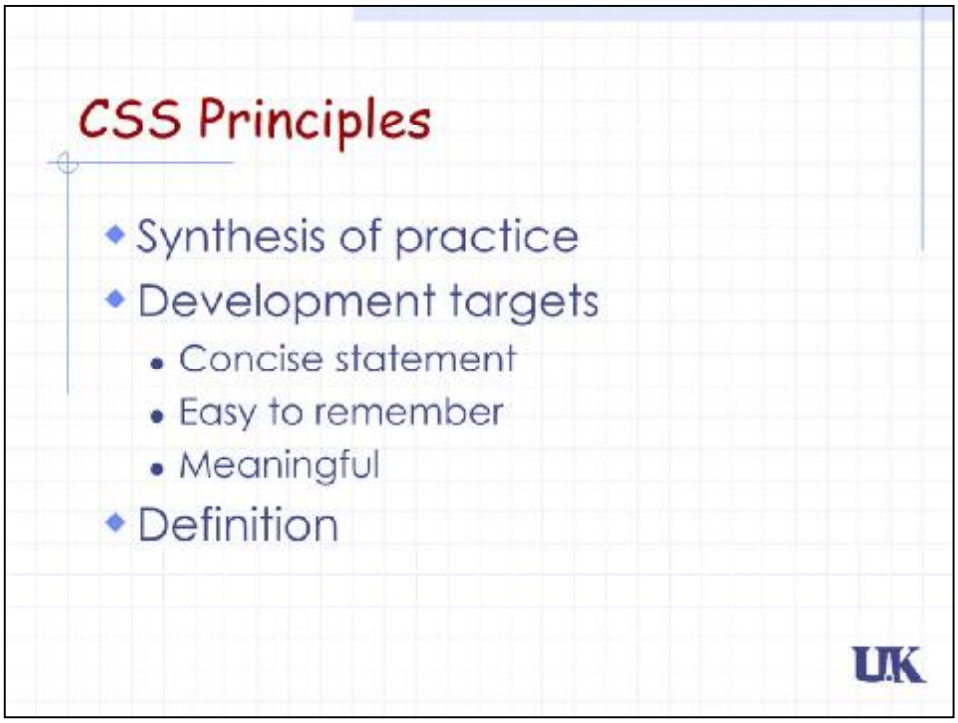


Even though anecdotal comments refute the perceived problems, they are not systematically measured and are not clearly documented. There is a need to document such results and outcomes in order to provide a basis for properly evaluating project outcomes from the CSS process. The process developed here allows for such systematic evaluation of the benefits through a reproducible process with the use of measured outcomes. The process allows for a well documented approach that could provide the support for any decisions made as well as allow for future improvements.

The benefit analysis process presented here is used to either justify actions for a project or provide benchmarks for improving project delivery. The approach allows project teams to measure outcomes and determine the effectiveness of their actions on a specific project. At the same time, these outcomes can serve as the benchmark for improving project delivery in future projects. The measured benefits can also be used agency wide for justifying the CSS process and improvement the project delivery process.

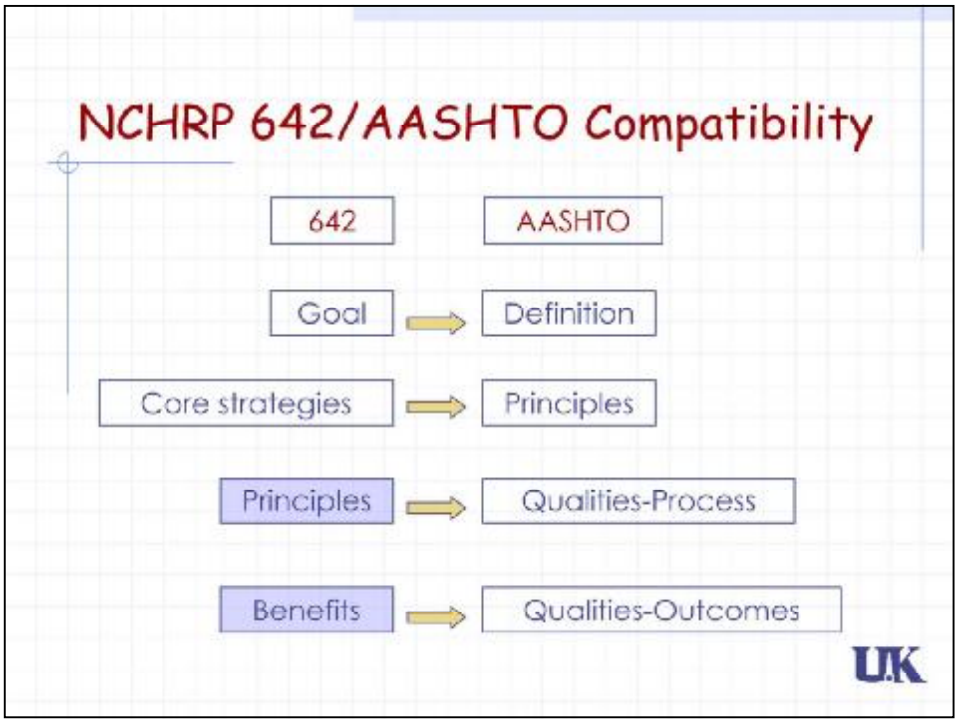


The approach developed here links project specific actions to measured outcomes that are used in evaluating the project approach and assist in improving the process. Central to this benefit analysis approach is the understanding and use of CSS principles that guide projects. Once these principles are identified, associated benefits from their application can be identified and measured to quantify the effect of these actions for the agency and the community. CSS is a principle-driven, benefit-justified effort that can enhance an agency's goals and interaction with stakeholders and the public. In this process, the application intensity of each principle using the project attributes (scope, scale and context) is first defined. Benefits are selected to be measured and are associated to the principles in order to allow for determining the extent of the principle effect on each benefit. Finally, the measures to be used (quantitative and/or semi-quantitative) are defined.



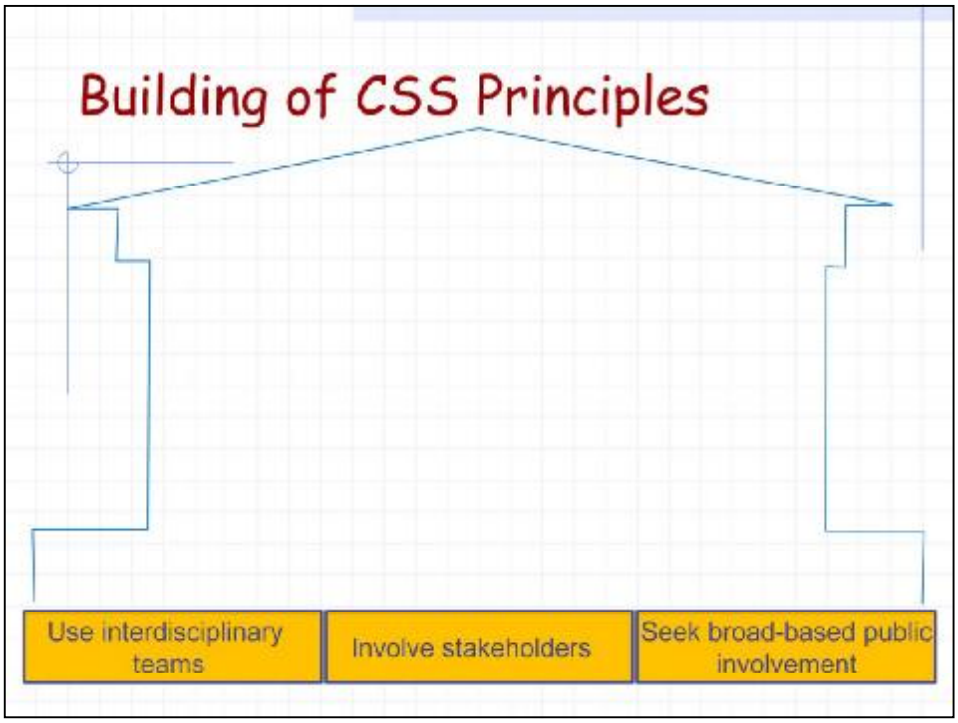
A fundamental component of the research to quantify benefits was the identification of CSS principles. Previous documented work related to principles was reviewed and considered in combination with specific targets, or criteria that would render usable applicable, and understandable principles. Significant effort was also devoted to the task of defining principles.

The project development process was reviewed and associated actions were identified that could be considered the corner stone for the activities to be completed in each phase. These actions include the identification of the appropriate project players including the team members to participate in the project development and the stakeholders that could have an influence on the project, the definition of the process to be followed for the project development, the goals to be achieved through this process as a result of the process, and the actions required to assure that the project was a success.



It was considered critical to the acceptance and implementation of this process being developed as part of the NCHRP 642 report that linkage to the AASHTO approach be established. Compatibility and linkage between the two concepts is shown here. The principles and the benefits are the focal point of this training and guidelines as the specifications of this relationship is what allows for the quantification of the benefits of CSS actions.

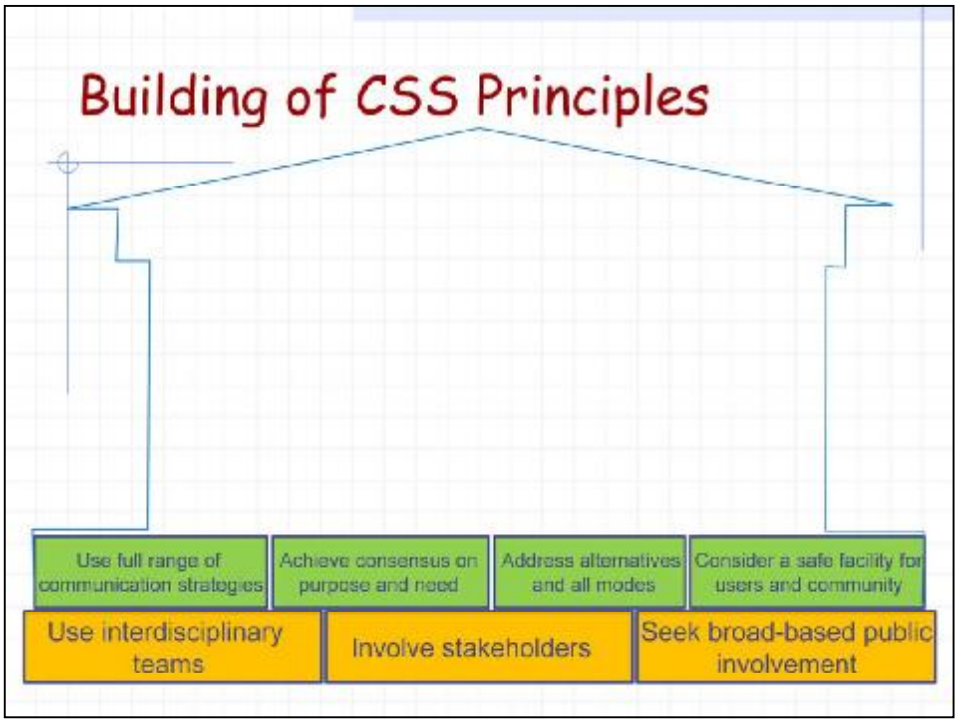
The AASHTO approach is described in the Summary Report of the Joint AASHTO/FHWA Context Sensitive Solutions Strategic Planning Process and is available at http://environment.transportation.org/environmental_issues/context_sens_sol/



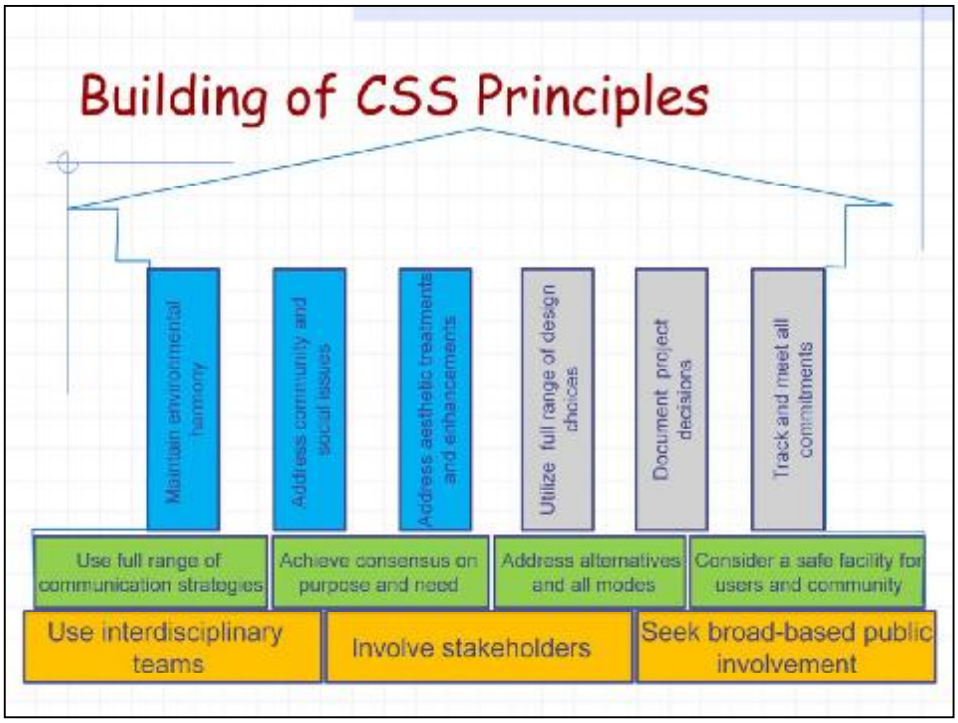
Fifteen principles necessary for a successful CSS project were identified from the project development/delivery process. These principles build upon each other and have cause and effect relationships. Understanding the principles and their interaction promotes knowledge of CSS fundamentals and process relations, thus furthering comprehension of how CSS projects are developed.

A representation of these relationships is provided in here to show the dependencies among principles as a building.

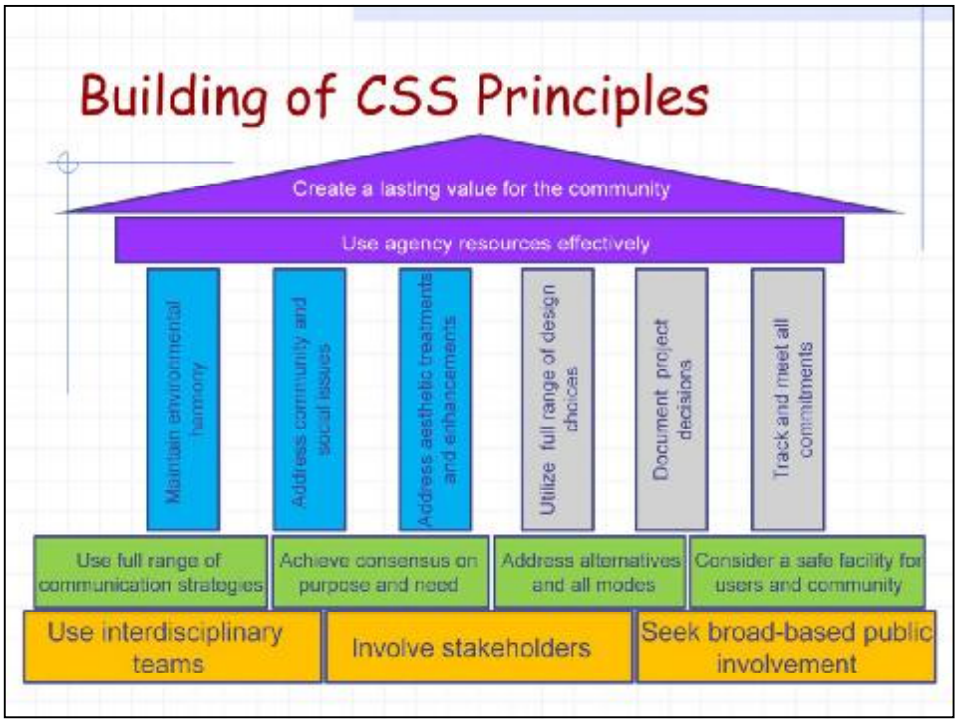
Gold: are the three fundamental principles that ground a CSS project initiative… they are absolutely necessary, but not sufficient for success. They represent the foundation for successful CSS projects. Without their application we get traditional projects or projects that actually get bogged down or even get stopped. When the movement referred to as Thinking Beyond the Pavement got started, these principles were foremost in the minds of those desiring to improve the project development process, gain the trust of the public and be better stewards of the environment.



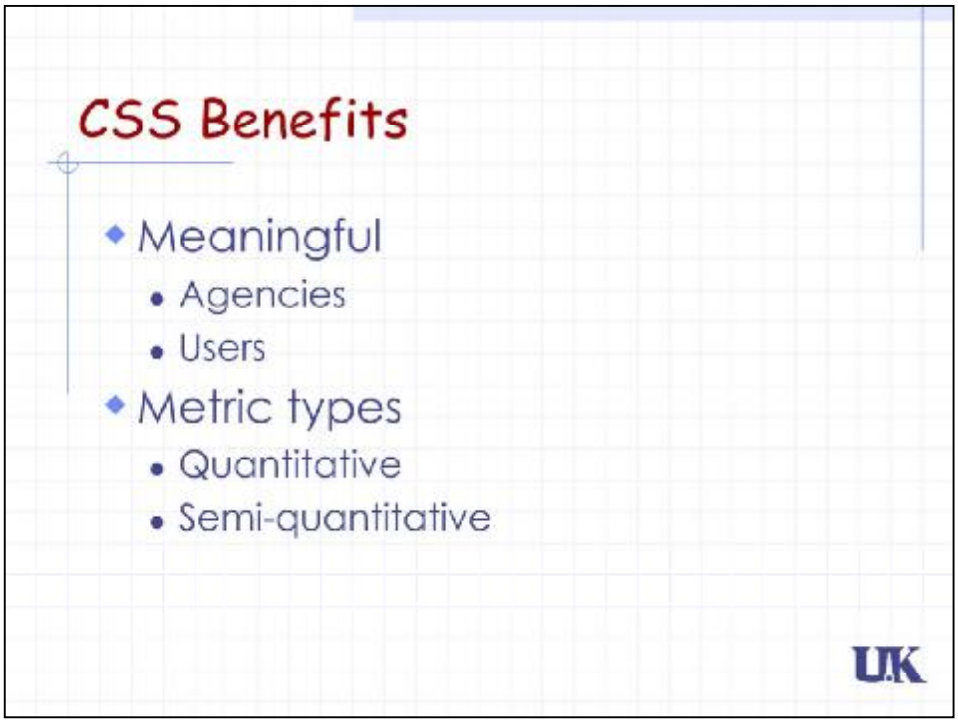
Green: are the four basic principles that are at the heart of the focused activity carried out by the project's professionals while being informed and guided by all stakeholders. These principles should be utilized for all projects regardless of whether CSS is applied. Moreover, these principles will allow for a timely completion of the project and avoidance of potential stops.



Blue and Gray: are the six enabling principles -- those things that are guided by the project's environmental setting (blue) and the project's administration or agency process management (gray). The "blue" principles allow for achieving and creating a lasting value for the community and enable the project team to reach these goals. The "gray" principles allow the team to manage and use the agency's resources effectively including the required management and administration project responsibilities of the agency.



Purple: are the top two principles -- the ultimate focus or goals of the project development process using CSS – representing expectations for agency and community.

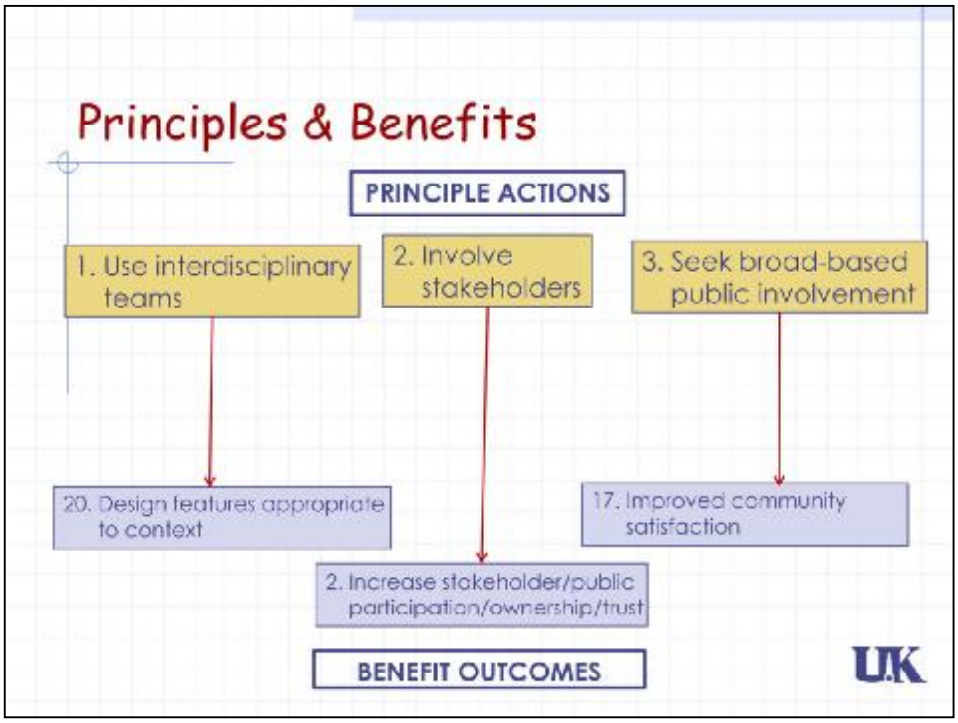


Benefits are desirable outcomes of the project development process. The benefits are grouped in two basic categories based on who accrues the benefits, i.e. the agency or the users. Some of the benefits are internal to the agency's operations and have no clearly understood benefit to the users.

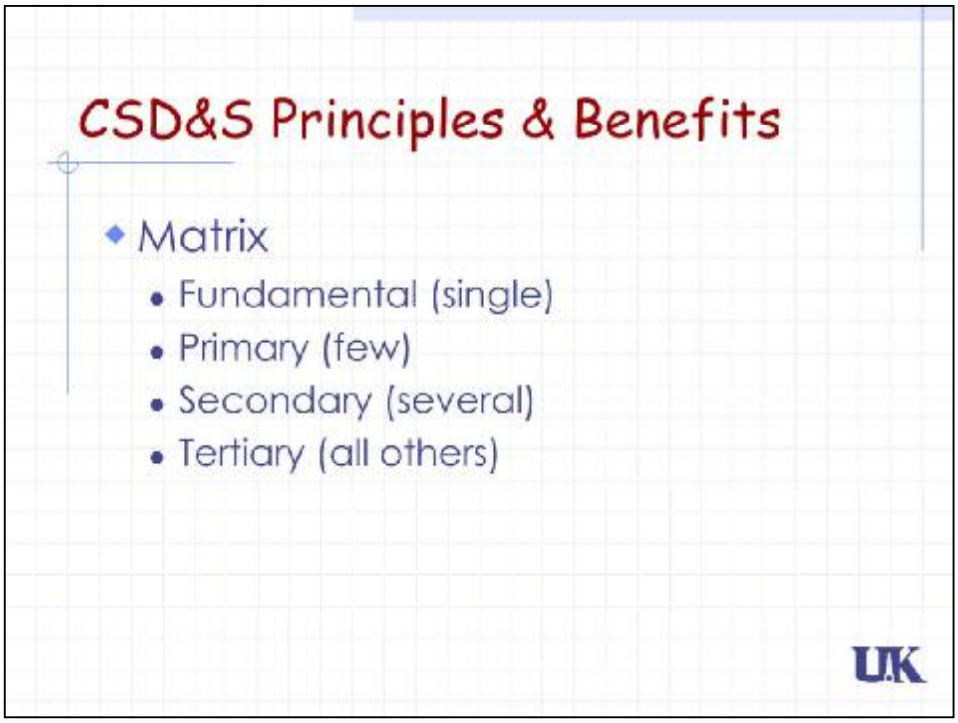
Indicators were defined to provide the basis for understanding the data to be collected and measured. Quantitative and semi-quantitative indicators were developed to capture and measure the impact of each benefit. These metric indicators are summarized and their associated tools for collecting the data are provided in the Guidelines.

These are 11 benefits identified to apply to the agency. Most are associated with project budget, schedule, and performance. Others such as improved stakeholder/public feedback identify ways to improve community satisfaction for the project or identify alternative resources for enhancements through increased partnering opportunities.

These are 11 benefits identified to apply to the user. Most of these are associated with project mobility options, safety, and minimized impact. All of these benefits contribute to the community satisfaction and livability.



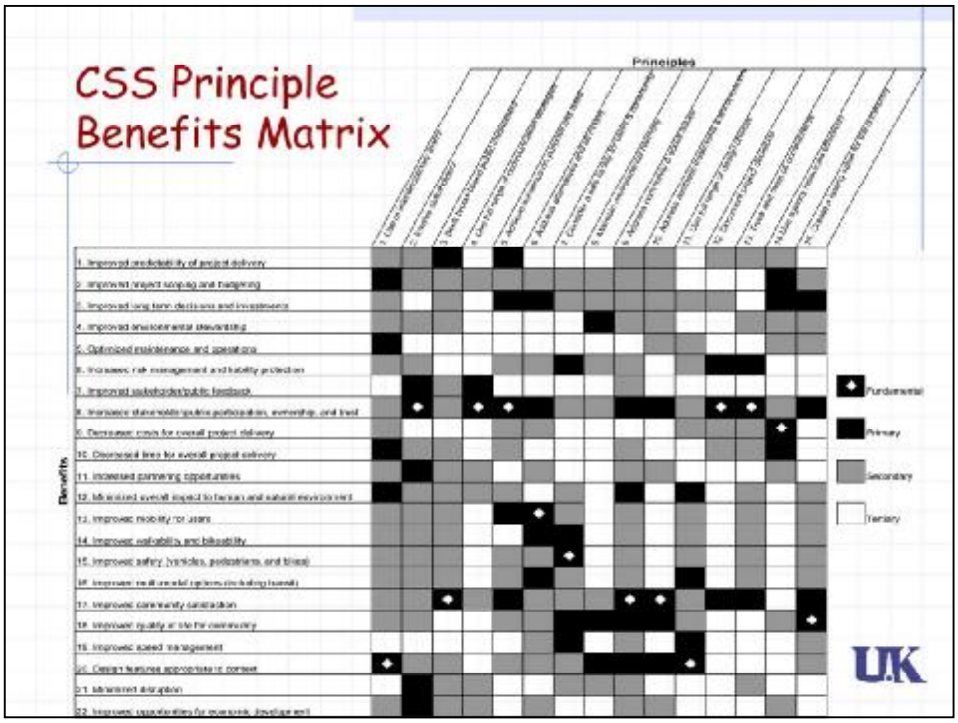
In order to make a meaningful evaluation process CSS principle actions are related to benefit outcomes. This allows for the identification of the cause-effect relationship between actions and outcomes. As you can see from the example above, utilizing interdisciplinary team will allow for identification of design features appropriate to context. Involving stakeholders will increase their participation, ownership and trust. Seeking broad-based public involvement will improve community satisfaction. Understanding these relationships is critical in achieving desired project outcomes.



While it is reasonable to assume that the application of a principle could result in several benefits, performing such analyses may prove impractical due to the range and quantity of data required. To develop a manageable tool, a matrix was developed identifying those benefits that have a strong relationship to principles. A combination of expert panel and case study investigation was used to establish and refine these relationships.

Categories of benefits are as follows: 1) primary benefits have a strong relationship to the principle; 2) secondary benefits have a moderate relationship to the principle; and 3) tertiary benefits have a weak relationship to the principle.

For each principle one primary benefit was designated <u>fundamental</u> providing a single indicator to capture the benefit of applying the principle. The fundamental benefit allows an agency to perform a focused evaluation of a CSS project in the event that resources are not available to complete a full-scale evaluation of all associated benefits.



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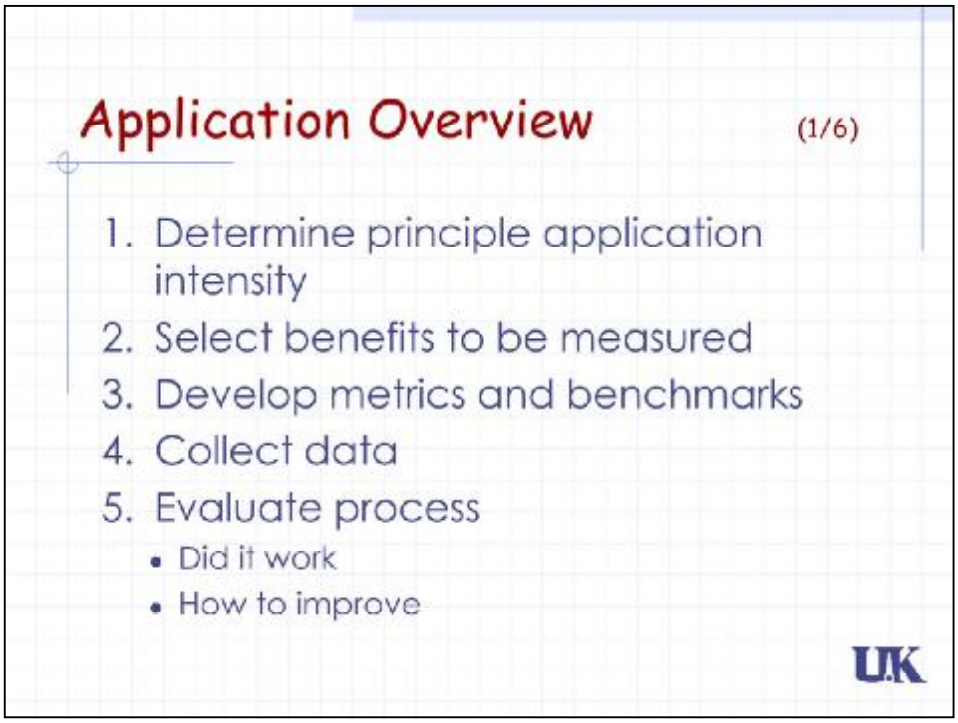
For each principle one primary benefit was designated <u>fundamental</u> providing a single indicator to capture the benefit of applying the principle. The fundamental benefit allows an agency to perform a focused evaluation of a CSS project in the event that resources are not available to complete a full-scale evaluation of all associated benefits.

The principle-benefit matrix provided here was developed to capture the extent of the principle-benefit relationships based on expert panel and case study findings. The 15 principles are cross tabulated with the 22 benefits to form a matrix that is color-coded to show the categories of principles; fundamental, primary, secondary, and tertiary.



Project evaluation can be summarized in a five step process:

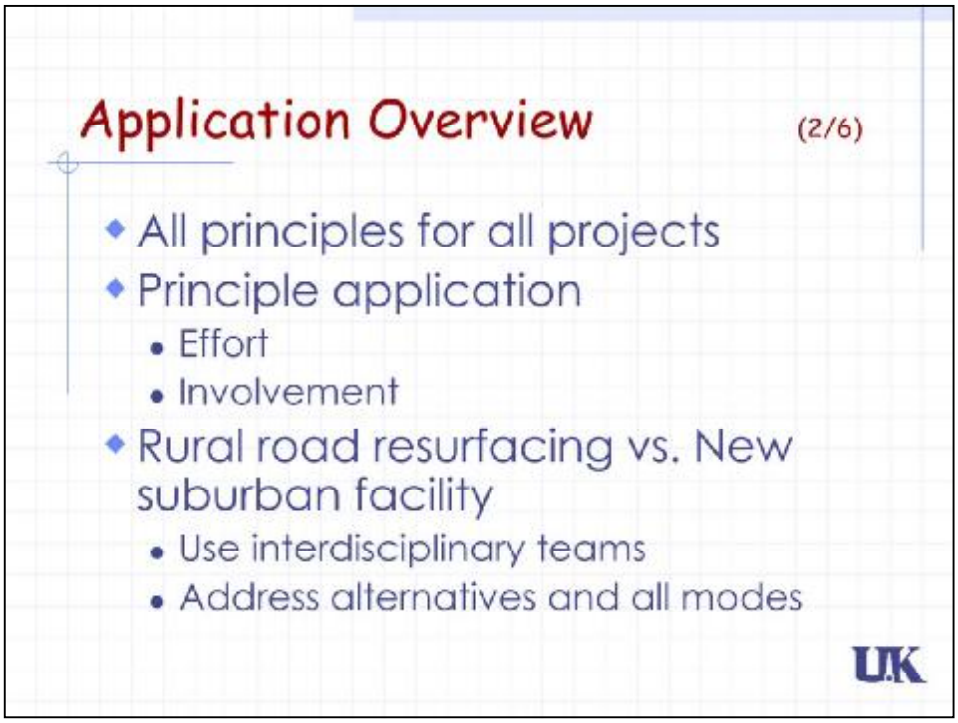
First the level of intensity of how the CSS principles will be applied on the project must be determined.

Second the project team must identify those benefits that will be evaluated on the project.

Identifying benefits early in the project development process will allow for the establishment of benchmarks, by which to evaluate performance.

This will allow the team to define a data collection process throughout the project to ensure that critical data points are not missed.

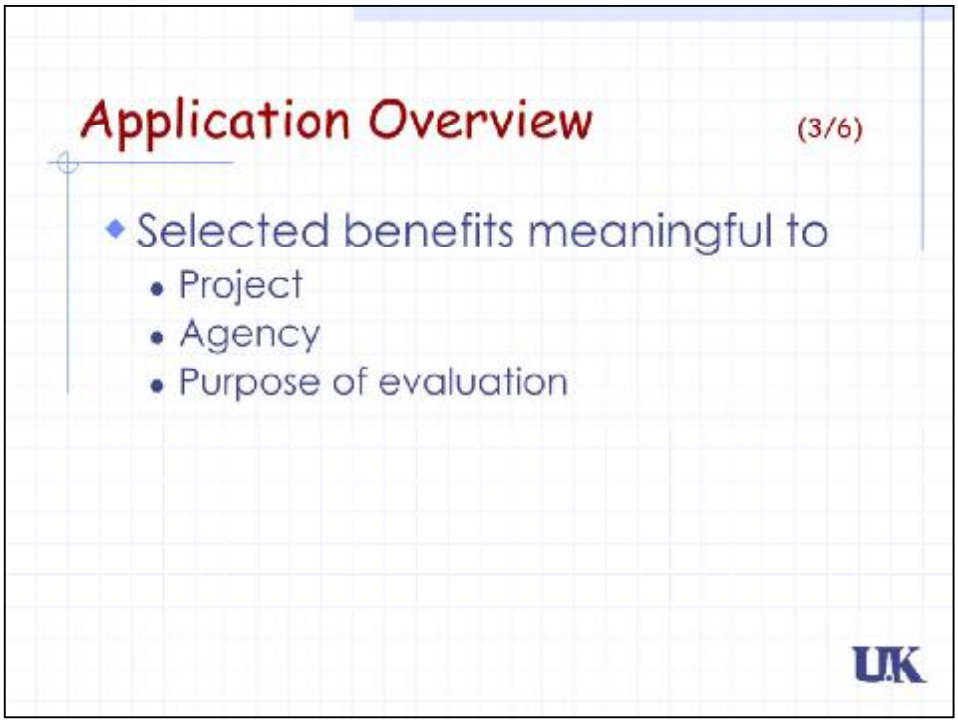
Finally the project team or agency can use the collected data to carryout the evaluation identifying the level of success of the project. By linking performance to the CSS action principles the evaluation can also be used to identify areas of improvement for subsequent stages of the project or for use on other projects.



All principles apply in all projects. Unique project attributes (scope, scale and context) require that the application level of each principle be determined to meet the unique characteristics of the project. Each of these can directly affect the application (depth and breadth) of the principle. This will define the amount of effort a team needs to put forth to accomplish the principle and the work required to properly apply it.

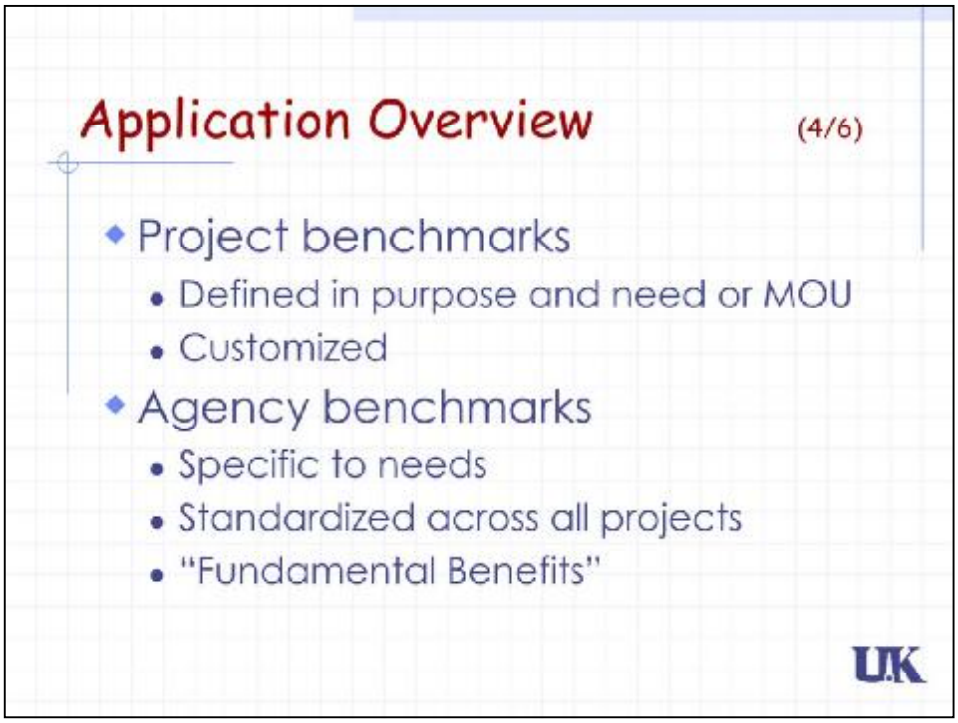
Let's consider two different projects: a rural road resurfacing and a new suburban facility. Now, let's consider principle 1: use interdisciplinary teams. In this case the first project requires as team members fewer disciplines (such as a traffic engineer and a construction engineer) while the second project will require a larger team composition with more disciplines involved (such a highway designer, a public community specialist, a landscape architect, a right of way specialist and so on). In this case the level of effort increases and hence there are more elements to be considered based on the scale and context of the project.

There are similar differences when considering principle 6: address alternatives and all modes. The first project will require the evaluation of possibly adding bicycles as another mode (if the facility is utilized by cyclists) while the second project may include pedestrian, bicycle, transit accommodation as other modes or evaluation of more alternatives (two vs. four lanes for example). Such actions will increase the effort to be expanded for properly applying this principle in the second project



The benefit selected must be meaningful, either to the project or agency depending upon the purpose of the evaluation. Selecting a small number of benefits allows for reduced data collection needs and eliminates the collection of unused data.

The purpose of the analysis (project improvement, project justification, agency CSS justification or agency project delivery improvement) will also contribute in selecting benefits. For example, agency wide evaluations may focus only on fundamental benefits while project evaluations may require the use of primary benefits to monitor specific project outcomes.

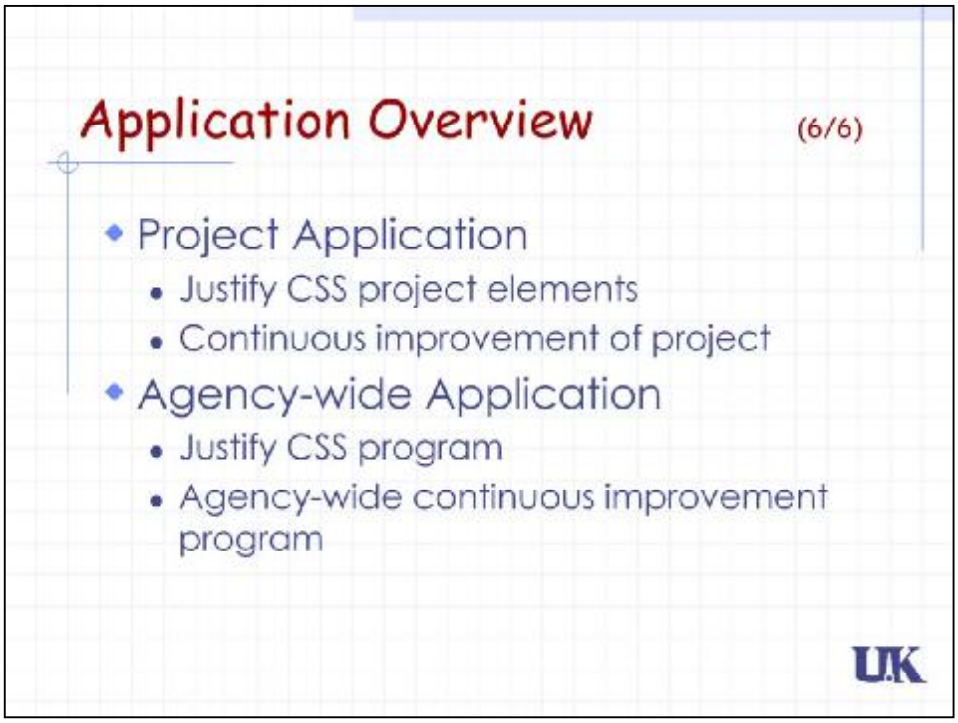


Benchmarks are the ruler upon which the accrued benefits will be measured. They measure the extent of benefit achievement and vary based on project or agency purpose These can be established in many ways, such as identifying targeted values of performance when used as a part of a project justification process, or as the performance of last years projects when used as part of an agency wide continuous improvement program.

Agency wide evaluations must be standardized across all projects and should strive to minimize data collection efforts. Focusing only on the identified fundamental benefits allows the evaluation to capture the critical outcomes of CSS with minimal analysis. In any instance, due consideration should be given to the selection and establishment of benchmarks.

A critical step in the evaluation is establishing a data collection plan early in the process. A forensic approach to data collection and evaluation does not allow for a meaningful analysis as data must be collected in a timely fashion. For instance, if stakeholder attendance is not collected at the time of the meeting, it is difficult if not impossible to recreate the data set.

The results from NCHRP 642 indicate that agencies do not systematically collect data to evaluate project performance. The project team and the agency must be committed to the evaluation approach and have the resources necessary to collect the pertinent data. Once collected this data should be maintained and made accessible to those responsible for the final evaluation and stored to allow further analysis in the future.



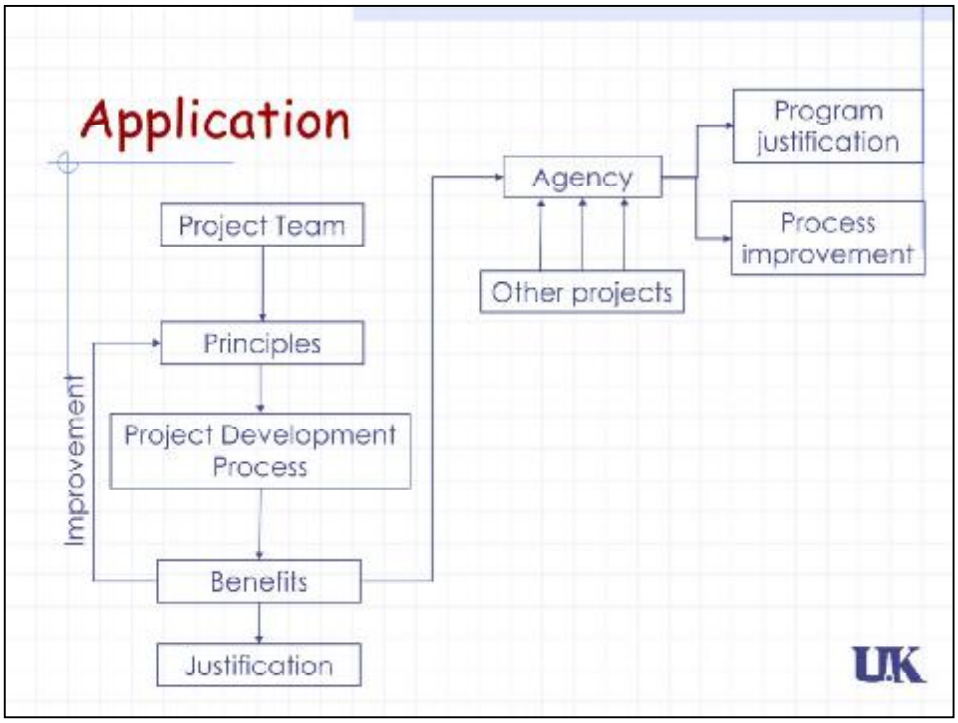
It is anticipated that the benefit analysis may be used for four distinct applications. Depending upon each of these uses, the project team may decide to measure different benefits to meet the different evaluation needs.

Justification of CSS Project/Project Elements. Benefits are measured to allow for the project team to justify specific project elements (design or activities) throughout the project development process. Direct measuring and quantification of project benefits is used to address concerns about the project outcomes. These measured outcomes allow for greater acceptance of the project and can be used as an example in future projects.

Continuous Improvement of the Project. Benefits are measured in conjunction with the principles-benefit matrix as a tool for a continuous improvement of the project itself. Measured outcomes for benefits accruing throughout the project development process are monitored to identify problems in the project approach and/or outcome prior to completion of the project allowing for corrective actions before the completion of the project.

Justification of Agency CSS Program. Benefits are measured to allow for an agency to justify and evaluate the effectiveness of an agency wide CSS program or process. The use of agency wide measured outcomes allows for determining the appropriateness of CSS in project development and demonstration of the benefits to the agency to legislature and interested public parties.

Continuous Improvement of Agency Process. Benefits are measured in conjunction with the principle-benefit matrix as a tool for a continuous improvement of the agency's project development process. The benefit analysis can identify where improvements in project development have been made as well as identify opportunities for improvement. The measured outcomes are used to determine the benefits not accrued based on the agency's desires and to then initiate a review of the process to determine actions that directly beget those benefits.



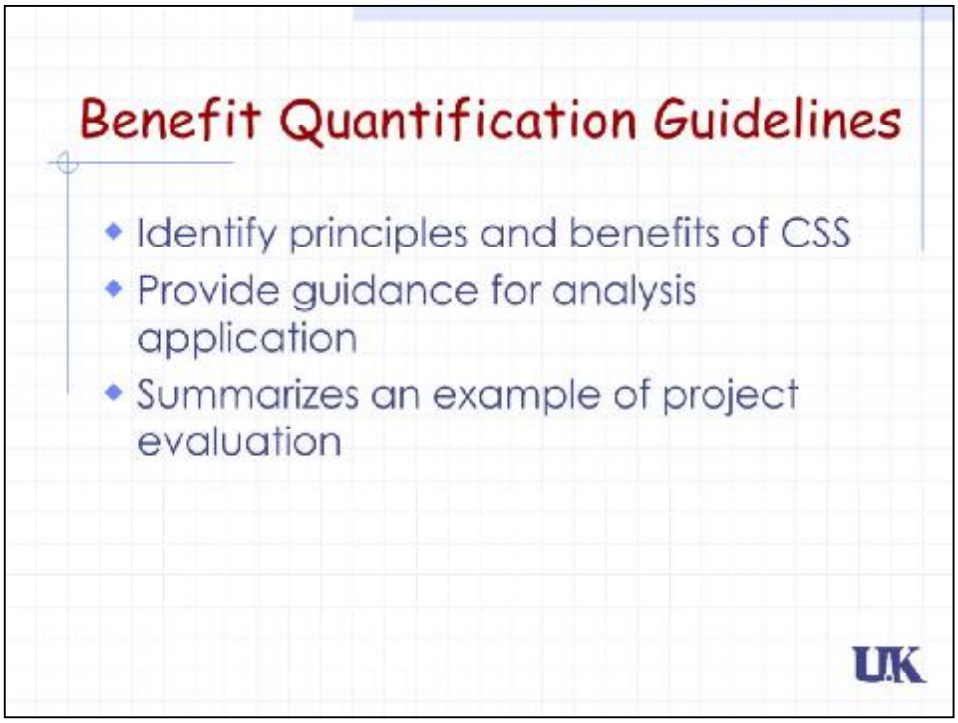
This graphic demonstrates the four uses of the benefit evaluation and where the feedback loops are located in the process to achieve each of the four applications.

1.The simplest application is justification of a project element, where benefits are accrued and recorded to justify project expenditures or actions.

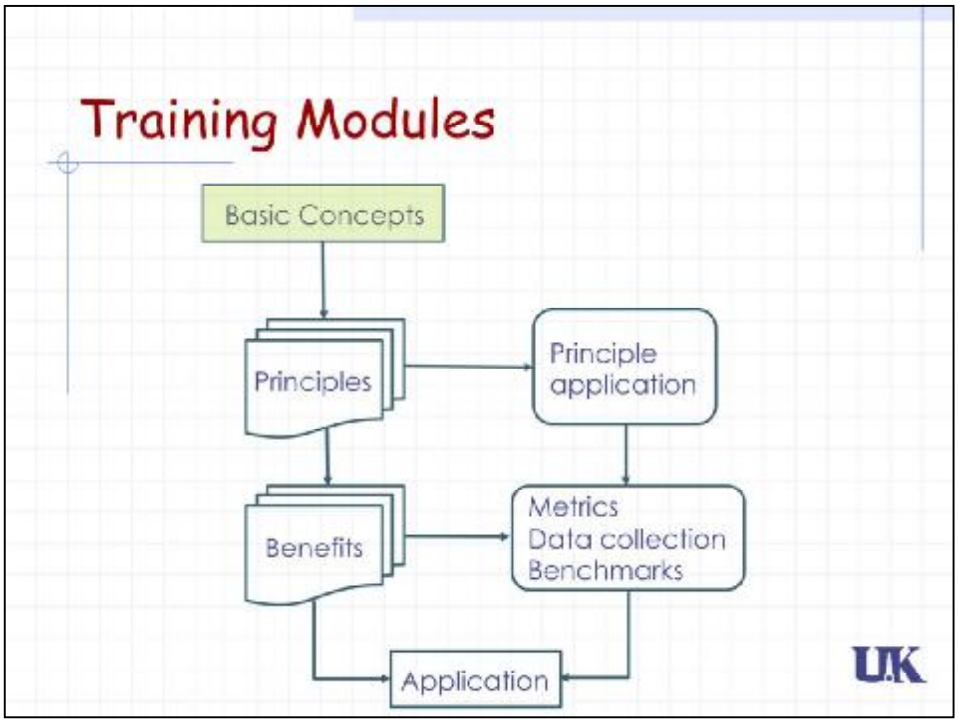
2.Continuous improvement of a project analyzes benefits prior to project completion and feeds this information back into the decision making process so that principle intensities may be adjusted to improve the project outcomes.

3.The benefit information can be forwarded to the transportation agency and along with benefit data from other projects can be used to justify the CSS program or

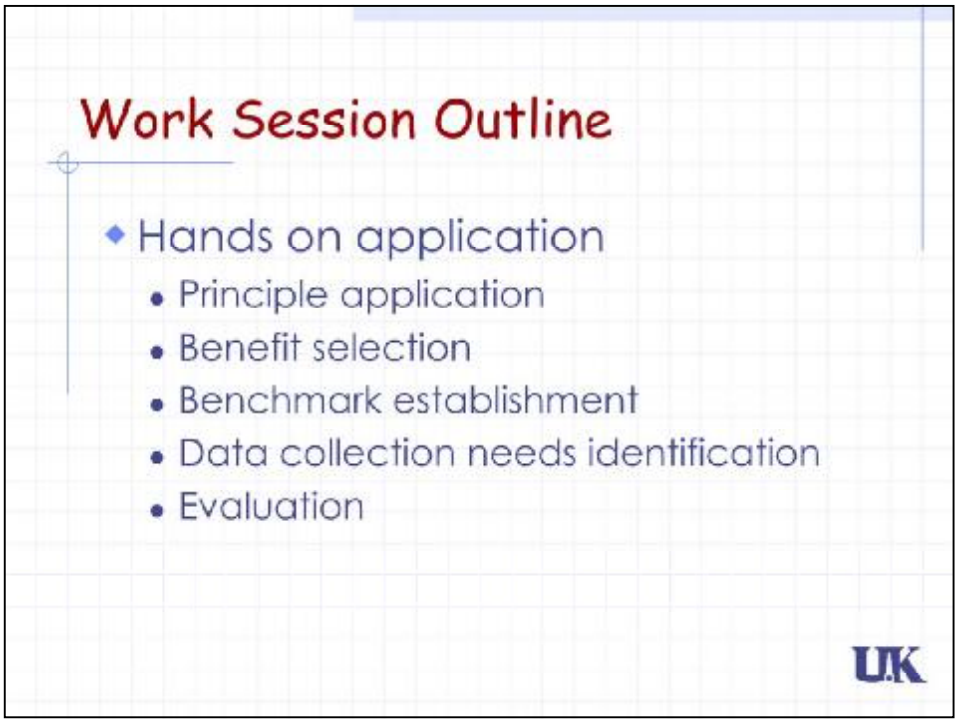
4.The same information can be used to adjust principle intensities or areas of concentration agency-wide in order to improve the next round of projects.



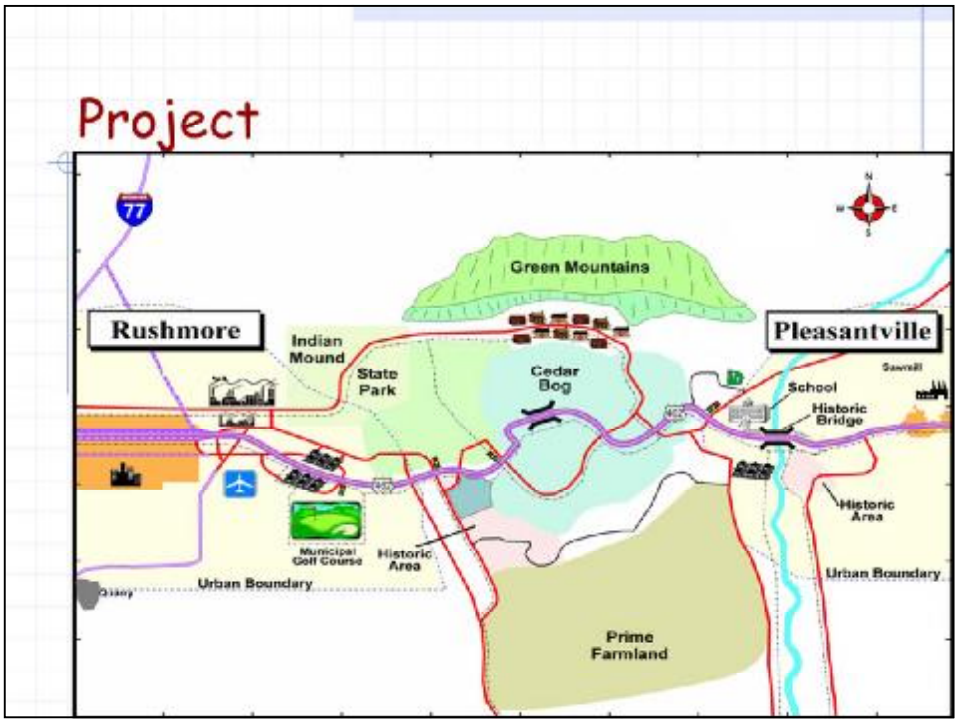
The concepts presented in this presentation are more fully addressed and discussed in the Benefit Quantification Guidelines as well as in the following modules of this presentation. These provide an in depth understanding of the individual principles and benefits, the ability to apply the benefit evaluation and analysis and a detailed example of how this approach may be applied to a project.



This concludes the basic concepts module of this training. The concepts of application, principle and benefit relationships will be explored in further detail in the following section.



The main learning objective for this exercise is to demonstrate the benefit analysis application approach through a fictional case study and allow participants to work on the case. The participants will have to work through all the steps required to complete the benefit analysis and use collected data to evaluate the project and determine whether the benefits accrued. The case study is set up to accomplish a project justification benefit analysis. A need exists to be able to analyze and measure the benefits of CSS and its impact on projects in order to demonstrate a best use of agency resources.



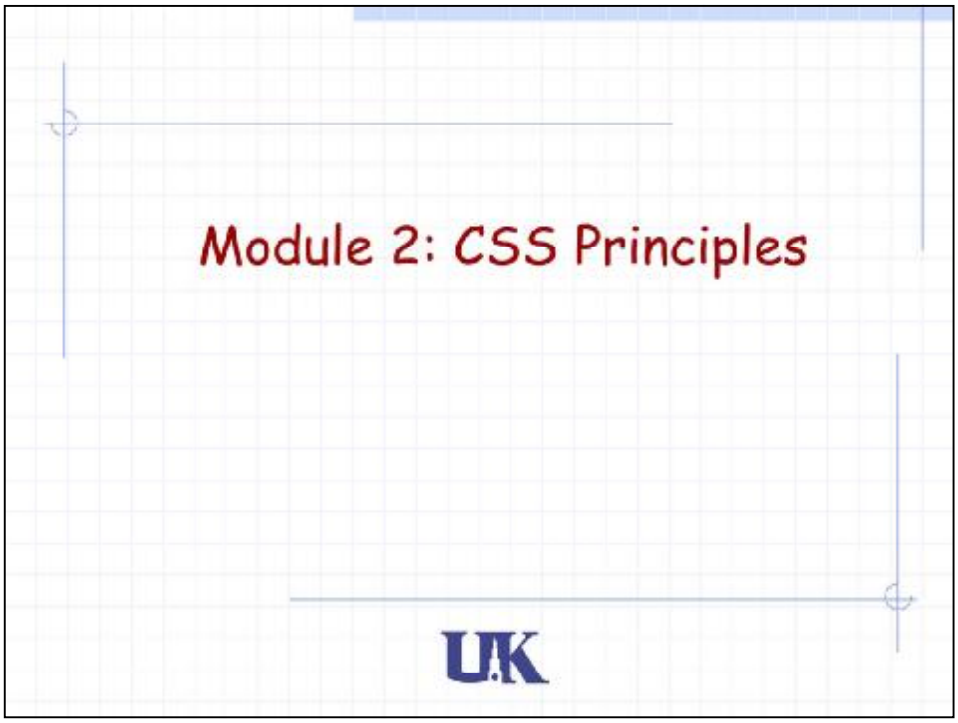
Refer to the handout for additional details. This setting will be used throughout the work sessions to demonstrate the benefit quantification.

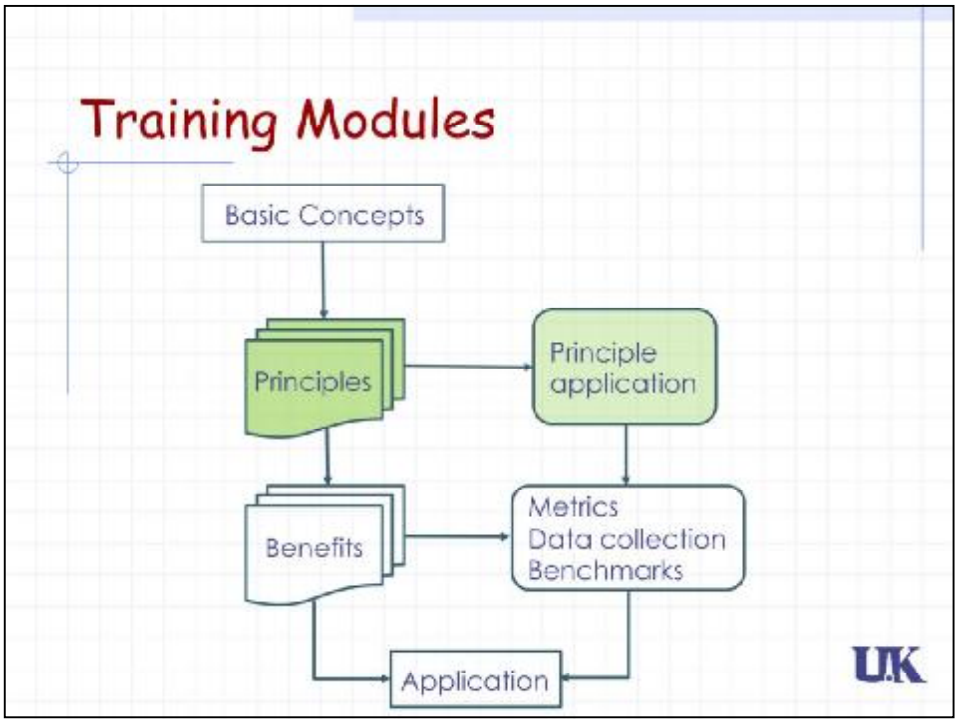
Setting

•10 mile section

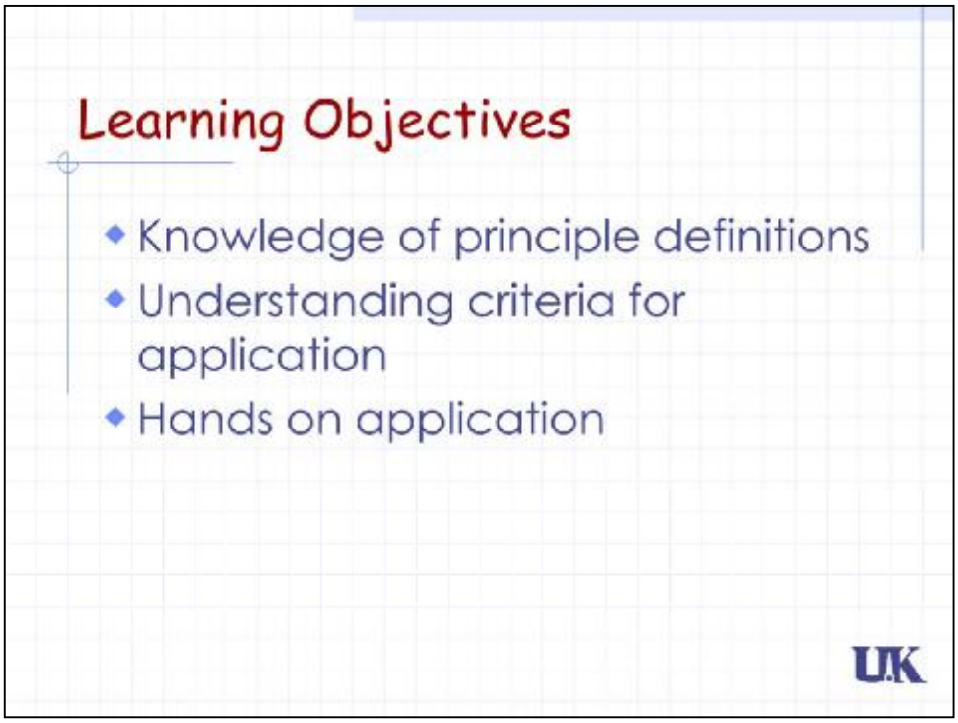
•Realignment and widening in six-year plan

•Early stage of project development


Module 2: CSS Principles
UK



In this section we will discuss in detail each of the 15 CSS principles and identify the criteria for application and benefits associated with each.

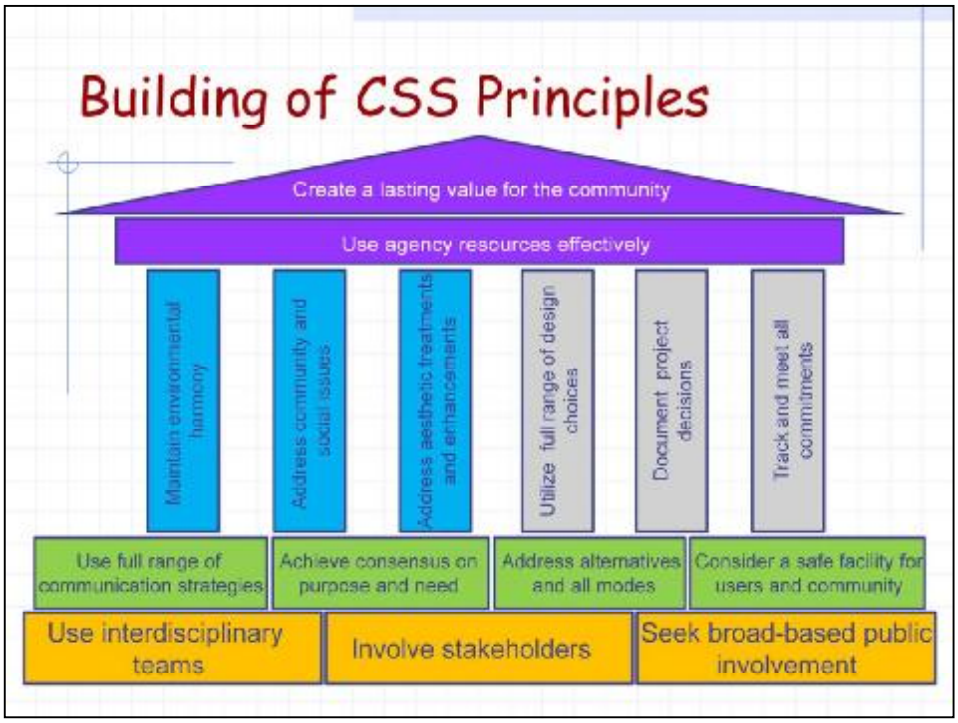


The main learning objective for this module is to develop an understanding of the 15 principles and their definition. We will then review the criteria for application for each of the principles and seek to understand their impact on the project. Next review the application of the principles in CSS projects that have been case studied. Finally we will work through a case study to allow the participants experience in identifying proper principle intensity and actions for the example.

At the conclusion of this section participant will be able to:

Comprehend principles and their interactions.

Apply the criteria for application to determine principle actions



The building of CSS principles is a graphic depiction of the 15 principles in groupings that help us understand their role in the project development process.

We will walk through the groupings from bottom to top to see how they relate and build upon each other (having cause-effect relationships). The 15 principles are complete – that is by acting on each of them an agency will produce a successful CSS project with measurable benefits.

We have color coded the groupings for the purpose of this presentation:

Gold: are the three fundamental principles that ground a CSS project (they are absolutely necessary, but not sufficient for success);

Green: are the four basic principles that are central to the activities to be carried out by the project's professionals while being informed and guided by all stakeholders;

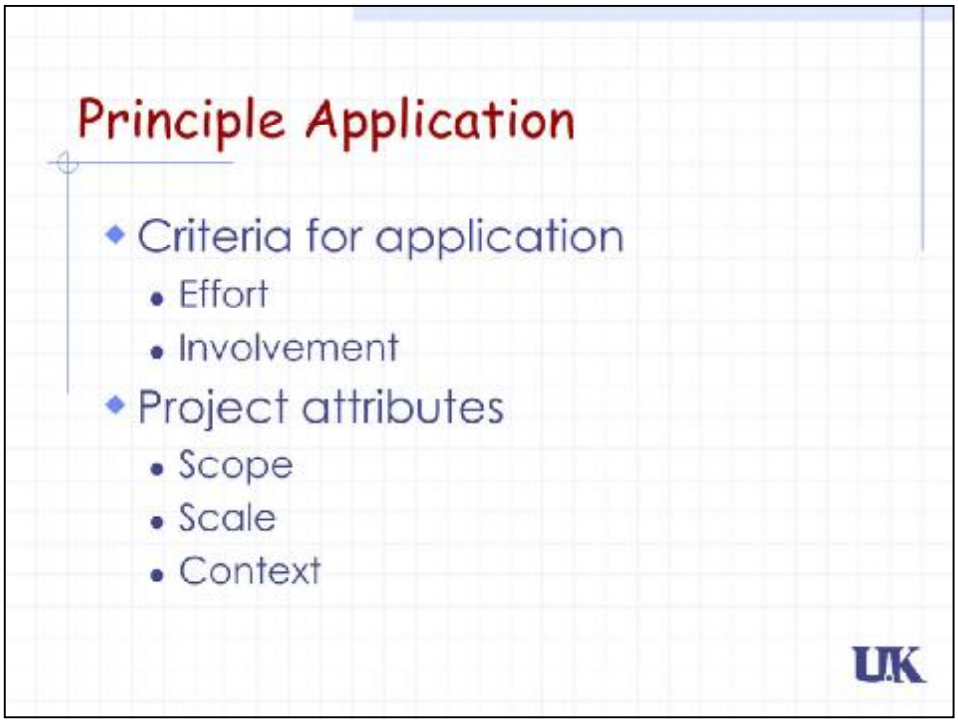
The Blue and Gray: are the six enabling principles – the blue are the context sensitivity enabling principles, those things that are guided by the project's environmental setting and the gray are the agency action enabling, set by the agency; and finally the

Purple: are the long range principles -- the ultimate focus or goals of the project development process using CSS – representing expectations for agency and community.

Now we will take a closer look at each group…

Of the five step process, this section discusses step 1: determining the level of effort for applying the principle for the project.

All 15 CSS principles should be applied on all projects. However, unique project attributes (scope, scale and context) require that the application level of each principle should be determined to meet the unique characteristics of the project. Each of these can directly affect the application (depth and breadth) of the principle.

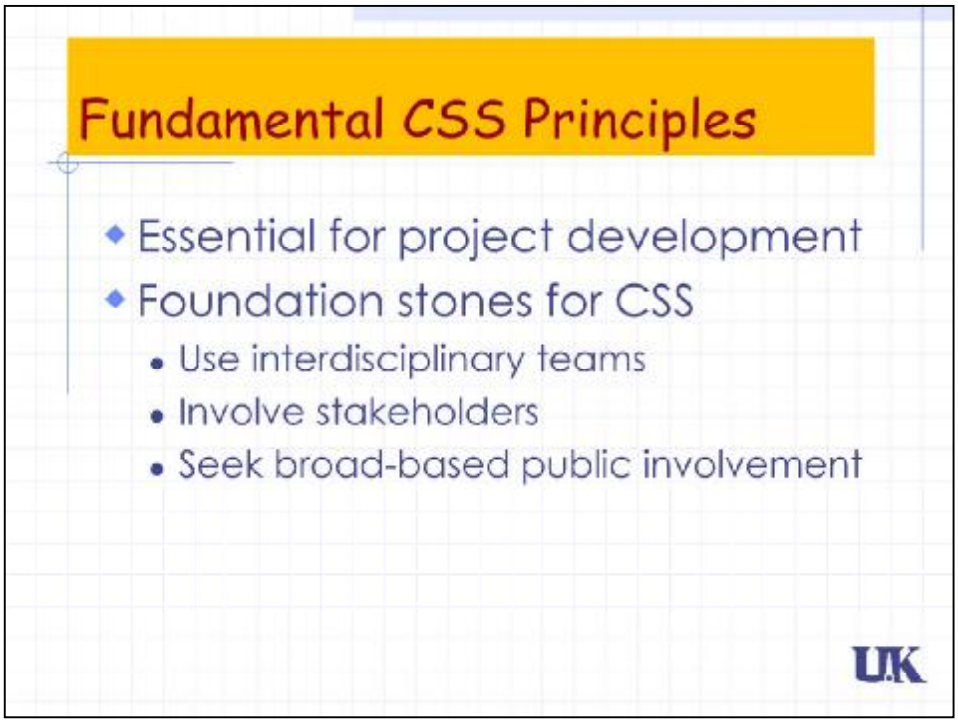


For every principle, a set of criteria for application were developed that define the required actions to be taken to ensure the proper application of the principle. The criteria for application discussed above for each principle are provided to assist the project team in the implementation of the principles within the project. These criteria guide the team in determining the appropriate level of effort required for the application of the principle. The level of effort is determined by the scope, scale and context of he project.

Scope: As the scope of the project increases, the number of involved disciplines expands, requiring increased members on the team. A resurfacing project may only involve a construction engineer and maintenance engineer in addition to the contractor. On the other hand a new construction project would require expertise in planning, highway design, construction, maintenance and other appropriate disciplines.

Scale: As the scale of the project increases, the demands on the project increase as well. This may require new expertise to coordinate the project, as well as require multiple persons to perform the work. A major new construction effort may require multiple highway design engineers, with individuals focused solely on specific project aspects. Conversely on a small project, a single engineer may be able to address all these issues at once.

Context: The varying context of the project has a direct impact on the project as well. As new constraints and resources are encountered or impacted the appropriate team members must be identified. This would include environmental specialists, historic preservationists, special user groups and others as needed.



The foundation consists of the Fundamental Principles:

Use interdisciplinary teams. An interdisciplinary project development team is established early based on the needs of the specific project and is utilized appropriately throughout the project planning, design and construction phases.

Involve stakeholders. A full range of stakeholders is involved with the transportation agency as deemed appropriate and preferably beginning in the early stages of the project. Stakeholders to be included are resource agencies, elected officials, citizen/neighborhood organizations, business, and community and interest group representatives.

Seek broad-based public involvement. Involvement is fostered from all interested and affected persons throughout the project development process utilizing a variety of means to solicit participation beyond any required public hearings.

These represent the foundation for successful CSS projects. Without their application we get traditional projects or projects that get bogged down or even get stopped. When the movement referred to as -- thinking beyond the pavement -- got started these principles were foremost in the minds of those desiring to improve the project development process, gain the trust of the public and be better stewards of the environment.

We provide criteria of application for each principle to assist the project team in determining the appropriate intensity and application of the principle. These criteria define the principle in a substantive way.

Criteria for application

All appropriate disciplines and team members are identified during appropriate phases of the project, beginning with scoping, in accordance with the context, extent and impact of the project.

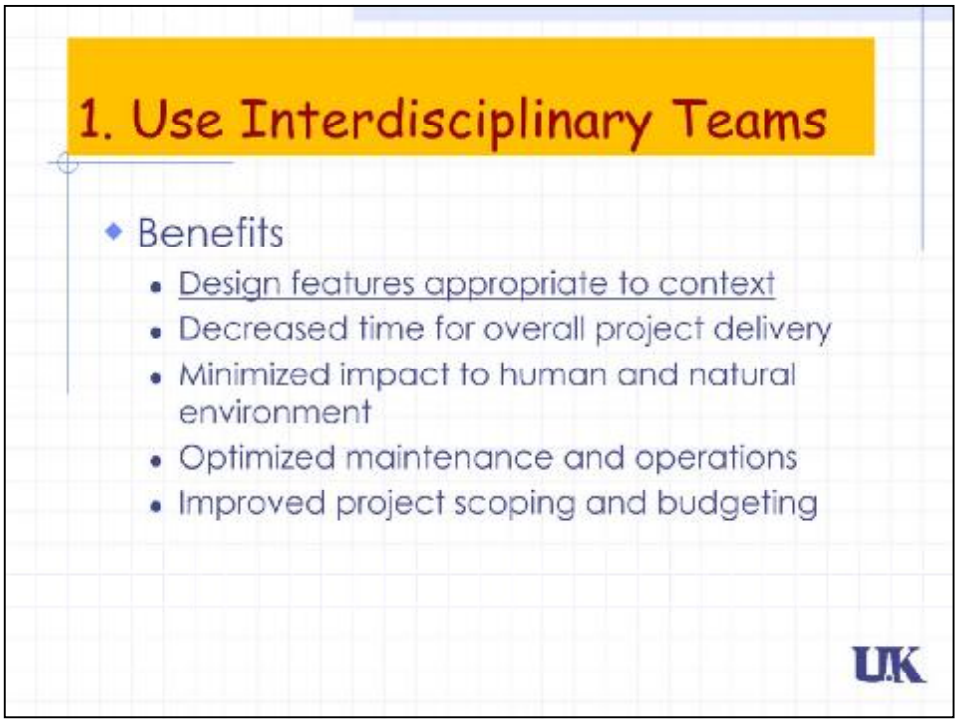
Project professionals have the necessary, diverse and appropriate expertise to move the project successfully through all project phases.

Team members understand their role on the project and the roles of team members vary throughout the project in accordance with their expertise and the project phase.

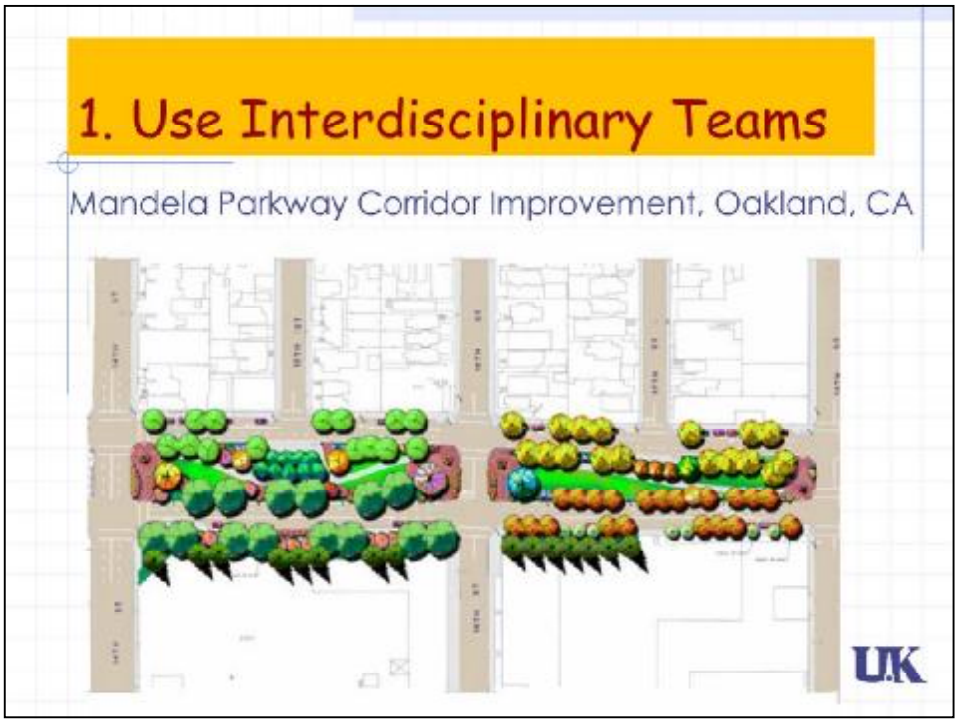
Timely, open, two-way communication is maintained among team members.

Input by all team members is given due consideration.

[Presenter Note: An example of application can be given based on your experience and/or the “Proper Use” section of the Guidelines.]



The benefits listed are considered primary with the “design features appropriate to context” being the fundamental benefit. The use of such teams allows for input from all members while developing the design and allows for addressing specific elements by each team member as they may influence design. This benefit can best be determined using semi-quantitative assessment of expert opinion and community satisfaction.

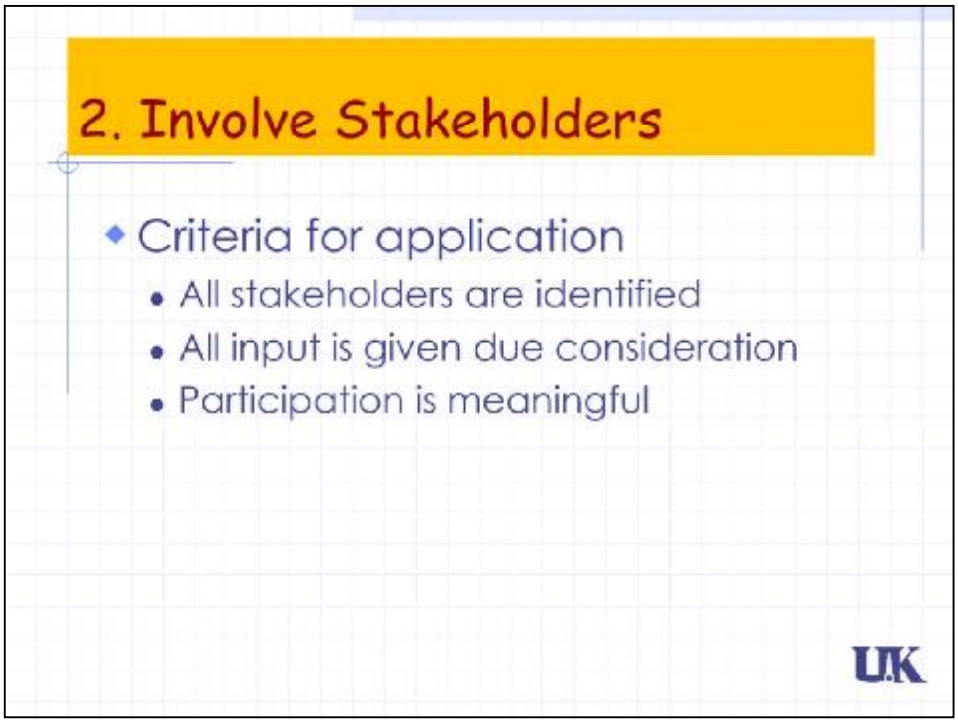


This project is under construction aiming to improve and reconstruct the Mandela Parkway in Oakland, CA.

The interdisciplinary team assembled for this project included all appropriate and required disciplines. The Office of Landscape Architecture took the lead for this project and the other departments within Caltrans provided functional support – this included Civil, Hydraulics, Traffic, Highway Operations, Electrical, Environmental Engineering, Cultural Resources and Right of Way.

Caltrans worked closely with the City of Oakland's Public Works Agency and the various impacted departments such as Parks and Recreation, Electrical, Traffic, ADA Commission, City Council. Representing the West Oakland neighborhood were three community members called the Landscape Subcommittee of the Community Advisory Board, who regularly attended meetings throughout the design process and still give their input.

Participants of the case study survey indicated that all team members were involved extensively in the design phase. The participants also noted that several also worked in the planning and construction phases. Some specialties were included to address specific aspects of the project, such as electrical to address specialty lighting requirements.



Stakeholders are all local governments and resource agencies, development agencies, and groups with special standing that could be involved in the project and can have an influence in completing and/or providing permits for certain project phases.

Criteria for application

All affected stakeholders are identified at the appropriate phase of the project and reviewed/updated throughout.

All stakeholder input is given due consideration.

Processes are in place to ensure participation by stakeholders is meaningful, timely and can provide informed project decisions.

The benefits listed are considered primary with the "Increased stakeholder/public participation, ownership and trust" being the fundamental benefit. Involving stakeholders throughout the project development process will increase their participation, since their input will be solicited at certain points of the process, improve trust in the process, since their opinion will be valued and considered, and enhance ownership of the project, since their concerns will be addressed and their input considered. This benefit can best be determined using the semi-quantitative assessment of expert opinion and stakeholder satisfaction.

In addition to the Arizona DOT (ADOT) and FHWA, the stakeholder groups included the Big Park Regional Coordinating Council, Yavapai County, Coconino National Forest, City of Sedona and Coconino County.

Those stakeholders worked cooperatively with the ADOT on Executive, Public Outreach and Project Management Teams and on the Segment Concept Design panels. As a consequence there was close cooperation and involvement with ADOT in the early phases of project development.

Stakeholder initiatives including grants were an outgrowth of this interaction/cooperation.

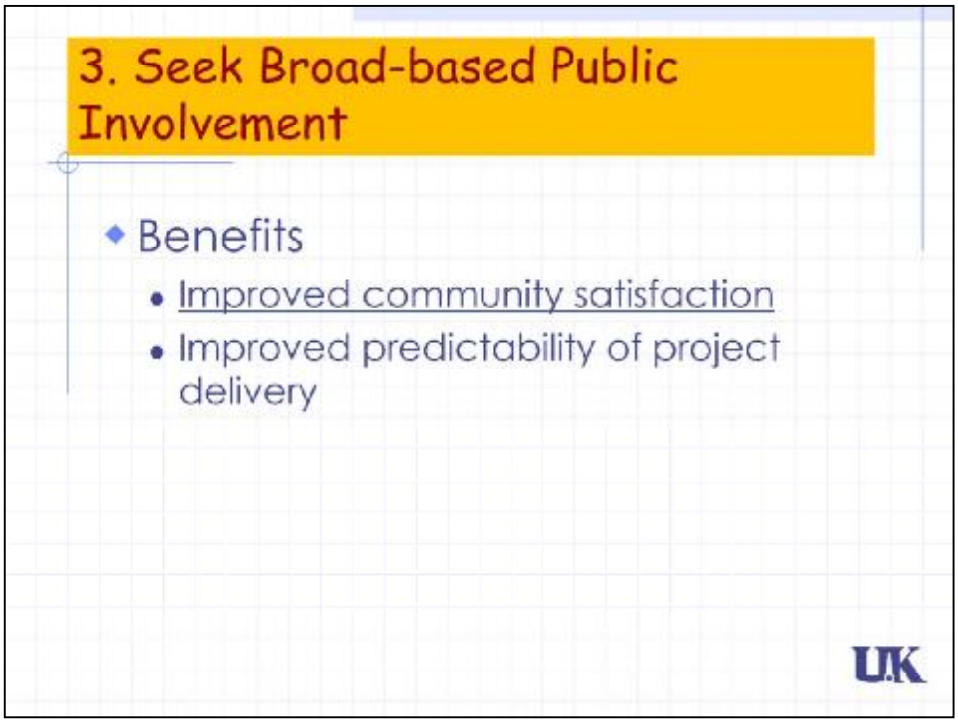
Criteria for application

The project team identifies all interested and affected persons early in the project development process.

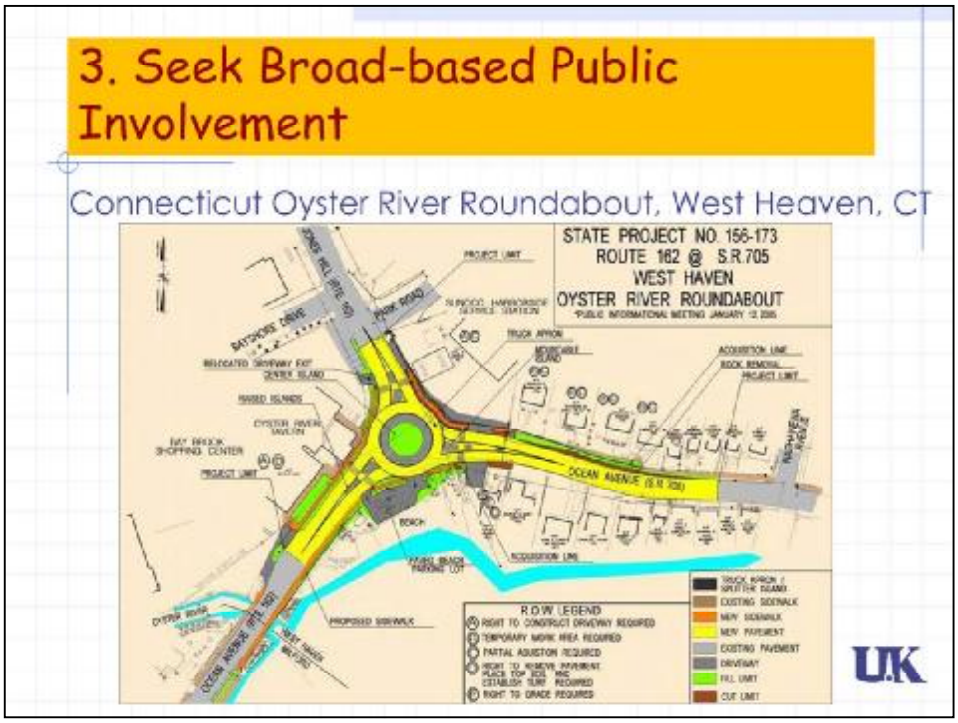
The project team proactively identifies what information they need from the public and the methods needed to solicit that input.

Opportunities for public involvement are provided throughout the entire project development process.

A transparent and rational decision making process is in place to incorporate public input.



The benefits listed are considered primary benefits with “improved community satisfaction” being the fundamental benefit. The consideration of comments received during the public involvement process will increase community satisfaction regarding the process and the solution developed and enhance the agency's image for future projects. This benefit can best be determined using the semi-quantitative assessment of expert opinion and stakeholder satisfaction.

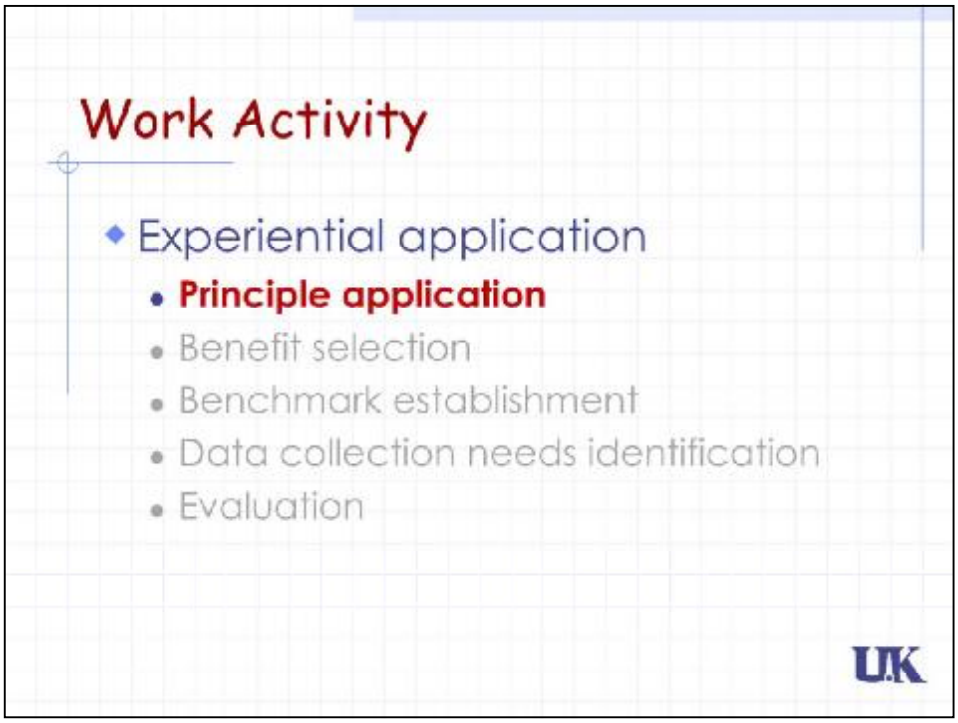


The location of this 3-leg roundabout is uniquely situated along Long Island Sound adjacent to a small parking lot serving a public beach and surrounded with single family homes and a small shopping plaza.

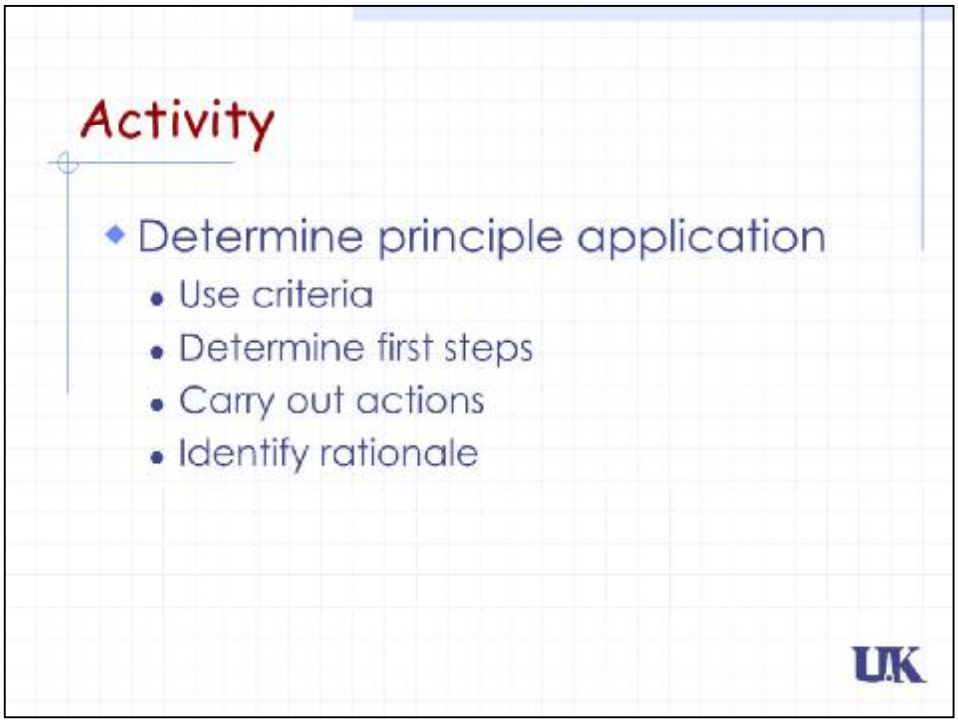
The planning, design, and construction phases involved the affected home owners and business interests along with the local town officials.

The final intersection design that avoided takings, the incorporation of specific features such as sidewalks as well as construction phasing to avoid the busiest summer months were the direct result of community involvement.

Visualization techniques were useful from the very outset in consideration of the roundabout option. Much of the success of this project is attributed to the early involvement of all interested parties.



The main learning objective for this exercise is to demonstrate the benefit analysis application approach through a fictional case study and allow participants to work on the case. The participants will have to work through all the steps required to complete the benefit analysis and use collected data to evaluate the project and determine whether the benefits accrued. The case study is set up to accomplish a project justification benefit analysis. A need exists to be able to analyze and measure the benefits of CSS and its impact on projects in order to demonstrate a best use of agency resources.



Based on the case study, participants are to work with their group to accomplish the following tasks:

1. For all Fundamental principles determine the required first steps for proper application. Use the criteria of application to determine how each principle will be applied. This should identify the components or steps required for applying the principle.

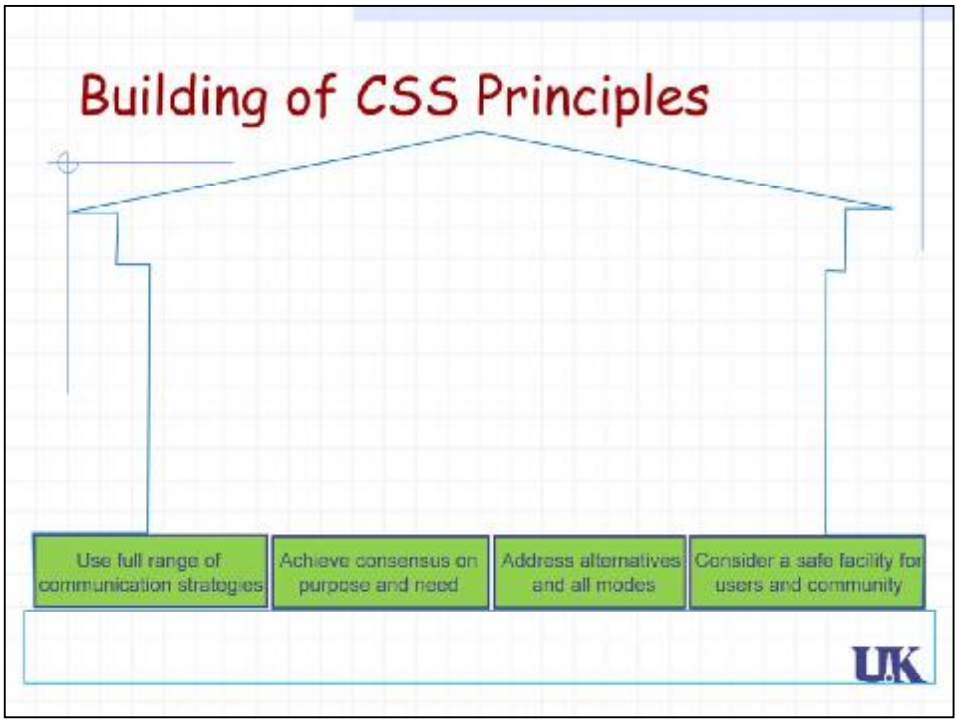
2. For the assigned principle, the team should identify the required actions (i.e. identify specific elements required for the application) to fulfill the first steps identified. For each of the assigned principle, the team needs to identify the rationale for the actions taken.

Principle Worksheet 1

Principle	First Steps	Actions
Use interdisciplinary teams	1. Determine required expertise 2. Identify team roles 3. _____	1. Historic preservation; Highway designer; Landscape architect;… 2. HD: PM; LA: Asst PM; HP: as needed;…
Involve stakeholders		
Seek broad-based public involvement		

Form to be used by participants.

For example, one criterion for application for principle 1 is all disciplines are identified. The appropriate action for this will be to review the full scope of the project and determine the required expertise.



Now we will take a closer look at the basic principles.

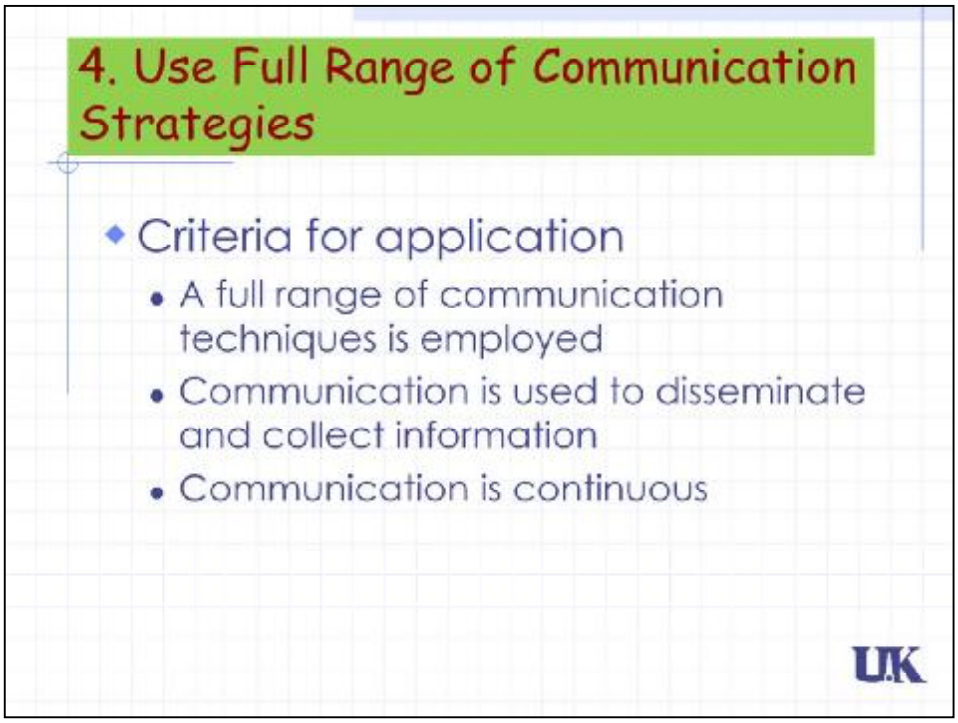
Remembering our CSS building… the floor is comprised of four basic principles that are needed to facilitate a project and are required for timely completion by a transportation agency:

Use full range of communication strategies. A variety of approaches to appropriately engage and solicit input from stakeholders/public is used in the project development process.

Achieve consensus on purpose and need. The purpose and need of the project has been established by a full range of stakeholders/public, the agency and the project team.

Address alternatives and all modes. All appropriate modes are considered in the evaluation of alternatives and addressed given the project's purpose and need.

Consider a safe facility for users and community. The resulting project creates a safe facility for the project users and the community by addressing safety issues.

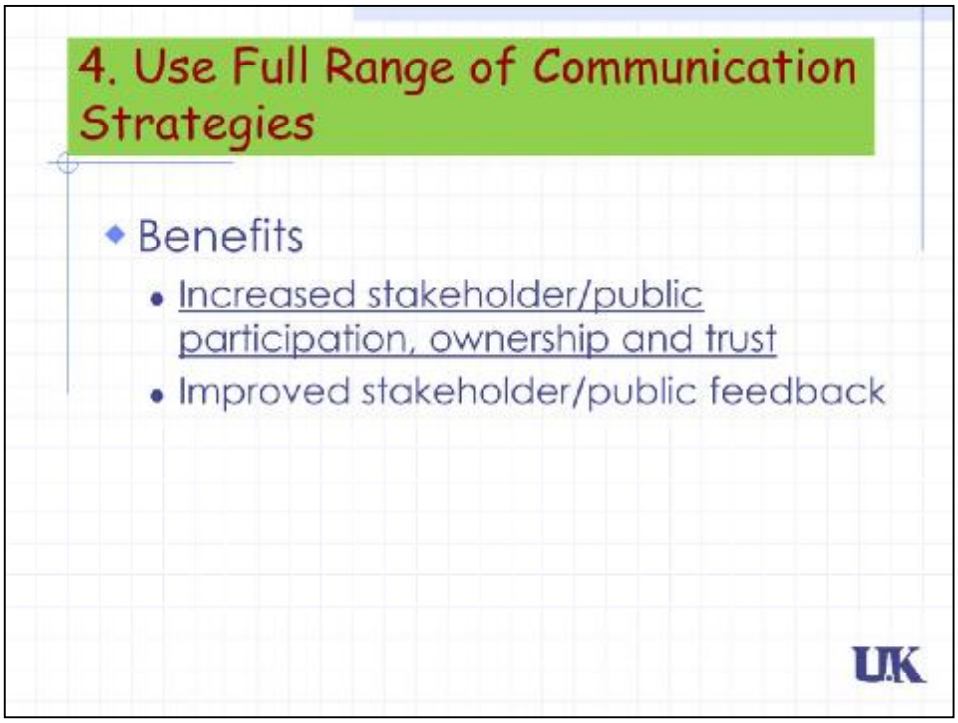


Criteria for application

The project team employs a full range of communication techniques appropriate to the purpose of the communication and the nature of the participants.

Communication methods must be used to both disseminate and collect needed information.

Communication is continued throughout the project and beyond.



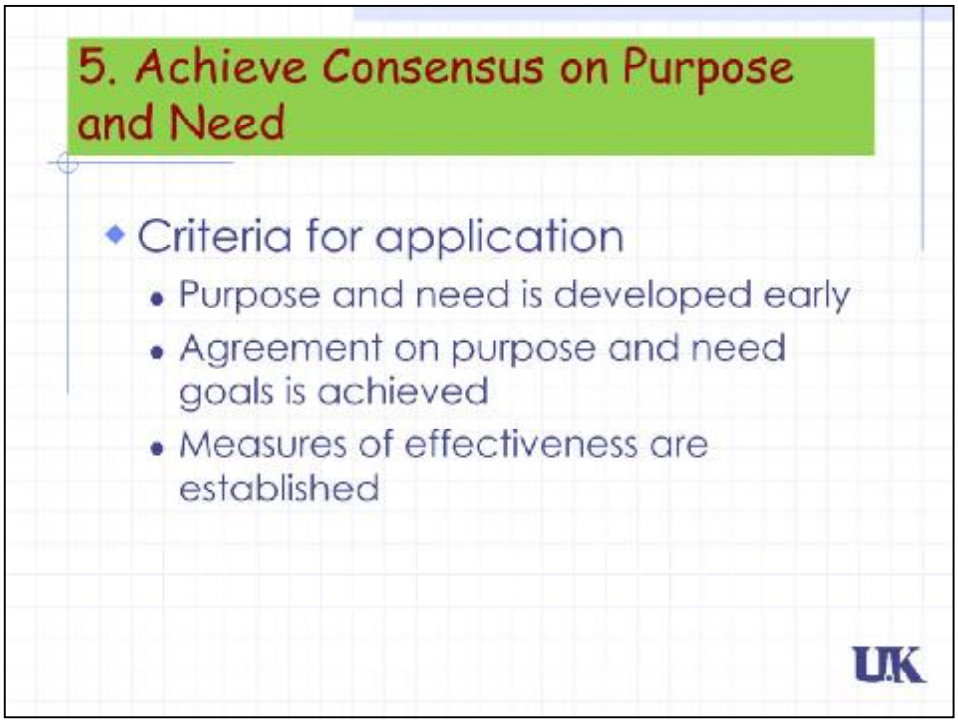
The two benefits listed are considered primary with “increased stakeholder/public participation, ownership and trust” being the fundamental benefit. The use of full range communication means will allow stakeholders to better participate in the process and therefore provide them with a more informed process for providing meaningful input. This benefit can best be determined using semi-quantitative assessment of expert opinion and community satisfaction and quantitative measures.

WYDOT incorporated video imaging early in the design phase of the project to help non-highway personnel and residents visualize the completed project.

Several public meetings were held, as well as, weekly work review sessions during project construction.

Daily announcements were made during rock blasting and other road closure operations. The community was kept informed by radio and brochures.

The Advisory Committee planned and determined times for road closures during the heavy tourist season. Working closely with the advisory committee improved relations with the DOT.



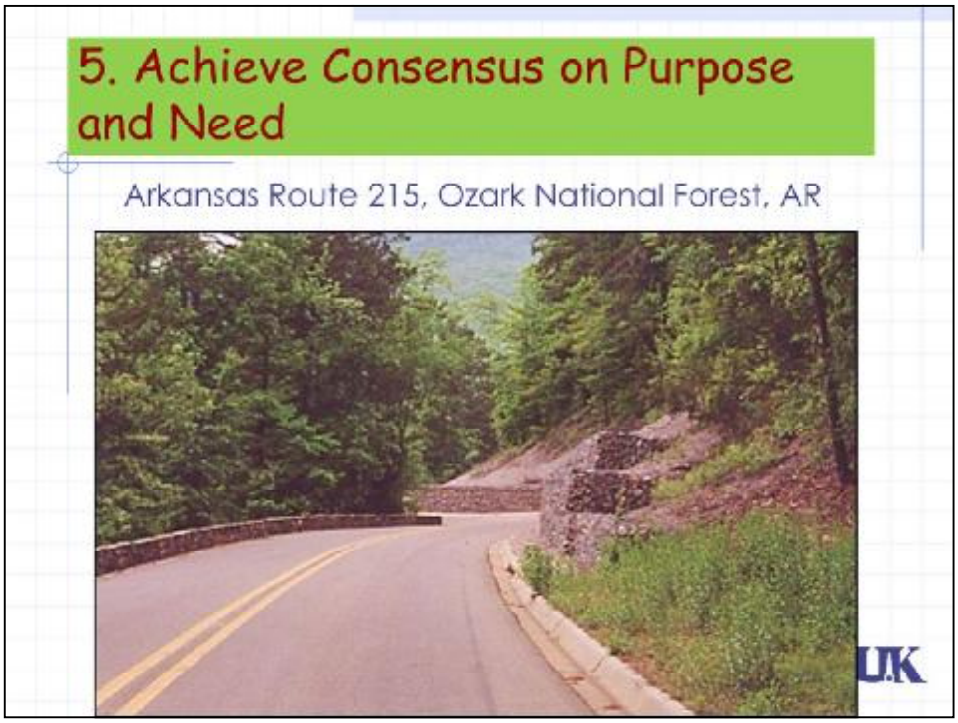
Criteria for application

The purpose and need statement is developed early in the project development process.

The purpose and need statement is based on consensus of the project team and interested and affected stakeholders/public.

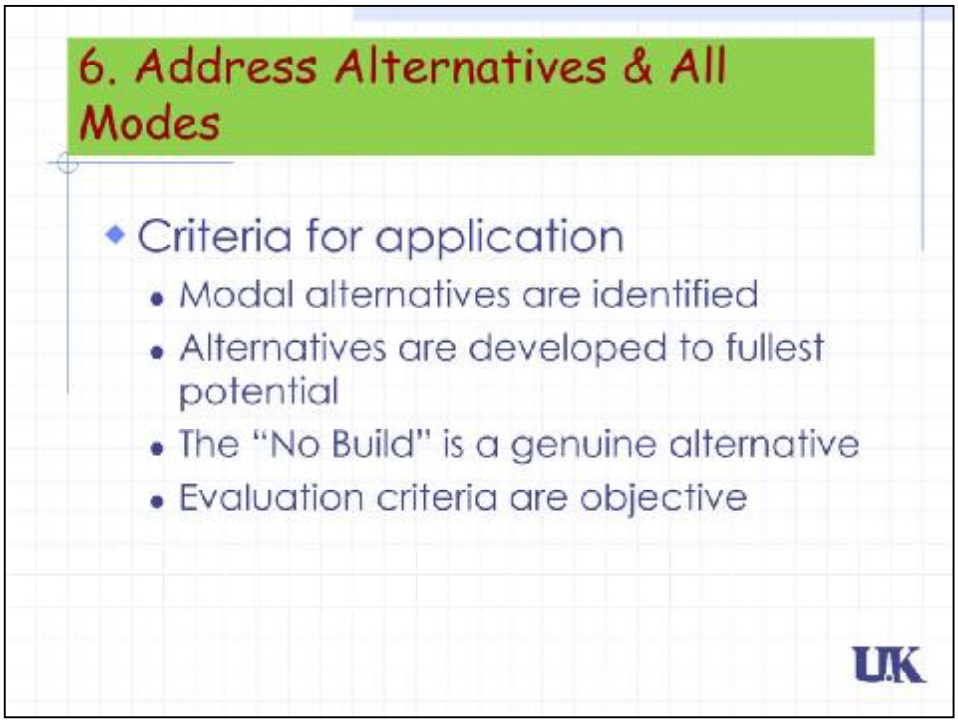
The purpose and need statement establishes measures of effectiveness to guide the decision-making process.

The benefits listed are considered primary with “increased stakeholder/public participation, ownership and trust” being the fundamental benefit. This benefit can best be determined using a quantitative measure of stakeholder involvement and semi-quantitative assessment of expert opinion and community satisfaction.



Providing for travel improvement and access to camping and other recreation opportunities while keeping the roadway foot print to a minimum was agreed upon. The consensus was achieved through a series of one-on-one conversations and group meetings involving the state DOT's divisional staffs, the US Forest Service, and the Water Quality and Scenic Preservation agencies beginning in the planning stage and continuing into the design stage.

This desired minimalist approach took a bit of design trial and error to achieve an acceptable solution which included a cross-section and geometrics that was sensitive to view sheds from the roadway <u>and</u> from the adjacent Mulberry River.



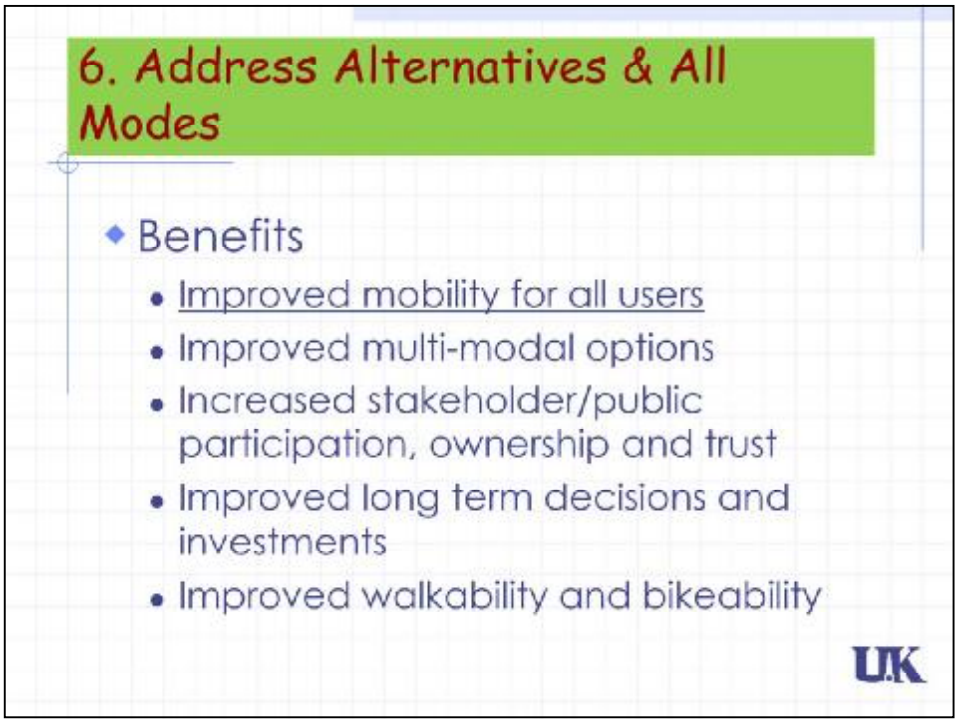
Criteria for application

Alternatives encouraging mode choice capable of addressing the issues in the purpose and need statement, are identified and developed.

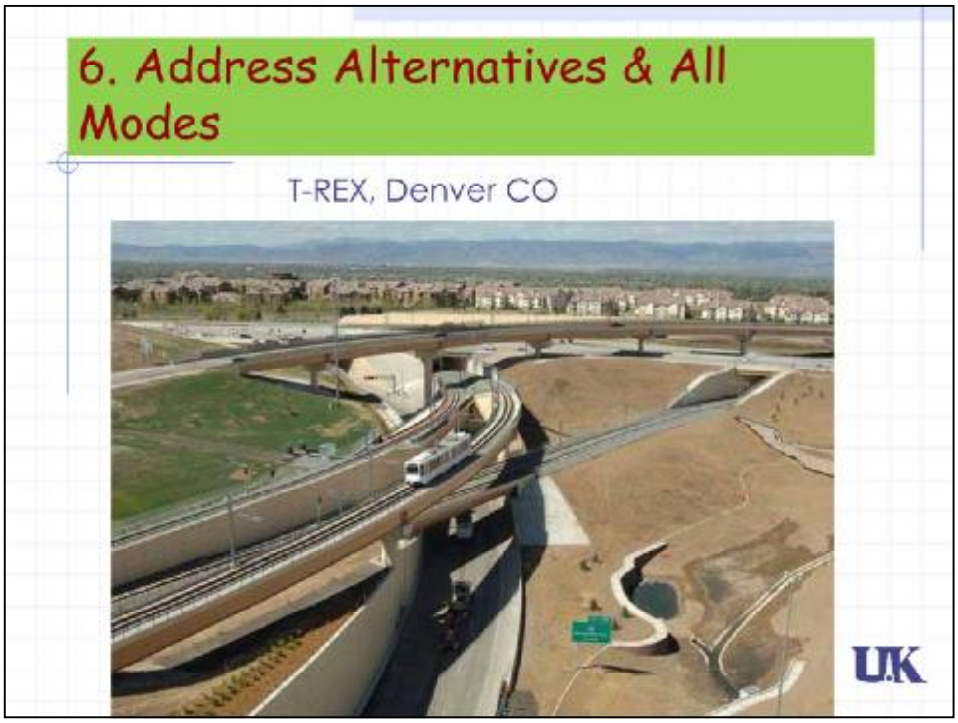
Each alternative is developed to its fullest potential appropriate to the stage of the project.

The "No Build" alternative is considered and is provided as a genuine alternative.

Alternative evaluation criteria are objective.



The benefits listed are considered primary with “improved mobility for all users” being the fundamental benefit. Consideration of all alternatives and modes will identify all potential options for the users to be considered. This benefit can best be determined using the quantitative measures of the inclusion and extent of each modal facility, the number of new or expanded modal choices, modal connectivity and modal safety as well as semi-quantitative assessment of expert opinion and community satisfaction.



During the MIS phase, a multi-level screening process was used to develop and evaluate modes such as Bus/HOV lanes, light rail transit, highway expansion, commuter rail transit; and alternative alignments.

A number of possible locations for transit stations were also developed and evaluated.

The design solution that best met purpose and need and minimized environmental impacts was a combination of highway widening and LRT corridors. LRT was chosen over additional highway expansion or HOV lanes because it provides very high capacity for very little space.

The project is in a very constrained corridor and a multi-lane highway expansion would have had numerous residential and business relocations.

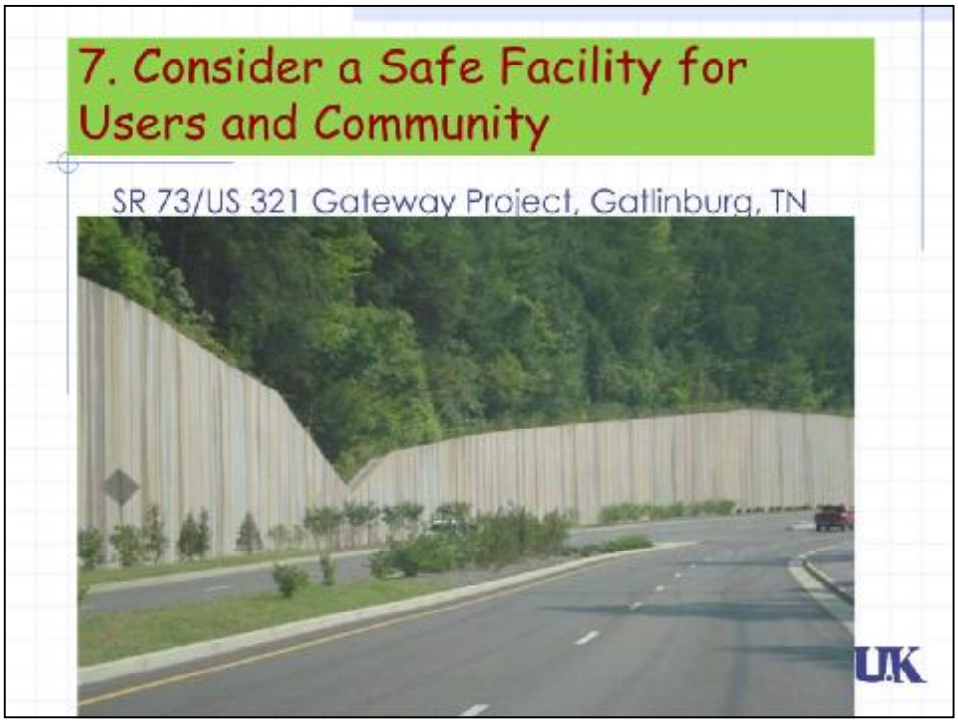
Criteria for application

A safety review is conducted at each phase of the project with consideration of the needs for all users.

Input from all modal user groups is sought to better understand their safety needs

The project team develops a solution addressing safety concerns.

The benefits listed are considered primary with “improved safety (vehicles, pedestrians and bikes)” being the fundamental benefit. Considering a safe facility will result in an improved safety level for all modes, since the needs of all users will be considered and addressed. This benefit can best be determined using quantitative measures of the crash frequency, crash rate and severity and semi-quantitative assessment of expert opinion and community satisfaction.

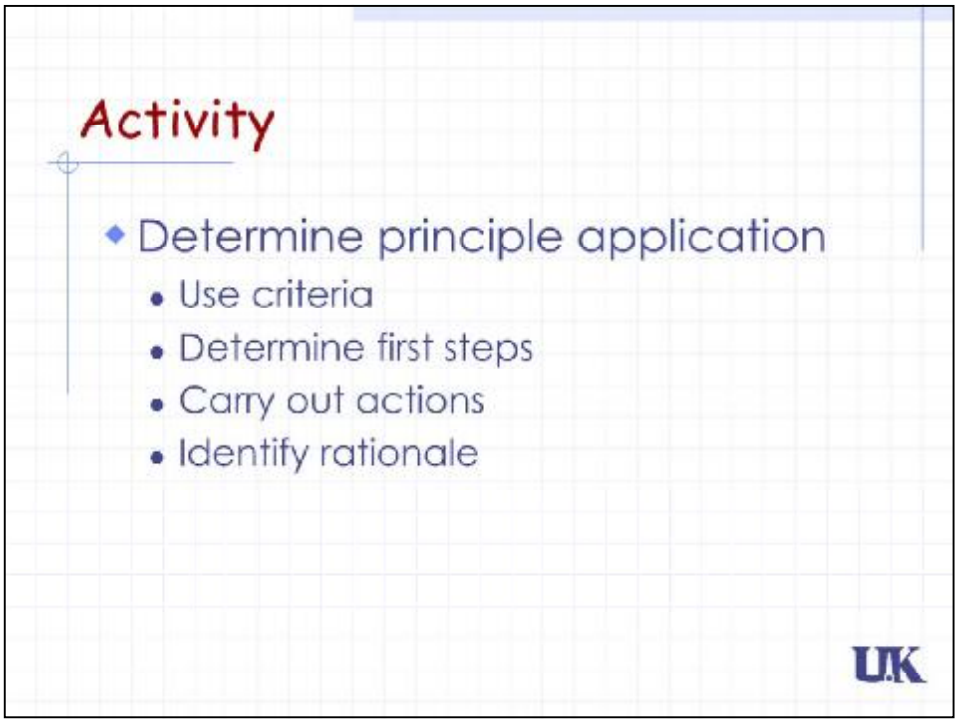


Flexibility in the design process resulted in transportation needs (increased capacity) being addressed with the recommended modifications without any design exceptions.

Safety was not compromised with the new design, and was expected to be enhanced with the adoption of the median boulevard concept with turn lanes at major intersections.

Some limited number of right-of-way tracts have only right in, right out access, but the impacts to these parcels was not significant.

To create a parkway experience, the addition of a landscaped median was coupled with reduced lane widths and a reduced speed limit.



Based on the case study, participants are to work with their group to accomplish the following task:

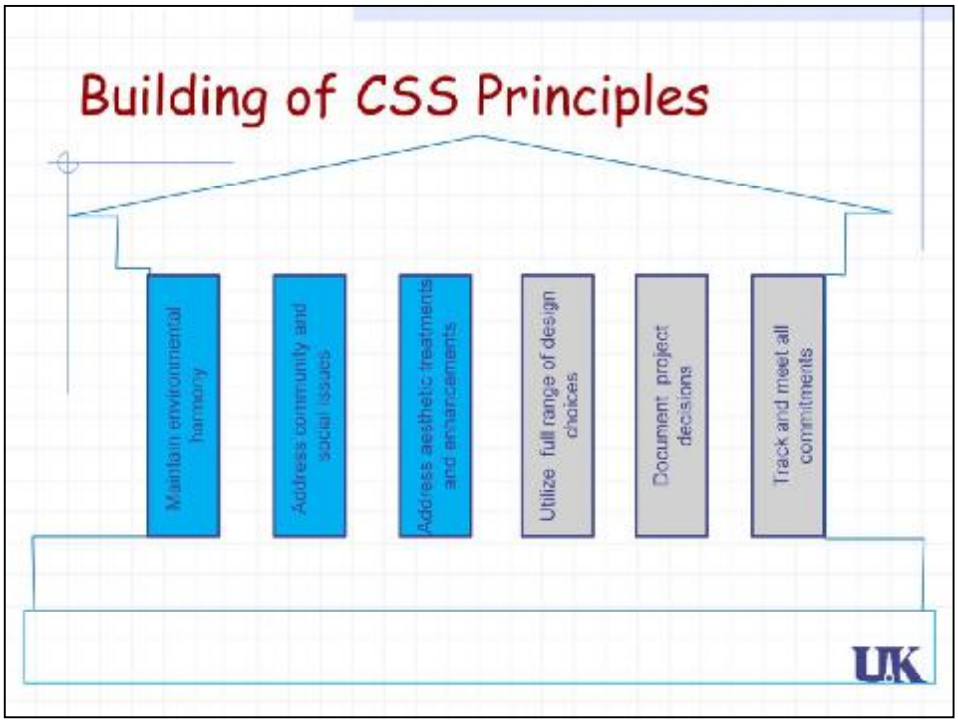
1. For all Basic principles determine the required first steps for proper application. Use the criteria of application to determine how each principle will be applied. This should identify the components or steps required for applying the principle.

2. For the assigned principle, the team should identify the required actions (i.e. identify specific elements required for the application) to fulfill the first steps identified. For each of the assigned principle, the team needs to identify the rationale for the actions taken.

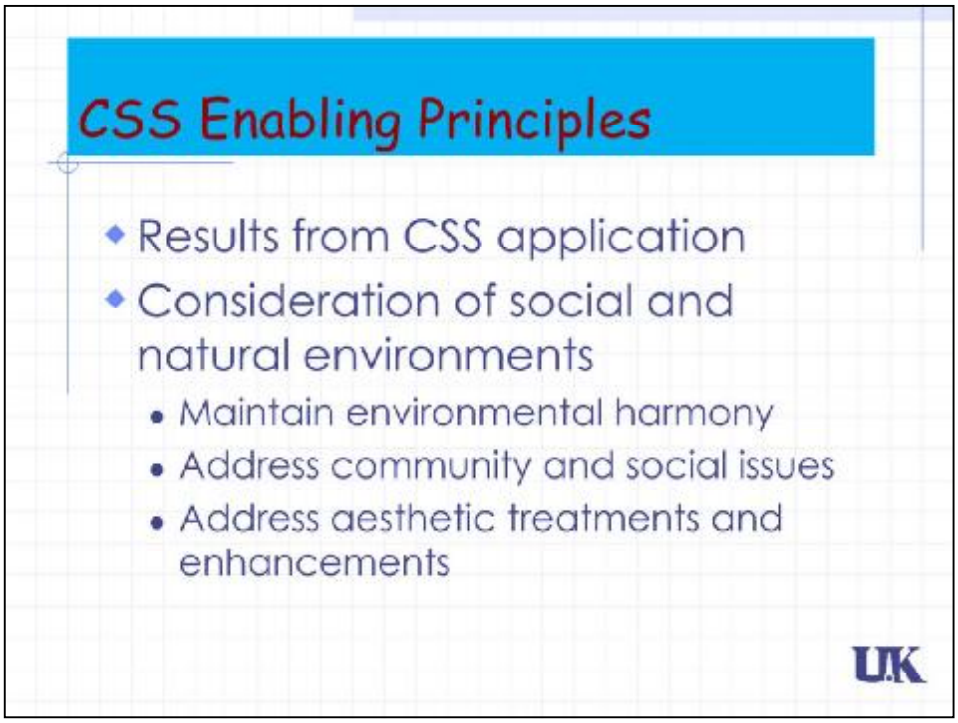
Principle Worksheet 2

Principle	First Steps	Actions
Use full range of communication strategies		
Achieve consensus on purpose and need		
Address alternatives and all modes		
Consider a safe facility for users and community		

Form to be used by participants.



Now we will take a closer look at the CSS and Agnecy enabling principles.



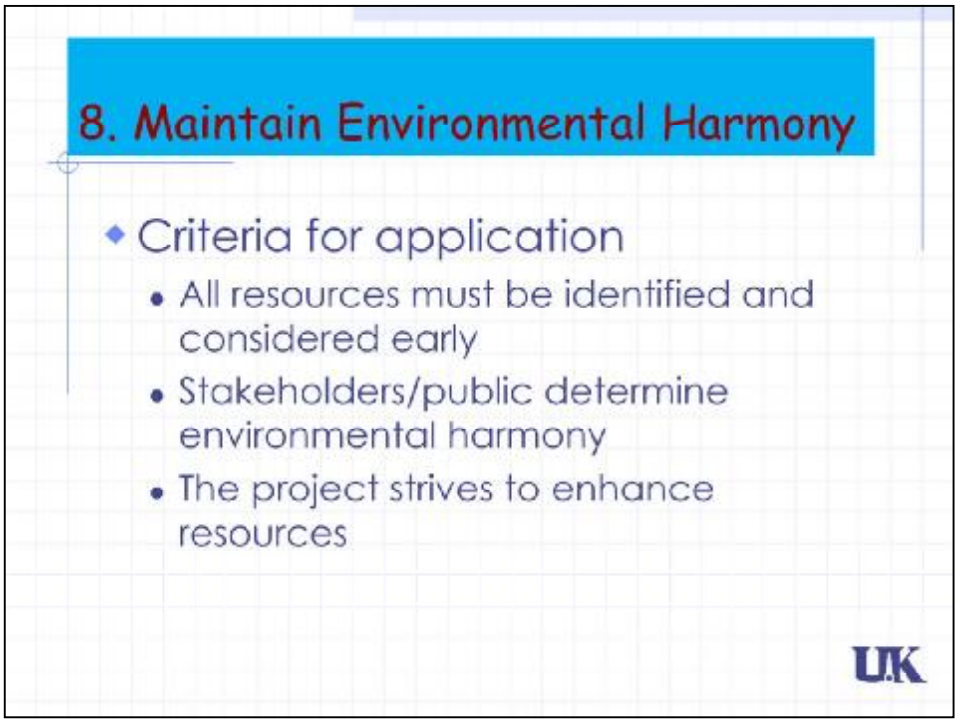
The columns in the building are enabling principles that are the tools that enable a project team. The first three enabling principles are Context-Sensitivity Enablers which achieve and create a lasting value for the community. These are:

Maintain environmental harmony. The resulting project is in agreement with its physical and social setting and minimizes disruption during construction and operations.

Address community and social issues. The resulting project addresses the issues identified through stakeholder/public involvement and provides a solution that preserves/enhances the community's resources and values.

Address aesthetic treatments and enhancements. The project develops aesthetically pleasing solutions that result in improvements compatible with community preferences and project context.

These include the consideration of social/cultural and natural environments and results from the application of other CSS principles.

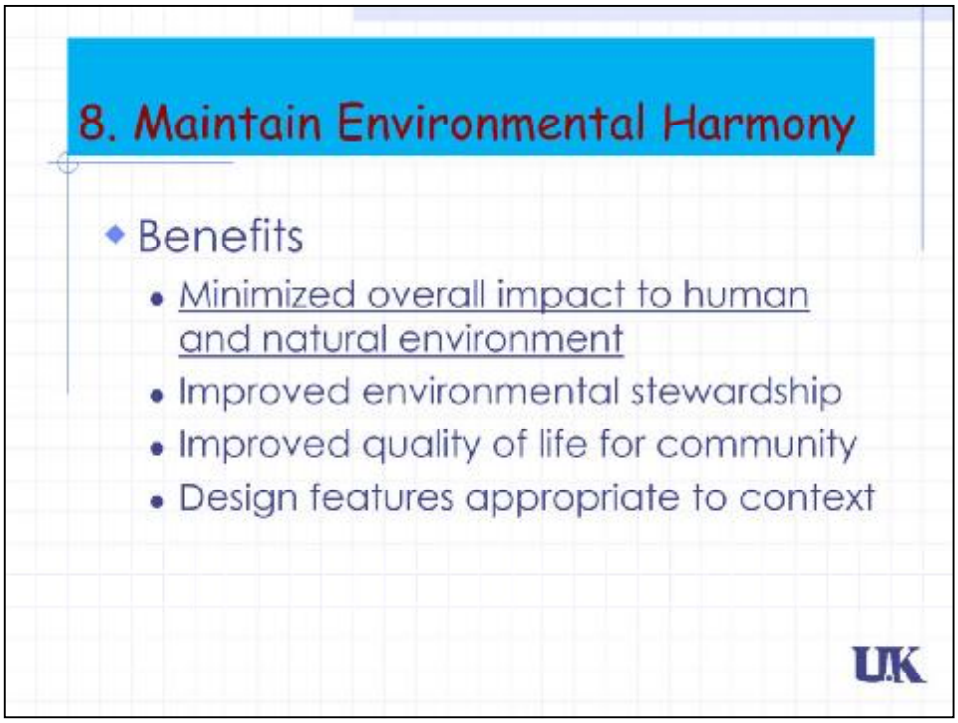


Criteria for application

All natural, human and cultural resources within the study area must be identified and considered in the project development process as early as possible.

Environmental harmony is determined by a variety of stakeholders/public.

The project strives to enhance resources, not merely maintain them.



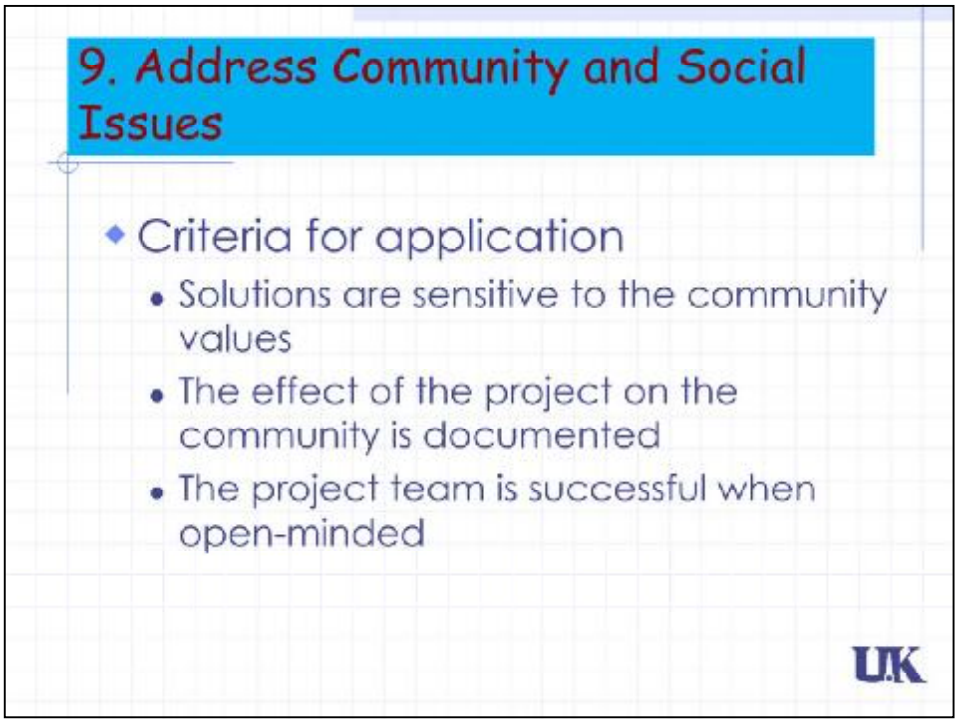
The benefits listed are considered primary with “minimized overall impact to human and natural environment” being the fundamental benefit. Achieving environmental harmony will result in minimized impacts to natural and human environment, since the appropriate issues will be considered and addressed.This benefit can best be determined using quantitative measures of the percent of human and environmental impacts, and the semi-quantitative assessment of expert opinion and community satisfaction.

Extensive landscaping and aesthetic treatments such as grass shoulders, wood timber guardrail, and stone facades matching indigenous outcrops were used to blend the roadway into the surrounding horse farm countryside traversed by the new roadway. Dry-stone walls were prominent along the corridor and approximately three miles of walls were dismantled and reconstructed or constructed.

Historic signature entrances to horse farms were avoided where practical and where impacted, new entrances were built to match the original entrances as part of the contract cost.

Roadway alignment and median widths were selected to minimize impact to matriarchal trees. Utility easement modifications were coordinated to lessen impact on trees. An endangered species, Running Buffalo Clover, was transplanted to a fence-protected easement purchased specifically for this purpose.

Water channel changes were combined to minimize and control erosion.



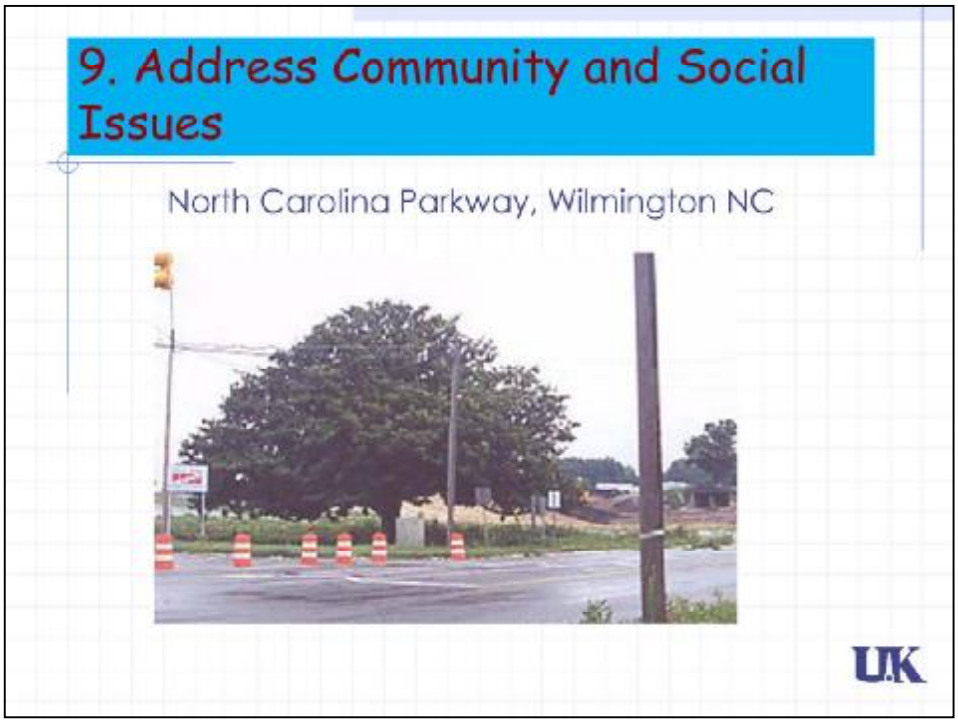
Criteria for application

The project team through public involvement interaction investigates and documents the context of the project in terms of community and social resources and how the project may affect that context.

Proposed solutions are sensitive to the community values and various cultures within the community.

The project team becomes more successful when is open-minded and considers non-traditional solutions that fit the community.

The benefits listed are considered primary with “improved community satisfaction” being the fundamental benefit. Considering community and social issues will improve community satisfaction, since the final design solution will address the community desires as they were formed during the public and stakeholder input meetings.This benefit can best be determined using the semi-quantitative assessment of expert opinion and community satisfaction.



Both the alignment and cross-section were changed from the earlier plans to accommodate two major industries that had since developed adjacent to the originally planned alignment. The alignment was further altered to avoid the possibility of disturbing hazardous wastes near a chemical storage facility. The alignment and overpass assured that an abandoned rail line bed would remain unobstructed for possible future urban rail use.

The section adjacent to the downtown was designed to include land dedicated to parking near the historic area.

An old magnolia in the path of the road near the point it connects with the existing Cape Fear Bridge was “preserved” in a unique way with community involvement that included using the wood to craft benches for the city’s museum and with the help of an arborist over 100 young saplings were reproduced to be placed in parks throughout the city.

Criteria for application

The process for selecting various elements for the aesthetic design involves the appropriate team members and stakeholders/public.

Design elements are selected in accordance to the context of the project and reflect the character of the area.

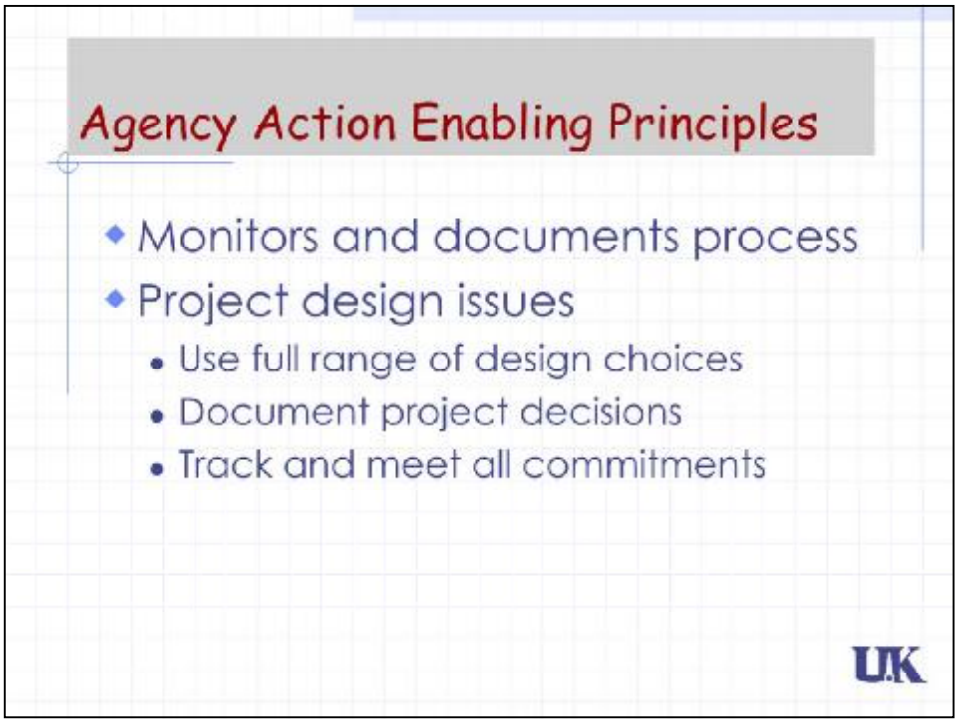
The benefits listed are considered primary with “improved community satisfaction” being the fundamental benefit. Providing aesthetic treatments will improve community satisfaction, since the final design solution will address the community desires as they were formed during the public and stakeholder input meetings. This benefit can best be determined using the semi-quantitative assessment of expert opinion and community satisfaction.

The project incorporated considerable use of aesthetic treatments and enhancements. Included were stone facades for an overpass bridge, landscaping, and a $500,000 contract for decorative plantings.

In addition, a multi-use path was constructed. Local civic groups assisted with additional tree plantings and annual flower plantings in raised medians along the roadway.

The city and a local university created stone gateways along the road. The city also provided decorative lighting and long mast light signals to be incorporated on the project.

The Kentucky Transportation Cabinet (KYTC) is currently in negotiations with the city to turn over land-locked property to create a city park.



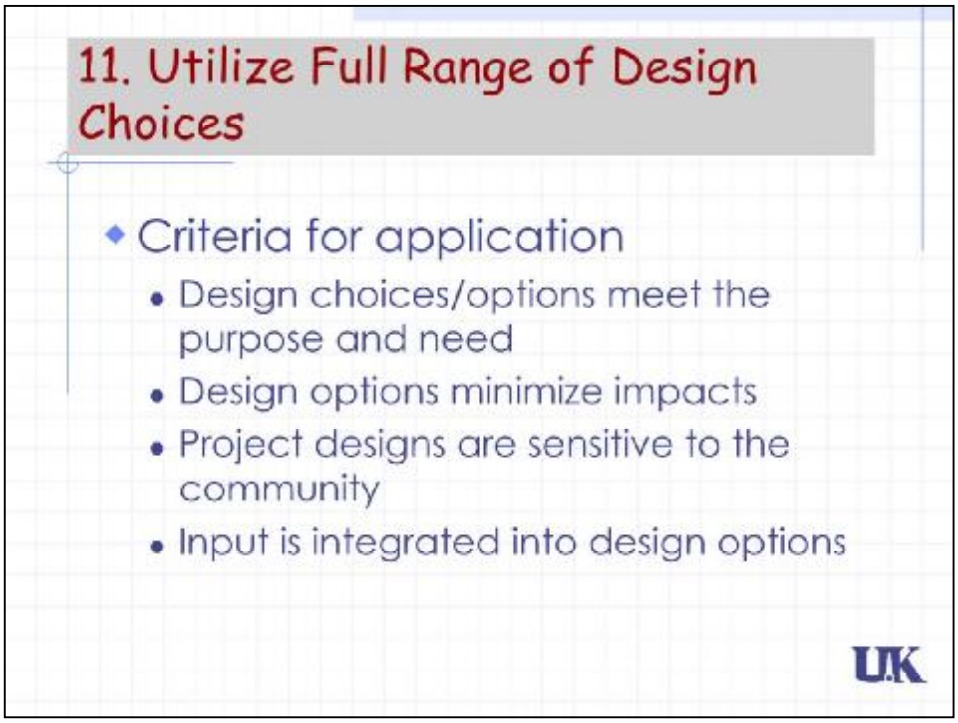
The next three columns are the Agency Action Enabling principles that enable a project team to use agency resources effectively. These are:

Utilize full range of design choices. All appropriate design options are considered and evaluated by the project team based on agreed project context criteria and input of the stakeholders/public.

Document project decisions. All project decisions are documented to create a clear and open record, assure continuity through all project phases and provide a framework for measuring results.

Track and meet all commitments. All commitments made in the various phases of the project to the stakeholders/public are documented and tracked to assure that they were met in the solution.

These include the issue of project design choices range provided by the design professional along with the more administrative/management project responsibilities of the agency.



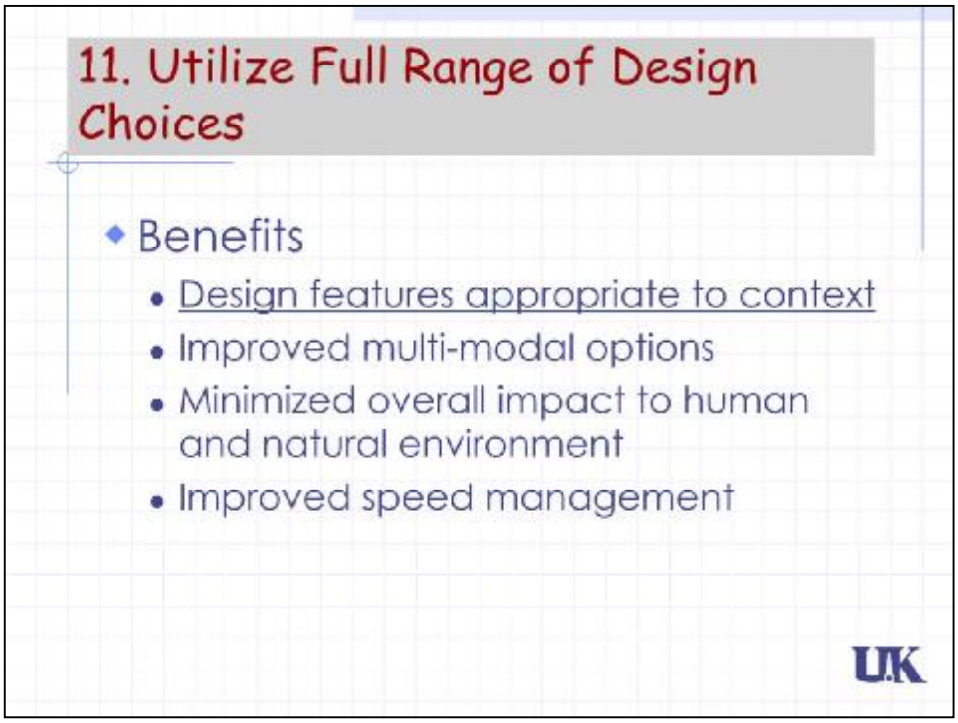
Criteria for application

Alternative design choices/options are developed that meet the purpose and need of the project.

All design options developed must *avoid, minimize and mitigate* impacts to natural, human and cultural resources and attempt to *enhance* these resources where possible.

The project designs are sensitive to the community values and various cultures within the community.

Stakeholder and public input is collected and integrated into design options.



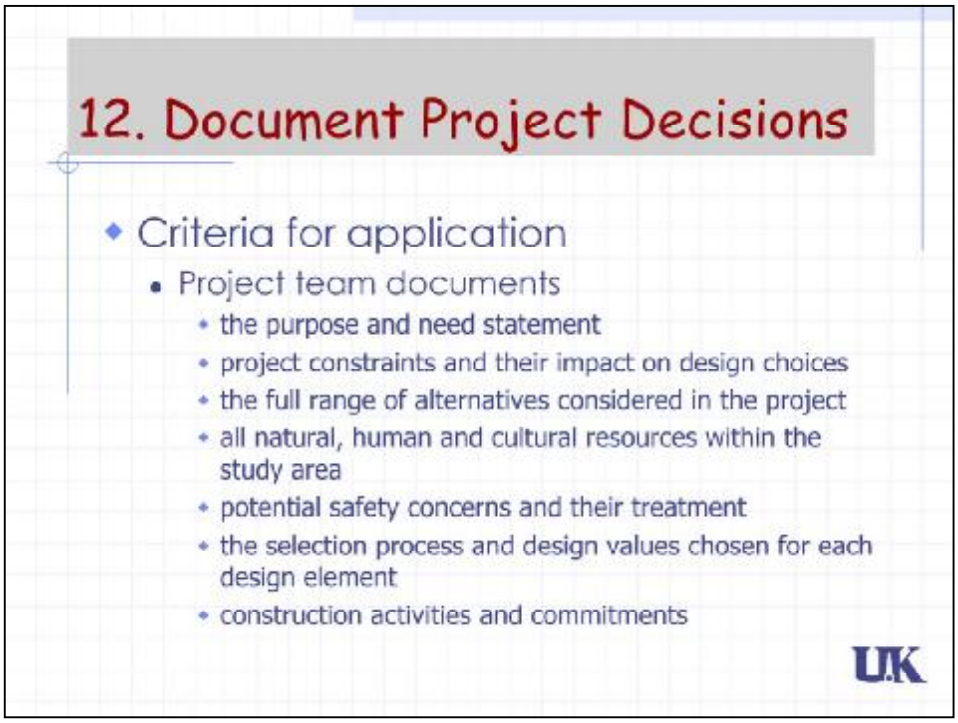
The benefits listed are considered primary with “design features appropriate to context” being the fundamental benefit. Utilizing a full range of design choices will result in developing a project solution that will have design features that are appropriate to the context since all concerns will be considered and addressed in a proper manner. This benefit can best be determined using the semi-quantitative assessment of expert opinion and community satisfaction.

Preliminary alternatives identified and evaluated included.:

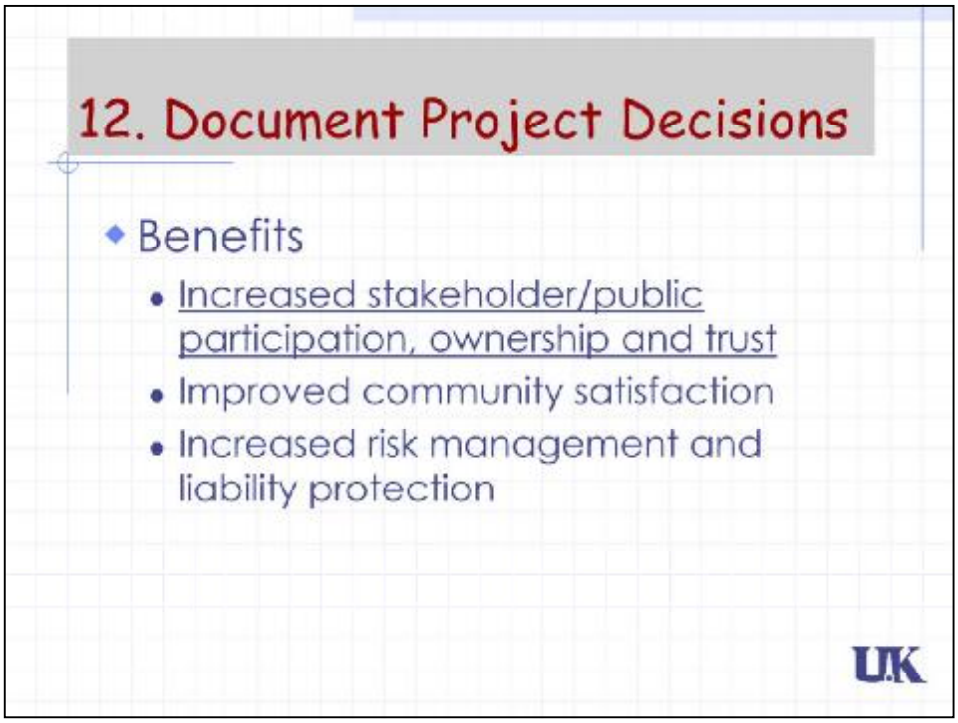
- The No-Build, which functions as a baseline for comparison
- Transportation Systems Management (TSM)/Travel Demand Management (TDM)
- Four-Lane Divided
- Five-Lane Undivided
- Cherry Hill Road Full Bridge Interchange Option

The alternatives were refined by using available options to the design -- the four-lane and five-lane options were evaluated to serve bicycle traffic using both a wide (14 ft) shared outside lane, and an independent 5 ft bicycle lane. The evaluation showed that the 5 ft bike lane did not require additional ROW or have increased impacts and would better serve bicycle traffic.

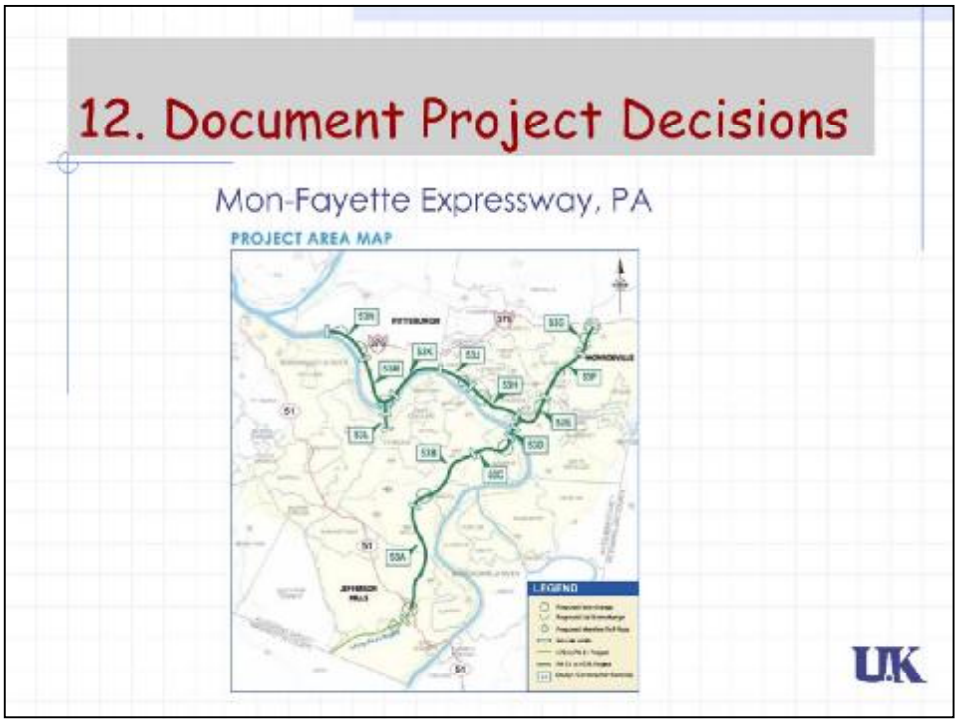
A variable tree-lawn width was used along the corridor to minimize right of way impacts. Retaining walls and lane shifts were also used throughout the project to fit the roadway into the community.



There are several documents that a team needs to maintain and retain for documenting decisions and actions undertaken. These documents become the record of decision and could be used in the future to support decisions made and could be used in legal cases. Providing adequate documentation can ensure proper communication between the project team, the public and reviewing agencies. The documentation of design exceptions provides the means for the designer to go on record regarding a recommended context-sensitive design solution. In addition, the necessary information is recorded in sufficient detail to support the transportation agency's decision and deviate from the typical design. One of the most important aspects of CSS as related to construction activities is to clearly document and communicate all project commitments. The use of documentation in the project development process is a means of achieving an appropriate level of safety, while managing liability exposure.



The benefits listed are considered primary with “increased stakeholder/public participation, ownership and trust” being the fundamental benefit. The documentation of project decisions will increase stakeholder trust in the process, since there will a record of the decisions made throughout the entire process and it could be used to support all choices made. This benefit can best be determined using the quantitative measure of stakeholder involvement and semi-quantitative assessment of expert opinion and community satisfaction.



The project team hired a facilitation consultant who also tracked and documented all efforts. Goals and objectives were set for the various meetings and the results for each meeting were documented and summarized in a detailed report.

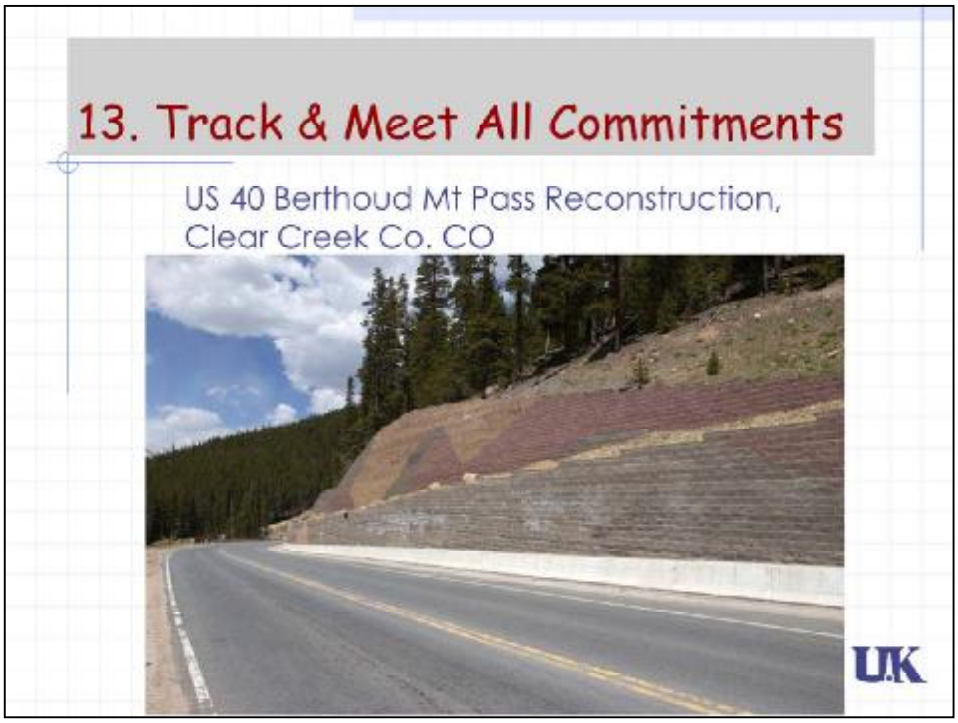
Criteria for application

Identify and document project commitments in all project phases.

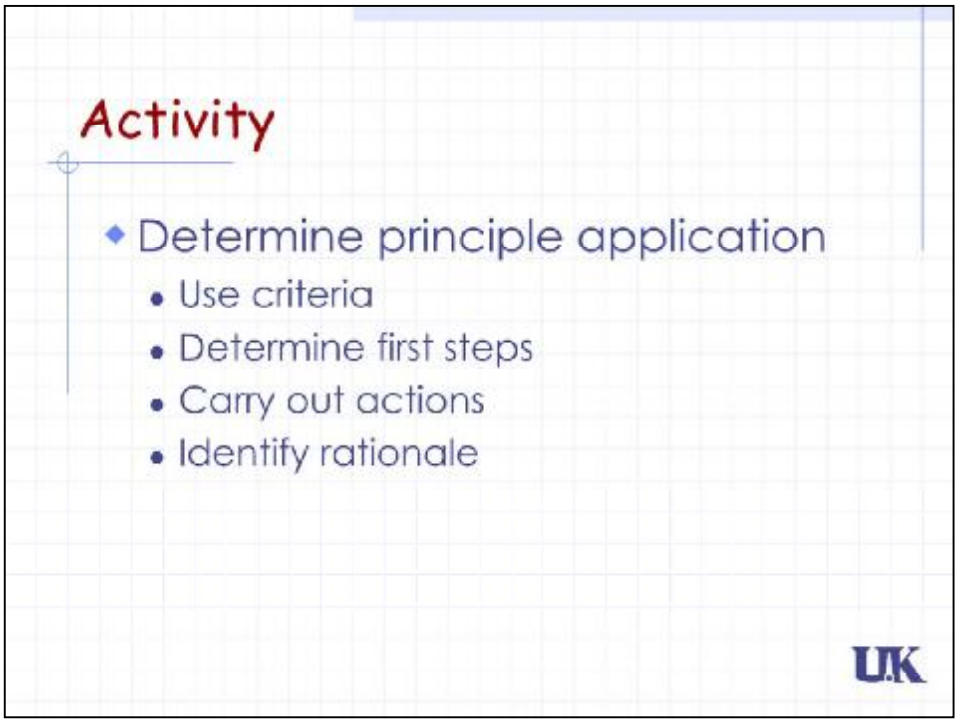
Ensure that all project commitments are satisfactorily addressed prior to project completion. There is also a need to determine who will assess the level of compliance with the commitments made.

Maintain all project commitments throughout the project development process and over the service life of the facility.

The benefits listed are considered primary with "increased stakeholder/public participation, ownership and trust" being the fundamental benefit. Tracking and meeting project commitments will increase stakeholder ownership, since it will demonstrate that their input and commitments made during the various project phases were met, trust, since the commitments made were followed through, and possibly participation in future projects, since it will indicate that involvement is considered important. This benefit can best be determined using a quantitative measure of stakeholder involvement and semi-quantitative assessment of expert opinion and community satisfaction.



The culmination of the extensive public involvement was the completion of the EA with a FONSI, plus ongoing working meetings with stakeholders through the design and construction phases. CDOT does not have a formalized system to track commitments in the Berthoud Pass EA into the design and construction. The EA was required reading for the design teams working on projects, as well as the construction engineers administering contractor's work. Regular meetings were held throughout the design and construction phases that included federal resource agencies and CDOT environmental staff. This helped insure that commitments in the EA were followed through. This approach was successful. With construction virtually complete, all commitments made have been addressed.



Based on the case study, participants are to work with their group to accomplish the following task:

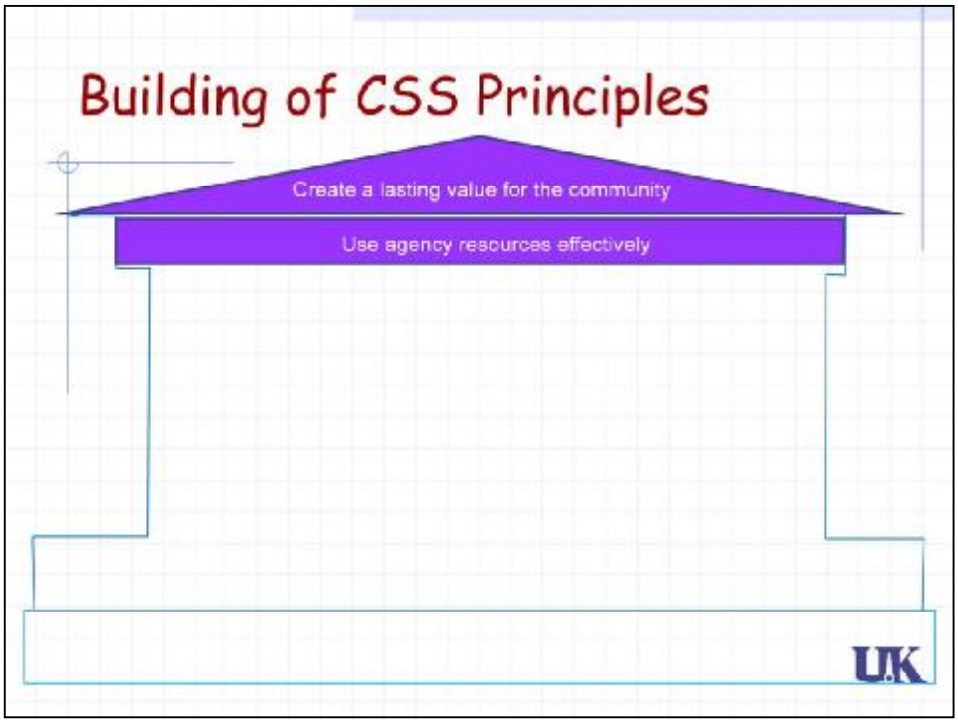
1. For all CSS Enabling principles determine the required first steps for proper application. Use the criteria of application to determine how each principle will be applied. This should identify the components or steps required for applying the principle.

2. For the assigned principle, the team should identify the required actions (i.e. identify specific elements required for the application) to fulfill the first steps identified. For each of the assigned principle, the team needs to identify the rationale for the actions taken.

Principle Worksheet 4

Principle	First Steps	Actions
Maintain environmental harmony		
Address community and social issues		
Address aesthetic treatments and enhancements		
Use full range of design choices		
Document project decisions		
Track and meet all commitments		

Form to be used by participants.

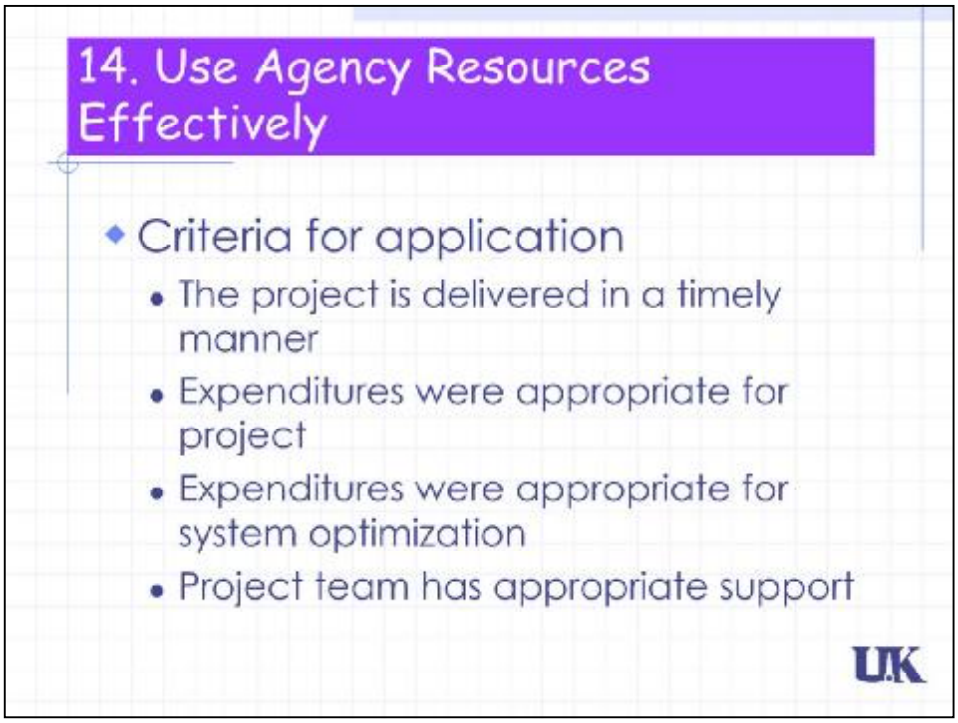


Now we will take a closer look at the long range principles.

The top of the CSS building represents the long-range or over-riding principles appropriate to the agency and the community.

Use agency resources effectively. The project has used time, expertise and budget in an effective way to deliver the project and conserve resources.

Create a lasting value for community. The resulting solution becomes an asset to the community with involved parties agreeing that it meets or exceeds expectations and is compatible with the long term vision of the community.

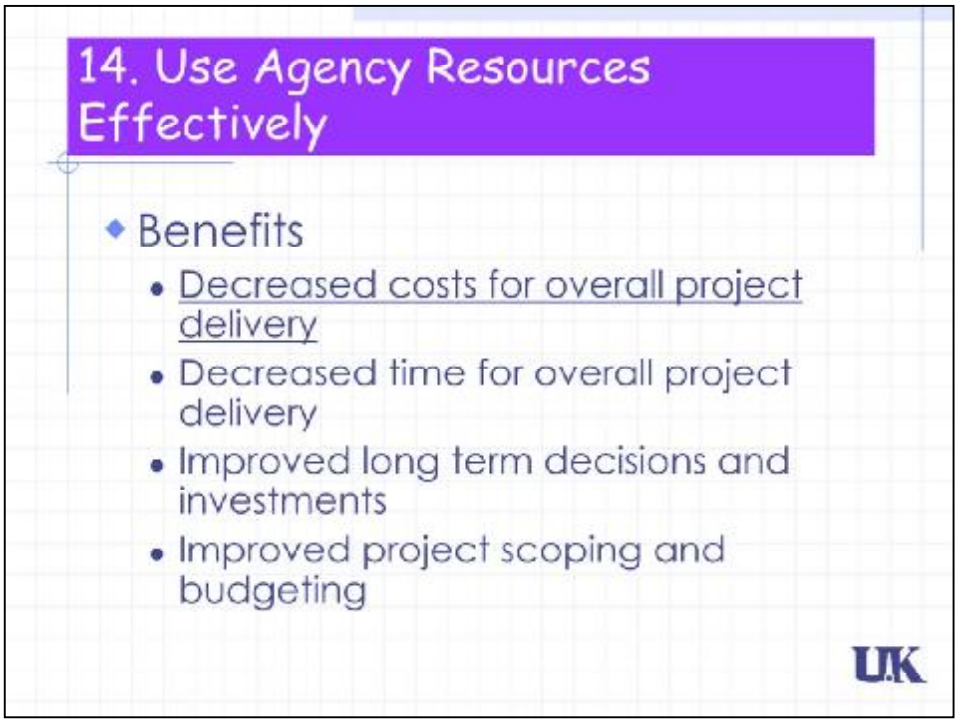


Criteria for application

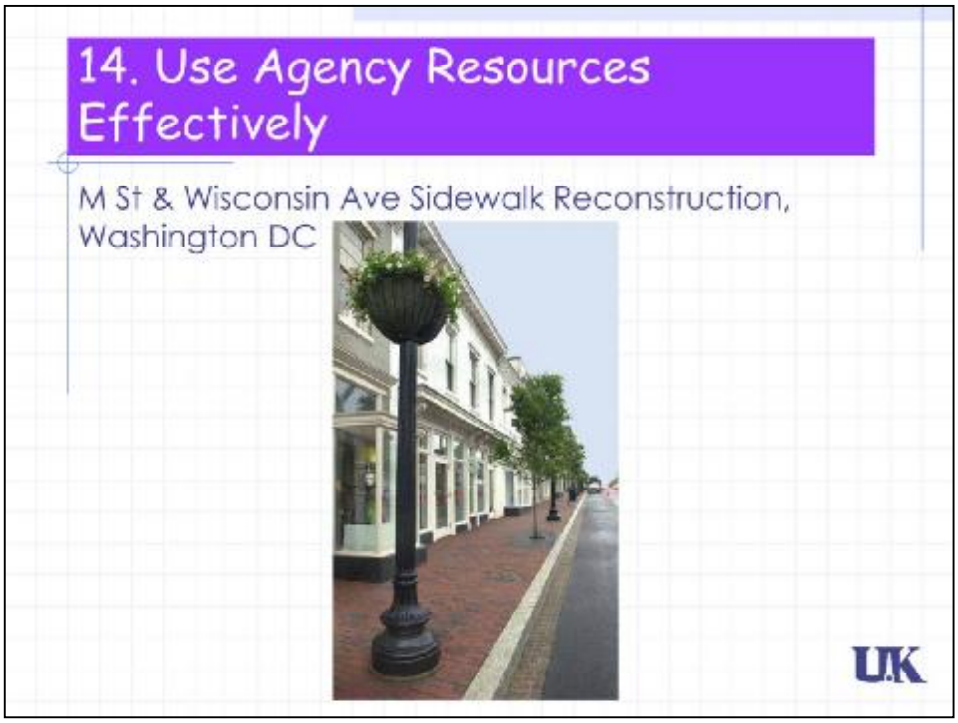
The project is delivered in a timely manner.

Expenditures were appropriate for the project scope/context.

The project team has the appropriate support and resources to effectively carry out their task.



The benefits listed are considered primary with “decreased costs for overall project delivery” being the fundamental benefit. The effective use of all project resources will have as an immediate result the decreased cost for overall project delivery, since it will optimize all resources (interdisciplinary team, stakeholder, and public) to their maximum potential. This benefit can best be determined using the quantitative measure of the total project delivery cost and semi-quantitative assessment of expert opinion.



DCDOT coordinated with utilities with rights-of-way in the sidewalk area to jointly access the sidewalk areas for each entities repair/upgrade requirements. This minimized disruption, downtime to the facility for sidewalk users, allowed joint use of signage, minimized public/stakeholder contact requirements, and allowed sharing of equipment.

All parties agreed to work at night to minimize loss of daytime parking and income to local businesses. This allowed for cost sharing and prevented undesirable damage to the sidewalk by eliminating succeeding follow-on utility work.

By working with the utilities, DCDOT was able to compress fifteen years of construction work into four years.

Criteria for application

The project meets the purpose and need statement.

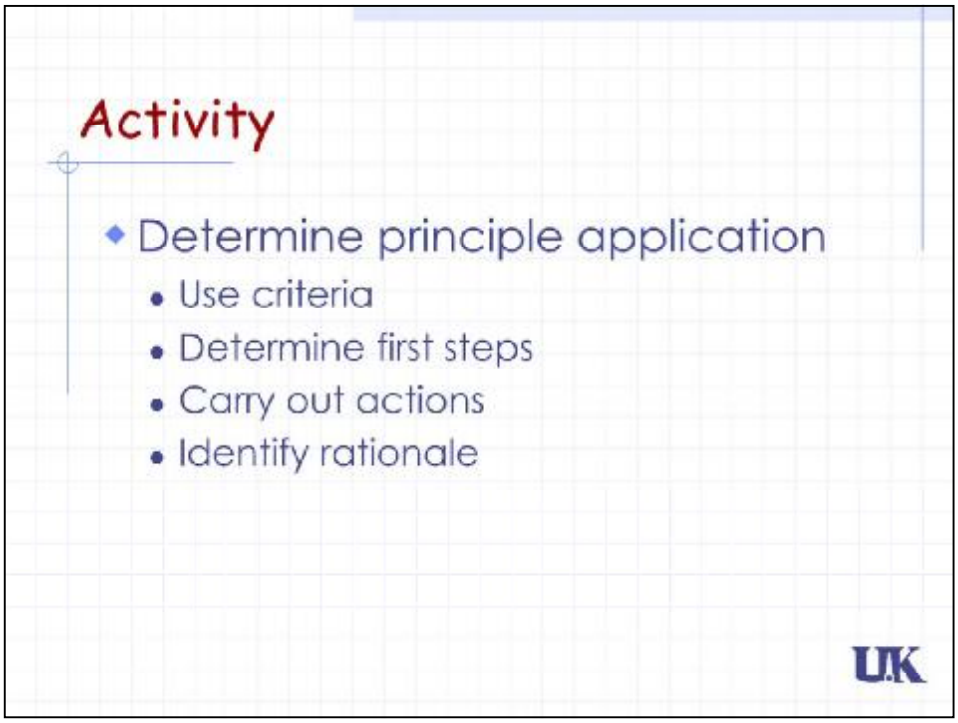
The project is compatible with long range community plans.

The project incorporates solutions that move beyond addressing mobility and address quality of life issues and community values.

The project is sustainable in terms of social, economic and ecological impacts.

The benefits listed are considered primary with "improved quality of life for community" being the fundamental benefit. A project that creates a lasting value to the community will improve quality of life, since it will be a project reflecting the community vision and address the public and stakeholder issues and concerns. This benefit can best be determined using a semi-quantitative assessment of expert opinion and community satisfaction.

The project team stated that the process developed for this project resulted in achieving the safety The 12300 South DB Project minimized disruption to the community by implementing UDOT's first "turn-key" right-of-way program. UDOT assembled a team of experienced professionals to assist project personnel, local governments and community groups with solving problems of property owners and tenants. The group's focus and innovative solutions increased the public's positive perception of the project and UDOT. Incorporating all landscape and aesthetic treatments that highlighted the natural, historical, and present characteristics of the cities of Draper and Riverton created a pleasant and safe environment that promoted walkability and bikeability and improved the quality of life for the community.



Based on the case study, participants are to work with their group to accomplish the following task:

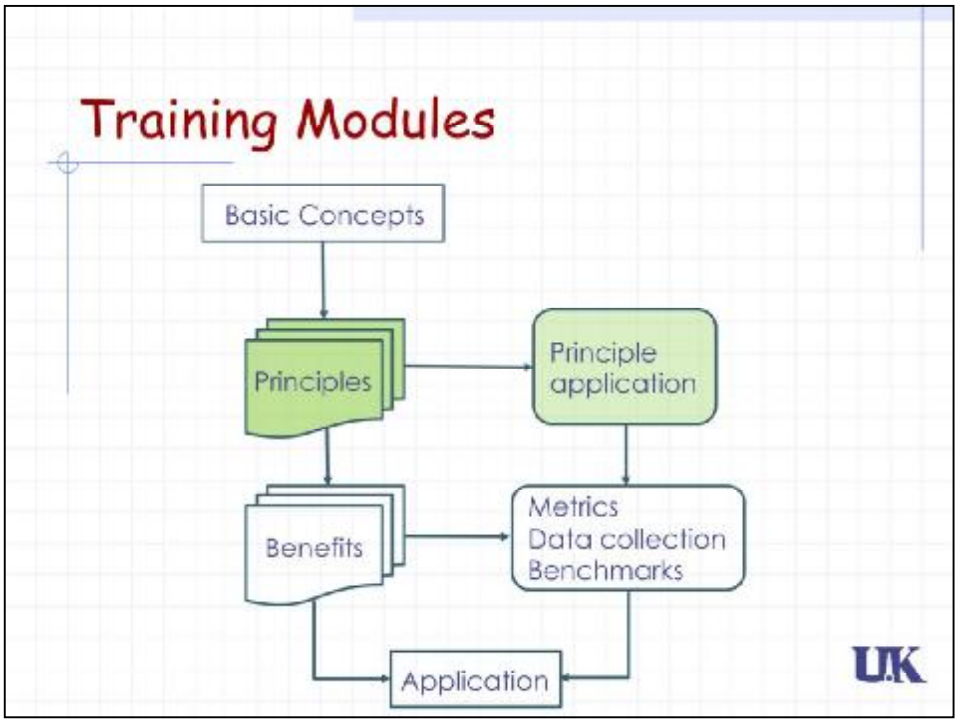
1. For all Long Range Project principles determine the required first steps for proper application. Use the criteria of application to determine how each principle will be applied. This should identify the components or steps required for applying the principle.

2. For the assigned principle, the team should identify the required actions (i.e. identify specific elements required for the application) to fulfill the first steps identified. For each of the assigned principle, the team needs to identify the rationale for the actions taken.

Principle Worksheet 5

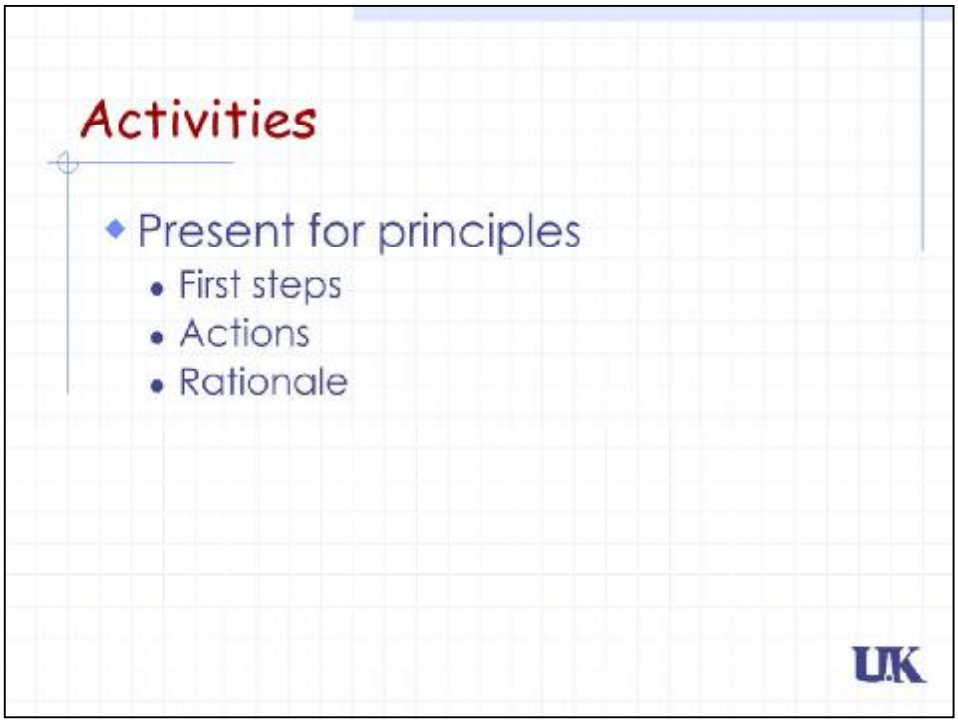
Principle	First Steps	Actions
Use agency resources effectively		
Create a lasting value for community		

Form to be used by participants.



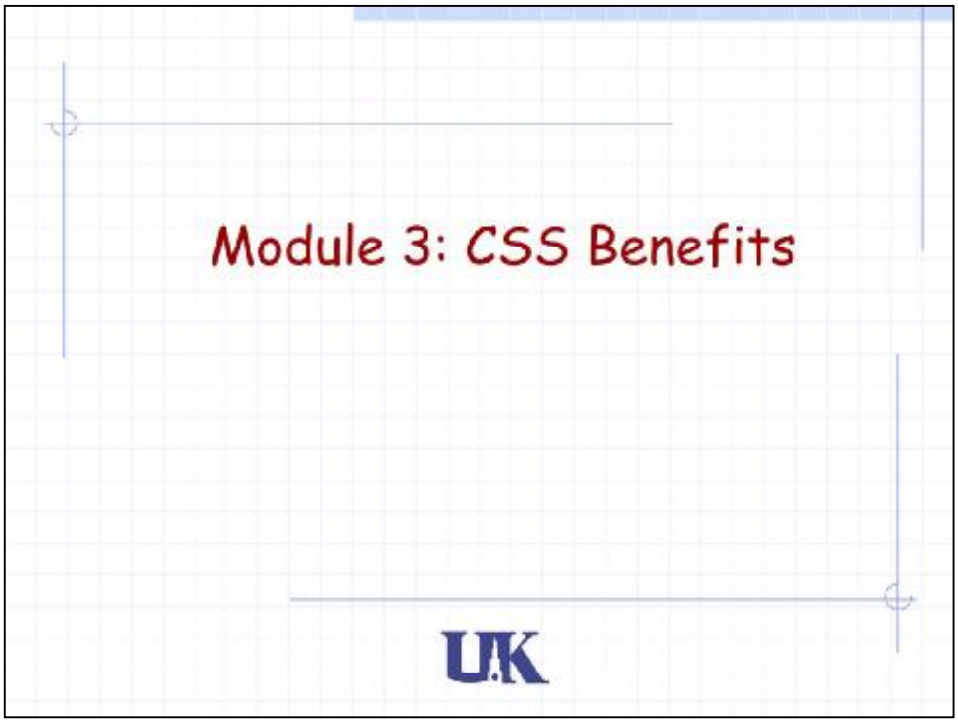
This concludes the discussion on the principle application. In this section we have addressed how principle intensity varies with respect to the individual project attributes and how the criteria for application can be used to guide the project team in selecting the appropriate intensity and actions to meet the project requirements. Each of the principles have also been introduced and discussed to identify how proper application can help the project realize the fundamental benefits.

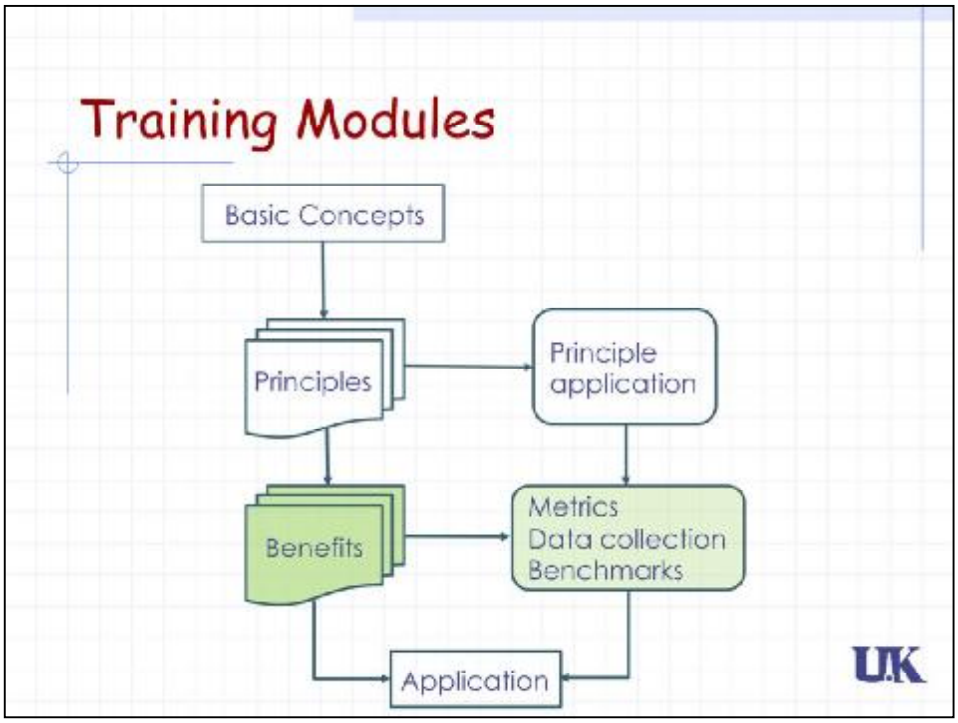
The first activity in this example focused on applying the principle application concepts through the use of the previously summarized example.



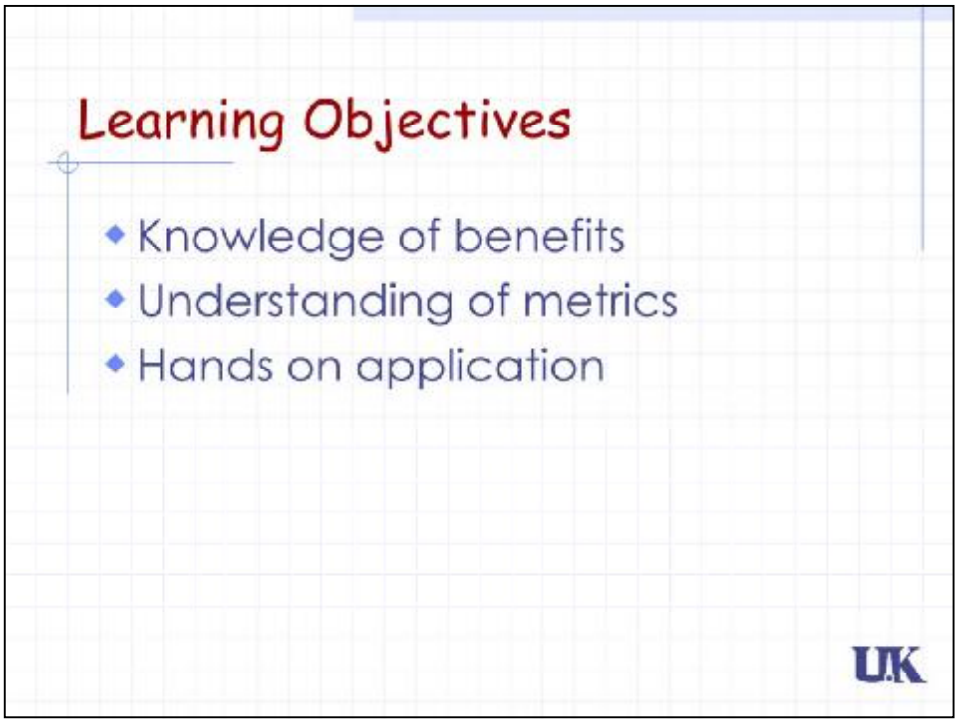
Based on the case study, participants are to work with their group to accomplish the following tasks:

1. Each team should present the work completed for the assigned principles by explaining the required first steps and actions to apply the principle and rationale for required actions for proper application of the principle.


Module 3: CSS Benefits
UK



This module deals with benefit selection and evaluation. Specifically we will address how to select the benefits to be measured, how to measure those benefits and discuss special issues that must be addressed in order to feed that information into either of the four identified applications.

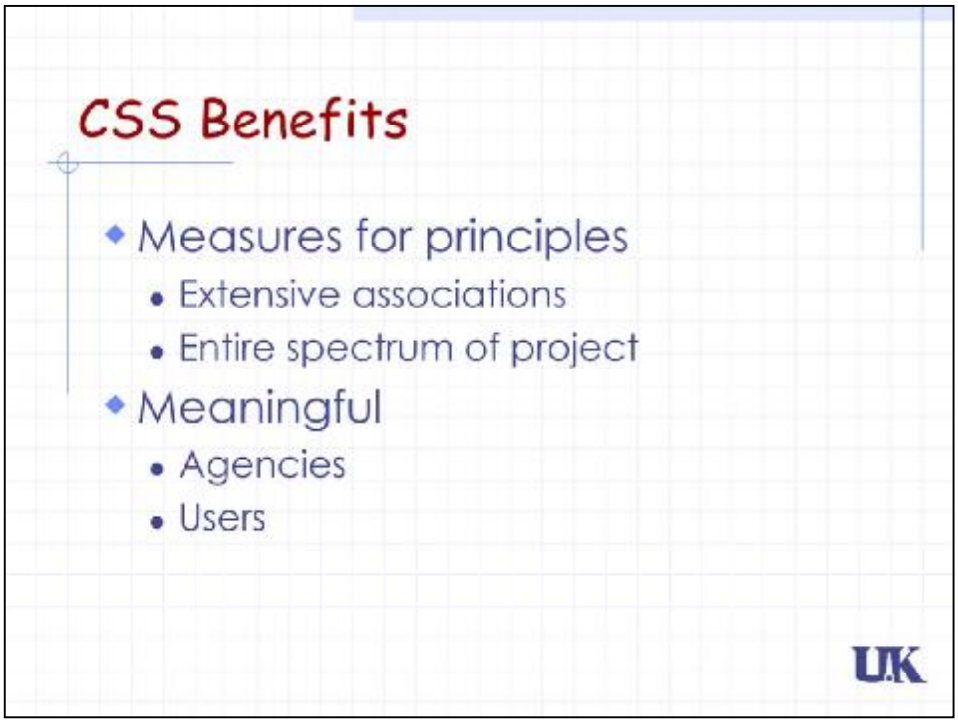


The objective of this module is to present and define each of the 22 CSS benefits identified through NCHRP 642. The various metrics for each benefit will then be reviewed to develop a thorough understanding of its application use and limitations. Following this module, we will conduct the next stage of the example in order to develop a hands on understanding of the benefits and their metrics.

At the completion of this module participants should be able to:

Comprehend benefits, their metrics and benchmarks.

Select benefits for use in project application.



As presented in module 1 through the principle-benefit matrix, the 22 benefits are direct measures of the application of the 15 principles. The 22 benefits capture potential outcomes throughout the entire project development process. The benefits have extensive associations with numerous principles, which underscores the need to record both the principle outcome as well as benefit accrual or project outcome. The benefits are grouped in two basic categories based on who accrues the benefits, either the transportation agency or the users. This differentiation is needed since some of the benefits are internal to the agency's operations and will have no clearly understood impact on the users. This allows the agency to determine which benefits could be shared internal to the agency and those that the users will best perceive.

The benefit selected must be meaningful, either to the project or agency depending upon the purpose of the evaluation. Selecting a small number of benefits allows for reduced data collection needs and eliminates the collection of unused data. The purpose of the analysis (project improvement, project justification, agency CSS justification or agency project delivery improvement) will also contribute in selecting benefits. For example, agency wide evaluations may focus only on fundamental benefits while project evaluations may require the use of primary benefits.

As stated earlier the 22 benefits can be categorized Agency Benefits and User Benefits. These 11 benefits are identified to apply to the agency. Most of these are associated with project budget, schedule, and performance. Others such as improved stakeholder/public feedback identify ways to improve community satisfaction for the project or identify alternative resources for enhancements through increased partnering opportunities.

1. Improved Predictability of Project Delivery relates to the ability of a transportation agency to reliably program and to deliver projects within reasonable time limits.

2. Improved project scoping and budgeting. All vital concerns are effectively identified, appropriate actions incorporated and project costs estimated prior to lettings resulting in minimal design changes.

3. Improved long term decisions and investments. This benefit relates to agency actions that improve the environment on a local or regional basis, provide stimuli to local economy, and improve social equity by creating jobs and remedying social problems.

4. Improved environmental stewardship. The resulting project promotes ecologically sound outcomes that minimize negative impacts while promoting long-term sustainable environmental benefits.

5. Optimized maintenance and operations. Proper consideration of maintenance and operational issues during project development can provide significant cumulative benefits once a facility is completed and in service.

6. Increased risk management and liability protection. The documentation of design exceptions is a significant part of the process, ensuring that designers limit their liability when using flexible design and varying from adopted guidelines.

7. Improved stakeholder/public feedback. This benefit relates to a transportation agency obtaining information from stakeholders/public about specific transportation project needs or about the suitability of proposed transportation project details.

8. Increased stakeholder/public participation, ownership, and trust. This benefit relates to a high degree of stakeholder/public involvement in the transportation project development process that results in improved stakeholder/public opinion about the transportation agency creating a reservoir of goodwill and trust for future transportation projects.

9. Decreased costs for overall project delivery. This benefit relates to reduced total agency costs for transportation project development compared to conventional non-CSD&S projects.

10. Decreased time for overall project delivery. This relates to reduced total agency time for transportation project development.

11. Increased partnering opportunities. Stakeholder involvement will enhance the opportunities for joint development by identifying possible areas where outside funds could be jointly pursued, and opportunities for leveraging mitigation/enhancement funds with other grants, etc.

These are 11 benefits identified to apply to the user. Most of these are associated with project mobility options, safety, and minimized impact. All of these benefits contribute to the community satisfaction and livability.

12. Minimized overall impact to human and natural environment. This benefit results from a project that has limited intrusion on natural resource and existing communities.

13. Improved mobility for users. This benefit addresses improving mobility for transportation facility users and providing a balanced mobility for all users according to the purpose and need of the project.

14. Improved walkability and bikeability. Improving both walkability and bikeability, as part of transportation project, are generally supplementary concerns. Sometimes those improvements can be very beneficial to overall transportation goals and community development.

15. Improved safety (vehicles, pedestrians, and bikes). The benefit is improved safety for vehicles, pedestrians and bikes as appropriate to a project.

16. Improved multi-modal options (including transit). Accommodating multi-modal options and their connectivity can be achieved by thoughtfully considering a range of modal options at the appropriate stage of project development.

17. Improved community satisfaction. A CSD&S project will be integrated into the community and, over time, it will be perceived as an enhancement.

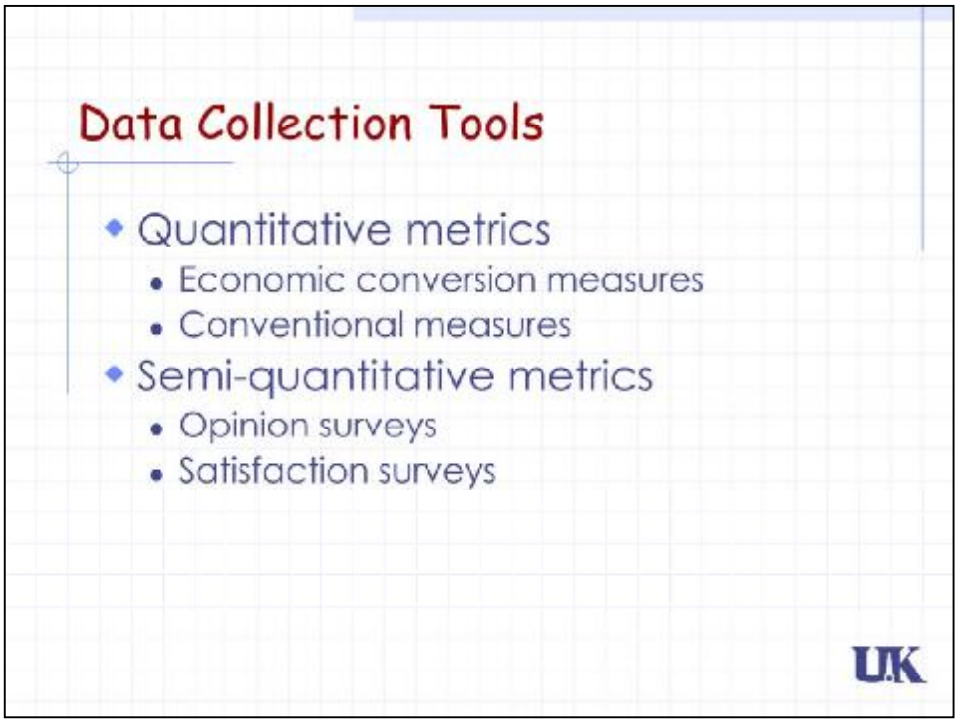
18. Improved quality of life for community. A successful CSD&S project improves the overall quality of life for members of a community.

19. Improved speed management. Proper speed management provides a roadway that influences speeds that motorists employ while properly accommodating those speeds by design.

20. Design features appropriate to context. Obtaining a facility that matches the context of the area in which it is placed is a fundamental benefit of CSD&S. Each project has unique requirements that must be aligned with the setting in which it resides in terms of community, environmental resources, etc.

21. Minimized construction related disruption. While temporary, construction work can severely impact motorists, communities and the environment. Steps necessary to minimize construction disruption should be developed prior to the onset of work and included in the project commitments.

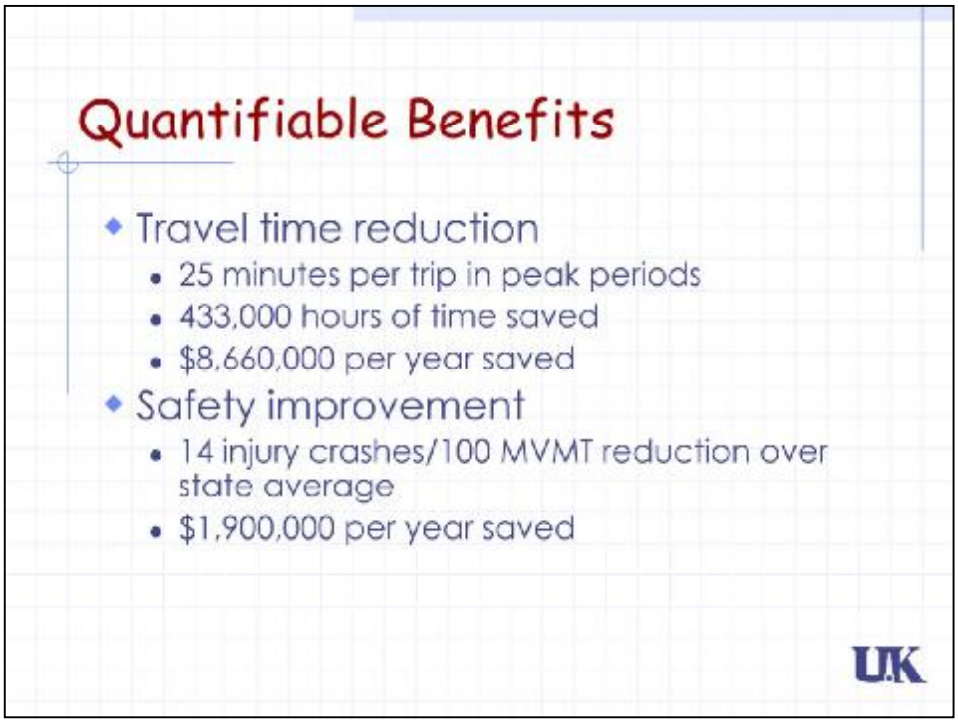
22. Improved opportunities for economic development. Stakeholder involvement will enhance the opportunities for economic development by identifying possible areas where such opportunities can arise.



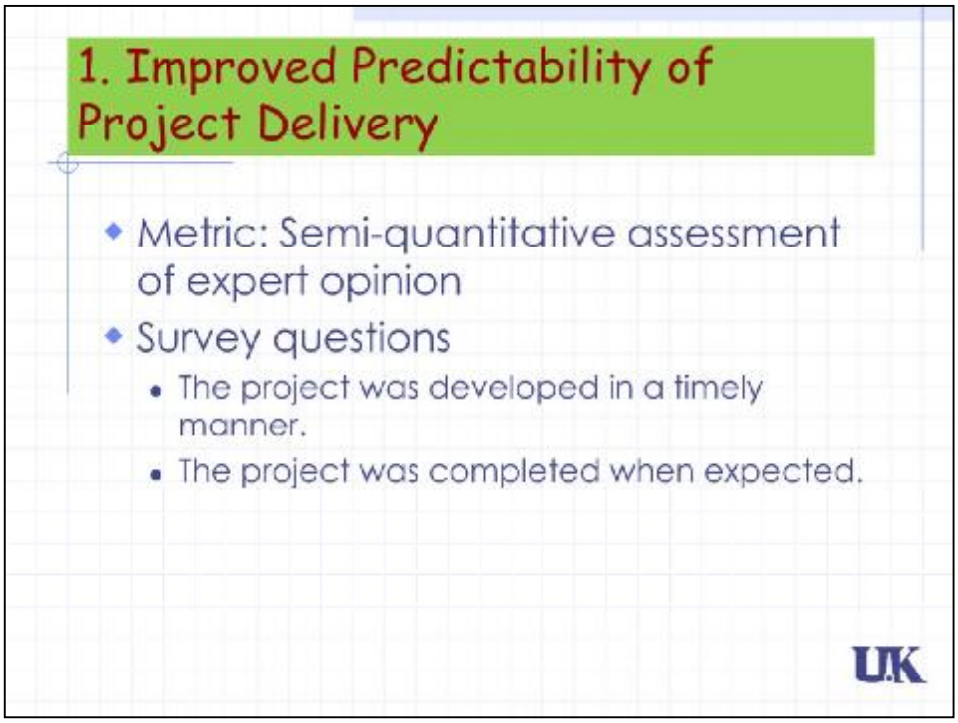
Two types of benefit measures are used to develop benefit assessment.

Quantitative metrics are those benefits that can be objectively quantified through measurement or counting. Some of these measures are conventional measures such as number of lane miles, delay estimates, acres of impacted land etc, while some can readily be converted into economic measures (dollars). Tables are provided that could be used in standardizing the appropriate data to be collected, collecting the quantitative data and summarizing the data.

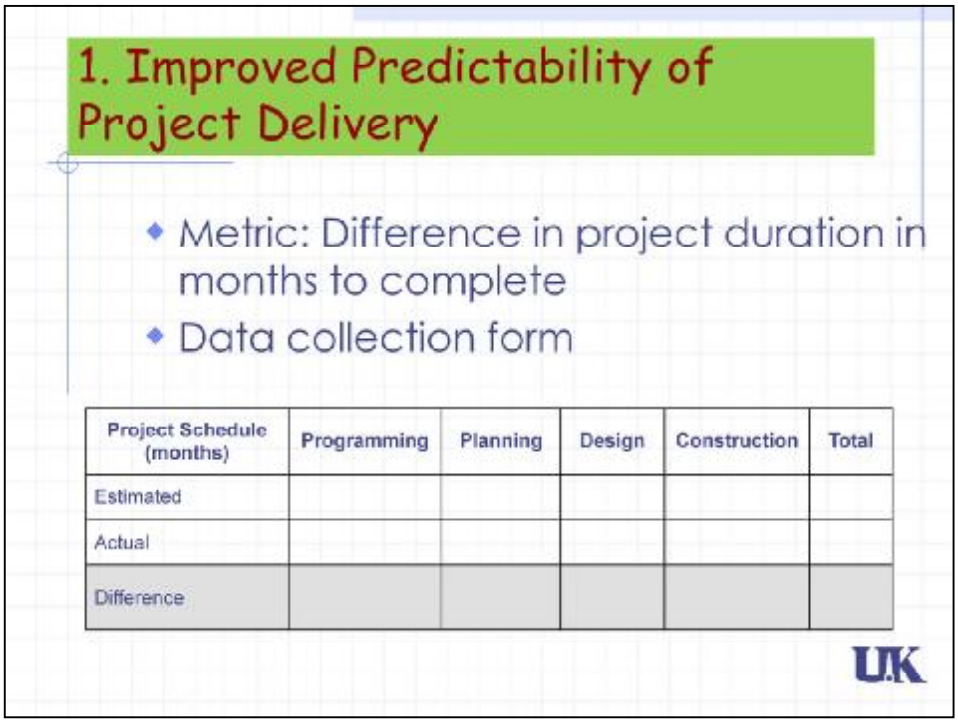
The semi-quantitative measures present questions that could be used in a survey identifying the appropriate audience, i.e. team members or stakeholders/public. These measures focus on expert opinion (team members) and opinion (stakeholders and public) identifying how well the respondent perceived the benefit to accrue. Semi-quantitative measures also measure satisfaction of the respondent in terms of how well the project and/or project development process was performed.



The project team decided to quantify in dollars those benefits for which cost data was readily available. These included the travel time reduction for improved mobility and crash reduction for improved safety. The travel time reduction resulted in 433,000 hours of saved travel time based on 25 minutes per trip for each of the peak hours resulting in $8,660,000 per year (based on TRB Research Circular 477). Injury crashes were similarly reduced by 14 per 100 million VMT resulting in total savings of $1,900,000 per year (based on FHWA HRT-05-51).



Improved predictability of project delivery is measured with both a semi quantitative and quantitative metric. The semi quantitative metric is a measure of expert opinion captured by surveying the project team. It measures two items “The project was developed in a timely manner” and “The project was completed when expected.” While these may appear to be the same the first addresses more the reasonableness of the project development process, while the second addresses its concurrence with the schedule. A project could drag on for years in an untimely manner, however, that may be in accordance with the schedule. While a project also may develop reasonably well but be slightly delayed by unforeseen problems which are readily addressed.



The quantifiable metric measures the difference in project duration by project phase. This information and data is typically available in project files. The planned or estimated duration can be compared to the actual duration by project phase and overall. Verification is possible by query to project manager/team. It is anticipated that the use of an interdisciplinary team and improved scoping provided by the CSS approach will allow for a project schedule which reduces the difference in scheduled and actual completion.


Application Overview
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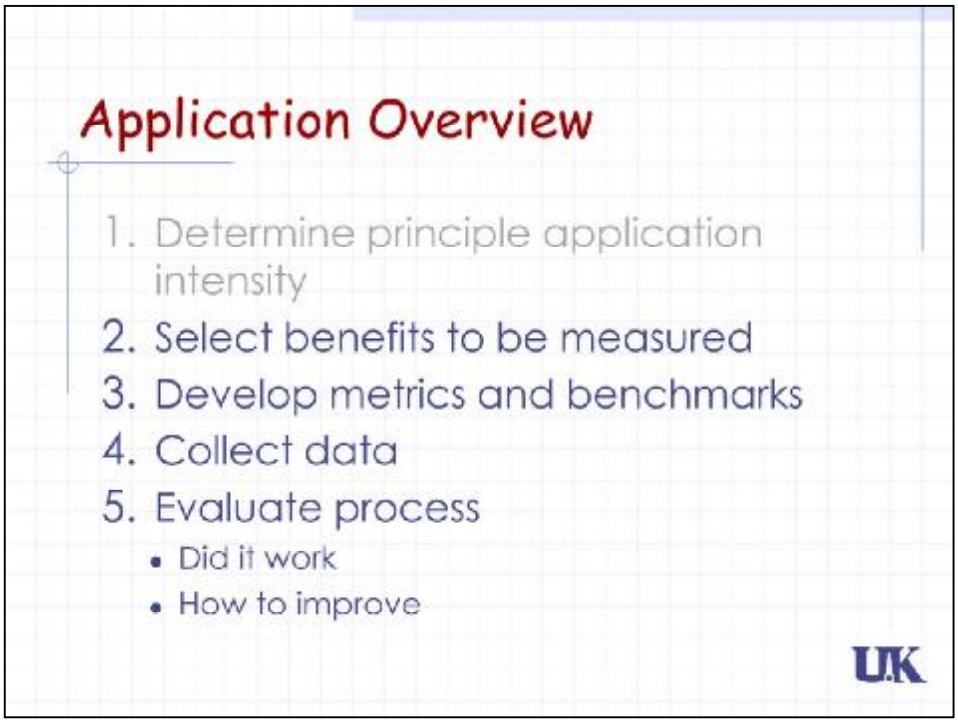


Of the five step process, this section discusses steps 2, 3, 4 and 5. These include:

Identification of those benefits that will be evaluated on the project.

The establishment of benchmarks, by which to evaluate performance and

Defining a data collection process throughout the project to ensure that critical data points are not missed.

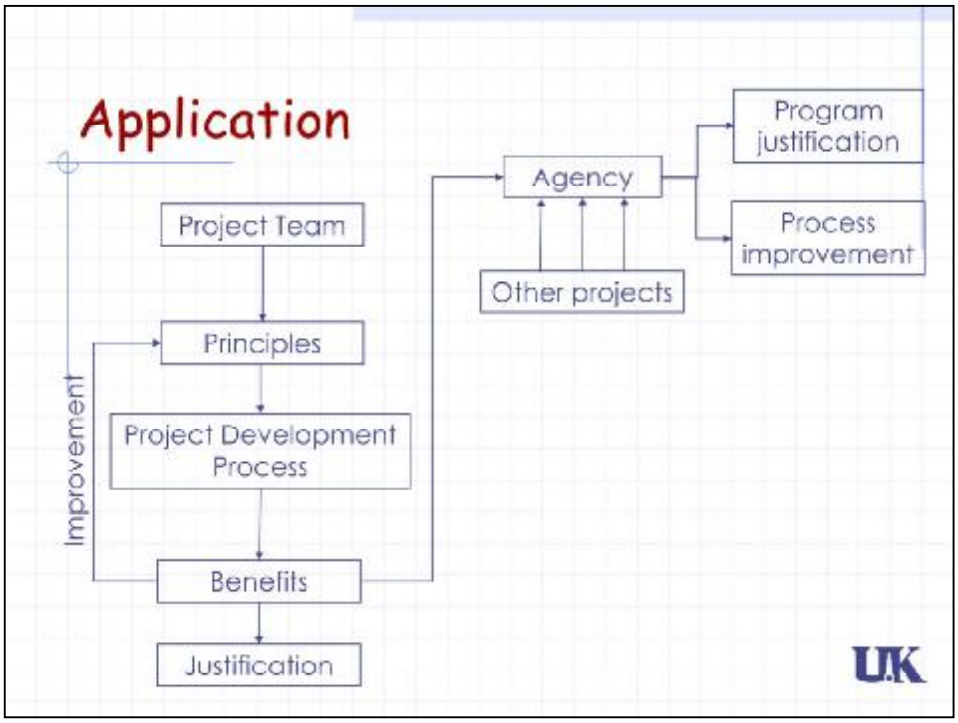
Conducting the evaluation to determine the level of success of the project.

By linking performance to the CSS action principles the evaluation can also be used to identify areas of improvement for subsequent stages of the project or for use on other projects.

Benefit Selection

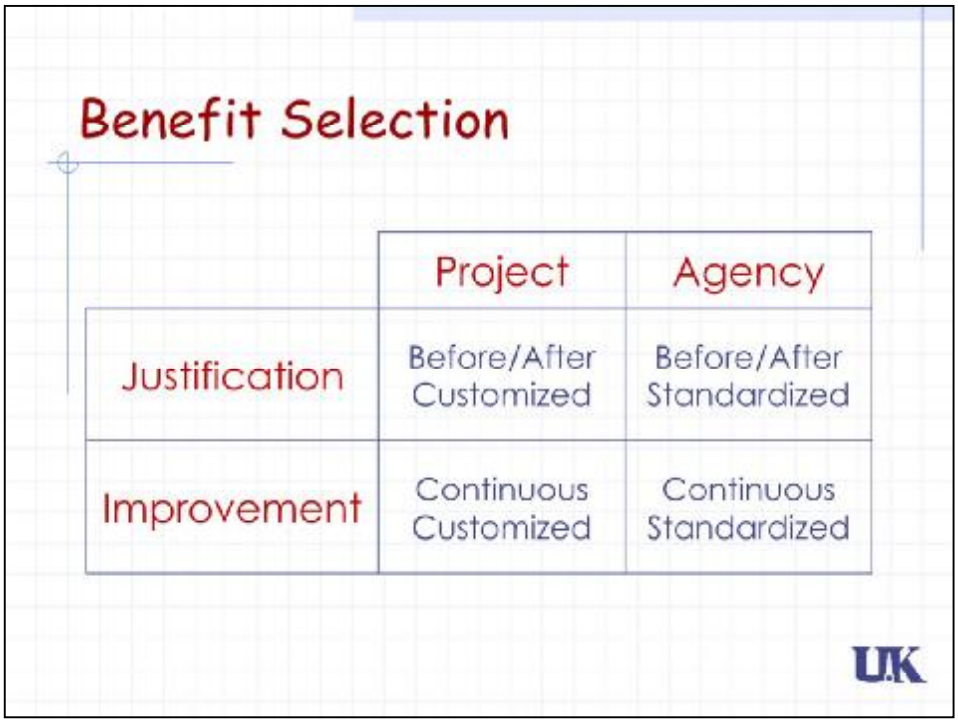
- Understand application and use
- Potential applications
  - Project justification
  - Project improvement
  - Program justification
  - Program improvement

UK

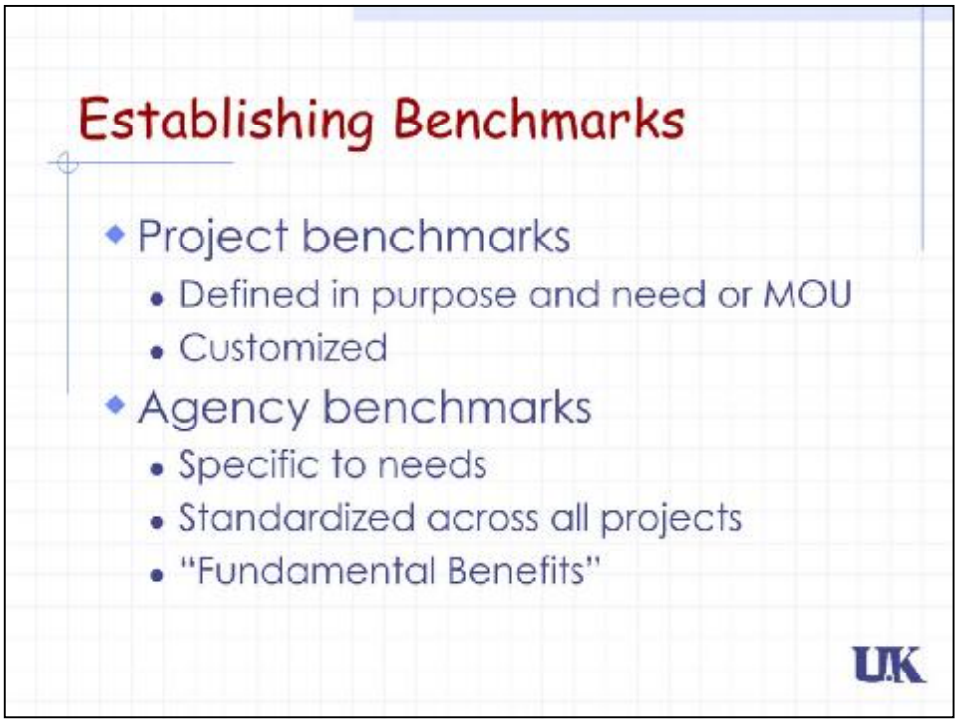


This graphic demonstrates the four uses of the benefit evaluation and where the feedback loops are located in the process to achieve each of the four applications.

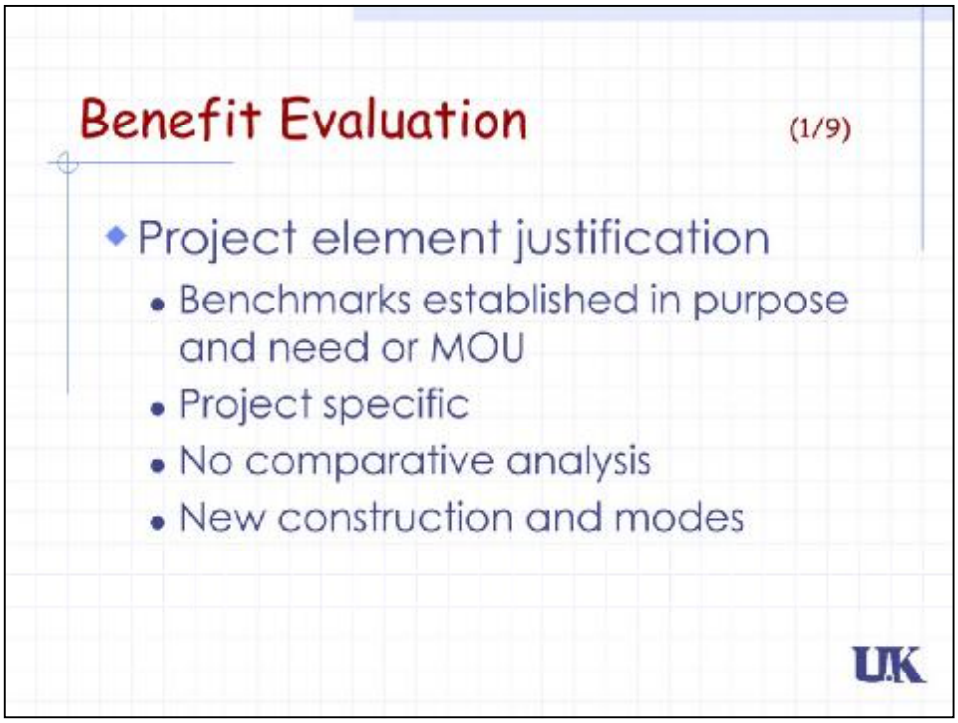
1. The simplest application is justification of a project element, where benefits are accrued and recorded to justify project expenditures or actions.
2. Continuous improvement of a project analyzes benefits prior to project completion and feeds this information back into the decision making process so that principle intensities may be adjusted to improve the project outcomes.
3. The benefit information can be forwarded to the transportation agency and along with benefit data from other projects can be used to justify the CSS program.
4. The same information can be used to adjust principle intensities or areas of concentration agency-wide in order to improve the next round of projects.



NEED TO ADD DISCUSSION AND EXAMPLE!



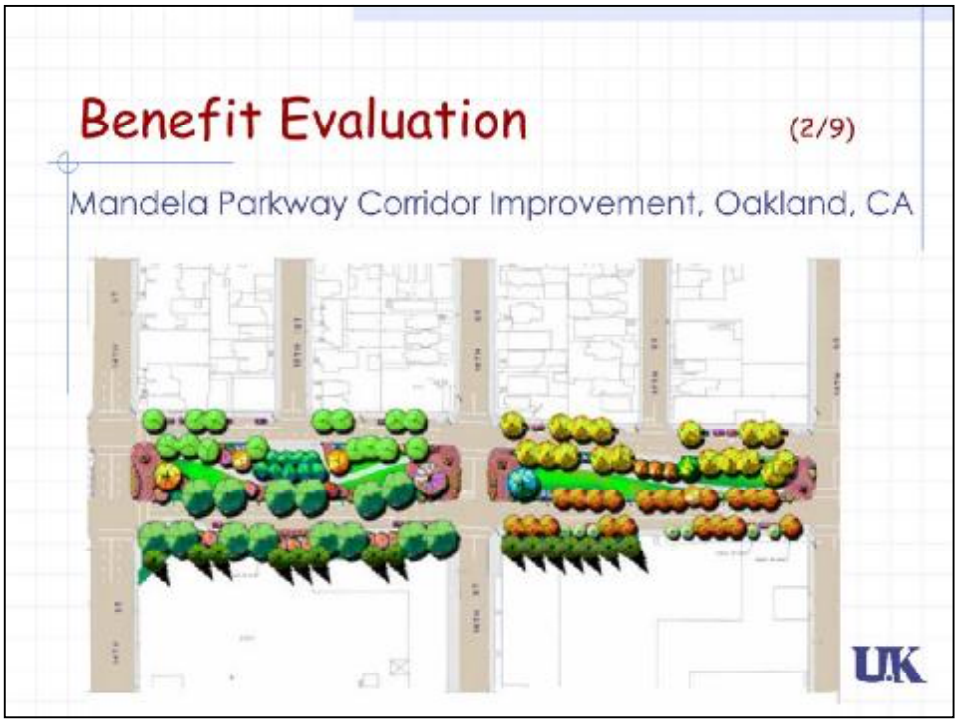
Benchmarks are the ruler upon which the accrued benefits will be measured. They measure the extent of benefit achievement and vary based on project, agency, purpose. These can be established in many ways, such as identifying targeted values of performance when used as a part of a project justification process, or as the performance of last years projects when used as part of an agency wide continuous improvement program. Agency wide evaluations must be standardized across all projects and should strive to minimize data collection efforts. Focusing only on the identified fundamental benefits allows the evaluation to capture the critical outcomes of CSS with minimal analysis. In any instance, due consideration should be given to the selection and establishment of benchmarks.



Justification of CSS Project/Project Elements. Benefits are measured to allow for the project team to justify specific project elements (design or activities) throughout the project development process. Direct measuring and quantification of project benefits is used to address concerns about the project outcomes. These measured outcomes allow for greater acceptance of the project and can be used as an example in future projects.

This evaluation approach aims to quantify benefits brought about by specific CSS project elements, which may increase time effort or cost.

Benchmarks are directly related to specific objectives and project needs. By identifying targeted performance measures there is no need for any before/after analysis or comparison with non-CSS projects.

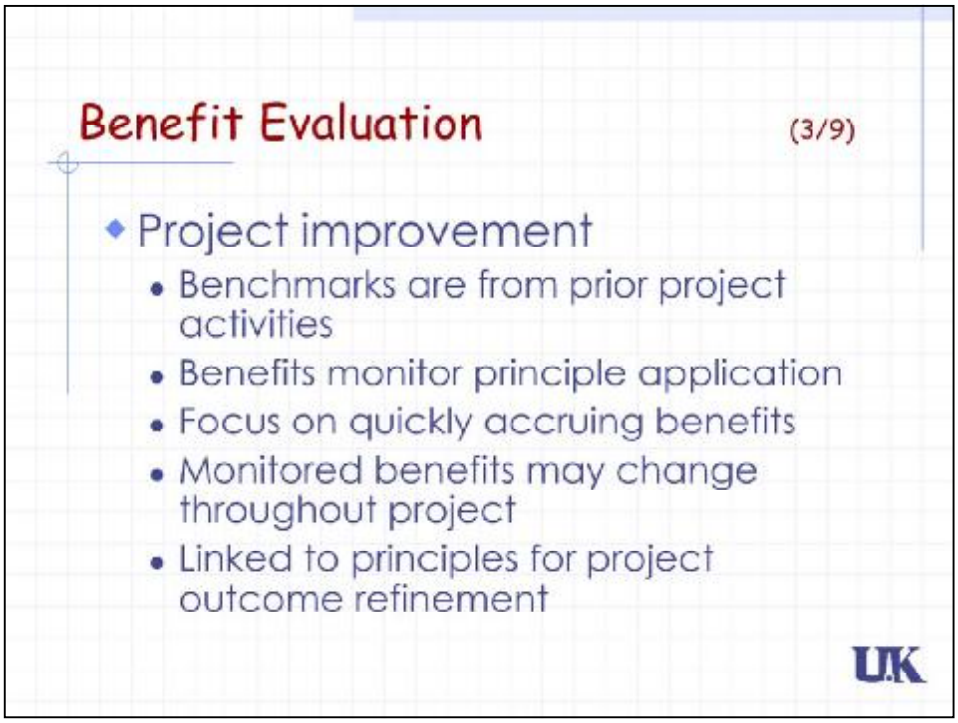


Benefit: Improved mobility for users

Metric: Additional bike path

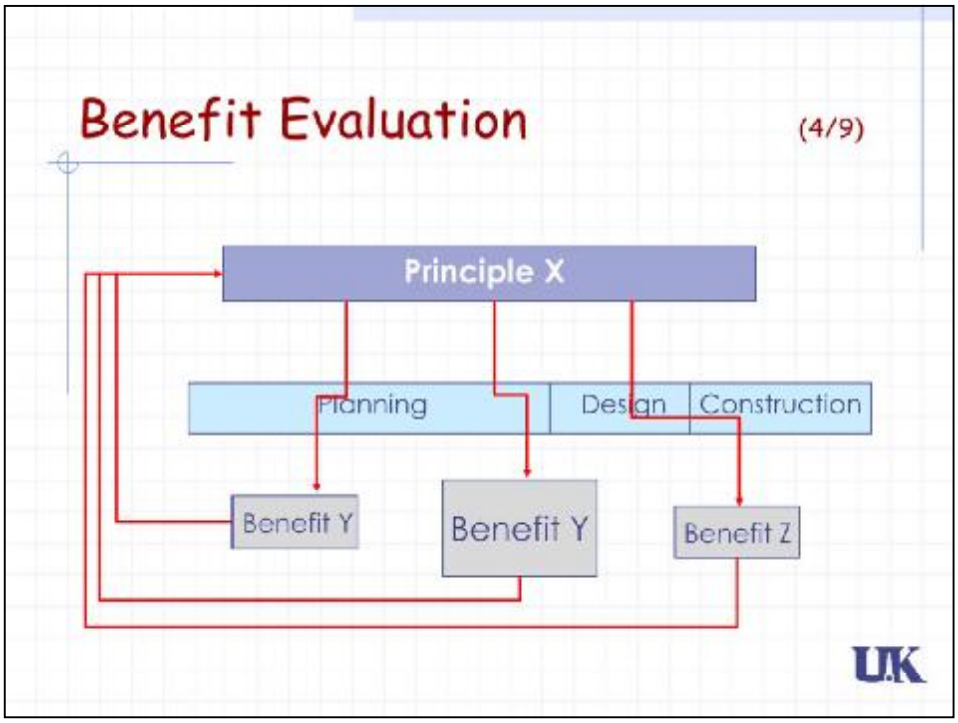
Benchmark: None

Data collection: Before/after; Questionnaire



Continuous Improvement of the Project. Benefits are measured in conjunction with the principles-benefit matrix as a tool for a continuous improvement of the project itself. Measured outcomes for benefits accruing throughout the project development process are monitored to identify problems in the project approach and/or outcome prior to completion of the project allowing for corrective actions before the completion of the project.

This evaluation approach assists the Project team in determining trajectory of the project by monitoring the application of principles NOT the accrual of benefits, as many benefits may not be realized until after project completion. Therefore project improvement should focus on fundamental and primary benefits. As some benefits may not be present throughout the entire project development process, the monitored benefit may not be present throughout the project and therefore the benefits must be quickly accruing and its metrics are easy to collect to reduce the turn around time for the improvement loop.



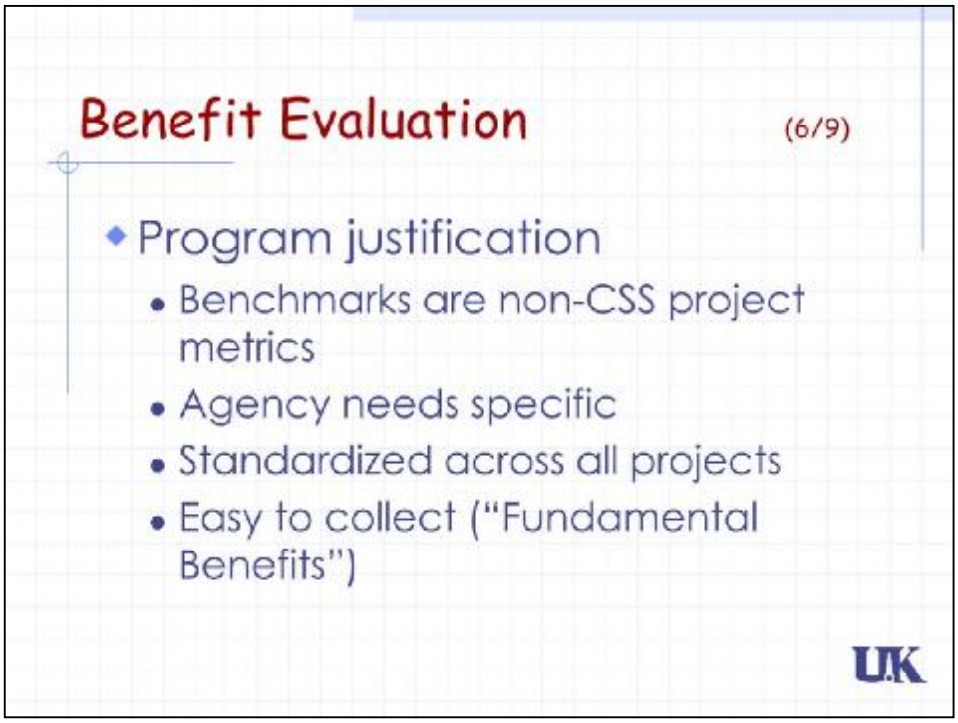
This graphic demonstrates how project improvement evaluations continue throughout the project in each phase. For instance public participation may drop off after all planning and design decision have been made. While in the planning phase the benefit is periodically measured to determine whether any adjustments in principle intensity are needed, and used as a benchmark for the next iteration of evaluation. As noted previously, the monitored benefits may change as they are no longer accruing on the project. At that time, it may be more appropriate to monitor other benefits such as satisfaction based semi-quantitative measures.

Benefit: Increased stakeholder/public participation, ownership, and trust

Metric: Participation (count)

Benchmark: Increasing participation throughout project

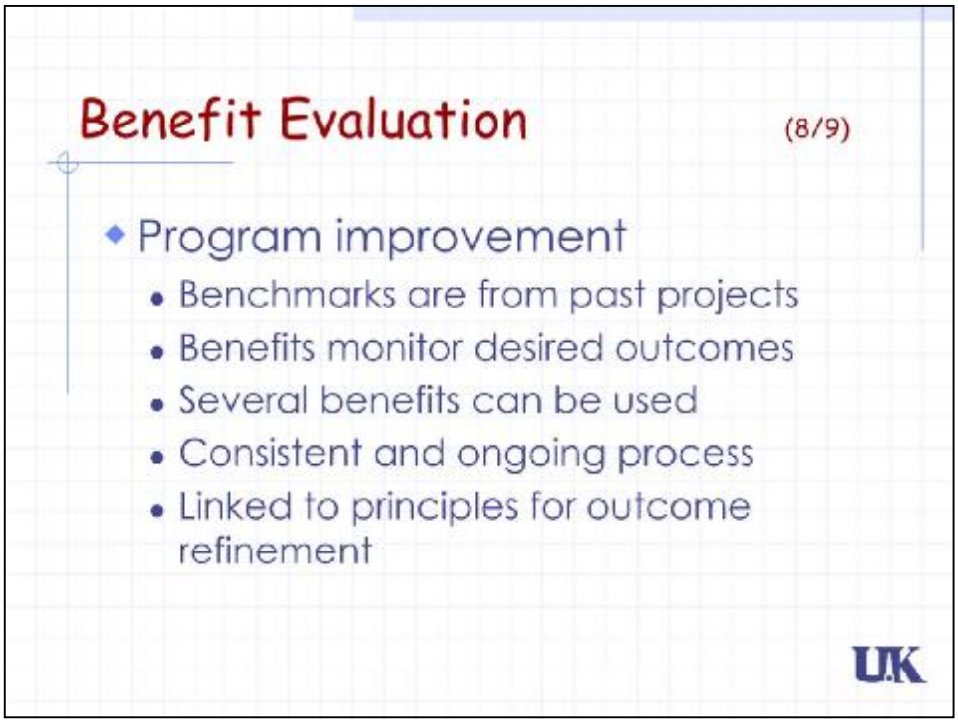
Data collection: Throughout project



Justification of Agency CSS Program. Benefits are measured to allow for an agency to justify and evaluate the effectiveness of an agency wide CSS program or process. The use of agency wide measured outcomes allows for determining the appropriateness of CSS in project development and demonstration of the benefits to the agency to legislature and interested public parties.

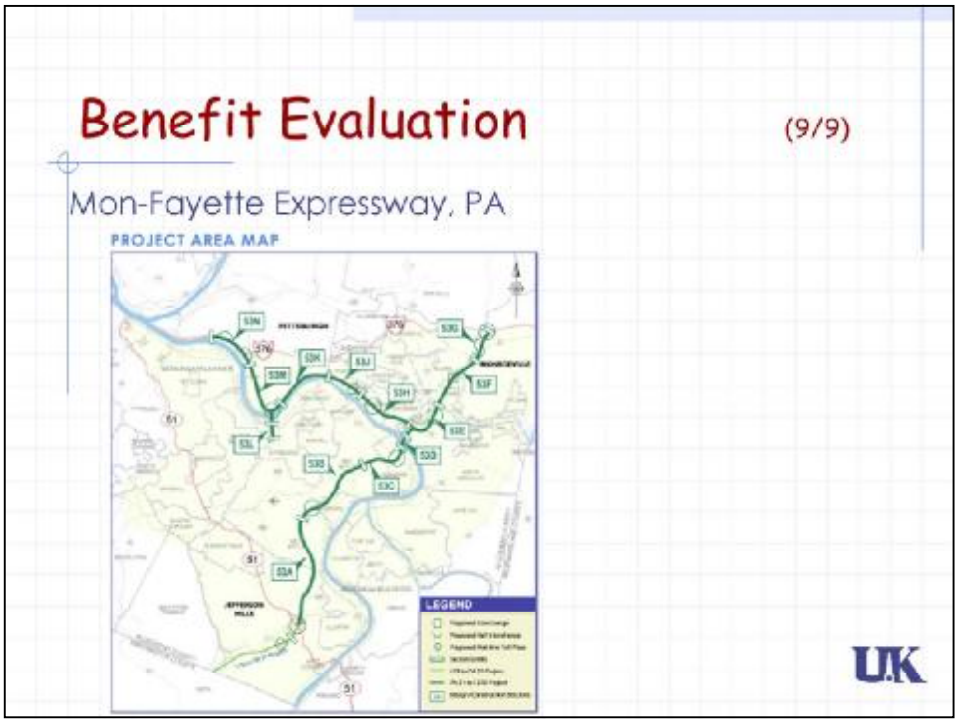
This evaluation approach aims to justify an agency wide CSS process. As such these metrics and their collection methodologies must be standardized across the entire agency and cannot be project specific as the previous applications. The use of fundamental benefits allows for a monitoring of all principles with minimal data collection efforts.

Benefit: Improved predictability of project delivery
Metric: Contract modifications /Change orders
Benchmark: Before/After CSS implementation
Data collection: Continuously after project completion



Continuous Improvement of Agency Process. Benefits are measured in conjunction with the principle-benefit matrix as a tool for a continuous improvement of the agency's project development process. The benefit analysis can identify where improvements in project development have been made as well as identify opportunities for improvement. The measured outcomes are used to determine the benefits not accrued based on the agency's desires and to then initiate a review of the process to determine actions that directly beget those benefits.

Finally the evaluation can be used to provide continuous improvement of an entire agency program. As with agency wide justification these metrics must be standardized, however, a wider range of benefits may be monitored. This will allow the program to be fluid and change with the changing political and fiscal realities of future transportation projects.

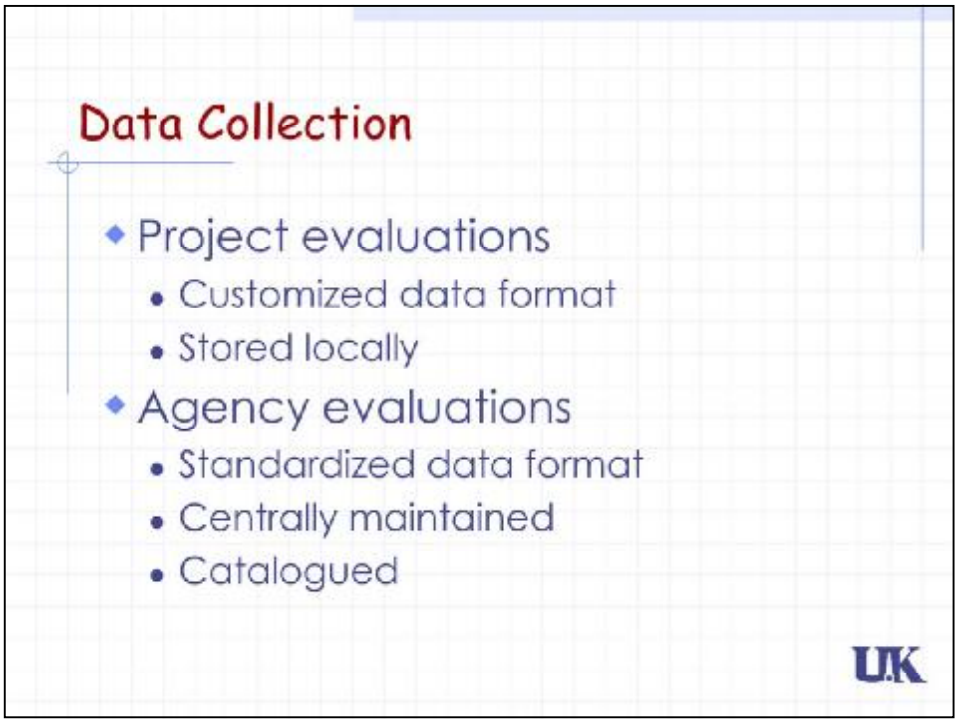


Benefit: Improved project predictability; Improved community satisfaction; Improved community input

Metric: Questionnaire/semi-quantitative

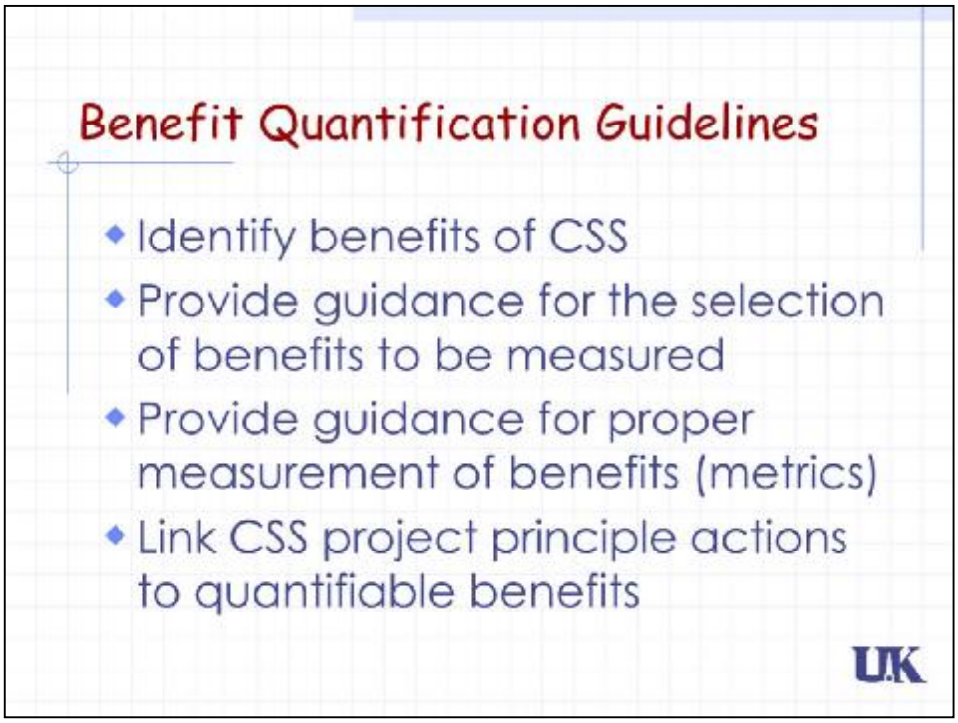
Benchmark: Continual Improvement

Data collection: Continuous

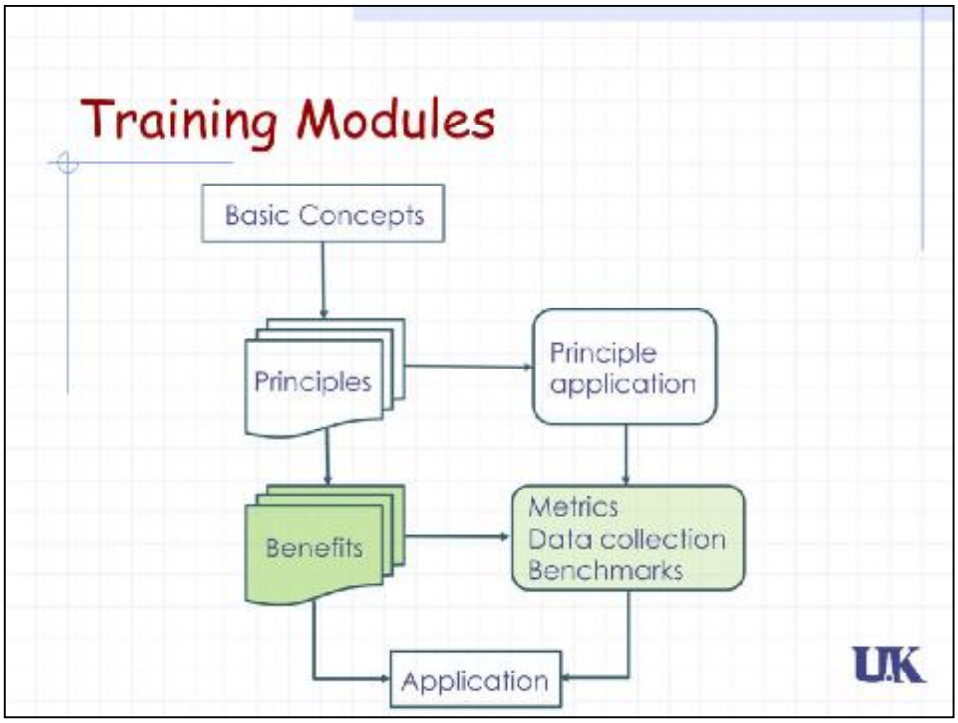


In order to carry out the evaluation, data must be collected, maintained and made accessible for future use. Again depending upon the intended evaluation data collection procedures must be modified to suit its intended purpose. Generally data collected for use on a project will be stored locally which allows for immediate availability for all interested parties. For agency wide evaluations a highly structured, collection, and maintenance program must be used to ensure data availability into the future and applicability across all projects.

The project team and the agency must be committed to the evaluation approach and have the resources necessary to collect the pertinent data. Once collected this data should be maintained and made accessible to those responsible for the final evaluation and stored to allow further analysis in the future.

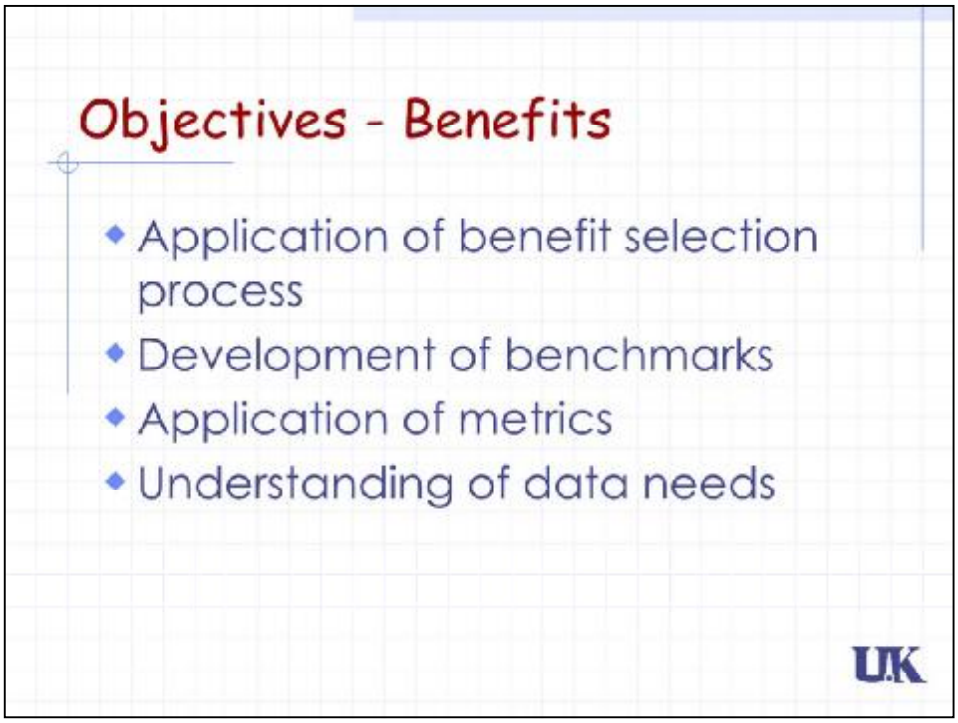


The information summarized above is presented in detail in Benefit Quantification Guidelines document as part of NCHRP 642. This document provides both the definition, metrics and associated principles for each benefit, but also guidance for application including how to identify which benefits should be measured, what are special considerations that should be made to properly measure each metric and how can those benefits and metric be linked to the principle actions in order to improve project and/or agency performance. You are encouraged to read the full guide before implementing any of the evaluation approaches within your agency or project.



This concludes the discussion on the benefit evaluation. In this section we have addressed how to select the benefits to be measured based on evaluation needs, how to use the metrics to measure those benefits and discussed special issues that must be addressed in order to feed that information into any of the four identified applications of project justification, project improvement, program justification and program improvement.

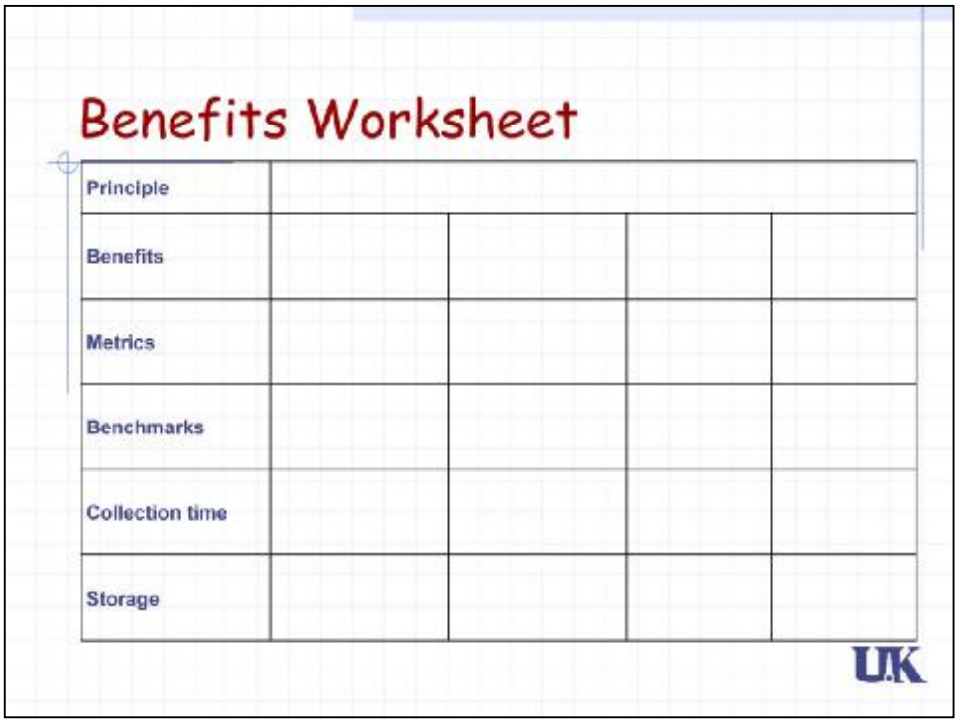
The next activity in this example will focus on selecting and evaluating project benefits as concepts through by continuing the previous example.



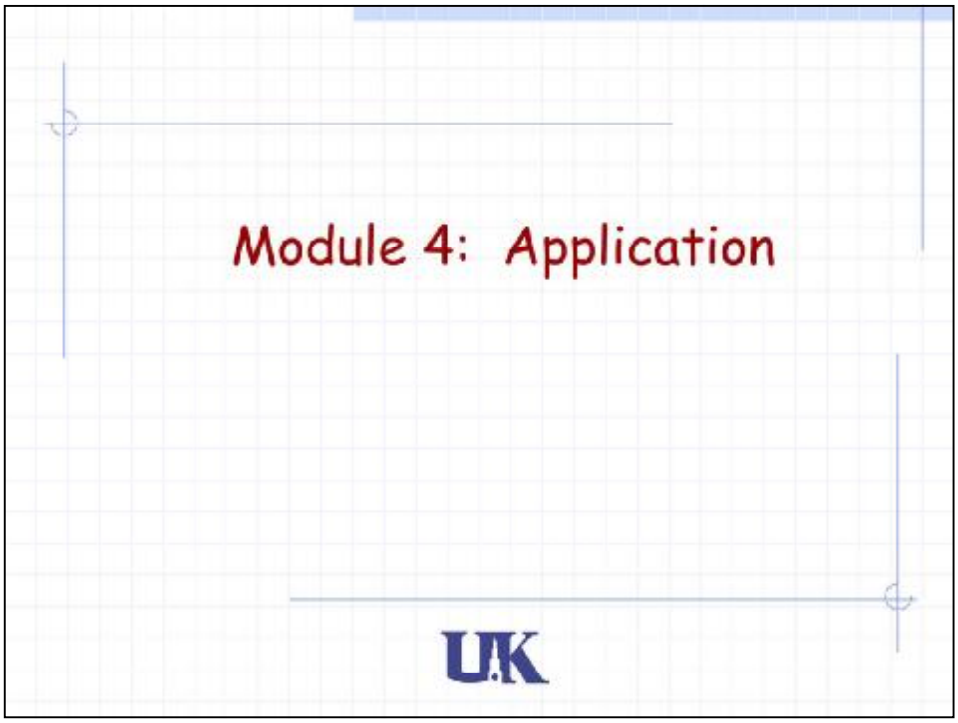
The second activity deals with establishing the process for measuring and monitoring anticipated benefits. Participants should select the appropriate benefits to accomplish the project justification evaluation. The development of benchmarks is critical in the evaluation process and participants are required to identify them. The methods for selecting the required data should be identified along with any data storage and accessibility needs.

Participants will work within their group to accomplish the following four tasks:

1. Benefit selection: Using the principle-benefit matrix, select appropriate benefits for each assigned principle from the previous work session. Benefits should be selected to justify the application of the actions for two principles and the improvement of actions from the application of the other two principles at the project level. The rationale for selecting the benefits should be stated.
2. Metrics: Appropriate metrics to measure the benefits should be identified. Participants should determine the data to be collected, the time for collection, and storage (location, media, gate keeper) for use in the future.
3. Benchmark development: Participants should develop benchmarks to evaluate each of these selected benefits.
4. Presentation: Each group is required to present the benefits selected for one of the justification and one of the improvement principles, the associated benchmarks, the metrics to measure them, and the data needs (what, when, where) for measuring them.



Worksheet for participants


Module 4: Application
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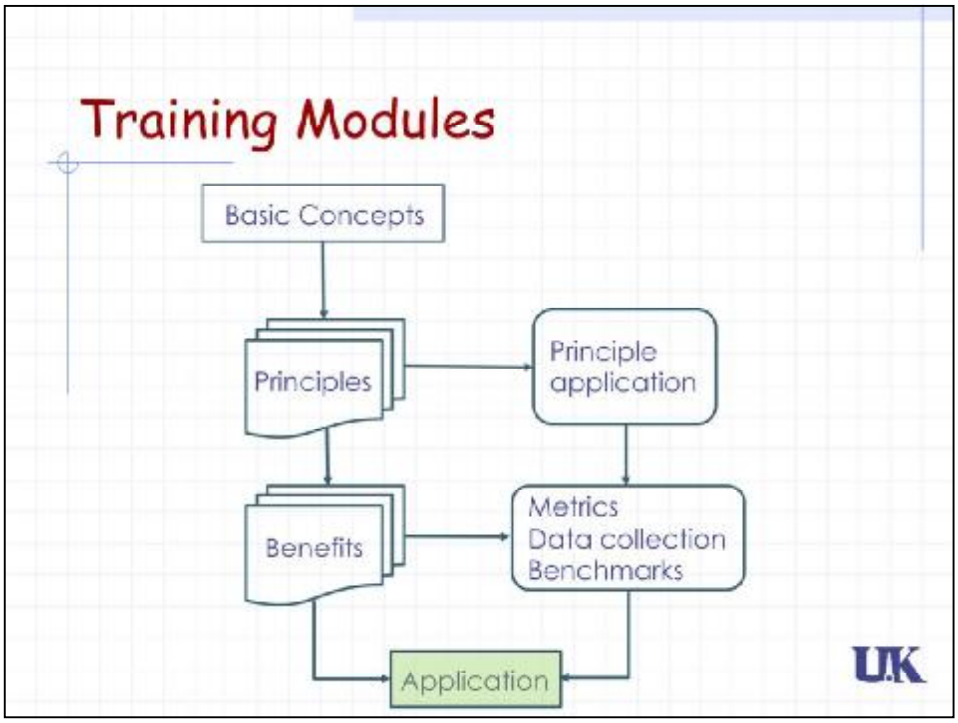
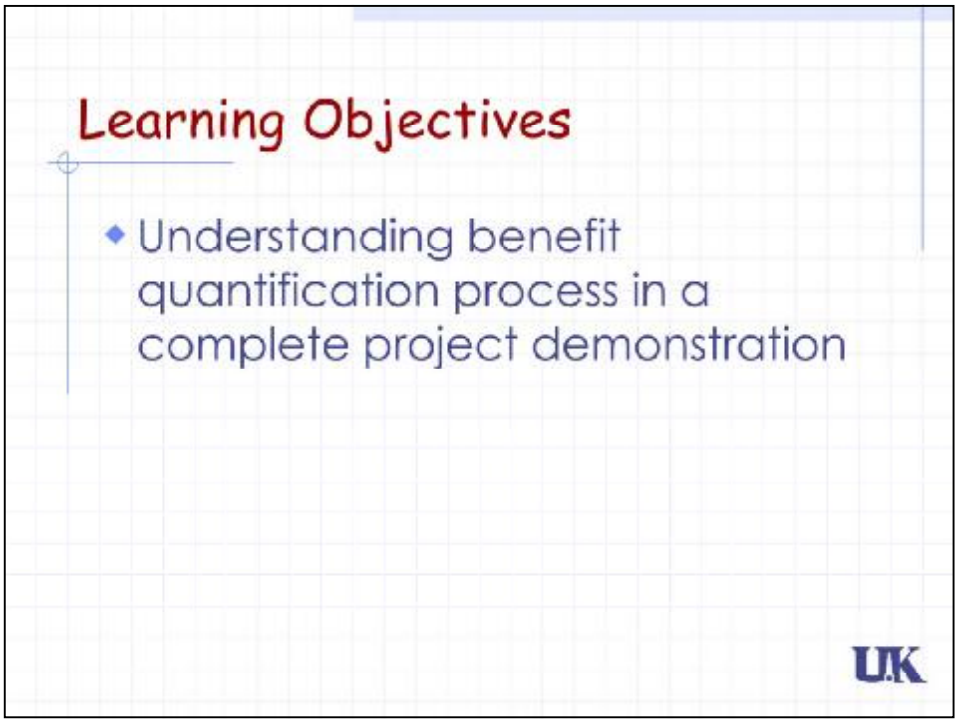


The next section of this training module will present a hypothetical project approach identifying the principles and benefits to be addressed on the example similar to those presented earlier by each group. At the end of the presentation, data for each monitored metric will be presented and evaluated against the established benchmarks. The groups will then be asked to review the approach and identify ways in which the approach could be improved to increase the project outcomes.

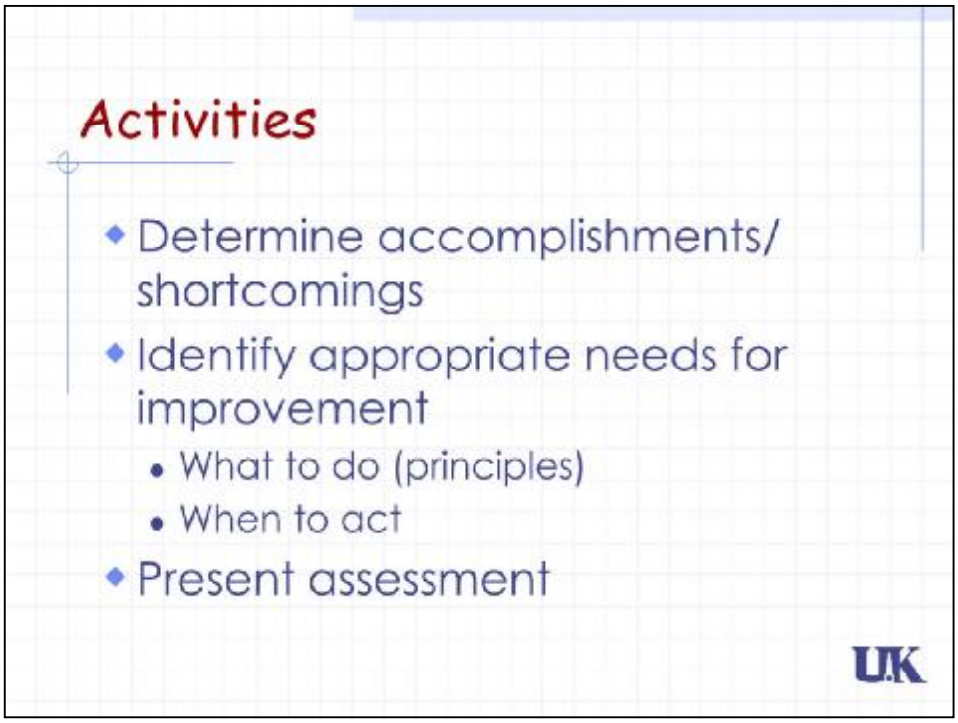
The following slides present the hypothetical approach taken by the instruction team to address this project.



The objective of this module is to demonstrate the entire process for quantifying benefits of the CSS project.

At the end of this presentation a participant should be able to:

Understand the benefit quantification process.



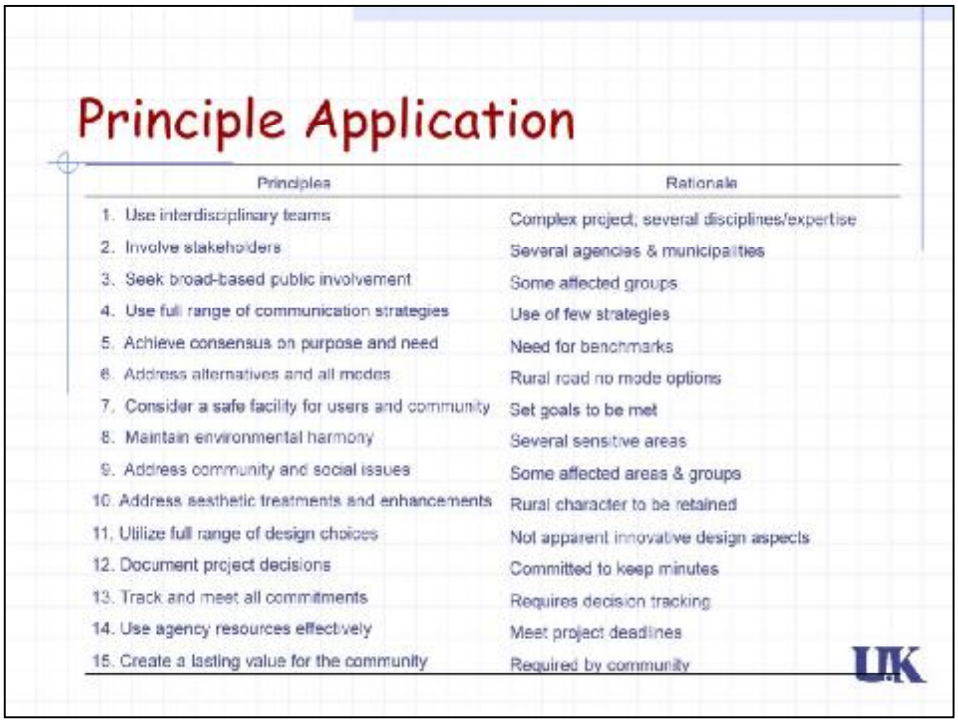
Participants will work within their group to accomplish the following tasks:

1. Principle application: Evaluate level of accomplishment or shortcomings for each principle and determine required actions to improve in the future.
2. Benefit evaluation: Review metrics and consider whether metrics used capture principle application. Identify additional elements to be collected and monitored.
3. Needs to improve: Participants should identify any actions required to improve the process and identify metrics that could be used for an agency monitoring process.
4. Presentation: Each group is required to present their assessment of:

   a. principle application;

   b. actions to improve; and

   c. metrics for agency monitoring efforts.



Principle Application

Principles	Rationale
1. Use interdisciplinary teams	Complex project, several disciplines/expertise
2. Involve stakeholders	Several agencies & municipalities
3. Seek broad-based public involvement	Some affected groups
4. Use full range of communication strategies	Use of few strategies
5. Achieve consensus on purpose and need	Need for benchmarks
6. Address alternatives and all modes	Rural road no mode options
7. Consider a safe facility for users and community	Set goals to be met
8. Maintain environmental harmony	Several sensitive areas
9. Address community and social issues	Some affected areas & groups
10. Address aesthetic treatments and enhancements	Rural character to be retained
11. Utilize full range of design choices	Not apparent innovative design aspects
12. Document project decisions	Committed to keep minutes
13. Track and meet all commitments	Requires decision tracking
14. Use agency resources effectively	Meet project deadlines
15. Create a lasting value for the community	Required by community

This table summarizes the intensities for the selected project.

Benefits

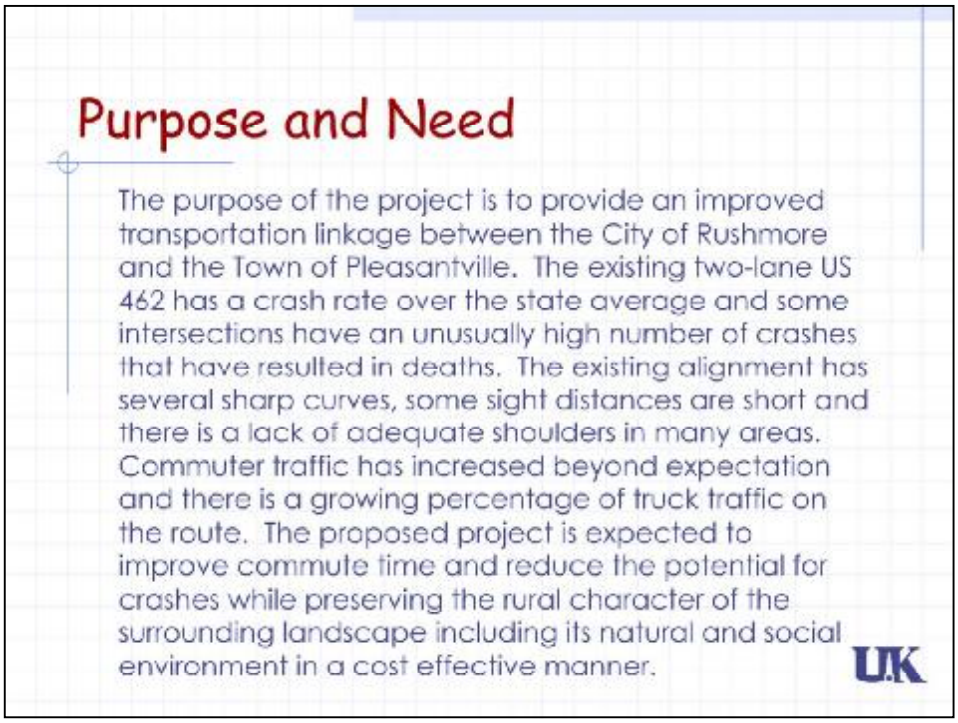
Principles	Benefits
1. Use interdisciplinary teams	Appropriate design (20); decreased delivery time (10)
2. Involve stakeholders	Stakeholder/public trust (8) and feedback (7)
3. Seek broad-based public involvement	Community satisfaction (17); improved predictability (1)
4. Use full range of communication strategies	Stakeholder/public trust (8) and feedback (7)
5. Achieve consensus on purpose and need	Stakeholder/public trust (8)
6. Address alternatives and all modes	User mobility (13); community satisfaction (17)
7. Consider a safe facility for users and community	Improved safety (15); quality of life (18)
8. Maintain environmental harmony	Improved stewardship (4); quality of life (18)
9. Address community and social issues	Community satisfaction (17); minimized impact (12)
10. Address aesthetic treatments and enhancements	Community satisfaction (17); quality of life (18)
11. Utilize full range of design choices	Appropriate design (20);speed management (19)
12. Document project decisions	Stakeholder/public trust (8); risk management (6)
13. Track and meet all commitments	Stakeholder/public trust (8); community satisfaction (17)
14. Use agency resources effectively	Decreased costs (9); improved budgeting (2)
15. Create a lasting value for the community	Quality of life (18); long term decisions (3)

This table summarizes the intensities for the selected project.

The Department determined that a team should be assembled to deal with the project in order to assure that all pertinent issues and aspects of the project will be addressed. An interdisciplinary project team was established to provide the proper knowledge and expertise to be applied to project development process and the alternatives that may be considered. This depth of knowledge will ensure that the project team identifies and examines all potential solutions and critical issues that may arise. A core team was established that included a highway engineer (to deal with the roadway design issues), an environmental specialist (to address environmental issues), a structural engineer (to deal with structures and bridges along the corridor), a construction engineer (to deal with future construction issues), a planner (to deal with potential concerns regarding future development), a traffic operations engineer (to deal with traffic and operational issues), landscape architect (for addressing aesthetic treatments), and a right of way specialist (to deal with right of way issues).

The appropriate stakeholders were also identified and an Advisory Committee was created to assure that all issues are discussed and addressed in a timely fashion. Project stakeholders included regulatory agencies and elected officials; U.S. Forest Service, U.S. Fish and Wildlife Service, Corps of Engineers, State Division of Wildlife, State Historic Preservation Office, and the mayors of Rushmore and Pleasantville.

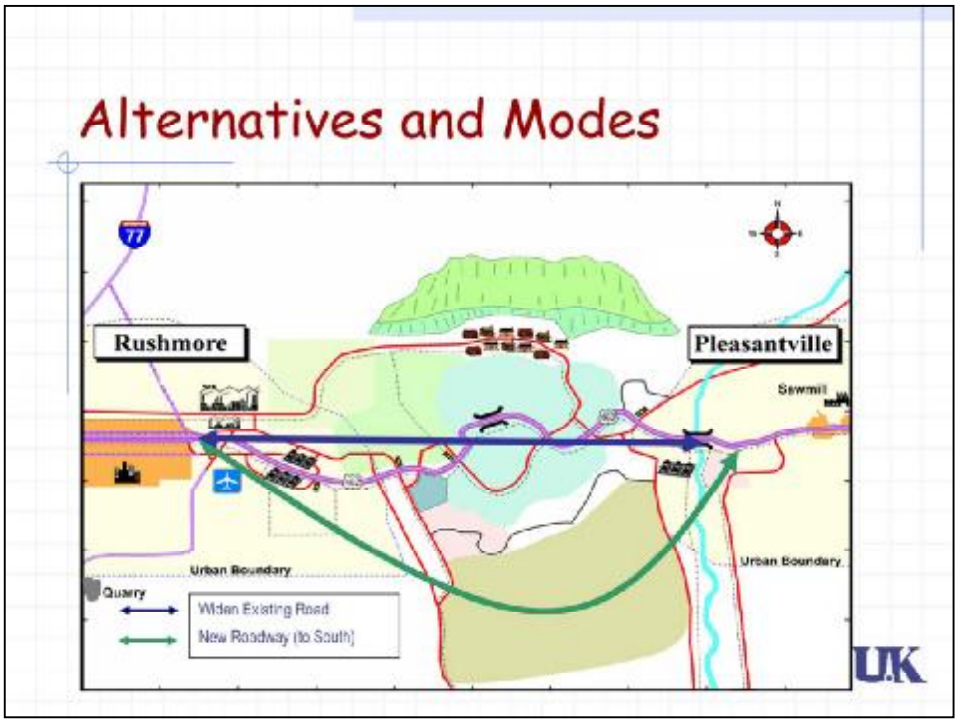
The Project Team decided that three public meetings will be conducted to solicit input regarding issues and concerns about the project.



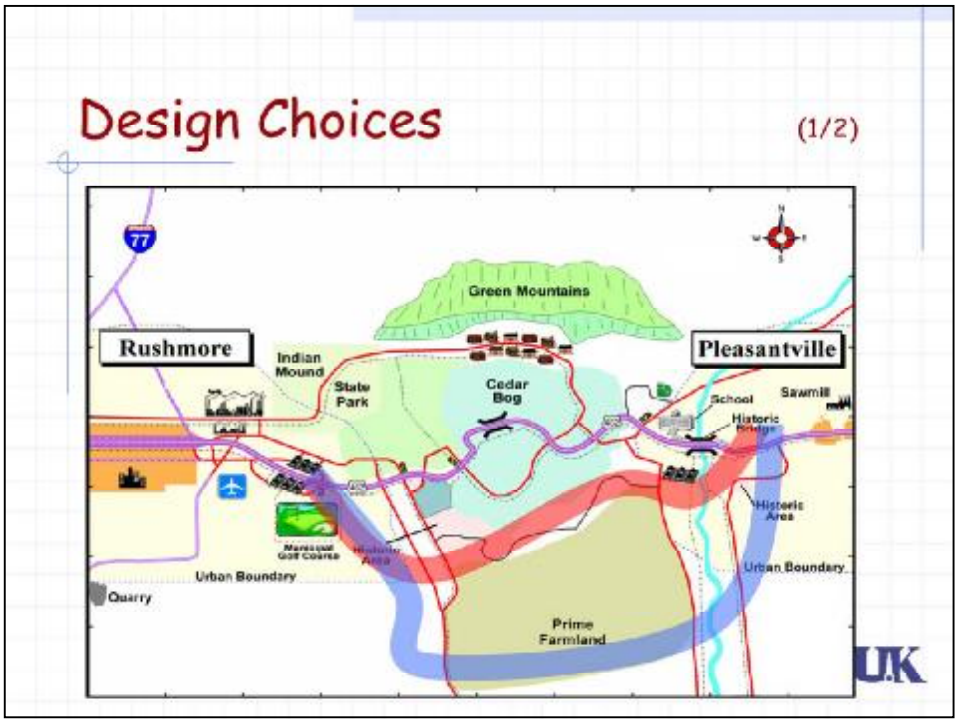
The Project Team worked with the Advisory Committee to develop a concise and agreed upon purpose and need for the project. The document developed identified the most critical problem(s) and other concerns that are important to keep in balance, made the consensus-based business case that the intended project is worthwhile, and established the measures of effectiveness for measuring the project performance. The lead paragraph of the purpose and need developed was as shown above.

Based on the understanding of the issues in the study area, the advisory committee also established in the purpose and need statement the metrics that they would use to measure the success of the project and direct the design of the appropriate solution. These established measures are stated above.

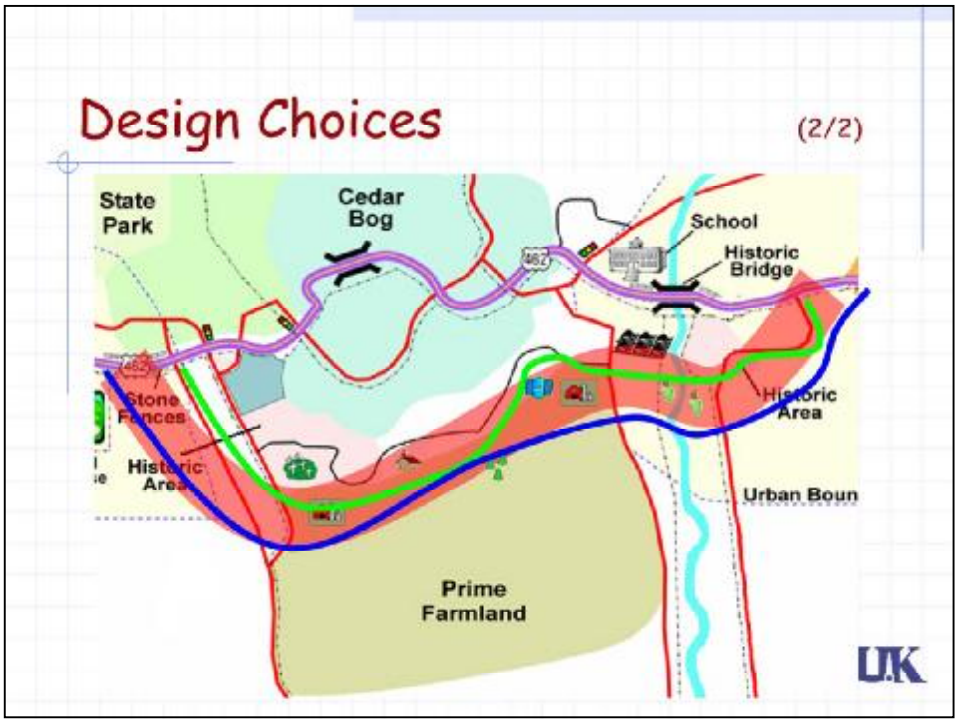
In order to address the community and social issues, the project team worked with the advisory committee to identify the various concerns from all interested parties. Included in this summary also were environmental resources that have been identified as having special value to the area and/or are protected by national or state regulations. This allowed the project team to map the “Red Flags” and constraints within the study area, that provided the context for the project as shown above. By thoroughly documenting these constraints at the beginning of the project, it allowed the project team to proceed with the design, without running into any pitfalls further in the process.



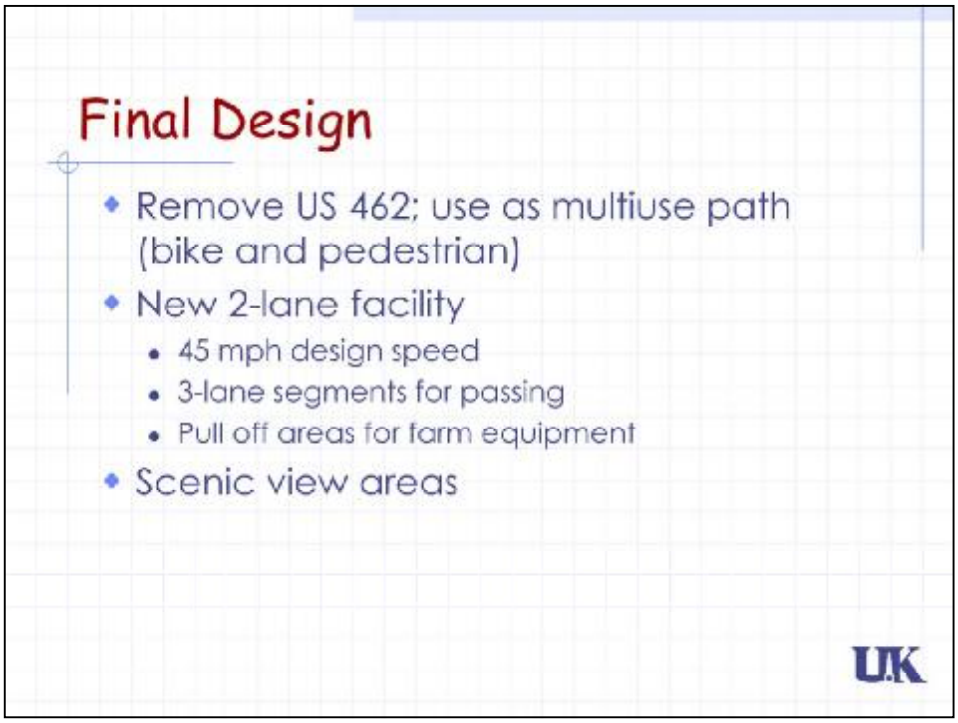
The Project Team was committed to identify alternatives and address all modes in order to find the “best” solution to the problem. To proceed with this approach, the No-Built alternative was identified to be used as the basis for any comparisons. The recently developed Access Management Plan of the state will be applied throughout the development of the project. The build alternatives will evaluate the option of roadway improvements along the existing corridor as well as the development of a new facility. These conceptual alternatives are shown above and were presented and discussed with the Advisory Committee as well as to the public through a structured involvement process. Another important aspect for addressing community and social issues was the commitment of the transportation agency to accept, consider, and evaluate non-traditional solutions, such as the use of roundabouts, the provision of a bike facility and maintenance of the existing facility as a multiuse path. All of the alternatives were then to be evaluated against the mobility, safety and cultural criteria established in the purpose and need statement.



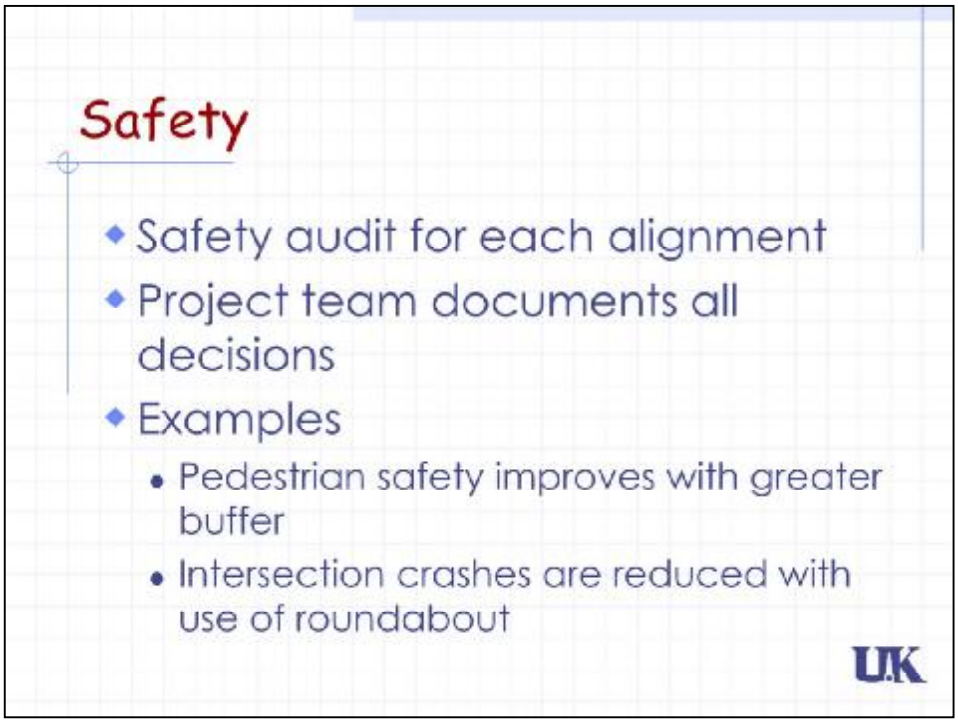
Based on input received from the public meetings and in cooperation with the Advisory Committee the project team determined that a new facility was the preferred option. The next step was to identify potential corridors for further investigation. Based on the community and social constraints as well as other issues of significance submitted by regulating resource agencies (US Soils Conservation Service, US Department of Agriculture, US Fish and Wildlife Service, State Historic Preservation Office, State Environmental Protection Agency) the Team identified potential corridors for the new facility shown above.



Once the corridors were identified, further investigation of areas of concern and environmental constraints were explored to provide direction for potential alignments. These investigations identified several wetlands near the river, as well as, an area of hazardous soils where farming equipment and materials were stored for many years. Additionally, individual farm tracts were identified to prevent them from being bifurcated due to the proposed project. Based on these refined constraints, potential alignments were identified aimed to minimize and mitigate potential impacts as shown above.



Each alternative will provide a separate parallel bicycle facility and adequate sidewalks in the areas within the urban boundaries. The existing US 462 will be removed and maintained as a multiuse path (pedestrian and bicycle). The new facility will be designed as a two-lane roadway with a design speed of 45 mph to address speed concerns raised at the public meetings and noted in the web surveys. There will be also three-lane segments to allow for adequate passing as well as pull-off areas for farm equipment once queues start forming. Roundabouts will be used as entry/gateway points both at Rushmore and Pleasantville and at the intersections entering and exiting the historic areas. The sidewalks along the historic areas as well as in the built up areas of Rushmore and Pleasantville will use brick overlay based on the requests of the Historic Preservation Society and the neighborhood associations. A scenic view area will be developed to allow for a view to Cedar Bog on the north and to the scenic barns in the south. Improved access through the historic areas will assist the economic development of new and existing businesses.



The safety of the proposed alternative alignments was evaluated with the use of the Highway Safety Manual to determine the anticipated number of crashes. A safety review of the alignments was also conducted as a separate and independent element of the project to assure that the evaluation has been conducted properly and all potential issues have been adequately addressed and resolved. A well documented process was followed, where all potential issues identified were listed along with an explanation describing why these were considered by the Project Team to be (or not be) a safety issue. The list should also include the corresponding potential solutions, as well as, a description of how these issues were addressed within the project constraints. For example, the safety of pedestrians in the built up area of Rushmore was identified as an issue and the solution proposed was to provide greater separation between the roadway and the sidewalk by increasing the buffer zone to 10 feet and considering the use of shrubbery. The crashes at the signalized intersection of US 462 were addressed with a roundabout reducing the number of conflict points as well as speeds through the intersection.

The proposed alignment considered the roadway environment, both natural and human, in order to develop a solution without disturbing but rather complementing them. This translates to an alignment that follows closely the natural terrain and promotes scenic views from the roadway as well. The roundabouts used are landscaped appropriately and they will be maintained by the local agencies. The use of steel reinforced wooden guardrails was utilized to preserve the rural feeling of the area. Stone fences that were in disrepair were rebuilt through an agreement with the State Historic Preservation Office where the alignment intentionally was brought closer to the property to use highway funds for repairs and showcase the historic structures of the town through the road project. The development of the scenic overlook for the Cedar Bog is also a significant enhancement of the project.

Measured Benefits

(1/10)

Improved predictability of project delivery

Project Schedule (months)	Programming	Planning	Design	Construction	Total
Estimated	8	5	10	10	33
Actual	8	6	14	24	52
Difference	0	1	4	14	19

UK

Measured Benefits

(2/10)

Improved project scoping and budgeting

Scope Change/Change Order No.	Cost ($,000)	Time delay (months)
Existing roadway undercut: need for geotechnical study	500	2
Reconstruct historic fences	250	12

Improved environmental stewardship

Regulatory Agencies	Mandated	Enhancement/ Mitigation
US Fish and Wildlife; State Wildlife	Avoid Cedar Bog	Use old road as bike path

UK

Measured Benefits

(3/10)

Increased risk management and liability protection

Legal Action	Cost ($)	Time delay (months)
None		

Improved stakeholder/public feedback

Meeting with…	Number of responses	Was project modified based on responses?
Advisory committee	5	Consider bike options and limit farm takings
Advisory committee	3	Evaluate input for purpose and need benchmarks

UK

Measured Benefits

(4/10)

Increased stakeholder/public participation

Meeting with…	Date	No. of Attendees	Project Phase
Advisory committee	5/1/10	10	Planning
US Fish and Wildlife	5/10/10	4	Planning
Advisory committee	7/10/10	12	Planning

UK

Measured Benefits

(5/10)

Decreased costs for overall project delivery

Project Cost	Planning	Design	Construction	Total
Actual ($'000s)	500	4,500	80,000	85,000

Scope Change/Change Order No.	Cost ($,000)	Time delay (months)
Existing roadway undercut; need for geotechnical study	500	2
Reconstruct historic fences	250	12

UK

Measured Benefits

(6/10)

Decreased time for overall project delivery

Project Schedule (months)	Programming	Planning	Design	Construction	Total
Estimated	8	5	10	10	33
Actual	8	6	14	24	52

Measured Benefits

(7/10)

Minimized overall impact to human and natural environment

Environmental Resource	Units	In Project Area	Impacted	Percent
Residential Properties	EA	None		
Commercial Properties	EA	None		
Environmental Justice Properties	EA	None		
Parks 4(f)	acres	None		
Endangered Species Habitat	acres	None		
Wetlands	acres	None		
Streams	ft	None		

UK

Measured Benefits

(8/10)

Improved mobility for users

Mode of Travel	Travel time (min)		LOS	
	Before	After	Before	After
Bike	NA	30	NA	B
Auto	45	25	E	D

Measured Benefits

(9/10)

Improved safety (vehicles, pedestrians, and bikes)

Crash Type	Before		After		Change in Rate
	Crashes	Rate	Crashes	Rate	
Total	41	75	29	40	-35
Property Damage Only (PDO)	27	49	22	30	-19
Injury	13	24	7	10	-14
Fatal	1	2	0	0	-2
Pedestrian	4	7	1	1	-6
Bicycle	5	9	0	0	-9
STATE AVERAGE		55		42	

UK

Measured Benefits

(10/10)

Improved speed management

	Operating Speed (85th Percentile)
Expected	40 mph
Actual	50 mph

UK

Benefit Targets (1/2)

No.	CSS Benefit	Stakeh.	Team
1	Improved predictability of project delivery	2.5	2.6
2a	Improved project scoping	NA	2.9
2b	Improved project budgeting	NA	2.8
3	Improved long term decisions and investments	NA	3.3
4	Improved environmental stewardship	NA	3.4
5	Optimized maintenance and operations	NA	3.2
6	Increased risk management protection and liability protection	NA	3.0
7	Improved stakeholder/public feedback	NA	3.4
8a	Increased stakeholder/public participation	3.0	3.4
8b	Increased stakeholder/public ownership	3.0	3.6
8c	Increased stakeholder/public trust	3.0	3.4
9	Decreased costs for overall project delivery	NA	2.3
10	Decreased time for overall project delivery	2.0	2.6
11	Increased partnering opportunities	2.0	3.0

Overall, both stakeholders and team members indicated that several benefits materialized as a result of the process followed. Almost all benefits have a score greater than 3.0 indicating that the survey participants at least agree that the benefit was achieved. Benefits that had high scores (equal or greater than 3.7, indicating that most of the participants strongly agree) include “Improved quality of life for community”, “Improved walkability and bikeability”, “Improved community satisfaction”, “Improved safety”, and “Fit with local government land use plan”. These benefits indicate that the project resulted in a better environment for the community and there is an agreement between team members and stakeholders on these issues.

There are a few benefits that had a score below 3.0 that indicate that the respondents believe that the benefit was marginally materialized. These include “Decreased costs for overall project delivery”, “Decreased time for overall project delivery”, “Improved predictability of project delivery”, and “Improved project scoping and budgeting”. These answers indicate that the respondents perceive that the process resulted in longer time and higher costs for the project and had no significant effects on predictability neither of the completion nor in its budgeting and scoping.

An apparent trend of the benefits materialized is the consistent difference between the perspective of the team and the stakeholders, where for all common benefits the team scored them higher.

Benefit Targets

(2/2)

No	CSS Benefit	Stakeh.	Team
12	Minimized overall impact to human and natural environment	3.0	3.3
13	Improved mobility for all users	2.9	3.5
14a	Improved walkability	3.5	3.9
14b	Improved bikeability	3.5	3.9
15	Improved safety (vehicles, pedestrians, and bikes)	3.5	3.7
16	Improved multi-modal options	2.5	3.4
17	Improved community satisfaction	2.2	3.8
18	Improved quality of life for community	4.0	3.8
19	Improved speed management	--	3.3
20	Design features appropriate to context	3.5	3.5
21	Minimized disruption	3.0	3.1
22	Improved opportunities for economic development	3.0	3.4

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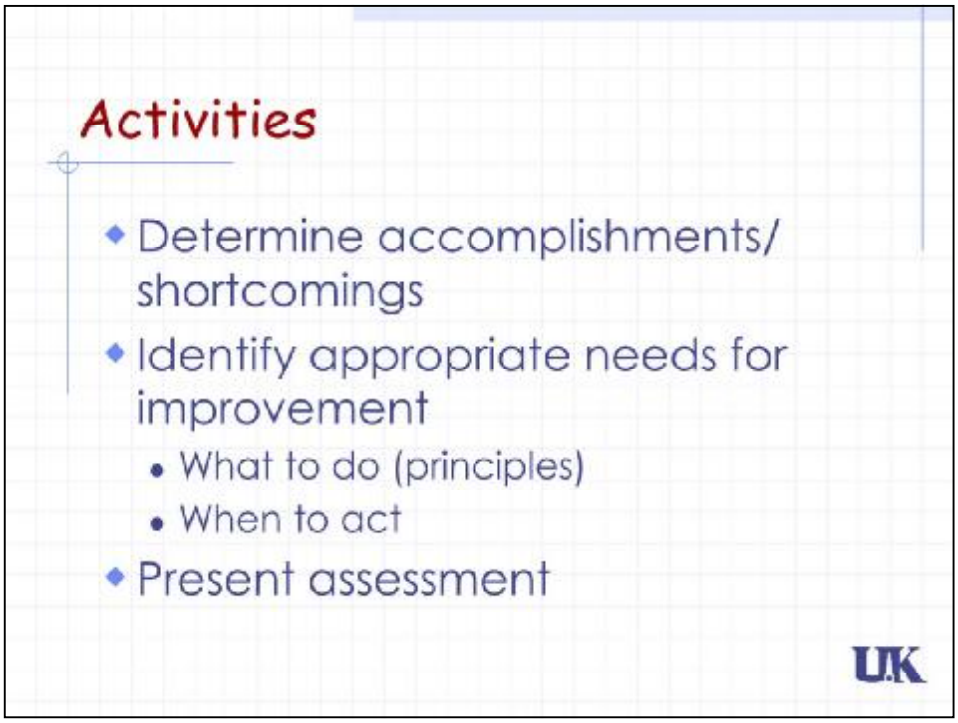


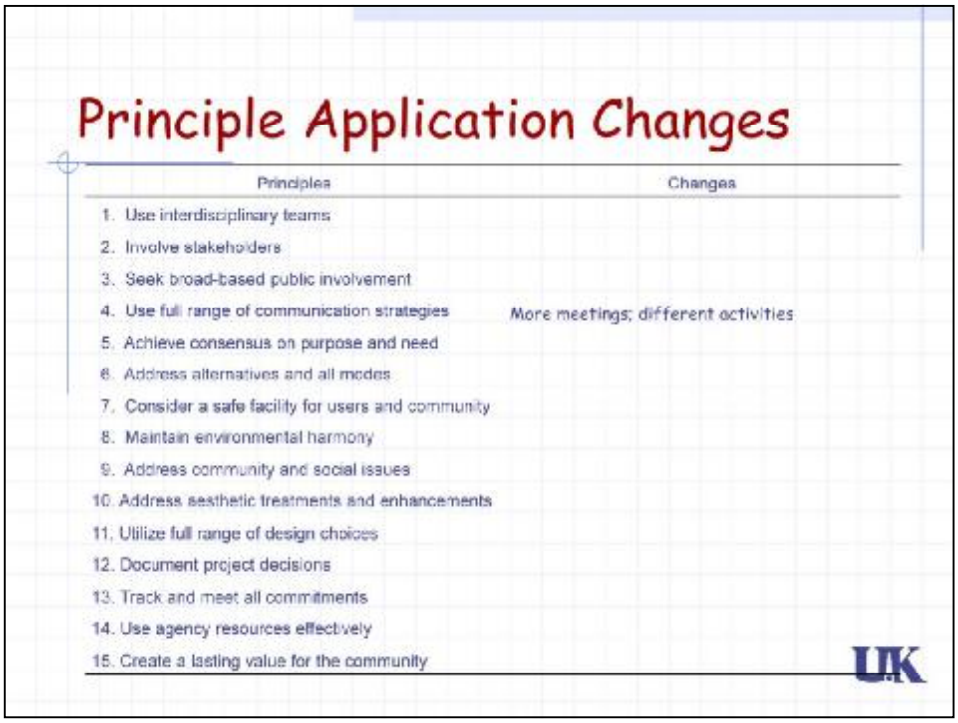
Participants should **review all slides** in the module and work within their group to accomplish the following tasks:

1. Principle application: Evaluate level of accomplishment or shortcomings for each principle and determine required actions to improve in the future.
2. Benefit evaluation: Review metrics and consider whether metrics used capture principle application. Identify additional elements to be collected and monitored.
3. Needs to improve: Participants should identify any actions required to improve the process and identify metrics that could be used for an agency monitoring process.
4. Presentation: Each group is required to present their assessment of:

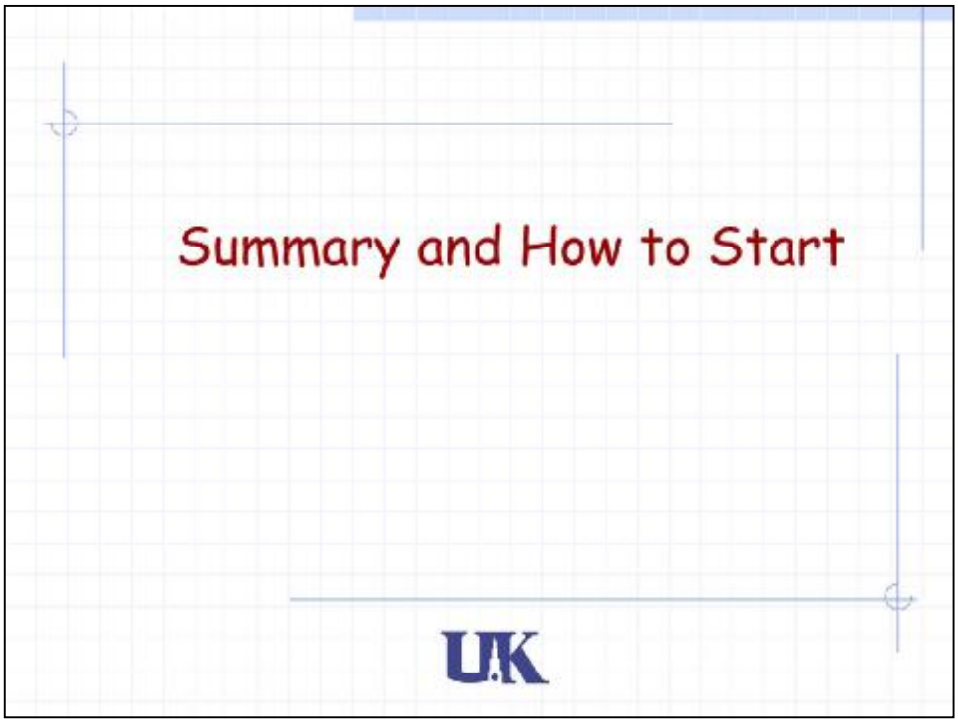
   a. principle application;

   b. actions to improve; and

   c. metrics for agency monitoring efforts.



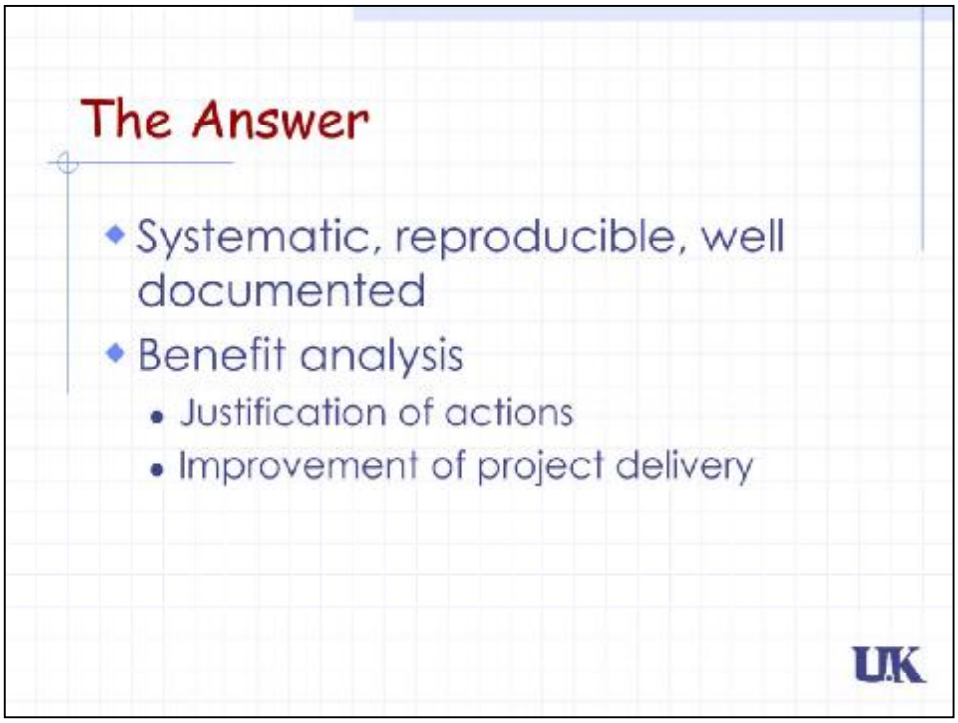
This table summarizes the required changes in principle actions for the selected project.



Demonstrating benefits of context sensitive design and solutions (CSS) is of significant value to transportation agencies and stakeholders involved in project delivery. The workshop presented a practical set of guidelines for use in assessing the benefits of CSS actions. The “Why, What, How and When” of benefit quantification was addressed and explained. The process allows for continuous quality improvement that could be used to improve project delivery and apply agency resources more effectively.

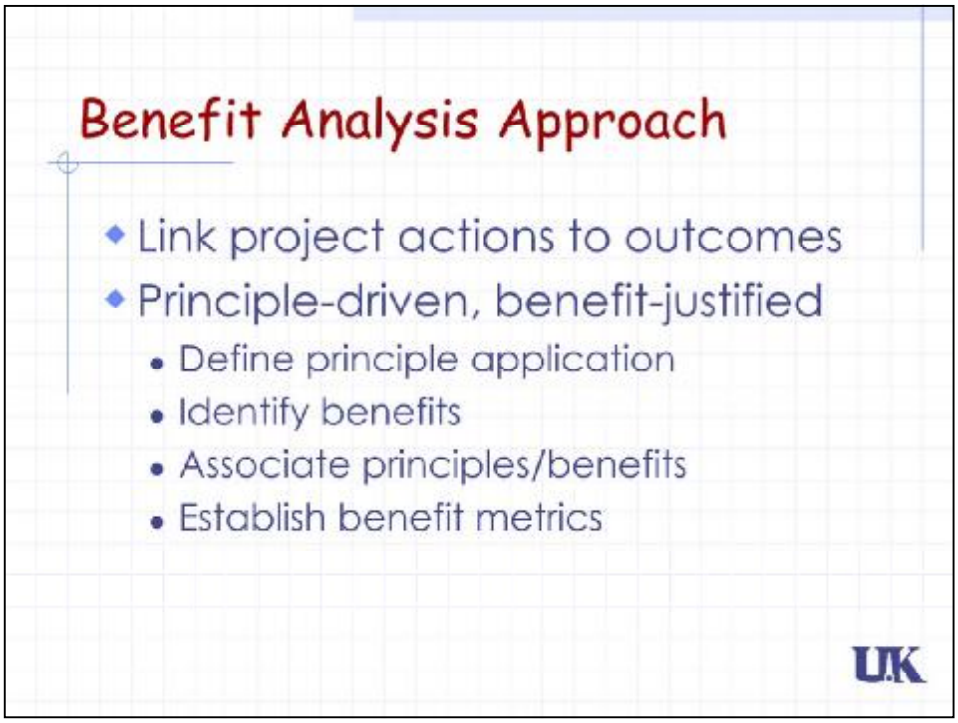
The basic concept for the Context Sensitive Solutions is to develop a project that balances the mobility, safety, environmental, and social needs. Its goal is to achieve a project development process that provides an outcome harmonizing transportation requirements with community needs and values. The solution to be developed will address the agency expectations for deliver an on-time and within budget project along with the stakeholders expectations of addressing natural and human environment and community expectations of delivering a project that will improve the quality of life.

Efforts to apply the CSS process have been viewed negatively by some transportation agencies. Typical concerns are stated as a waste of money to include features that either are more expensive or unnecessary, the project takes longer to complete in order to accommodate more public involvement, and safety is compromised with the use of reduced standards or placement of obstacles (trees) in medians. However, these are often more of a perception than a reality based on anecdotal testimonies.

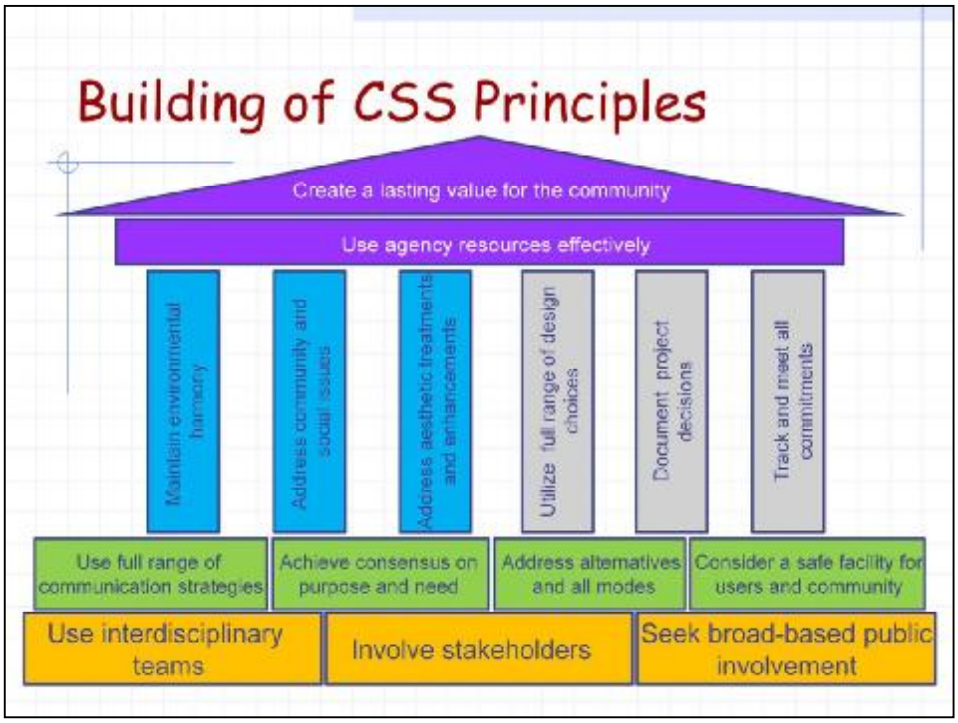


Even though anecdotal comments refute the perceived problems, they are not systematically measured and are not clearly documented. There is a need to document such results and outcomes in order to provide a basis for properly evaluating project outcomes from the CSS process. The process developed here allows for such systematic evaluation of the benefits through a reproducible process with the use of measured outcomes. The process allows for a well documented approach that could provide the support for any decisions made as well as allow for future improvements.

The benefit analysis process presented here is used to either justify actions for a project or provide benchmarks for improving project delivery. The approach allows project teams to measure outcomes and determine the effectiveness of their actions on a specific project. At the same time, these outcomes can serve as the benchmark for improving project delivery in future projects. The measured benefits can also be used agency wide for justifying the CSS process and improvement the project delivery process.



The approach developed here links project specific actions to measured outcomes that are used in evaluating the project approach and assist in improving the process. Central to this benefit analysis approach is the understanding and use of CSS principles that guide projects. Once the level of effort for applying the principles is identified, associated benefits from their application can be identified and measured to quantify the effect of these actions for the agency and the community. CSS is a principle-driven, benefit-justified effort that can enhance an agency's goals and interaction with stakeholders and the public. In this process, the level of application of each principle using the project attributes (scope, scale and context) is first defined. Benefits are selected to be measured and are associated to the principles in order to allow for determining the extent of the principle effect on each benefit. Finally, the measures to be used (quantitative and/or semi-quantitative) are defined.



Fifteen principles necessary for a successful CSS project were identified from the project development/delivery process. These principles build upon each other and have cause and effect relationships. Understanding the principles and their interaction promotes knowledge of CSD&S fundamentals and process relations, thus furthering comprehension of how CSD&S projects are developed.

A representation of these relationships is provided in here to show the dependencies among principles as a building.

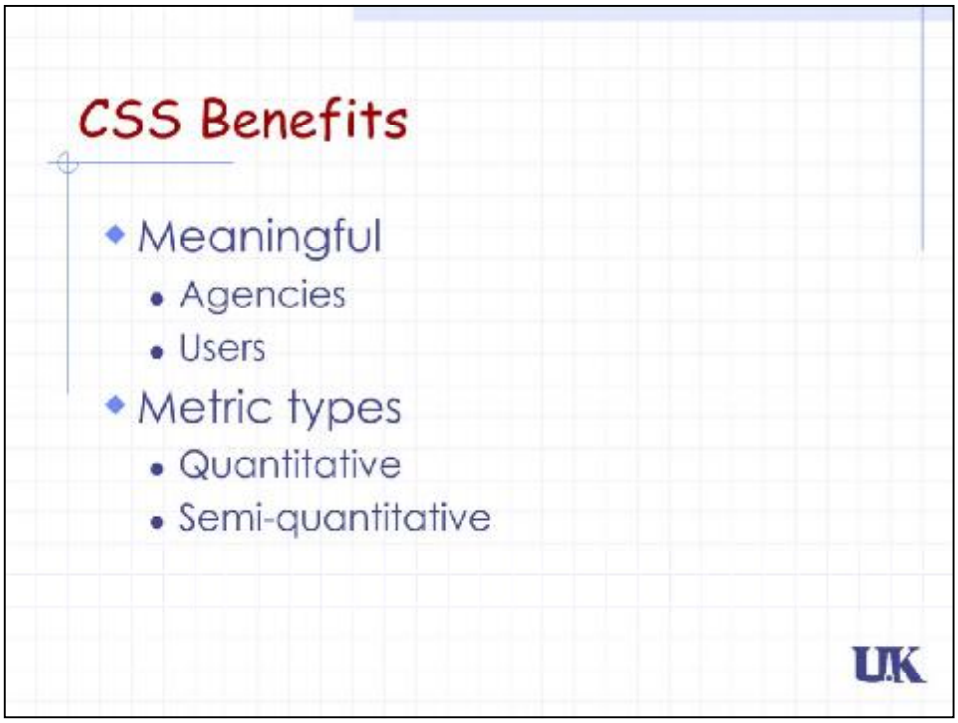
Gold: are the three fundamental principles that ground a CSS project initiative… they are absolutely necessary, but not sufficient for success;

Green: are the four basic principles that are at the heart of the focused activity carried out by the project's professionals while being informed and guided by all stakeholders;

The Blue and Gray: are the six enabling principles -- those things that are guided by the project's environmental setting (blue) and the project's administration or agency process management (gray); and finally the

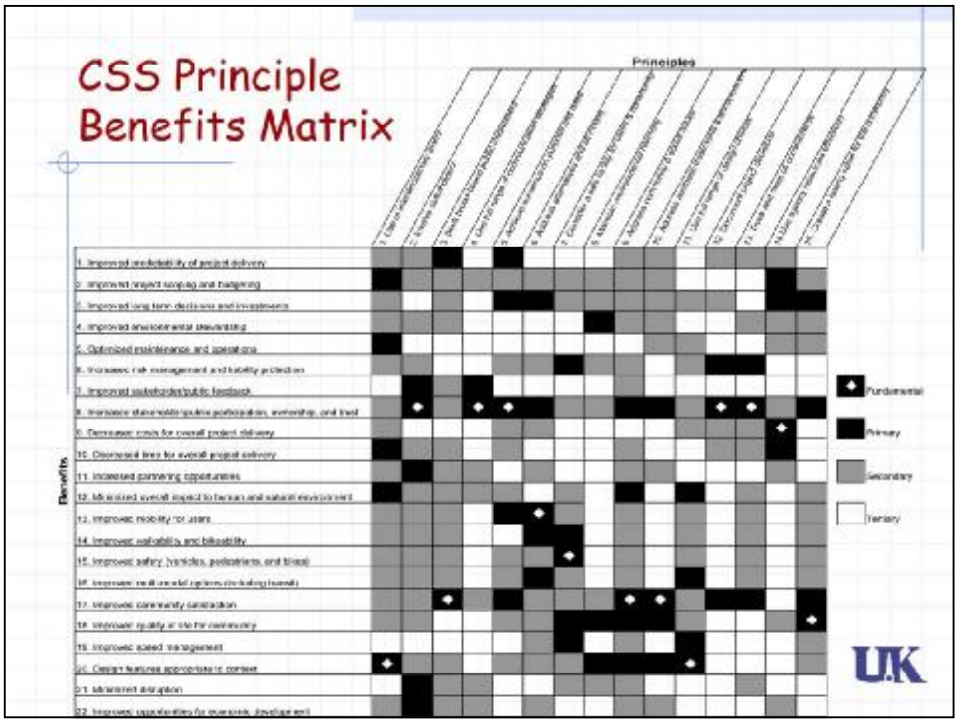
Purple: are the top two principles -- the ultimate focus or goals of the project development process using CSS – representing expectations for agency and community.

The following slides will break down these relationships into more detail.



Benefits are desirable outcomes of the project development process. The benefits are grouped in two basic categories based on who accrues the benefits, i.e. the agency or the users. Some of the benefits are internal to the agency's operations and have no clearly understood benefit to the users.

Indicators were defined to provide the basis for understanding the data to be collected and measured. Quantitative and semi-quantitative indicators were developed to capture and measure the impact of each benefit. These metric indicators are summarized and their associated tools for collecting the data are provided in the Guidelines.



The principle-benefit matrix provided here was developed to capture the extent of the principle-benefit relationships based on expert panel and case study findings. The 15 principles are cross tabulated with the 22 benefits to form a matrix that is color-coded to show the categories of principles; fundamental, primary, secondary, and tertiary.

Project evaluation can be summarized in a five step process:

First the level of effort of how the CSS principles will be applied on the project must be determined.

Second the project team must identify those benefits that will be evaluated on the project.

Identifying benefits early in the project development process will allow for the establishment of benchmarks, by which to evaluate performance.

This will allow the team to define a data collection process throughout the project to ensure that critical data points are not missed.

Finally the project team or agency can use the collected data to carryout the evaluation identifying the level of success of the project. By linking performance to the CSS action principles the evaluation can also be used to identify areas of improvement for subsequent stages of the project or for use on other projects.

Key Concepts

- Start evaluation early/now
  - Establish evaluation needs early
  - Apply all principles
  - Establish benchmarks
  - Collect, maintain, and make data accessible

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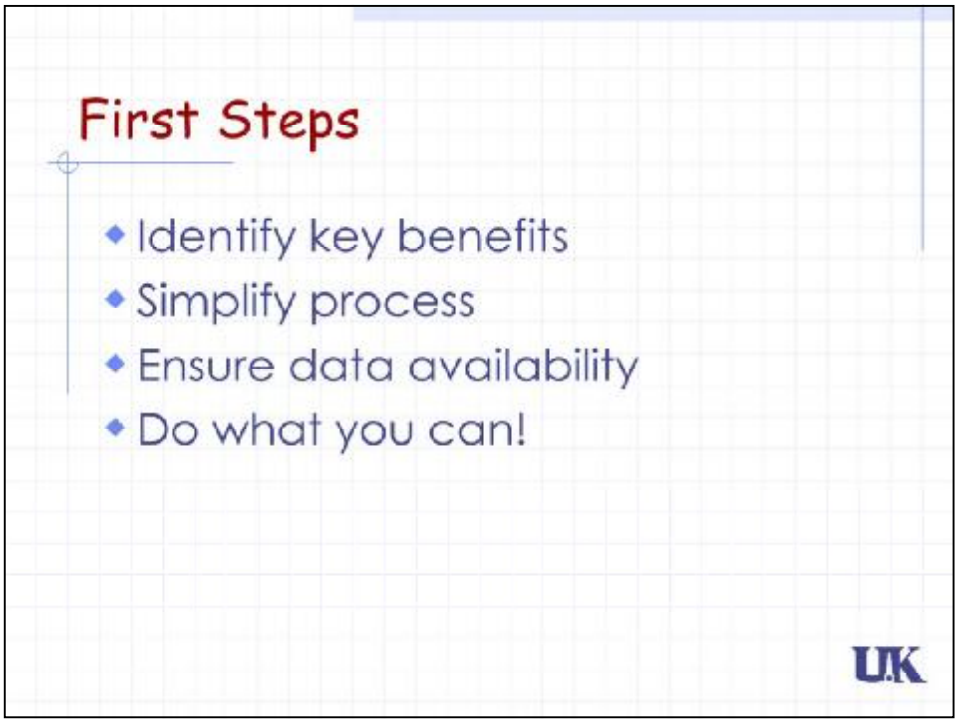

The process defined here may seem intimidating for some agencies. It should be emphasized that an agency or a team can select a few benefits to monitor, apply them in some pilot projects and commit in the data collection and dissemination. Once these efforts are under way, then additional steps can be taken to implement more steps and expand the process in more, and eventually in all, projects.

Taking the first step is the biggest commitment in this process.

Workshop Handouts & Agenda

CASE STUDY

Setting

In the state's current six-year highway facilities improvement plan, the Department of Highways has programmed for a widening and realignment project for US 462 in Happi County. The section of US 462 is a 10-mile segment between Rushmore and Pleasantville with a projected ADT of 20,000 vehicles per day.

Although only in its early stage of planning (funding availability was just announced), the project is already generating controversy and opposition. Critics of road construction express concern for the integrity and esthetic appeal of the region's rural character. Many opponents of the project attended the first meeting to study feasibility. So the press is closely following the controversy. For their part, supporters of the project point to the greater transportation needs arising from the economic growth and dynamism of the region. In addition, supporters, as well as, the Department of Highways are concerned about the potential safety and capacity shortcomings of not constructing a roadway as some roadway opponents demand.

Given its mission to serve the public, the Department of Highways is now in the middle of the debate between the contending parties. The search for consensus will undoubtedly call for much flexibility in the process. The opposition is organized and can generate support among the general public by pointing out previous department projects that ignored the social, historical and environmental needs of communities. Gaining the public's trust and support will require serious effort.

The major issues and concerns of the project setting are discussed below:

- <u>Economic growth</u>

  For many years, Happi County roads have been considered adequate for the volume of traffic they had to accommodate. In the past, the bulk of the traffic consisted of local motorists and a few commercial vehicles (mainly agricultural). Two years ago, Pleasantville attracted a meat processing plant that currently employs 300 people. In rural areas of Happi County, a significant amount of logging is being conducted. Heavily loaded logging trucks travel constantly on US 462 to access the sawmill east of Pleasantville. Last year, a rock quarry/asphalt plant was opened three miles south of Rushmore along US 462.

- <u>Environmental concerns</u>

  There are several environmental concerns for the Happi County and Rushmore area including a large area of prime farmland that needs to be preserved; several wetlands

that are habitat for the Tennessee bat (an endangered species); motorists frequently delight in seeing deer, wild turkeys, pheasant and waterfowl as they drive along the road; motorists enjoy the traditional farmhouses and rustic barns that dot the landscape, fearing that the proposed project will lead to the destruction of the bog and encourage housing development in the prime farmland and therefore eliminate the area's rural charm; and a woodland, east of the wetland, with many old growth trees.

- Safety

  Some of the roadway opponents claim that the existing roadways are adequate to address the future needs for the community. Unfortunately, some of the attributes that give the existing road its pleasing, rural character may present hazards to motorists. US 462 has two 10-foot lanes and in some locations there are no shoulders. There are 13 at grade intersections along US 462 and a number of residential driveways. Many trees and several stone walls are located very close to the roadway. Some of the existing congestion on the roadways in the area are attributed to older drivers and farm equipment who often drive at slow speeds (30-35 mph) and cause traffic to back up for up to a quarter of a mile even during off-peak hours. Motorists have complained about the aggressive behavior of truckers using the road, especially when traffic becomes congested.

- Public/Stakeholder Concerns

  Not all residents of Rushmore and Happi County are pleased with the changing character of the region. Landowners along US 462 are unhappy with the increase in traffic, especially the rising number of large trucks. They claim the road project will generate much additional traffic, leading to further deterioration in the region's livability. A historic preservation group (Rushmore Forever) is opposed to the loss of any historic structures and landmarks and especially the Antioch Church and Cemetery. It recently petitioned the keeper of the National Register of Historic Places, the U.S. Park Service, to designate the church area a historic district. Most environmentalists are opposed to the new road. They believe that the home of the bats will be disturbed and they have formed a group called "Friends of the Bog." They favor either a few small improvements along the current route or a no-build alternative, since they are afraid than any road will take more of the wetland or prime farmland. But, opposition extends far beyond those whose land is directly affected. Included in the ranks of opponents are: a variety of environmentalists; anti-urban sprawl advocates; and historic preservationists. In addition,

many residents are unhappy about the growing suburbs outside Rushmore and Pleasantville. They fear that the proposed project will mean more undesirable growth in the form of more subdivisions, strip malls and manufacturing plants, as well as a spillover of growth into the prime farmland. Many residents cherish the beauty of their rural lifestyle, which they believe to be imperiled by the proposed project. They envision the loss of scenic farmlands and woodlands. In addition, some people that commute between the two towns are unhappy with the prospects of long delays during the several years of work on the road.

- Highway Department

  For more than five years, local politicians have pressed the state legislature to provide funds for improving US 462. Last year, funds were finally appropriated. When this project was first discussed in the 1990s, Department and local officials anticipated that it would generate opposition. They held several preliminary discussions about mitigating potential resistance and building a public consensus supporting the project. However, the rapid emergence of vocal opposition forces was unexpected, as was the range of contentious issues. Department officials are confronted now by a difficult situation. Detractors of the project have been outspoken. Due to the variety of issues they have raised, the Department of Highways cannot deal with the opposition by showing only one argument against the project is false or overstated. That is, department officials must address stakeholder objections on a wide range of both general and specific issues. In addition, the barrage of negative publicity about the project appears to have intimidated the large number of people in favor of the project. Many supporters, even some local politicians who favor the project, have yet to state their support publicly. Even when they have good arguments, they hesitate to counter some of the opponents' claims. The opposition forces are well organized and are in touch with nationally organized environmental groups. In contrast, no group is trying to assemble a vocal support base in the region. Still, despite the articulate opposition of opponents and the relative silence of supporters, Department officials believe that a majority of local residents want to see a new road with greater capacity and safety built.

- Fiscal Constraints

  At the same time the department of highways budget has been cut due to decreased tax revenues. Many political opposition groups have begun heavily scrutinizing highway projects identifying waste and "pork barrel" projects of the local politicians and highway contractors. As a result the department has a need to justify all elements of the project as being

necessary in order to demonstrate the need for utilizing them. The available budget for the project is $65 million.

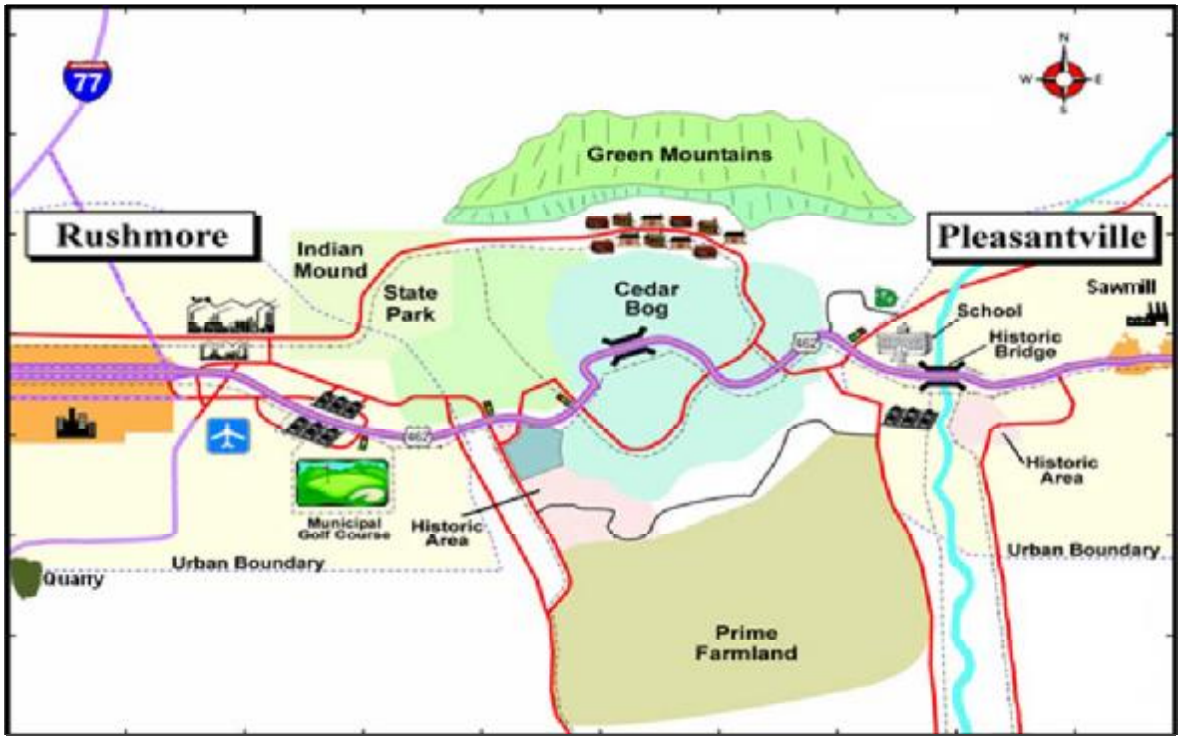

Figure 1 Schematic diagram of existing conditions

NCHRP 642 Training Module 2 Handout -- Principles

Principles and application criteria summary

Principle	Criteria for application
1. Use interdisciplinary teams	• All disciplines and team members are identified • Project professionals have the necessary expertise • Team members understand their role on the project • Two-way communication is maintained • All input is given due consideration
2. Involve stakeholders	• All stakeholders are identified • All input is given due consideration • Participation is meaningful
3. Seek broad-based public involvement	• All interested and affected persons are identified • The project team identifies information needed from the public • Opportunities for public involvement are provided • Decision making process is in place
4. Use full range of communication strategies	• A full range of communication techniques is employed • Communication is used to disseminate and collect information • Communication is continuous
5. Achieve consensus on purpose and need	• Purpose and need is developed early • Agreement on purpose and need goals is achieved • Measures of effectiveness are established
6. Address alternatives and all modes	• Modal alternatives are identified • Each alternative is developed to its fullest potential • The “No Build” alternative is a genuine alternative • Alternative evaluation criteria are objective
7. Consider a safe facility for users and community	• Safety review is conducted • Input from all modal user groups is sought • Solution addressing safety concerns is developed
8. Maintain environmental harmony	• All resources must be identified and considered early • Stakeholders/public determine environmental harmony • The project strives to enhance resources
9. Address community and social issues	• Solutions are sensitive to the community values • The effect of the project on the community is documented • The project team is open-minded
10. Address aesthetic treatments and enhancements	• Appropriate aesthetic design is implemented • Aesthetic design involves team and stakeholders/public
11. Utilize full range of design choices	• Design choices/options meet the purpose and need • Design options minimize impacts • Project designs are sensitive to the community • Input is integrated into design options

Principles and application criteria summary (cont'd)

12. Document project decisions	• Project team documents o the purpose and need statement o project constraints and their impact on design choices o the full range of alternatives considered in the project o all natural, human and cultural resources within the study area o potential safety concerns and their treatment o the selection process and design values chosen for each design element o construction activities and commitments
13. Track and meet all commitments	• Identify and document project commitments • Ensure project commitments are addressed • Maintain all project commitments
14. Use agency resources effectively	• The project is delivered in a timely manner • Expenditures were appropriate for project • Expenditures were appropriate for system optimization • Project team has appropriate support
15. Create a lasting value for the community	• Project meets purpose and need • Project is compatible with community plans • Project addresses quality of life issues • Project is sustainable

1. *Use Interdisciplinary Teams*

Criteria for Application

- All appropriate disciplines and team members are identified during appropriate phases of the project, beginning with scoping, in accordance with the context, extent and impact of the project.
- Project professionals have the necessary, diverse and appropriate expertise to move the project successfully through all project phases.
- Team members understand their role on the project and the roles of team members vary throughout the project in accordance with their expertise and the project phase.
- Timely, open, two-way communication is maintained among team members.
- Input by all team members is given due consideration.

Benefits	Rationale	Indicators
Design features appropriate to context	The use of such teams will allow for input from all members while the design is developed and allow for addressing the specific elements required by each team member as they may influence design.	♦ Semi-quantitative assessment of opinion and satisfaction level
Decreased time for overall project delivery	The interaction between team members will allow for resolution of issues that may arise in the subsequent phases of the project development process and therefore reduce the time requirements for each phase and the entire project.	♦ Number of months by project phases and total duration ♦ Semi-quantitative assessment of expert opinion
Minimized impact to human and natural environment	The use of such teams will allow for input from all members while the design is developed and allow for addressing the specific human and natural concerns by each team member as they may influence the project design.	♦ Percentage of human and environmental impacts of alternative used for project compared to other alternatives ♦ Semi-quantitative assessment of opinion and satisfaction level
Optimized maintenance and operations	The inclusion of traffic operations and maintenance as team members will allow for more streamlined operations for the facility and facilitate any future special needs for the upkeep of the facility.	♦ Annual cost in dollars ♦ Semi-quantitative assessment of expert opinion

2. *Involve Stakeholders*

Criteria for Application

- All affected stakeholders are identified at the appropriate phase of the project and solicited for input/updated throughout.
- All stakeholder input is given due consideration.
- Processes are in place to ensure participation by stakeholders is meaningful, timely and can provide informed project decisions.

Benefits	Rationale	Indicators
Increased stakeholder/public participation, ownership and trust	Involving stakeholders throughout the project development process will increase their participation, since their input will be solicited at certain points of the process, improve trust in the process, since their opinion will be valued and considered, and enhance ownership of the project, since their concerns will be addressed and their input considered.	♦ Stakeholder involvement measures ♦ Semi-quantitative assessment of opinion and satisfaction level
Improved stakeholder/public feedback	The involvement of stakeholders will allow for a more appropriate and organized feedback process, since it has the potential to be customized.	♦ Economic development indicators ♦ Semi-quantitative assessment of expert opinion
Minimized construction related disruption	The stakeholder involvement has the potential to identify means for reducing the disruption to the community by identifying desirable closure periods for construction and/or providing suggestions for alternative routes.	♦ Work zone, lane closings and detour duration in days ♦ Semi-quantitative assessment of opinion and satisfaction level

3. *Seek Broad-Based Public Involvement*

Criteria for Application

- The project team identifies all interested and affected persons early in the project development process.
- The project team proactively identifies what information they need from the public and the methods needed to solicit that input.
- Opportunities for public involvement are provided throughout the entire project development process.
- A transparent and rational decision making process is in place to incorporate public input.

Benefits	Rationale	Indicators
Improved community satisfaction	The consideration of comments received during the public involvement process will increase community satisfaction regarding the process and the solution developed and enhance the agency's image for future projects.	♦ Semi-quantitative assessment of opinion and satisfaction level
Improved long term decisions and investments	The consideration of comments received during the public involvement process will assure that the solution developed fits with the long term goals of the community.	♦ Increased transportation/ community long term benefit relative to cost ♦ Semi-quantitative assessment of expert opinion
Improved predictability of project delivery	The use of a broad-based public involvement will allow for the identification of all possible areas of concern and their proper resolution, which in turn has the potential to reduce future delays and thus improve predictability of project delivery.	♦ Project duration in months to complete ♦ Semi-quantitative assessment of expert opinion

4. *Use Full Range of Communication Strategies*

Criteria for Application

- The project team employs a full range of communication techniques appropriate to the purpose of the communication and the nature of the participants.
- Communication methods must be used to both disseminate and collect needed information.
- Communication is continued throughout the project and beyond.

Benefits	Rationale	Indicators
Increased stakeholder/public participation, ownership and trust	The use of full range communication means will allow stakeholders to better participate in the process and therefore provide them with a more informed process for providing meaningful input.	♦ Stakeholder involvement measures ♦ Semi-quantitative assessment of opinion and satisfaction level
Improved stakeholder/public feedback	The use of full range communication means will allow stakeholders to fully understand the issues and elements of the project and thus enhance their ability to provide the appropriate feedback when required.	♦ Number of stakeholder responses ♦ Semi-quantitative assessment of expert opinion

5. *Achieve Consensus on Purpose and Need*

Criteria for Application

- The purpose and need statement is developed early in the project development process and is revised as warranted during planning and preliminary design.
- The purpose and need statement is based on consensus of the project team and interested and affected stakeholders/public.
- The purpose and need statement establishes measures of effectiveness to guide the decision-making process.

Benefits	Rationale	Indicators
Increased stakeholder/public participation, ownership and trust	Achieving consensus on purpose and need by the stakeholders will allow for increased participation and engagement in the process as well as a feeling of ownership of the project, since its purpose and need will reflect their input and values.	♦ Stakeholder involvement measures ♦ Semi-quantitative assessment of opinion and satisfaction level
Improved predictability of project delivery	Achieving consensus on purpose and need by all parties will allow for addressing all concerns in a timely manner and avoid unanticipated delays.	♦ Project duration in months to complete ♦ Semi-quantitative assessment of expert opinion
Improved long term decisions and investments	Achieving consensus on purpose and need will assure that the solution developed fits with the long term goals of the community.	♦ Increased transportation/ community long term benefit relative to cost ♦ Semi-quantitative assessment of expert opinion
Improved mobility for users	The consideration of all modes will allow for the identification and inclusion of all modes appropriate for the community and thus enhance mobility options and choices for the users of the facility.	♦ Index of quality of travel for all modes ♦ Semi-quantitative assessment of opinion and satisfaction level
Improved community satisfaction	Achieving consensus on purpose and need will allow for developing a project that is in sync with the community vision, since its purpose and need will reflect such input and vision thus resulting in a project that will satisfy the community.	♦ Semi-quantitative assessment of opinion and satisfaction level

6. *Address Alternatives and All Modes*

Criteria for Application

- Alternatives encouraging mode choice capable of addressing the issues in the purpose and need statement, are identified and developed.
- Each alternative is developed to its fullest potential appropriate to the stage of the project.
- The "No Build" alternative is considered and is provided as a genuine alternative.
- Alternative evaluation criteria are objective.

Benefits	Rationale	Indicators
Improved mobility for users	Consideration of all alternatives and modes will identify all potential options for the users to be considered.	♦ Index of quality of travel for all modes ♦ Semi-quantitative assessment of opinion and satisfaction level
Improved multi-modal options	Consideration of all alternatives and modes will improve the connectivity of modes and identify potential new modes that could be part of the project and therefore improve the modal choices for the facility users.	♦ Each modal facility element inclusion and extent ♦ Modal connectivity (count/volume) and safety (crashes/severity) ♦ Semi-quantitative assessment of opinion and satisfaction level
Increased stakeholder/public participation, ownership and trust	Consideration of all alternatives and modes will improve stakeholder participation, since their input will be sought to identify potential alternatives and modes to be considered, ownership of the project, since their input will solicited and considered in the final project design, and trust in the process, since their comments will be considered and addressed during the project development process.	♦ Stakeholder involvement measures ♦ Semi-quantitative assessment of opinion and satisfaction level
Improved long term decisions and investments	Consideration of all alternatives and modes will assure that the solution developed fits with the long term goals of the community.	♦ Increased transportation/ community long term benefit relative to cost ♦ Semi-quantitative assessment of expert opinion
Improved walkability and bikeability	Consideration of all alternatives and modes will improve the options for pedestrians and bicyclists.	♦ New and expanded options for pedestrians and bicyclists ♦ Index of quality of travel for bicyclists and pedestrians ♦ Semi-quantitative assessment of opinion and satisfaction level

7. *Consider a Safe Facility for Users and Community*

Criteria for Application

- A safety review is conducted at each phase of the project with consideration of the needs for all users.
- Input from all modal user groups is sought to better understand their safety needs.
- The project team develops a solution addressing safety concerns.

Benefits	Rationale	Indicators
Improved safety (vehicles, pedestrians and bikes)	Considering a safe facility will result in an improved safety level, since the needs of all users will be considered and addressed.	♦ Number of crashes, crash frequency and severity ♦ Improved design features by type ♦ Semi-quantitative assessment of opinion and satisfaction level
Improved quality of life for community	Considering a safe facility will result in an improved quality of life for the community, since a safer facility will allow for lower crash rates.	♦ Semi-quantitative assessment of opinion and satisfaction level ♦ Alignment with community plans (land use and activity pattern)
Improved speed management	Considering a safer facility will result in improved speed management, since the design elements provided in the project design will consider speed issues as part of their selection and aim in addressing speed management.	♦ Operating speed (expected/ actual) ♦ Semi-quantitative assessment of opinion and satisfaction level
Improved walkability and bikeability	Considering a safe facility will result in an improved safety level for pedestrians and bicyclists, since their needs will be considered and addressed.	♦ Modal safety (crash/severity) ♦ Semi-quantitative assessment of opinion and satisfaction level
Increased risk management and liability protection	Considering a safe facility will result in increased risk management protection, since all decisions will be documented and properly supported.	♦ Number of legal action taken against the agency ♦ Semi-quantitative assessment of expert opinion

8. *Maintain Environmental Harmony*

Criteria for Application

- All natural, human and cultural resources within the study area must be identified and considered in the project development process as early as possible.
- Environmental harmony is determined both by the stakeholders/public and appropriate studies.
- The project strives to enhance resources, not merely maintain them.

Benefits	Rationale	Indicators
Minimized overall impact to human and natural environment	Achieving environmental harmony will result in minimized impacts to natural and human environment, since the appropriate issues will be considered and addressed.	♦ Percentage of human and environmental impacts of alternative used for project compared to other alternatives ♦ Semi-quantitative assessment of opinion and satisfaction level
Improved environmental stewardship	Aiming to maintain environmental harmony will demonstrate the commitment of the agency to environmental concerns and issues and improve the agency's stewardship.	♦ Increased or enhanced mitigation beyond mandated ratio/acres ♦ Semi-quantitative assessment of expert opinion
Improved quality of life for community	Achieving environmental harmony will result in improved quality of life for the community, since all social and natural environment issues will be considered and addressed.	♦ Semi-quantitative assessment of opinion and satisfaction level ♦ Alignment with community plans (land use activity patterns)
Design features appropriate to context	Maintaining environmental harmony will result in developing a project solution that will have design features that are appropriate to the context since the environmental concerns will be considered and addressed in a proper manner.	♦ Semi-quantitative assessment of opinion and satisfaction level

9. *Address Community and Social Issues*

Criteria for Application

- The project team through public interaction investigates and documents the context of the project in terms of community and social resources and how the project may affect that context.
- Proposed solutions are sensitive to the community values and various cultures within the community.
- The project team is open-minded and considers non-traditional solutions that fit the community.

Benefits	Rationale	Indicators
Improved community satisfaction	Considering community and social issues will improve community satisfaction, since the final design solution will address the community desires as they were formed during the public and stakeholder input meetings.	♦ Semi-quantitative assessment of opinion and satisfaction level
Increased stakeholder/ public participation, ownership and trust	Considering the community and social issues will enhance stakeholder participation, since their input will be sought, ownership, since their comments and suggestions will be considered in the project's solution, and trust, since their input will be seriously considered and included in the final project design.	♦ Stakeholder involvement measures ♦ Semi-quantitative assessment of opinion and satisfaction level
Minimized overall impact to human and natural environment	Considering the community and social needs will minimize the impact to human environment, since all appropriate issues will be addressed and appropriate solutions will be sought to be included in the final project design.	♦ Percentage of human and environmental impacts of alternative used for project compared to other alternatives ♦ Semi-quantitative assessment of opinion and satisfaction level
Improved quality of life for community	Consideration of community and social issues will improve the quality of life since comments and input from public involvement that were addressed in the final project design will result in a project that will be enhance their quality of life.	♦ Semi-quantitative assessment of opinion and satisfaction level ♦ Alignment with community plans (land use and activity patterns)
Design features appropriate to context	Consideration of community and social issues will result in a design that fits the context, since comments and input from public involvement will be addressed in the final project design.	♦ Semi-quantitative assessment of opinion and satisfaction level

10. *Address Aesthetic Treatments and Enhancements*

Criteria for Application

- The process for selecting various elements for the aesthetic design involves the appropriate team members and stakeholders/public
- Design elements are selected in accordance to the context of the project and reflect the character of the area..

Benefits	Rationale	Indicators
Improved community satisfaction	Providing aesthetic treatments will improve community satisfaction, since the final design solution will address the community desires as they were formed during the public and stakeholder input meetings.	♦ Semi-quantitative assessment of opinion and satisfaction level
Increased stakeholder/public participation, ownership, and trust	Providing aesthetic treatments will enhance their participation, since their input will be sought, ownership in the project, since their comments and suggestions will be considered in the project's solution, and trust, since their input will be seriously considered and included in the final project design.	♦ Semi-quantitative assessment of opinion and satisfaction level
Improved quality of life for community	Providing aesthetic treatments will improve quality of life for the community, since the final design solution will provide an aesthetically pleasing environment	♦ Alignment with community plans (land use and circulation) ♦ Semi-quantitative assessment of opinion and satisfaction level

11. *Utilize Full Range of Design Choices*

Criteria for Application

- Alternative design choices/options are developed that meet the purpose and need of the project.
- Design options developed must *avoid, minimize or mitigate* impacts to natural, human and cultural resources and attempt to *enhance* these resources where possible.
- The project designs are sensitive to the community values and various cultures within the community.
- Stakeholder and public input is collected and integrated into design options.

Benefits	Rationale	Indicators
Design features appropriate to context	Utilizing a full range of design choices will result in developing a project solution that will have design features that are appropriate to the context since all concerns will be considered and addressed in a proper manner.	♦ Semi-quantitative assessment of opinion and satisfaction level
Improved multi-modal options	Utilizing a full range of design choices will improve the options for mode connectivity and include any new modes identified in the final design solution.	♦ New and or expanded modal choices ♦ Modal connectivity (count/volume) and safety (crashes/severity) ♦ Semi-quantitative assessment of opinion and satisfaction level
Minimized overall impact to human and natural environment	Utilizing a full range of design choices will minimize the impact to natural and human environment, since all appropriate issues will be addressed and appropriate solutions will be sought in the final project design.	♦ Percentage of human and environmental impacts of alternatives used for project compared to other alternatives ♦ Semi-quantitative assessment of opinion and satisfaction level
Improved speed management	Utilizing a full range of design choices will result in improved speed management, since the design elements provided in the project design will consider speed issues when are selected and aim in addressing speed management.	♦ Operating speed (expected/ actual) ♦ Semi-quantitative assessment of opinion and satisfaction level

12. *Document Project Decisions*

Criteria for Application

Input from the project team, stakeholders and public involvement activities documents:

- the purpose and need statement
- project constraints and their impact on design choices
- the full range of alternatives considered in the project
- all natural, human and cultural resources within the study area
- potential safety concerns and their treatment
- the selection process and design values chosen for each design element
- construction activities and commitments

Benefits	Rationale	Indicators
Increased stakeholder/public participation, ownership and trust	The documentation of project decisions will increase stakeholder trust in the process, since there will a record of the decisions made throughout the entire process and it could be used to support all choices made.	♦ Stakeholder involvement measures ♦ Semi-quantitative assessment of opinion and satisfaction level
Improved community satisfaction	Documentation of project decisions will improve community satisfaction since it will demonstrate that the choices were made based on community and stakeholder input and provide a rational support for each choice made.	♦ Semi-quantitative assessment of opinion and satisfaction level
Increased risk management and liability protection	Documentation of project decisions will result in increased risk management and liability protection, since all project decisions will be documented and properly supported.	♦ Number of legal action taken against the agency ♦ Semi-quantitative assessment of expert opinion

13. *Track and Meet All Commitments*

Criteria for Application

- Identify and document project commitments in all project phases.
- Ensure that all project commitments are satisfactorily addressed prior to project completion.
- Maintain all project commitments throughout the project development process and over the service life of the facility.

Benefits	Rationale	Indicators
Increased stakeholder/public participation, ownership and trust	Tracking and meeting project commitments will increase stakeholder ownership, since it will demonstrate that their input and commitments made during the various project phases were met, trust, since the commitments made were followed through, and possibly participation in future projects, since it will indicate that involvement is considered important	♦ Meetings attended by stakeholders ♦ Semi-quantitative assessment of opinion and satisfaction level
Improved community satisfaction	Tracking and meeting project commitments will improve community satisfaction, since it will demonstrate that their input and commitments solicited during the public involvement process were met and followed through resulting in a project in accordance with community vision and values.	♦ Semi-quantitative assessment of opinion and satisfaction level
Increased risk management and liability protection	Tracking and meeting project commitments will result in increased risk management an liability protection, since all project decisions will be documented and properly supported.	♦ Number of legal action taken against the agency ♦ Semi-quantitative assessment of expert opinion

14. *Use Agency Resources Effectively*

Criteria for Application

- The project is developed in a timely manner.
- Expenditures are appropriate for the project scope/context.
- The project team has the appropriate support and resources to effectively carry out their task.

Benefits	Rationale	Indicators
Decreased costs for overall project delivery	The effective use of all project resources will have as an immediate result the decreased cost for overall project delivery, since it will optimize all resources (interdisciplinary team, stakeholder, and public) to their maximum potential.	♦ Decreased dollar cost amount for project delivery ♦ Number and cost of change orders/Scope Changes ♦ Semi-quantitative assessment of expert opinion
Decreased time for overall project delivery	The effective use of all project resources will have as an immediate result the decreased time for overall project delivery, since it will optimize all resources (interdisciplinary team, stakeholders, and public) to their maximum potential.	♦ Number of months by project phases and total project duration ♦ Semi-quantitative assessment of expert opinion
Improved long term decisions and investments	The effective use of all resources will improve sustainable decision and investments, since it will allow for a better attainment of community vision and goals.	♦ Increased transportation/ community long term benefit relative to cost ♦ Semi-quantitative assessment of expert opinion

15. *Create a Lasting Value for the Community*

Criteria for Application

- The project meets the purpose and need statement.
- The project is compatible with long range community plans.
- The project incorporates solutions that move beyond addressing mobility and address quality of life issues and community values.
- The project is sustainable in terms of social, economic and ecological impacts.

Benefits	Rationale	Indicators
Improved quality of life for community	A project that creates a lasting value to the community will improve quality of life, since it will be a project reflecting the community vision and address the public and stakeholder issues and concerns.	♦ Semi-quantitative assessment of opinion and satisfaction level ♦ Alignment with community plans (land use and activity/circulation patterns)
Increased stakeholder/public participation, ownership and trust	A project that creates a lasting value to the community will improve stakeholder ownership, since the project reflects their input, trust, since it will demonstrate that the input was considered and addressed, and possibly participation in future projects, since their participation was valued and considered.	♦ Stakeholder involvement measures ♦ Semi-quantitative assessment of opinion and satisfaction level
Improve long term decisions and investments	A project that creates a lasting value for the community will improve long term decision and investments, since it will allow for a better attainment of community vision and goals.	♦ Increased transportation/ community long term benefits relative to costs ♦ Semi-quantitative assessment of expert opinion
Improved community satisfaction	A project that creates a lasting value for the community will improve community satisfaction, since it will consider and address public and stakeholder input and result in solutions that will provide a project appropriate to its context.	♦ Semi-quantitative assessment of opinion and satisfaction level

NCHRP 642 Training Module 3 Handout -- Benefits

Benefit metrics summary

Benefit	Indicators
1. Improved predictability of project delivery	Difference in project duration in months to complete Semi-quantitative assessment of expert opinion
2. Improved project scoping and budgeting	Number and cost of change orders/scope changes Semi-quantitative assessment of expert opinion
3. Improved long term decisions and investments	Semi-quantitative assessment of expert opinion
4. Improved environmental stewardship	Increased or enhanced mitigation beyond regulatory mandates Semi-quantitative assessment of expert opinion
5. Optimized maintenance and operations	Annual cost, hours or closures in dollars Semi-quantitative assessment of expert opinion
6. Increased risk management protection	Number and cost of legal action taken against project Semi-quantitative assessment of expert opinion
7. Improved stakeholder/public feedback	Number of stakeholder/public responses Semi-quantitative assessment of expert opinion
8. Increased stakeholder/public participation, ownership and trust	Stakeholder involvement measures Semi-quantitative assessment of opinion and satisfaction level
9. Decreased costs for overall project delivery	Decreased dollar cost amount for project delivery Number and cost of change orders/scope changes Semi-quantitative assessment of expert opinion
10. Decreased time for overall project delivery	Number of months by project phases and total duration Number and cost of change orders/scope changes Semi-quantitative assessment of expert opinion
11. Increased partnering opportunities	Number of Memorandum of Agreements or grants established Semi-quantitative assessment of expert opinion
12. Minimized overall impact to human and natural environment	Percentage of human and environmental impacts of project Semi-quantitative assessment of opinion and satisfaction
13. Improved mobility for users	Index of quality of travel for all modes Semi-quantitative assessment of opinion and satisfaction
14. Improved walkability and bikeability	New and expanded options for pedestrians and bicyclists Index of quality of travel for pedestrians and bicyclists Modal safety (crash/severity) Semi-quantitative assessment of opinion and satisfaction
15. Improved safety (vehicles, pedestrians and bikes)	Number of crashes, crash rate and severity Semi-quantitative assessment of opinion and satisfaction

Benefit metrics summary (cont'd)

16. Improved safety (vehicles, pedestrians and bikes)	Number of crashes, crash rate and severity Semi-quantitative assessment of opinion and satisfaction
17. Improved multi-modal options (including transit)	Each modal facility element inclusion and extent Modal connectivity (count/volume) Modal safety (crash/severity) Semi-quantitative assessment of opinion and satisfaction
18. Improved community satisfaction	Semi-quantitative assessment of opinion and satisfaction
19. Improved quality of life for community	Semi-quantitative assessment of opinion and satisfaction Alignment with community plans (semi-quantitative)
20. Improved speed management	Operating speed (expected/actual) Semi-quantitative assessment of opinion and satisfaction
21. Design features appropriate to context	Semi-quantitative assessment of opinion and satisfaction
22. Minimized construction related disruption	Work zone, lane closings and detour duration in days Semi-quantitative assessment of opinion and satisfaction
23. Improved opportunities for economic development	Economic development indicators Semi-quantitative assessment of expert opinion

NCHRP 642 Training Module 3 Handout -- Benefits

1. Improved predictability of project delivery

Metric Indicator: Difference in project duration in months to complete
This information and data is typically available in project files. The planned or estimated duration can be compared to the actual duration by project phase and overall. Verification is possible by query to project manager/team.

Project schedule (months)	Programming	Planning	Design	Construction	Total
Estimated					
Actual					
Difference					

Metric Indicator: Semi-quantitative assessment of expert opinion
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time (e.g., at the end of project phases). The survey can be administered to stakeholders. The degree of agreement can also be determined by administering the survey to the project manager/team members.

This metric will be measured using an opinion scale through a project team and stakeholder surveys from the following statements:

- **The project was developed in a timely manner.**
- **The project was completed when expected.**

2. Improved project scoping and budgeting

Metric Indicator: Number and cost of change orders/scope changes
The number (and dollar magnitude) of change orders can be determined from project records (construction phase).

This metric is the same as the metric used for evaluating the benefit "Decreased costs forf overall project delivery".

Scope Change/Change Order No.	Cost ($)	Time delay (months)

Metric Indicator: Semi-quantitative assessment of expert opinion
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time (e.g., at the end of project phases). The survey can be administered to stakeholders. The degree of agreement can also be determined by administering the survey to the project manager/team members.

This metric will be measured using an opinion scale through a project team survey from the following statements:

- **Project scoping was improved.**
- **Project budgeting was improved.**

3. Improved long term decisions and investments

Metric Indicator: Semi-quantitative assessment of expert opinion
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time or simply at the end of the pertinent activity. The survey material can be administered to the project team members, members of the CAC and other stakeholder representatives. If all three groups are surveyed the degree of agreement could also be determined.

This metric will be measured using an opinion scale through a project team survey from the following statement:

- **Long term decisions and investments were employed on this project.**

4. Improved environmental stewardship

Metric Indicator: Increased or enhanced mitigation beyond regulatory mandates
Obtain required environmental clearance documents (EIS, EA/FONSI) from regulatory agencies for mitigation/enhancements (out-of-kind mitigation, creation of mitigation or conservation banks, and participation in regional ecologic initiatives). This information will be compared to mandated requirements in the project.

Regulatory Agencies	Mandated	Enhanced/Mitigated

Metric Indicator: Semi-quantitative assessment of expert opinion
Measuring opinion requires the development/use of a standard question set with a rating scale. The satisfaction level can be measured over time or simply at the end of the pertinent activity. Members of the CAC and other stakeholder representatives can be surveyed (particularly resource agencies).

This metric will be measured using an opinion scale through a project team survey from the following statement:

- **Environmental Stewardship improved**

5. Optimized maintenance and operations

Metric Indicator: Annual cost, hours or closures in dollars
Obtain maintenance records including cost data and duration of maintenance activities on the roadway.

Item	Annual Cost ($/yr)	Duration (days)
Utilities		
Roadway maintenance		
Landscaping /mowing		
Other		

Metric Indicator: Semi-quantitative assessment of expert opinion
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time. The survey material can be administered to the project manager and maintenance manager (and facility responsible maintenance staff). The degree of agreement could also be determined.

This metric will be measured using an opinion scale through a project team survey from the following statement:

- **Maintenance and operations activities are optimized.**

6. Increased risk management and liability protection

Metric Indicator: Number and cost of legal actions taken against project
Obtain legal records demonstrating impacts (time and costs) on project completion. Interviews with project team members may be needed to identify full extent of these actions.

Legal Action	Cost ($)	Time delay (months)

Metric Indicator: Semi-quantitative assessment of expert opinion
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time or simply at the end of pertinent activity. Members of the CAC and other stakeholder representatives can be surveyed (including affected residential or commercial property owners). The degree of agreement can also be determined by administering to the project manager/team members.

This metric will be measured using an opinion scale through a project team survey from the following statement:

- **Risk management and liability protection was increased.**

7. Improved stakeholder/public feedback

Metric Indicator: Number of stakeholder/public responses
Review of project record including meeting minutes is required to determine the number of responses per meeting, and the agency's documentation of due consideration of the input. Verification is possible by querying the project manager/team.

Meeting with…	Number of responses	Was project modified based on responses?

Metric Indicator: Semi-quantitative assessment of expert opinion
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time (e.g., at the end of project phases). The degree of agreement can also be determined by administering the survey to the project manager/team members.

This metric will be measured using an opinion scale through a project team survey from the following statements:

- **Stakeholder and public input feedback increased compared to traditional (non-CSS) projects.**
- **The quality of stakeholder and public feedback improved compared to traditional (non-CSS) projects.**

8. Increased stakeholder/public participation, ownership, and trust

Metric Indicator: Stakeholder/public involvement measures (participation)
Participation is measured by number of stakeholders/public (by category) attending meetings over the entire project delivery cycle (by phase) to determine representation and repeat attendance. This information could be available from project files.

Meeting with…	Date	No. of Attendees	Project Phase

Metric Indicator: Meetings attended by stakeholders/public
This includes the number of meetings with specific major stakeholders including resource agencies, local governments and interest groups. Involving these groups throughout the project promotes partnering, shared decision making and enhances trust.

Metric Indicator: Semi-quantitative assessment of (ownership and trust) opinion and satisfaction level
Measuring opinion and satisfaction requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time (e.g., at the end of project phases). The survey can be administered to stakeholders/public. The degree of agreement can also be determined by administering the survey to the project manager/team members.

This metric will be measured using an opinion scale through a project team and stakeholder surveys from the following statements:

- **Stakeholder and public participation increased throughout the project.**
- **A sense of stakeholder and public ownership developed.**
- **Trust in the project team and transportation agency increased.**
- **The participants were treated fairly at public meetings and other venues.**
- **I am satisfied with the procedures and methods that allowed me to have input to project decisions.**
- **I am satisfied with the relationship I had with the project team.**

9. Decreased costs for overall project delivery

Metric Indicator: Decreased dollar cost amount for project delivery
Project delivery costs measured in dollars can be estimated and many agencies know the average cost required to deliver a project. This requires tracking costs by phase (and subsequently total delivery costs).

Project Cost	Programming	Planning	Design	Construction	Total
Actual					

Metric Indicator: Number and cost of change orders/scope changes
The number (and dollar magnitude) of change orders can be determined from project records (construction phase). This information/data allows for comparison with conventional projects.

This metric is the same as the metric used for evaluating the benefit "Decreased time for overall project delivery".

Scope Change/Change Order No.	Cost ($)	Time delay (months)

Metric Indicator: Semi-quantitative assessment of expert opinion
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time (e.g., at the end of project phases). The survey can be administered to stakeholders/public. The degree of agreement can also be determined by administering the survey to the project manager/team members.

This metric will be measured using an opinion scale through a project team survey from the following statement:

- **Costs for overall project delivery through construction decreased.**

10. Decreased time for overall project delivery

Metric Indicator: Number of months by project phases and total project duration
Project delivery time is usually measured in months and many agencies know the average time it takes to deliver a project. This requires tracking duration by phase (and subsequently total delivery time). This data allows duration comparisons between CSD&S and conventional projects by project or program managers.

Project Schedule (months)	Programming	Planning	Design	Construction	Total
Actual					

Metric Indicator: Number and cost of change orders/scope changes
The number (and dollar magnitude) of change orders can be determined from project records (construction phase). This information/data allows for comparison with conventional projects.

This metric is the same as the metric used for evaluating the benefit "Decreased costs for overall project delivery".

Scope Change/Change Order No.	Cost ($)	Time delay (months)

Metric Indicator: Semi-quantitative assessment of expert opinion
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time (e.g., at the end of project phases). The degree of agreement can also be determined by administering the survey to the project manager/team members.

This metric will be measured using an opinion scale through a project team survey from the following statement:

- **Time for overall project delivery decreased.**

11. Increased partnering opportunities

Metric Indicator: Number of Memorandum of Agreements or grants established
This information is typically available in the project files. Verification is possible by querying the project manager, team, CAC, and stakeholders.

Agreement /Grant with…	Purpose

Metric Indicator: Semi-quantitative assessment of expert opinion
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time (e.g., at the end of project phases). The survey can be administered to stakeholders. The degree of agreement can also be determined by administering the survey to the project manager/team members.

This metric will be measured using an opinion scale through a project team and stakeholder surveys from the following statement:

- **Opportunities for partnering increased.**

12. Minimized overall impact to human and natural environment

Metric Indicator: Percentage of human and environmental impacts of project
NEPA documentation will be reviewed to identify alternatives and takings (number, area, type/quality of taking). Obtain NEPA documentation for corresponding conventional project(s).

(a) Compare alternative used to others and determine the comparative level of impact (human and environmental) to the alternatives.
(b) Compare with similar data from corresponding conventional project(s)

Environmental resource	Units	In project area	Impacted	Percent impacted
Personal Properties	EA			
Commercial Properties	EA			
Environmental Justice Properties	EA			
Parks 4(f)	acres			
Endangered Species Habitat	acres			
Wetlands	acres			
Streams	ft			
Other				

Notes: Partial takings should be considered as a portion (e.g. 50%) of relocations
Economic conversion of environmental resources: "System for Valuing Changes to Environmental and Historic Amenities," University of Kentucky, 2004

Metric Indicator: Semi-quantitative assessment of opinion and satisfaction level
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time or simply at the end of the pertinent activity. Members of the CAC and other stakeholder representatives can be surveyed (particularly resource agencies).

This metric will be measured using an opinion scale through a project team and stakeholder surveys from the following statements:

- **Overall Impact to the human environment was minimized.**
- **Overall impact to the natural environment was minimized.**

13. Improved mobility for users

Metric Indicator: Index of quality of travel for all modes
The quality of travel can be determined using travel time estimates and Level of Service designations for each mode. This would require a project study.

Mode of Travel	Travel time	LOS
Walk		
Bike		
Mass Transit		
Auto		

Notes:

1. Pedestrian and Bicycle LOS : "Pedestrian and Bicycle Level of Service on Roadway Segments" TRR 2031, 2007
2. Transit LOS: "Transit Capacity and Quality of Service Manual, 2nd Edition", TCRP 100 , 2003
3. Auto LOS: "Highway Capacity Manual," TRB, 2000

Metric Indicator: Semi-quantitative assessment of opinion and satisfaction level
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time or simply at the end of the pertinent activity. The survey material can be administered to the project team members, members of the CAC and other stakeholder representatives. If all three groups are surveyed the degree of agreement could also be determined.

This metric will be measured using an opinion scale through a project team and stakeholder surveys from the following statements:

- **Overall mobility for users was improved.**
- **Overall mobility for financially disadvantaged users was improved.**

14. Improved walkability and bikeability

Metric Indicator: New and expanded options for pedestrians and bicyclists
This information is to be obtained from the project record (files and plans). The pedestrian and bicycle facilities and options available in terms of numbers and extent can be compared before/after and with similar conventional projects. Verification is possible by querying the project manager/team and CAC/stakeholders.

This metric will be evaluated using the data form provided for the benefit "Improved multi-modal options".

Modal Option Metric	Existing	Implemented
Pedestrian Facilities		
Sidewalk (ft)		
Crossing (ea)		
Other _____		
Bicycle Facilities		
Multi-Use Paths (mi)		
Bike Lanes (mi)		
Other _____		

Notes:
Economic conversion of bicycle facility benefits: "Guidelines for the Analysis of Bicycle Facilities" NCHRP 552, 2006

Metric Indicator: Index of quality of travel for bicyclists and pedestrians
The quality of travel can be determined using travel time estimates and Level of Service designations for bicyclists and pedestrians. This would require a project study.

Mode of Travel	Travel time	LOS
Walk		
Bike		

Notes:
Pedestrian and Bicycle LOS: "Pedestrian and Bicycle Level of Service on Roadway Segments" TRR 2031, 2007

Metric Indicator: Modal safety (crash/severity)
This information is to be obtained from the project record (files and plans). The modal safety in terms of crash/injury levels can be compared before/after. Verification is possible by querying the project manager/team and CAC/stakeholders.

Modal Safety	Crashes (before)	Crashes (after)	Change in crashes
Pedestrian			
Bicycle			

NCHRP 642 Training Module 3 Handout -- Benefits

Metric Indicator: Semi-quantitative assessment of opinion and satisfaction level
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time or simply at the end of the pertinent activity. The survey material can be administered to the project team members, members of the CAC and other stakeholder representatives. If all three groups are surveyed the degree of agreement could also be determined.

This metric will be measured using an opinion scale through a project team and stakeholder surveys from the following statements:

- **Walkability was improved.**
- **Bikeability was improved.**

15. Improved safety (vehicles, pedestrians, and bikes)

Metric Indicator: Number of crashes, crash rate and severity
The information/data can be found in project records (files and studies) as well a crash data bases maintained by most states. The number of crashes by type, frequency and severity should be collected.

Crash Type	Before	Crash Rate (Before)	After	Crash Rate (After)	Change in Crash Rate
Total					
Property Damage Only (PDO)					
Injury					
Fatal					
Pedestrian					
Bicycle					

Note: Economic conversion of crashes: "Crash Cost Estimates by Maximum Police Reported Severity within Selected Crash Geometries," FHWA-HRT-05-51, 2005.

Metric Indicator: Semi-quantitative assessment of opinion and satisfaction level
Measuring opinion requires the development/ use of a standard question set with a rating scale. The expert opinion of professionals (project/program managers and subject matter experts) within the responsible operating agency can be determined. Before/after results can be compared. A similar survey can be used with selected stakeholder groups.

This metric will be measured using an opinion scale through a project team and stakeholder surveys from the following statement:

- **Overall safety (vehicles, pedestrians and bikes) was improved.**

16. Improved multi-modal options (including transit)

Metric Indicator: Modal connectivity (count/volume)
This information is to be obtained from the project record (files and plans). The modal connectivity in terms of count/volume can be estimated by identifying possible connections between modes. Verification is possible by querying the project manager/team and CAC/stakeholders.

Modal Connectivity Options	Existing	Implemented
Pedestrian crossing (ea)		
Bike racks on buses		
Bike racks (parking)		
Park and ride facilities		
Bus stops on route		
Other		

Metric Indicator: Each modal facility element inclusion and extent
This information is to be obtained from the project record (files and plans). The modal options available in terms of numbers and extent can be compared before/after and with similar conventional projects. Verification is possible by querying the project manager/team and CAC/stakeholders.

This metric will be evaluated using the data form provided for the benefit "Improved modal options."

Modal Option Metric	Existing	Implemented
Automobile Facilities		
Single vehicle (lane-miles)		
High occupancy vehicle (lane-miles)		
Other _____		
Pedestrian Facilities		
Sidewalk (ft)		
Crossing (ea)		
Other _____		
Bicycle Facilities		
Multi-Use Paths (mi)		
Bike Lanes (mi)		
Other _____		
Transit (Bus)		
Routes (ea)		
Frequency (Trips/day)		

Transit (other)		
Routes (ea)		
Frequency (Trips/day)		
Other		

Notes:
Economic conversion of bicycle facility benefits: "Guidelines for the Analysis of Bicycle Facilities" NCHRP 552 2006

Metric Indicator: Modal safety (crash/severity)
This information is to be obtained from the project record (files and plans). The modal safety in terms of crash/injury levels can be compared before/after. Verification is possible by querying the project manager/team and CAC/stakeholders.

Modal Safety	**Crashes (before)**	**Crashes (after)**	**Change in crashes**
Pedestrian			
Bus			
Bicycle			
Auto			
Other			

Metric Indicator: Semi-quantitative assessment of opinion and satisfaction level
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time or simply at the end of the pertinent activity. The survey material can be administered to the project team members, members of the CAC and other stakeholder representatives. If all three groups are surveyed the degree of agreement could also be determined.

This metric will be measured using an opinion scale through a project team and stakeholder surveys from the following statement:

- **Multi-modal transportation options were improved.**

17. Improved community satisfaction

Metric Indicator: Semi-quantitative assessment of opinion and satisfaction level
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time (e.g., at the end of project phases). The survey can be administered to the CAC and other stakeholders. The degree of agreement can also be determined by administering the survey to the project manager/team members.

This metric will be measured using an opinion scale through a project team and stakeholder surveys from the following statement:

- **The community was satisfied with the project.**

18. Improved quality of life for community

Metric Indicator: Semi-quantitative assessment of opinion and satisfaction level
Measuring satisfaction requires the development/use of a standard question set with a satisfaction rating scale. The satisfaction level can be measured over time or simply at the end of the pertinent activity. Members of the CAC and other stakeholder representatives can be surveyed (particularly resource agencies).

This metric will be measured using an opinion scale through a project team and stakeholder surveys from the following statement:

- **Quality of life for the community was improved.**

Metric Indicator: Alignment with community plans
Measuring such alignment requires a standardized survey tool that uses a rating scale. The level of alignment can be assessed in categories of land use (i.e., residential, commercial or industrial) and measures of activity patterns (i.e., neighborhood walking). In case of weak or non-existent community plan, the metric could focus in measuring whether the project helped to develop such plans. The survey can be administered to the CAC and selected stakeholders including community planning officials and professionals.

This metric will be measured using an opinion scale through a project team and stakeholder surveys from the following statement:

- **The project is compatible with the community plan.**

19. Improved speed management

Metric Indicator: Operating speed (expected/actual)
Obtain before/after speed postings from project files. Evaluate speed data for various project postings with traffic volumes and agency speed records (85th percentile, etc). Determine design speed (AASHTO Green Book).

Compare speed data with those for similar conventional project(s)

	Operating Speed (85th Percentile)
Expected	
Actual	

Metric Indicator: Semi-quantitative assessment of opinion and satisfaction level
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time or simply at the end of the pertinent activity. The survey material can be administered to the project team members, members of the CAC and other stakeholder representatives. If all three groups are surveyed the degree of agreement could also be determined.

This metric will be measured using an opinion scale through a project team and stakeholder surveys from the following statement:

- **Vehicle speeds are appropriate for the context.**

20. Design features appropriate to context

Metric Indicator: Semi-quantitative assessment of opinion and satisfaction level
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time or simply at the end of the pertinent activity. The survey questionnaire can be administered to the project team members, members of the CAC and other stakeholder representatives. If all three groups are surveyed, the degree of agreement could also be determined.

This metric will be measured using an opinion scale through a project team and stakeholder surveys from the following statement:

- **Project features are appropriate to the surroundings and the community.**

21. Minimized construction related disruption

Metric Indicator: Work zone delays
Information and data can be obtained from the project files. Verification is possible by querying the project manager/team.

MOT Operations	Total Estimated Delay (hrs)
Actual	

Metric Indicator: Semi-quantitative assessment of opinion and satisfaction level
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time or simply at the end of pertinent activity. Members of the CAC and other stakeholder representatives can be surveyed (including affected residential or commercial property owners). The degree of agreement can also be determined by administering to the project manager/team members.

This metric will be measured using an opinion scale through a project team and stakeholder surveys from the following statement:

- **Disruption caused by the project was minimized.**

22. Improved opportunities for economic development

Metric Indicator: Economic development indicators
This information can be obtained by performing a market study, expert interviews or may be available in project files in the form of direct agreements with local businesses or stakeholders. Verification is possible by querying the project manager, team, CAC, and stakeholders.

Indicator	Economic impact
Business activity level ($/year)	
Jobs	
Total income ($/year)	
Other	

Notes:
Additional information on economic development indicators: "Guidebook for Assessing the Social and Economic Effects of Transportation Projects" NCHRP 456 2001

Metric Indicator: Semi-quantitative assessment of expert opinion
Measuring opinion requires the development/use of a standard question set with a rating scale. The opinion level can be measured over time (e.g., at the end of project phases). The survey can be administered to stakeholders. The degree of agreement can also be determined by administering the survey to the project manager/team members.

This metric will be measured using an opinion scale through a project team and stakeholder surveys from the following statement:

- **Opportunities for economic development were identified and exploited.**

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PREFACE TO THE GUIDELINES

The Guide's Purpose and Use

This guide was developed for project teams and their responsible agencies to quantify the transportation benefits of principle actions taken during the project development and delivery process. It was especially designed to capture those principle actions associated with Context Sensitive Design and Solutions (CSD&S) initiatives in addition to other traditional actions.

This guide is useful to program managers, project leaders or managers and project team members. Managers can use this guide to develop the data needed to justify actions taken during project development and to establish benchmarking procedures for a continuous improvement initiative. Project leaders or managers can use it to provide progress feedback during the project stages and to determine the quantitative benefits of specific principle-driven actions. Project team members can use the principle-benefit approach to understand the purpose and consequences of their activity throughout the life of the project. This is especially important if the project is expected to achieve a Context-Sensitive Design and Solution.

Agencies deciding to conduct these evaluations must be willing to collect the data in a timely manner using standardized methods, maintain a data/analysis archive and have a way to make this information readily available.

Why is this guide needed?

In an age of accountability and scarce funding there are many that believe government project actions and process changes should be based on a business case justification. Such justifications are numbers driven using either quantitative or semi-quantitative data. The methods used require clear objectives or action intensions to be specified and then coupled with describable and quantifiable benefits.

This guide provides the robust framework and tools needed to carry out the quantification of benefits from the principle-driven actions of a project development/delivery process intending to achieve CSD&S. It is a complete systematic approach that standardizes the collection and analysis of data needed to quantify benefits and/ or establish benchmarks for continuous improvement initiatives.

How is this guide best used?

Project Development Program Manager:

Program managers can use this guide to determine the quantifiable benefits of principle-driven project actions that were taken during the various stages of the project development process. The data can be used to justify types of actions and/or to establish benchmarks upon which to base process improvement decisions as part of an agency's continuous improvement initiative. It is recommended that this approach be applied to all projects, but it can be applied to a certain few and/or the focus can be on selected principle-driven actions of the project development process. This allows the agency a considerable amount of flexibility in using this benefit quantification approach.

Project Team Leader and Members:

Team leaders and members can use this guide to determine the quantifiable benefits of principle-driven actions that are taken during the various stages of a project's development process as part of their agency's justification and/or benchmarking assessments. Also, the approach allows for interim assessment of some principle-driven actions that could facilitate changes in action intensity during the progress of the project to more closely achieve the benefit level desired.

What are the key topics covered?

The key topics of this guideline are:

- Introduction to the approach of benefit quantification for projects
- Application requirements, standardized methods and data collection tools
- Project evaluation example illustrating a complete application
- The action principles of CSD&S project development
- The principle associated benefits of CSD&S

The Guide's Development

The research and case study required to develop this guide was carried out over a three year period. The process included: 1) the development of a framework of principle-driven actions and associated benefits; 2) the determination of the necessary data/information elements and development of the necessary survey and data collection forms; and 3) the application of the structured approach and standardized assessment tools to selected case study projects throughout the US. Over 100 potential projects were examined from 40 states. Thirty three projects were chosen for further study. Based on this experience the approach and

methods were refined and the entire sequence of work was documented in NCHRP 15-32 Report.

The study team and reviewers involved 18 individuals. All individuals had experience with the project development process and specifically the steps required to insure CSD&S. This group was multidisciplinary, with some from the private sector and some from government. The group's members had experience working in many states. While the core research team members were university based the majority of those involved in this project were practitioners having extensive transportation agency experience.

The Challenge

Once the systematic evaluation approach is established then data can be collected and analyzed. The steps must be established before hand and the data collected in a timely manner as actions progress – it is most difficult to do this exercise forensically. Conducting a data dependent business case justification that assesses benefits of project development actions requires establishing a systematic approach in advance. If a project team or responsible agency wants to determine the level of justification for selected project development actions then this guide will serve that purpose well. It can also provide the data needed to conduct continuous improvement initiatives at the project and program levels. This is desperately needed in transportation agencies.

Any transportation project development/delivery process should be principle-driven and benefit-justified. This guide provides a way to meet that need and can serve as a tool to continually improve the project processes to achieve effective and efficient transportation facilities.

Glossary of Key Definitions

To eliminate any possible misunderstandings and provide consistency in the common use of certain terms, it is essential to provide a dictionary of the terms used in the following guidelines.

Program manager: The person responsible for certain project functional phases, such as director of planning, design, maintenance, and operations but not necessarily directly involved in the specific project.

Project manager: The responsible lead person who coordinates various activities throughout (or at various stages) of the project development process and may be the decision authority on the final project solution.

Project team: The persons involved in the various development phases of a project and have most frequently a specific field of expertise needed to develop a best fit project solution.

Stakeholder: All local governments and resource agencies, development agencies and groups with special standing that could be involved in the project and can have an influence in completing and /or providing permits for certain project phases.

Public: Any potential user of the project or person of the community that may be impacted by the project whose input and opinion should be solicited and considered at appropriate points throughout the project development process.

Principle intensity: The breadth and depth of the application of a principle based on the project attributes (scope, scale and context).

Benefit analysis: A systematic process for identifying and measuring project outcomes to be applied in the desired evaluation process.

Satisfaction level: A method for establishing the level of satisfaction for an element by a person typically measured with a scale.

Opinion: A method for establishing the level of agreement to a concept by a person that is typically measured with a scale (mostly agree, agree, disagree, and mostly disagree).

Expert opinion: A method for establishing the level of agreement to a concept by a project team member (expert) that is typically measured with a scale (mostly agree, agree, disagree, and mostly disagree).

INTRODUCTION

The primary objective of these guidelines is to provide transportation agencies with a set of recommended practices for assessing benefits of Context Sensitive Design and Solutions (CSD&S) projects. Central to these practices is the understanding and use of CSD&S principles that guide projects. Once these principles are identified, associated benefits from their application can be identified and measured to quantify the effect of these actions for the agency and the community. Therefore, CSD&S is a principle-driven, benefit-justified effort that can enhance an agency's goals and interaction with stakeholders and the public. The need exists to be able to analyze and measure the benefits of CSD&S and its impact on projects (e.g. cost and delay) in order to demonstrate a best use of agency resources. This guide provides transportation agencies with a method and tools that will allow them to accomplish this.

Each transportation project is unique in terms of the nature, scope and importance of issues addressed. Those factors impact project purpose and need, community and environmental concerns, geometric conditions, traffic, safety history, and public priorities. Moreover, the uniqueness of transportation projects determines the intensity with which principles are applied to the project as well the benefits to be measured. Consequently, the opportunities to realize benefits will vary as well among projects. Thus it is necessary to have an assessment approach capable of accounting for both realized benefits and realized opportunities. This guide allows the benefit analysis to be tailored specifically to an individual project while at the same time providing meaningful data for agency-wide evaluation.

Focusing only on project outcomes will allow for an analysis of benefits, but will not allow for an understanding of how these outcomes were achieved. However, by applying the CSD&S principles on a project and identifying their potential benefits, a direct link between project actions and benefits can be readily identified. A proactive project approach uses this linkage by setting targets to be achieved for selected benefits and determining principle driven actions that must be made throughout the project development process to achieve these benefits. As a result the CSD&S principles provide the foundation for a systematic approach to project development and benefit analysis.

The next section of the guidelines provides a brief overview of the application process that an agency should undertake while attempting to estimate benefits from CSD&S applications. This is followed by an example project demonstrating this approach and providing insight in the assessment process. The guidelines also include two reference sections identifying and discussing 1) the CSD&S principles and their proper use, and 2) their associated benefits with metrics for measuring their magnitude.

APPLICATION

Use of Benefit Analysis

Several benefits and associated metrics can be used to measure project outcomes. Both the benefits and metrics vary in terms of data collection efforts and address various aspects of the project and project development process. Benefit analysis may be used for four distinct applications (Figure 1).

1. **Justification of CSD&S Project/Project Elements.** Benefits are measured to allow for the project team to justify specific project elements (design or activities) throughout the project development process. Direct measuring and quantification of project benefits is used to address concerns about the project outcomes. These measured outcomes allow for greater acceptance of the project and can be used as an example in future projects.
2. **Continuous Improvement of the Project.** Benefits are measured in conjunction with the principles-benefit matrix as a tool for a continuous improvement of the project itself. Measured outcomes for benefits accruing throughout the project development process are monitored to identify problems in the project approach and/or outcome prior to completion of the project allowing for corrective actions before the completion of the project.
3. **Justification of Agency CSD&S Program.** Benefits are measured to allow for an agency to justify and evaluate the effectiveness of an agency wide CSD&S program or process. The use of agency-wide measured outcomes allows for determining the appropriateness of CSD&S in project development and demonstration of the benefits to the agency, the legislature and interested public parties.
4. **Continuous Improvement of Agency Process.** Benefits are measured in conjunction with the principle-benefit matrix as a tool for a continuous improvement of the agency's project development process. The benefit analysis can identify where improvements in project development have been made as well as identify opportunities for improvement. The measured outcomes are used to determine the benefits not accrued based on the agency's desires and to then initiate a review of the process to determine actions that directly produce those benefits.

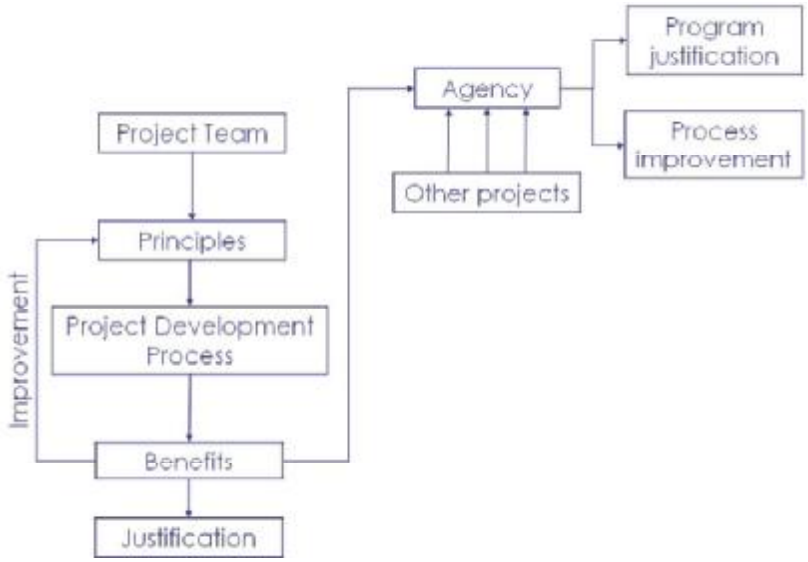

Figure 1 Benefit analysis

Principles

The project development/delivery process was examined to determine the discrete actions needed for a successful CSD&S project. These actions are stated as principles and they drive the activities and tasks needed to be completed during the project development process. It is these principles to which benefits can be associated and measured. The review of the project delivery process defined 15 principles to be used in the process as shown in Table 1.

Table 1 CSD&S Principles

1. Use interdisciplinary teams
2. Involve stakeholders
3. Seek broad-based public involvement
4. Use full range of communication methods
5. Achieve consensus on purpose and need
6. Address alternatives and all modes
7. Consider a safe facility for users and community
8. Maintain environmental harmony
9. Address community and social issues
10. Address aesthetic treatments and enhancements
11. Utilize full range of design choices
12. Document project decisions
13. Track and meet all commitments
14. Use agency resources effectively
15. Create a lasting value for the community

Some principles build on each other and have what appear to be hierarchal, cause-effect relationships. For example, principles 2 (involve stakeholders) and 3 (seek broad-based public involvement) will have a significant influence on principle 5 (achieve consensus on purpose and need) as well as shaping principle 4 (use full range of communication methods). Understanding the principles and their interaction promotes knowledge of CSD&S fundamentals and process relations and comprehension of how CSD&S projects are developed.

A good representation of these relationships is provided in Figure 2 showing the dependencies among principles as a building. The foundation of the building consists of the three Fundamental Principles of CSD&S:

- Use interdisciplinary teams
- Involve stakeholders
- Seek broad-based public involvement.

The floor is comprised of the four Basic Transportation Agency Principles that exist for every project:

- Use full range of communication strategies
- Achieve consensus on purpose and need
- Address alternatives and all modes
- Consider a safe facility for users and community

The six pillars of the CSD&S building are the six Agency Enabling Principles and Context-Sensitivity Enablers that provide for and ensure context-sensitivity:

<u>Context-Sensitivity Enablers</u>

- Maintain environmental harmony
- Address community and social issues
- Address aesthetic treatments and enhancements

<u>Agency Action Enablers</u>

- Utilize full range of design choices
- Document project decisions
- Track and meet all commitments

The lintel and roof of the building of CSD&S are the Long-Range Project Principles (Goals)

- Use agency resources effectively
- Create a lasting value for the community.

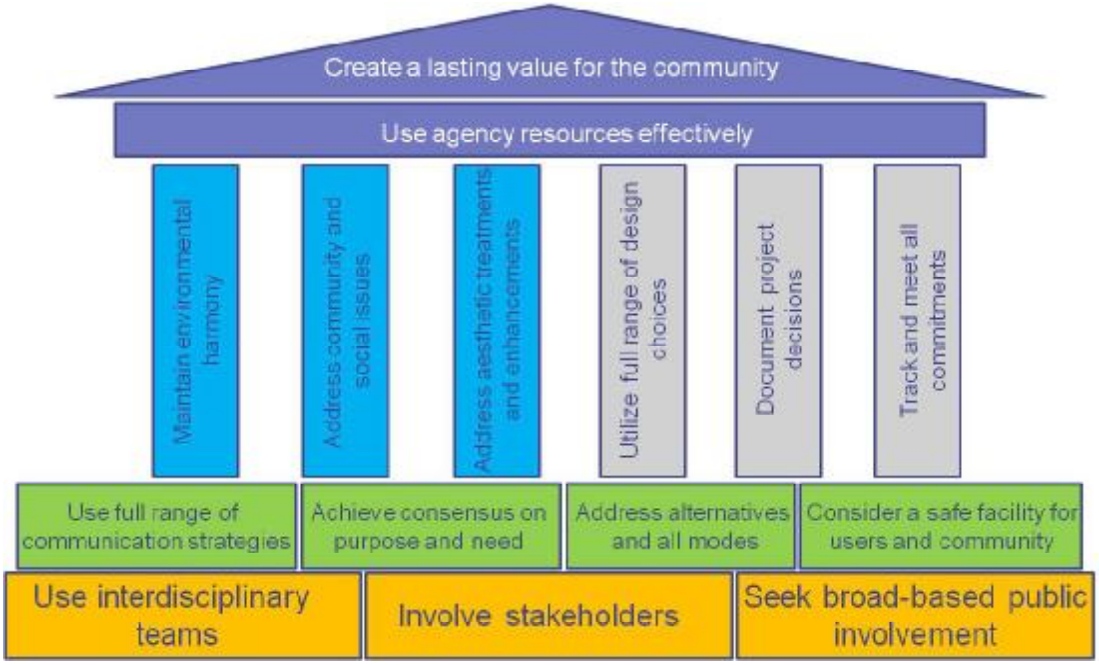

Figure 2 The building of CSD&S principles

Projects vary and the intensity with which CSD&S principles are used will vary as well. The three Fundamental Principles must be applied to have a CSD&S project development process. The four Basic Transportation Agency Principles are present regardless of whether or not a project employs CSD&S. The six enabling principles are the tools that enable a project team to achieve both create a lasting value for the community and use agency resources effectively, which should be the aim of all projects. While all principles will be present on any project, their relative intensity (as applied) will vary between projects. Similarly all benefits will be present; however, resulting benefits will vary accordingly.

The relative intensity of each principle should be examined, since the magnitude of benefits to be realized will be affected. This relative intensity is to be determined by the scope, scale, and context of the project. For example, for a small project, there may be a limited number of stakeholders involved, which will affect the extent and type of communication methods employed and the level of public involvement required. Extensive public involvement efforts may not be necessary to provide measurable benefits. On large, complex projects affecting many parties, greater stakeholder public involvement may be required to achieve an equivalent level of benefits.

Benefits

A total of 22 specific potential benefits are identified as a result of applying the 15 CSD&S principles (Table 2). The benefits are grouped in two basic categories based on who accrues the benefits, i.e. the agency or the users. This is needed since some of the benefits are internal to the agency's operations and have no clearly understood benefit to the users. This differentiation provides the agency with the ability to determine those other benefits and that the users will best recognize and use to judge the agency's project development process performance.

Table 2 CSD&S potential benefits

1. Improved predictability of project delivery
2. Improved project scoping and budgeting
3. Improved long term decisions and investments
4. Improved environmental stewardship
5. Optimized maintenance and operations
6. Increased risk management and liability protection
7. Improved stakeholder/public feedback
8. Increased stakeholder/public participation, ownership, and trust
9. Decreased costs for overall project delivery
10. Decreased time for overall project delivery
11. Increased partnering opportunities
12. Minimized overall impact to human and natural environment
13. Improved mobility for users
14. Improved walkability and bikeability
15. Improved safety (vehicles, pedestrians, and bikes)
16. Improved multi-modal options (including transit)
17. Improved community satisfaction
18. Improved quality of life for community
19. Improved speed management
20. Design features appropriate to context
21. Minimized construction related disruption
22. Improved opportunities for economic development

Principle-Benefit Matrix

A matrix of principles and benefits was developed to identify the relationship between benefits with the application of each CSD&S principle (Table 3). The matrix uses three levels of relationship between benefits and principles. Benefits having a strong relationship to a principle designated are identified as "primary benefits". Additional benefits having a potentially lower level of associated impact are designated, are "secondary benefits". Other benefits conceivably realized from the application of a principle are designated "tertiary benefits".

Table 3 Principles and associated benefits

Benefits \ Principles	1. Use of interdisciplinary teams	2. Involve stakeholders	3. Seek broad-based public involvement	4. Use full range of communication strategies	5. Achieve consensus on purpose and need	6. Address alternatives and all modes	7. Consider a safe facility for users & community	8. Maintain environmental harmony	9. Address community & social issues	10. Address aesthetic treatments & enhancement	11. Use full range of design choices	12. Document project decisions	13. Track and meet all commitments	14. Use agency resources effectively	15. Create a lasting value for the community
1. Improved predictability of project delivery	Secondary	Primary	Primary	Secondary	Primary	Secondary	Tertiary	Secondary	Secondary	Tertiary	Tertiary	Secondary	Secondary	Primary	Tertiary
2. Improved project scoping and budgeting	Primary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Tertiary	Tertiary	Tertiary	Primary	Secondary	Secondary
3. Improved long term decisions and investments	Secondary	Tertiary	Primary	Primary	Primary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Primary	Primary	Primary
4. Improved environmental stewardship	Secondary	Secondary	Secondary	Secondary	Tertiary	Tertiary	Secondary	Secondary	Secondary	Tertiary	Tertiary	Tertiary	Secondary	Secondary	Secondary
5. Optimized maintenance and operations	Primary	Tertiary	Tertiary	Tertiary	Tertiary	Secondary	Tertiary	Tertiary	Secondary	Secondary	Secondary	Tertiary	Tertiary	Secondary	Secondary
6. Increased risk management and liability protection	Secondary	Secondary	Secondary	Tertiary	Secondary	Secondary	Primary	Secondary	Secondary	Secondary	Secondary	Primary	Tertiary	Tertiary	Tertiary
7. Improved stakeholder/public feedback	Tertiary	Primary	Secondary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Primary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary
8. Increased stakeholder/public participation, ownership, and trust	Secondary	Fundamental	Secondary	Fundamental	Primary	Secondary	Secondary	Primary	Primary	Primary	Primary	Fundamental	Fundamental	Secondary	Primary
9. Decreased costs for overall project delivery	Primary	Tertiary	Tertiary	Tertiary	Secondary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Secondary	Secondary	Fundamental	Tertiary
10. Decreased time for overall project delivery	Primary	Secondary	Secondary	Tertiary	Secondary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Secondary	Primary	Primary	Tertiary
11. Increased partnering opportunities	Secondary	Primary	Secondary	Secondary	Tertiary	Secondary	Secondary	Secondary	Secondary	Tertiary	Tertiary	Tertiary	Secondary	Secondary	Secondary
12. Minimized overall impact to human and natural environment	Primary	Secondary	Secondary	Secondary	Secondary	Primary	Secondary	Primary	Tertiary	Tertiary	Primary	Secondary	Secondary	Secondary	Secondary
13. Improved mobility for users	Secondary	Secondary	Secondary	Secondary	Primary	Secondary	Secondary	Secondary	Secondary	Tertiary	Tertiary	Secondary	Secondary	Secondary	Secondary
14. Improved walkability and bikeability	Secondary	Secondary	Secondary	Secondary	Tertiary	Primary	Primary	Secondary	Secondary	Tertiary	Tertiary	Secondary	Secondary	Secondary	Secondary
15. Improved safety (vehicles, pedestrians, and bikes)	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Tertiary	Tertiary	Secondary	Secondary	Secondary	Secondary
16. Improved multi-modal options (including transit)	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Primary	Primary	Secondary	Secondary	Secondary	Secondary
17. Improved community satisfaction	Secondary	Secondary	Secondary	Secondary	Primary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Primary	Primary	Secondary	Secondary
18. Improved quality of life for community	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary
19. Improved speed management	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary
20. Design features appropriate to context	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary
21. Minimized disruption	Secondary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Secondary	Secondary	Secondary
22. Improved opportunities for economic development	Secondary	Tertiary	Tertiary	Tertiary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary

Fundamental ◆ Primary ■ Secondary ▒ Tertiary □

For each principle one primary benefit is designated fundamental providing a single indicator to capture the benefit of applying the principle. The fundamental benefit allows an agency to perform a focused evaluation of a CSD&S project in the event that resources are not available to complete a full-scale evaluation of all associated benefits.

The principle-benefit matrix provided in Table 3 was developed with careful consideration and captures the extent of the principle-benefit relationships based on case study findings. It is amenable to review and revision by users (where substantial experience indicates that other principle-benefit relationships are of more significance). However, wholesale changes are not recommended without sufficient background research.

Implementation

Benefit analysis may be used by the project team to justify project actions or to improve processes for the project. Transportation agencies can use the same benefit analysis to justify the agency program or use it as part of a continuous improvement process. For successful benefit analysis, the evaluation approach should be established from the outset of the project so that principles are properly applied, data is timely collected, and benefits are systematically measured. This process is as follows:

1. Determine the application intensity of each principle using the project attributes.
2. Select the benefit(s) to be measured and the quantitative and/or semi-quantitative measures to be used.
3. Establish benchmarks for comparing measured outcomes for benefit accrual.
4. Collect data/information using a standardized format (forms and surveys), acquire the data/information in a timely manner and record it in an appropriate format.
5. Analyze (using comparison, benchmarks and dollar conversions) and evaluate benefit accrual, and report data/information.

The following sections identify key considerations in each of the above steps in the applications process.

Principle Intensity

All 15 CSD&S principles presented in Table 1 should be applied on all projects. However, unique project attributes (scope, scale and context) require that the application intensity of each principle should be determined to meet the unique characteristics of the project. Each of these can directly affect the intensity (depth and breadth) of the principle application. The effect of these attributes is demonstrated for principle 1 use an interdisciplinary team.

Scope: As the scope of the project increases, the number of involved disciplines expands, requiring increased members on the team. A resurfacing project may only involve a construction engineer and maintenance engineer in addition to the contractor. On the other hand a new construction project would require expertise in planning, highway design, construction, maintenance and other appropriate disciplines.

Scale: As the scale of the project increases, the demands on the project increase as well. This may require new expertise to coordinate the project, as well as require multiple persons to perform the work. A major new construction effort may require multiple highway design engineers, with individuals focused solely on specific project aspects. Conversely on a small project, a single engineer may be able to address all these issues at once.

Context: The varying context of the project has a direct impact on the project as well. As new constraints and resources are encountered or impacted the appropriate team members must be identified. This would include environmental specialists, historic preservationists, special user groups and others as needed.

Table 4 compares relative intensity levels of all CSD&S principles for two projects. One is a small bridge resurfacing project in a rural area and the other a new facility construction in a suburban area. The individual attributes of each project require different intensities of principle application in order to achieve the CSD&S goal of finding a “best fit” transportation solution for the context that meets the expectations of transportation agency, stakeholders and community.

Table 4 Principle intensity level

Principles	Small rural bridge replacement	New suburban facility
1. Use interdisciplinary teams	L	H
2. Involve stakeholders	L	H
3. Seek broad-based public involvement	L	M
4. Use full range of communication strategies	L	M
5. Achieve consensus on purpose and need	M	H
6. Address alternatives and all modes	L	M
7. Consider a safe facility for users and community	M	M
8. Maintain environmental harmony	H	H
9. Address community and social issues	L	M
10. Address aesthetic treatments and enhancements	L	M
11. Utilize full range of design choices	M	H
12. Document project decisions	M	H
13. Track and meet all commitments	M	H
14. Use agency resources effectively	M	H
15. Create a lasting value for the community	L	M

Note: “L” is for low, “M” for medium, and “H” for high intensity

For each of the 15 principles, a set of criteria for application are provided to assist the project team in the implementation of the principles within the project. These criteria (Reference A) guide the team in determining the appropriate intensity of the principle. As an example, one of the criteria of application for principle 6, address alternatives and all modes, is stated as *"Multiple alternatives including various modes, capable of addressing the issues in the purpose and need statement, are identified and developed."*

This criterion directly references the purpose and need statement and as such is limited by the defined scope of the project therein. As discussed above, the scale and context of the project should also be considered in its application. A resurfacing project applying this criterion may only examine the feasibility of alternative construction phasing alternatives to reduce construction impacts. If the roadway is heavily utilized by cyclists, i.e. it has a different context, the addition of a bicycle lane may be considered. The expanded scope of a corridor planning study, however, requires that many more alternatives be considered to address the full extent of such a project. This may include 1) the examination of multiple modal options along the corridor including transit, pedestrian and cycling 2) roadway alternatives such as two or four lanes, divided or undivided highways, 3) as well as construction phasing alternatives.

Benefit Selection

It is anticipated that not all benefits will be measured on all projects. Benefits to be measured should be selected based on the need to determine project or agency goals. Such a selective approach will allow for focusing on specific measured outcomes and limit unnecessary data collection. Benefits to be measured should be carefully selected based upon the purpose of the benefit analysis and the availability of data to measure project outcomes (and the commitment to collect and store the data). A focused evaluation plan enables the agency or project team to measure pertinent benefits, collect all necessary data and conduct the appropriate evaluation.

Benefit selection considerations for the four primary assessment methods are discussed here. For project related evaluations (justification or continuous improvement), benefits need to be specific and tailored to the project, element or activity to be measured. For the continuous improvement of the project, targeted benefits are those quickly accruing and those allowing monitoring of the application of principles in order to permit adjusting the principle intensity in real time. For agency related evaluations (justification of program or continuous improvement of process), benefit measures need to be standardized to allow for summarizing and comparing data for all projects. This can be achieved with data that is obtainable for all projects without

extensive data collection and could be limited to measures of fundamental or primary benefits, since they capture the essence of CSD&S. For continuous improvement of agency processes, a broader range of benefits may be needed to capture the entire spectrum of project outcomes depending on the focus of the continuous improvement initiative. However, a wide range of benefit analysis will allow agency flexibility in dealing with future funding constraints and political realities.

Establish Benefit Benchmarks

The most critical element of the benefit analysis is the establishment of benchmarks for judging benefit accrual. Traditional analysis may use as benchmarks the difference in the measured outcome between before and after conditions or between CSD&S and non-CSD&S projects. However, such an analysis is often impractical due to lack of available data (before or non-CSD&S project). Benchmarks also vary greatly among agencies and projects, as well as, the purpose for which the benefit is being measured. For instance, if benefits are being measured for use in the continuous improvement of the agency process, the benchmark will be the measured outcome from the previous iteration. For benefits being measured to justify a CSD&S project, the benchmark is established relative to the project goals. It is therefore impractical to establish a single benchmark for each benefit metric to cover these benefit analysis options.

For benefit analysis on a single project, measures of effectiveness and their benchmarks should be explicitly stated in the purpose and need statement or in a memorandum of agreement or understanding (MOA/MOU). This approach allows for collecting only the required data for comparison and reduces data collection demands. These benchmarks should be both specific and tailored to the project and its context. Specificity is achieved by stating the desired benchmark to be targeted. For example, if the purpose and need statement calls for improved mobility, the specific target of decreased travel time by 20 percent compared to the existing conditions should be stated. Customization is achieved also this way, since benchmarking is specific to the project and agreed upon by team members and stakeholders. In the same example, an agency-wide goal of reducing travel time by 30 percent may be inappropriate for the context of this project.

As part of the continuous improvement of the agency process, a moving benchmark is established which is related to the measured outcomes of the previous round of projects. The evaluation is therefore established by determining the relative improvement of the process as it compared to the “benchmark” established by previous projects.

Data Collection, Maintenance and Accessibility

A data handling plan must be in place from the project outset. The plan identifies the data to be collected along with when is to be collected. In addition, how that data will be maintained and made accessible to users is also determined. Data needed to evaluate benefits is obtained throughout the project development process and often is available only for a short time. As an example, attendance level at stakeholder meetings is only available at the meeting. If pertinent data is not collected at that time, it may never again be obtainable. In addition, a system must be in place to maintain the data and make it accessible to those conducting the evaluation. For project specific benefit analysis, storage and accessibility may be less formal and available only to project team members. However, agency-wide efforts must have standardized data formats and provide a centrally located and catalogued data source so that others may access and analyze the data.

Evaluation

Once the data is collected it should then be analyzed by several methods depending on the nature of the metric and its intent:

- Quantitative data allows for establishing benchmarks and making direct ordinal comparison (using standard measures) and in some cases conversion to dollar amounts.
- Semi-quantitative data allows for making broad relational comparisons based on expert opinion and customer satisfaction. It can also be used to compare the views of the project team to the stakeholders/public. This information can be important as other data if, for instance, there is a goal to improve the public trust.

Principles

Benefits	1. Use of interdisciplinary teams	2. Involve stakeholders	3. Seek broad-based public involvement	4. Use full range of communication strategies	5. Achieve consensus on purpose and need	6. Address alternatives and all modes	7. Consider a safe facility for users & community	8. Maintain environmental harmony	9. Address community & social issues	10. Address aesthetic treatments & enhancements	11. Use full range of design choices	12. Document project decisions	13. Track and meet all commitments	14.Use agency resources effectively	15. Create a lasting value for the community
1. Improved predictability of project delivery	Secondary	Secondary	Primary	Tertiary	Primary	Tertiary	Tertiary	Tertiary	Secondary	Secondary	Tertiary	Secondary	Secondary	Secondary	Tertiary
2. Improved project scoping and budgeting	Primary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Tertiary	Tertiary	Tertiary	Primary	Secondary
3. Improved long term decisions and investments	Secondary	Tertiary	Secondary	Tertiary	Primary	Primary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Tertiary	Primary	Primary
4. Improved environmental stewardship	Secondary	Secondary	Secondary	Tertiary	Tertiary	Tertiary	Tertiary	Primary	Secondary	Secondary	Tertiary	Tertiary	Secondary	Secondary	Secondary
5. Optimized maintenance and operations	Primary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Secondary	Secondary	Tertiary	Tertiary	Secondary	Secondary
6. Increased risk management and liability protection	Secondary	Secondary	Tertiary	Tertiary	Secondary	Secondary	Primary	Secondary	Secondary	Tertiary	Secondary	Primary	Primary	Tertiary	Tertiary
7. Improved stakeholder/public feedback	Tertiary	Primary	Secondary	Primary	Tertiary	Tertiary	Tertiary	Tertiary	Secondary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary
8. Increased stakeholder/public participation, ownership, and trust	Secondary	Fundamental	Secondary	Fundamental	Fundamental	Primary	Secondary	Secondary	Primary	Primary	Secondary	Fundamental	Fundamental	Secondary	Primary
9. Decreased costs for overall project delivery	Secondary	Tertiary	Tertiary	Tertiary	Secondary	Secondary	Tertiary	Tertiary	Tertiary	Tertiary	Secondary	Secondary	Secondary	Fundamental	Tertiary
10. Decreased time for overall project delivery	Primary	Secondary	Secondary	Tertiary	Secondary	Tertiary	Tertiary	Tertiary	Secondary	Tertiary	Tertiary	Secondary	Secondary	Primary	Tertiary
11. Increased partnering opportunities	Secondary	Primary	Secondary	Secondary	Tertiary	Secondary	Tertiary	Tertiary	Secondary	Secondary	Tertiary	Tertiary	Tertiary	Secondary	Tertiary
12. Minimized overall impact to human and natural environment	Primary	Secondary	Secondary	Secondary	Secondary	Tertiary	Secondary	Fundamental	Primary	Tertiary	Primary	Tertiary	Secondary	Tertiary	Secondary
13. Improved mobility for users	Secondary	Secondary	Secondary	Tertiary	Primary	Fundamental	Secondary	Tertiary	Secondary	Tertiary	Secondary	Tertiary	Secondary	Tertiary	Secondary
14. Improved walkability and bikeability	Secondary	Secondary	Secondary	Tertiary	Tertiary	Primary	Primary	Tertiary	Secondary	Tertiary	Secondary	Tertiary	Secondary	Tertiary	Secondary
15. Improved safety (vehicles, pedestrians, and bikes)	Secondary	Secondary	Secondary	Tertiary	Secondary	Secondary	Fundamental	Tertiary	Secondary	Tertiary	Secondary	Tertiary	Secondary	Tertiary	Secondary
16. Improved multi-modal options (including transit)	Secondary	Secondary	Secondary	Tertiary	Secondary	Primary	Secondary	Tertiary	Secondary	Tertiary	Primary	Tertiary	Secondary	Tertiary	Secondary
17. Improved community satisfaction	Secondary	Secondary	Fundamental	Secondary	Primary	Secondary	Secondary	Secondary	Fundamental	Fundamental	Secondary	Primary	Primary	Tertiary	Primary
18. Improved quality of life for community	Secondary	Secondary	Tertiary	Tertiary	Secondary	Secondary	Primary	Primary	Primary	Primary	Secondary	Tertiary	Tertiary	Secondary	Fundamental
19. Improved speed management	Tertiary	Tertiary	Tertiary	Tertiary	Tertiary	Secondary	Primary	Tertiary	Secondary	Tertiary	Primary	Tertiary	Tertiary	Tertiary	Secondary
20. Design features appropriate to context	Fundamental	Secondary	Secondary	Tertiary	Secondary	Secondary	Secondary	Primary	Primary	Primary	Fundamental	Tertiary	Tertiary	Tertiary	Secondary
21. Minimized disruption	Tertiary	Primary	Secondary	Secondary	Tertiary	Tertiary	Secondary	Secondary	Secondary	Tertiary	Tertiary	Tertiary	Secondary	Tertiary	Tertiary
22. Improved opportunities for economic development	Secondary	Primary	Secondary	Secondary	Tertiary	Secondary	Tertiary	Tertiary	Secondary	Secondary	Tertiary	Tertiary	Tertiary	Secondary	Tertiary

Fundamental

Primary

Secondary

Tertiary

QUANTIFYING BENFITS FOR CONTEXT SENSITIVE SOLUTIONS

AGENDA

DATE

8:00-8:15	Introductions	Kirk
8:15-8:45	Basic concepts	Stamatiadis
8:45-9:00	Case study review/Break	
9:00-9:30	CSS principles 1 & Work session	Stamatiadis
9:30-10:00	CSS principles 2 & Work session	Kirk
10:00-10:30	CSS principles 3 & Work session	Stamatiadis
10:30-10:45	Break	
10:45-11:15	CSS principles 4 & Work session	Kirk
11:15-11:45	Principles work session	
11:45-12:00	Team presentations - principles	
12:00-1:00	Lunch break	
1:00-1:30	CSS benefits	Kirk
1:30-2:00	CSS benefits work session	
2:00-2:30	Team presentations	
2:30-2:45	Break	
2:45-3:30	Application example work session	Stamatiadis
3:30-4:00	Team presentations	
4:00-4:30	Closing remarks/Discussion	Stamatiadis/Kirk