Front End Planning and other Musings….

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ASU and School of Sustainable Engineering and the Built Environment

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- Who am I?
  - PhD, CE; MBA Engr. Mgt.
  - 21 years faculty member, including 15 at UT Austin
  - Sunstate Chair
  - Over $9.2 million (USD) in funded research
  - Member US National Academy of Construction
  - Fulbright Scholar
  - 14 PhD graduates, 85 MS graduates
  - Currently Director of School of Sustainable Engineering and the Built Environment

Fulton Schools Vision

Engineering vision

Leading Engineering Discovery and Innovative Education for Global Impact on Quality of Life.

Engineering mission

Provide an Environment Rich in Trans-disciplinary Research, Education, Entrepreneurship, and Leadership Resulting in Successful Engineers and Technologies that Benefit Society.

Ira A. Fulton Schools of Engineering

	Schools (Director)	Lead These Engineering Undergraduate Degree Programs	Coordinate across Engineering for these Grand Challenge Areas…
1	**Biological & Health Systems Engineering** (Open)	Bioengineering	Health Care - treatments and cures for human diseases and dysfunctions, re-engineering of biological systems and human physiology
2	**Sustainable Engineering & the Built Environment** (Edd Gibson)	Civil and Environmental Engineering Construction Engineering Construction Management Sustainable Engineering Emphasis (across all majors)	Sustainable Engineering – advance theory and practice of sustainable engineering. Provide access to clean water and clean air. Restore and improve urban infrastructure.
3	**Computing, Informatics & Decision Systems Engineering** (Ron Askin)	Computer Science Computer Systems Engineering Industrial Engineering Informatics (across all majors)	Secure cyberspace Health Care Delivery Systems – information, diagnostics, healthcare policy
4	**Electrical, Computer & Energy Engineering** (Stephen Phillips)	Electrical Engineering Nuclear Engineering certificate Electric power/energy concentration Arts, Media and Eng. concentration	Energy – generation, storage, transmission and distribution Security and Exploration – control, communication and identification
5	**Engineering of Matter, Transport, and Energy** (Kyle Squires)	Materials Science & Engineering Mechanical Engineering Aerospace Engineering Chemical Engineering	Security and Exploration – securing cyberspace, communications, monitoring threats, developing "self healing systems", exploring inaccessible regions

- Sustainable engineering is a revolutionary approach to engineering that:
  - focuses on the long-lasting improvement of the human condition,
  - redefines the design of infrastructure, natural, and social systems,
  - transforms the traditional design and construction methods of complex systems by the application of life cycle assessment, risk and uncertainty analysis, and other emerging techniques

The Built Environment

The built environment includes society's physical infrastructure and integrated systems such as housing, business and commerce, transportation, and utilities which facilitate the smooth operation of basic services supporting health, prosperity and social well-being.

Current Programs, Faculty and Enrollment

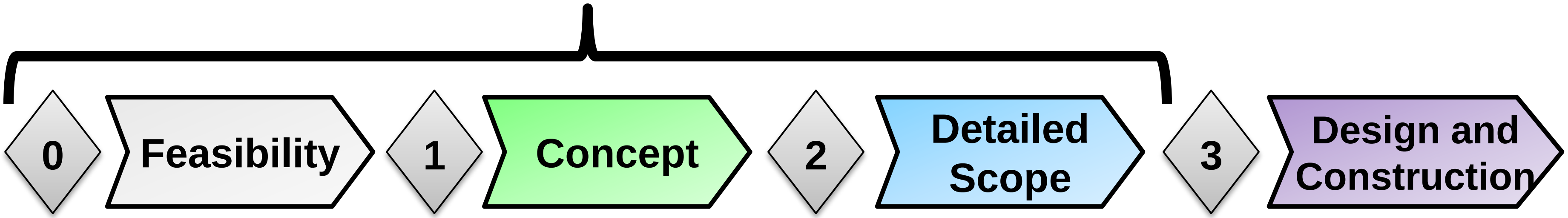
- Three programs
  - Civil, Environmental and Sustainable Engineering Degree Programs
  - DEW School of Construction
  - Construction Engineering (NEW)
- Faculty:
  - 38 full time
  - Four research professors/scientists
  - 15 Faculty Associates
- Enrollment, 1172

SEBE Programs

- SEBE Research
  - $6.5 M expenditures FY 2010
  - Trend is up 40 percent in three years (8.2 million backlog by close of year)
- Hiring:
  - Two new hires this year
    - Sustainable Systems (filled)
    - Environmental Fluid Dynamics (filled)
    - Innovations in Design and Construction of Infrastructure Systems (open)
  - New Programs Chairman for DEWSC (open)
  - Six or seven new hires next year (including two open)

Front End Planning Research

Front-End Planning Gated Process



Why do we build?

- Shelter
- Infrastructure, commerce, social
  - Worship
  - Business
  - Transportation
  - Energy
  - Water
  - Exploration
  - Entertainment
  - Defense

Are we always successful?

- No
- Challenge is to define success…..

Boston's Big Dig- One of Engineering's Biggest Mistakes?
Elizabeth M. Taurasi, Managing Editor -- Design News, July 27, 2006

Highway Robbery
October 15, 2006|By KIMBERLY KINDY and NATALYA SHULYAKOVSKAYA

Project delay causes finger-pointing
Street work that's been going on more than a year isn't finished, and the city and contractor blame each other Tulsa World 2009

Sierra Club sues EPA over Navajo power plant
TUESDAY, JULY 10, 2007

HARRAH'S SUED OVER FAILED BAHAMAS PROJECT , December 1, 2008

N.W.T. bridge $15M over budget
CBC News, Friday, February 12, 2010

Buyers sue Trump over failed Mexico condo project
Donald Trump was sued Friday by buyers who lost millions of dollars in deposits on a failed hotel-condo in the Mexican border city of Tijuana.
By ELLIOT SPAGAT /Associated Press Writer

Failed Alliant plant will cost utility
By Thomas Content of the Journal Sentinel

FutureGen Canceled by Department of Energy

How did CityCenter tower flaws persist?
Failed safeguards puzzle county inspections official
By Alexandra Berzon, Thursday, Jan. 8, 2009 .

How oversight failed in underground project
By Amy Goldstein, The Washington Post

Examples of failed aid-funded projects in Africa
Associated Press
Oil pipeline, fishing processing plant are few of the unsuccessful ones

Shell Urged to Abandon $20bn Siberian Pipeline That Could Drive Whale Species to Extinction
By Jonathan Brown, *Published on Tuesday, April 25, 2006 by the Independent / UK*

Failed K'bunkport project leads to auction
By The Mainebiz News Staff

South Charlotte Sees Failed Housing Projects

Amaechi wept over failed projects
News Aug 9, 2010

Chilean Power-Project Delays Have Investors Seeking Answers
By Anthony Esposito Published December 21, 2010
| Dow Jones Newswires

Failed Housing Project May Cost Taxpayers Even More

Despite Warnings, Washington Failed to Fund Levee Projects
To cut spending, officials gambled that the worst-case scenario would not come to be.
September 04, 2005|Richard A. Serrano and Nicole Gaouette | Times Staff Writers

DynCorp Project Delays Hampered Afghan Training, Audit Says
June 30, 2010 Bloomberg

Chevron Refinery Expansion Halted; 1,000 Jobs To Be Lost
July 2, 2009

Failed $2B Bloomfield Park project a monument to downturn
– The Detroit News

Failed Arizona Condo Conversion Project Sold
Jul 18, 2007

Success is in the eye of the beholder....

- Is it schedule?
- Is it price?
- Is it functionality?
- Is it profitability?
- Is it art?
- Is it meeting expectations?

Barriers

- Regulations…..
- Lack of knowledge
- Lack of commitment
- Failure to recognize urgency

Can we predict success?

- Similar to bio-signatures initiative for human health
- Yes, within reason, we can predict problems for projects and take action….

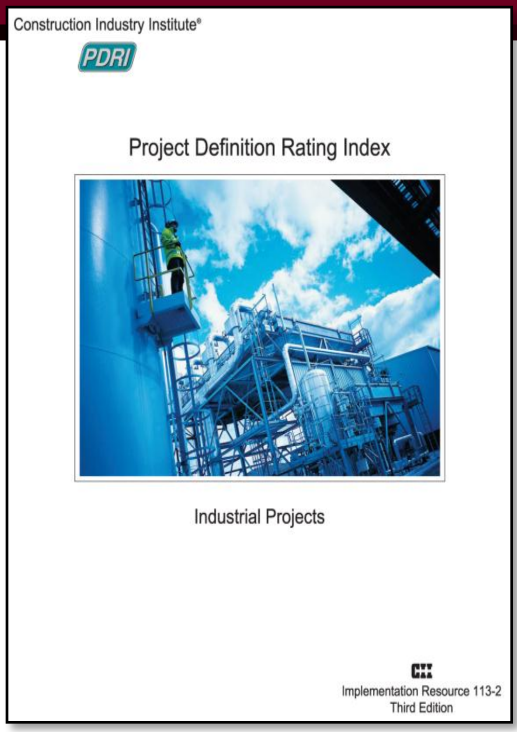
- Number of research projects: 10
- Number of team members or sponsor contacts: 135
- Number of companies/ organizations: >200
- Projects evaluated: >1000, >$58 Billion
  - Industrial, 60%
  - Buildings, 25%
  - Infrastructure, 15%

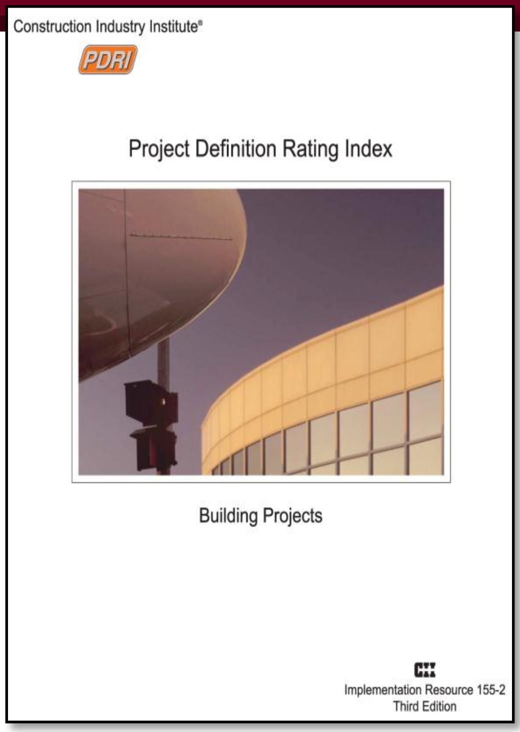
Research Input (1991-2011)

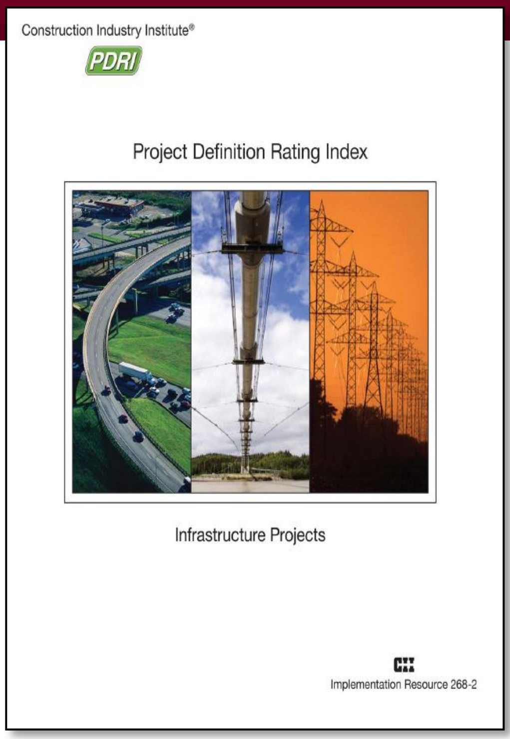
- Interviews: >200
- Case Studies: 38
- Number of workshops: 23
- Number of workshop participants: 327
- Other questionnaires to companies: >425
- Number of graduate students: 5 PhD, 14 MS

- An Acronym
  - **P**roject **D**efinition **R**ating **I**ndex
- An Index
  - Score along a continuum representing the level of scope definition
- A Risk Management Tool
  - Identify—score sheet and descriptions
  - Measure—scoring mechanism
  - Mitigate—action items

Available Assessment Tools







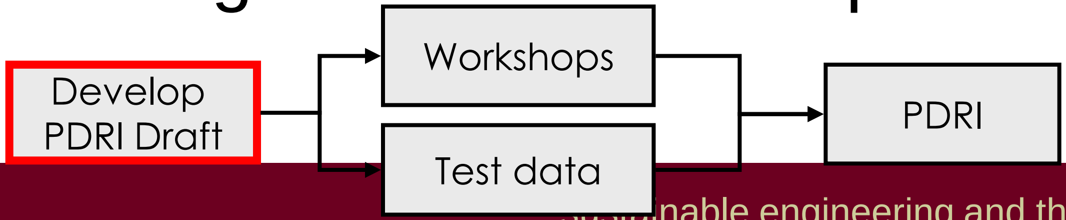
Industrial PDRI
1996

Building PDRI
1999

Infrastructure PDRI
2010

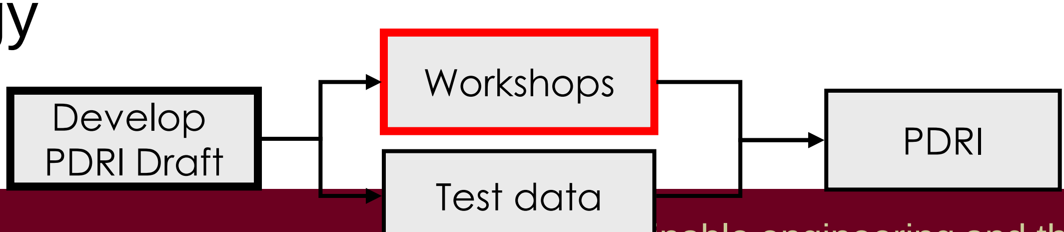
Developed PDRI Draft

- Literature review
- Beginning basis, Advance Planning Risk Assessment tool from TxDOT
- RT 268:
  - Definition of infrastructure projects--this research effort
  - Sub-team development of score sheet and descriptions
  - Feedback within their firms
- Finalized working draft for Workshop use

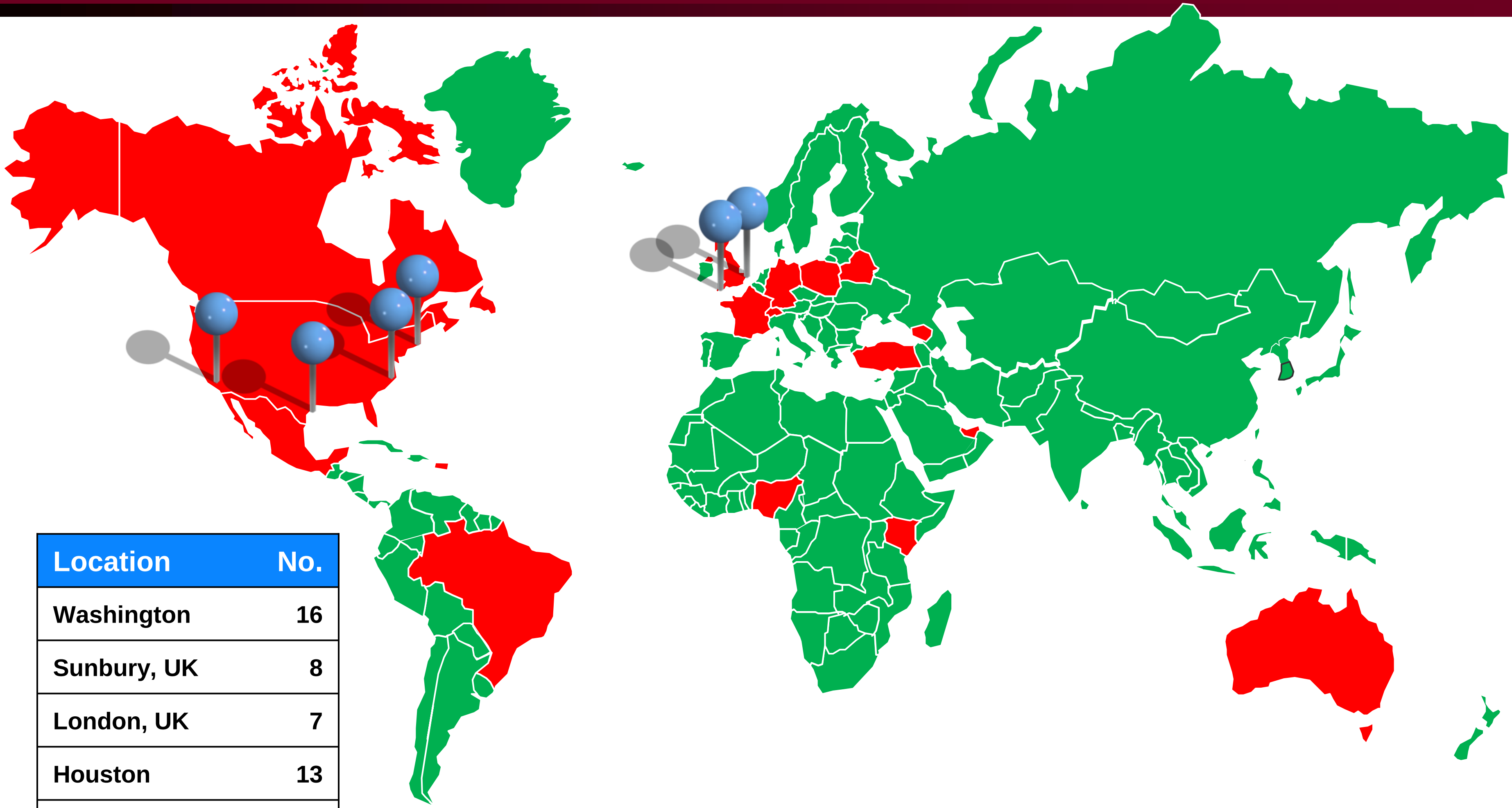


Workshops

- RT members hosted
- Geographically dispersed
- Purposive (expert) charrettes
  - >10 years experience
  - Worked in infrastructure planning
  - Owners and contractors
  - Targeted on three subsets of infrastructure projects
    - Fluids
    - People and freight
    - Energy



PDRI for Infrastructure: Global Input



Location	No.
Washington	16
Sunbury, UK	8
London, UK	7
Houston	13
New York	12
Los Angeles	8

Workshop Summary

■ **Participants:**	**64**
– Owner	27
– Contractor	37
■ **Experience:**	**23 yrs avg.**
■ **Organizations**	**36**
– Owner	15
– Contractors	21

Organizations Participating in Workshops

Owners

- Architect of the Capital
- BP
- Chevron
- Conoco Phillips
- European Investment Bank
- Exxon Mobil
- National Institute of Standards and Technology
- Port of Long Beach
- Salt River Project
- Sempra Global
- Smithsonian Institution
- UK Highways Agency
- UK Network Rail
- U.S. Army Corp of Engineers
- U.S. Department of Energy

Contractors

- AECOM
- Booz Allen Hamilton
- CH2M HILL
- CSA Group
- D' Orange Ltd
- European Construction Institute
- Fluor Enterprises
- Jacobs Engineering
- KBR
- KPFF
- Mustang Engineering
- P2S engineering
- Parsons
- Pathfinder LLC
- Phoenix Constructors
- Project Resource Company
- PSEG
- S & B Infrastructure Group
- Syngenta Engineering
- The RBA Group
- Worley Parsons

Project Definition Rating Index Weighting

- All 68 PDRI elements not equally important.
- Same process used for previous PDRI's
- Elements weighted in workshops
  - Participants asked to give value of relative value of each element
  - Answers normalized to 1000 total points
- Assessed consistency of responses, culled some respondents
- Looked at differences between owners and contractors, three sub-sets of infrastructure projects
- Set weights

Structure of PDRI

A	PROJECT STRATEGY	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Assessment Level
A.1	Need & Purpose Documentation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
A.2	Investment Studies & Alternatives Assessments	0	1	8	15	22	28	
A.3	Key Team Member Coordination	0	1	6	11	16	19	
A.4	Public Involvement	0	1	6	11	16	21	
Total	Category A (Maximum = 112)							NA

Legend:
0 = Not Applicable
1 = Complete Definition
2 = Minor Deficiencies
3 = Some Deficiencies
4 = Major Deficiencies
5 = Incomplete/Poor Definition

- Each Element Evaluated Independently
- Identify Gaps
- Establish Action Items
- Add Scores to determine overall score

ASU

Weighted Score Sheet (Section 1)

Legend:

- 0 = Not Applicable
- 1 = Complete Definition
- 2 = Minor Deficiencies
- 3 = Some Deficiencies
- 4 = Major Deficiencies
- 5 = Incomplete/Poor Definition

Five Levels of Definition

SECTION I - BASIS OF PROJECT DECISION

CATEG		Definition Level						Score
Eleme		0	1	2	3	4	5	
A. PRO								
A.1	Need & Purpose Documentation	0	2	13	24	35	44	
A.2	Investment Studies & Alternatives Assessments	0	1	8	15	22	28	
A.3	Key Team Member Coordination	0	1	6	11	16	19	
A.4	Public Involvement	0	1	6	11	16	21	
							CATEGORY A TOTAL	
B. OWNER/OPERATOR PHILOSOPHIES (Maximum = 67)								
B.1	Design Philosophy	0	2	7	12	17	22	
B.2	Operating Philosophy	0	1	5	9	13	16	
B.3	Maintenance Philosophy	0	1	4	7	10	12	
B.4	Future Expansion & Alteration Considerations	0	1	5	9	13	17	
							CATEGORY B TOTAL	
C. PROJECT FUNDING AND TIMING (Maximum = 70)								
C.1	Funding & Programming	0	1	6	11	16	21	
C.2	Preliminary Project Schedule	0	2	7	12	17	22	
C.3	Contingencies	0	2	8	14	20	27	
							CATEGORY C TOTAL	
D. PROJECT REQUIREMENTS (Maximum = 143)								
D.1	Project Objectives Statement	0	1	6	11	16	19	
D.2	Functional Classification & Use	0	1	6	11	16	19	
D.3	Evaluation of Compliance Requirements	0	1	6	11	16	22	
D.4	Existing Environmental Conditions	0	1	6	11	16	22	
D.5	Site Characteristics Available vs. Required	0	1	5	9	13	18	
D.6	Dismantling & Demolition Requirements	0	1	4	7	10	11	
D.7	Determination of Utility Impacts	0	1	6	11	16	19	
D.8	Lead/Discipline Scope of Work	0	1	4	7	10	13	

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Rank	Element	
1	A.1	Need & P
2	A.2	Investme
3	C.3	Continge
4	L.2	Design &
5	B.1	Design Pl
6	C.2	Prelimina
7	D.3	Evaluatio
8	D.4	Existing I
9	I.1	Capacity
10	A.4	Public In

A.1 Need & Purpose Documentation

The need for a project may be identified in many ways, including suggestions from operations and maintenance personnel, engineers, planners, local elected officials, developers, and the public. These projects may also be determined by current market needs or future growth. This process typically includes site visits and seeking input from individuals and/or agencies with relevant knowledge. Documentation should result in assessing the need and purpose of a potential project based on factual evidence of current and future conditions, including why the project is being pursued. It will eventually serve as the basis for identifying, comparing, and selecting alternatives. Issues may include:

- ❑ High-level project scope and definition
- ❑ Capacity improvement needs:
  - ❑ Existing levels of service
  - ❑ Modeling of future demands
  - ❑ Trend analysis and forecasted growth
- ❑ Profitability or benefit analysis
- ❑ Facility multi-modal or other multi-use capabilities, including interface options
- ❑ Current and future economic development needs
- ❑ Community concerns and critical issues, such as impact on cultural resources, adjacent facilities, land use, traffic, visual and so on
- ❑ Environmental and/or sustainability drivers
- ❑ Mitigation and remediation issues
- ❑ Constraints such as geographic, institutional, political, or technical
- ❑ Conformance with current geometric, general owner, or other jurisdictional standards
- ❑ Existing infrastructure conditions
- ❑ Safety improvements needs and expectations (including event frequency, severity, and hazards mitigation, as well as compliance requirements)
- ❑ Vulnerability assessment
- ❑ Input into any required planning documents such as a "Need & Purpose Statement" or other
- ❑ Other user defined

** Additional items to consider for Renovation & Revamp projects **

- ❑ Renovation & revamp project's compatibility with existing facilities

Understanding PDRI Scores

1000 Points (Worst) → **70 Points (Best)**

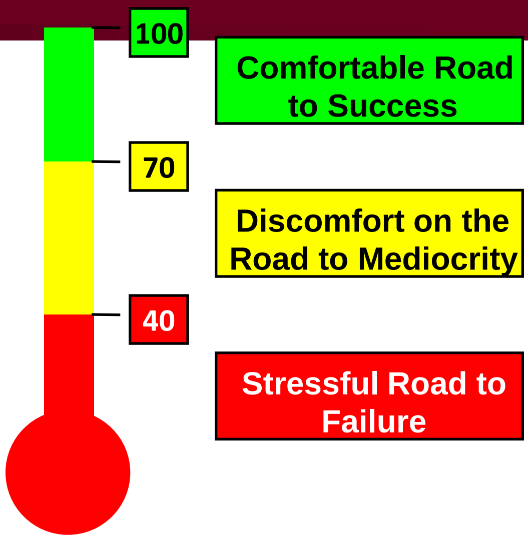
Comparison of Infrastructure Projects with PDRI Score Above and Below 200

Performance	PDRI Score <200 (Deviation from Plan)	PDRI Score >200 (Deviation from Plan)	Difference
Cost	-2%	+23%	**+25**
Schedule	+5%	+29%	**+24**
Change Orders	3%	10%	**+7**
Sub-Sample Size	13	9	

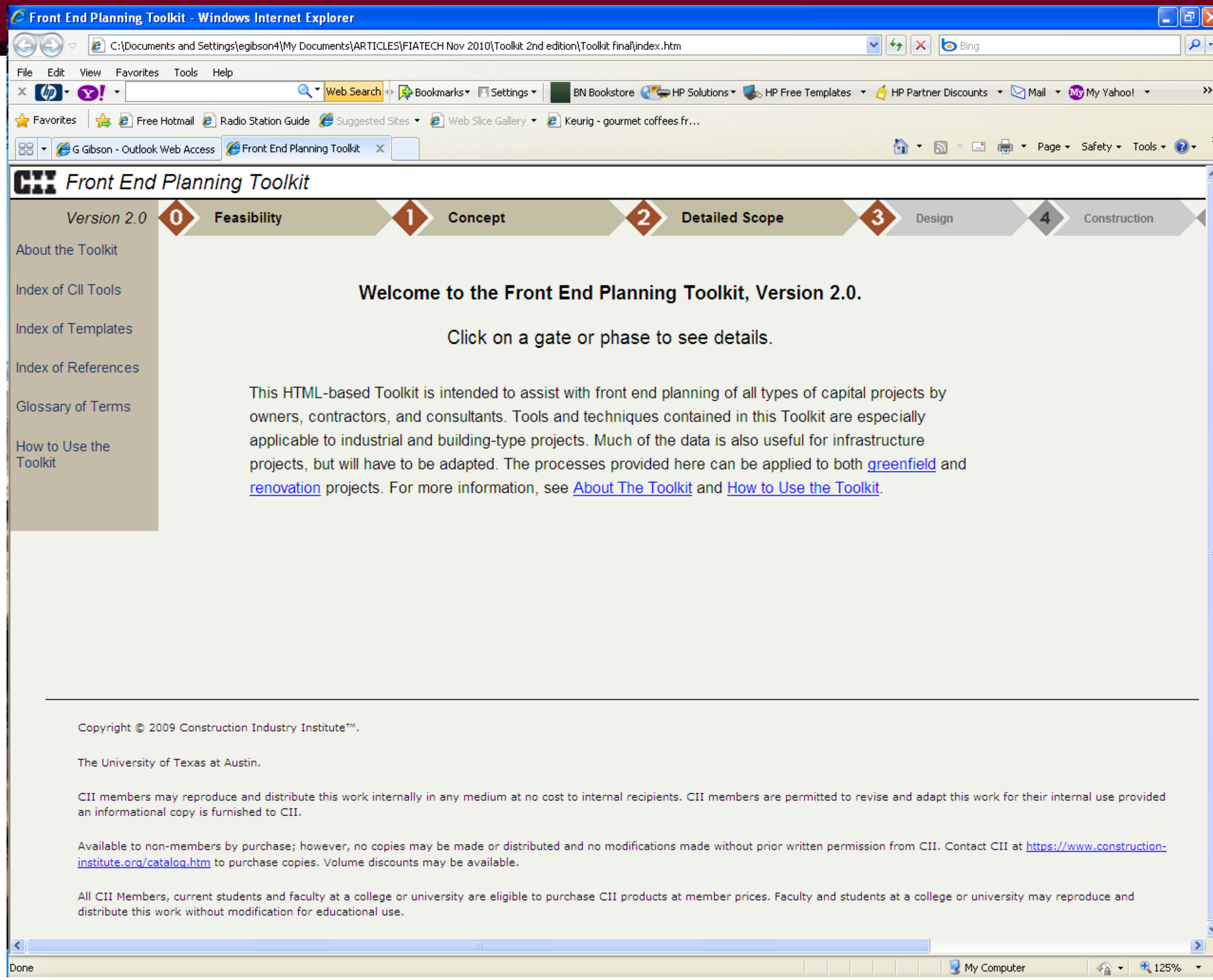
Limited Data !

The Alignment Thermometer

- Short questionnaire made up of 10 key alignment issues
- Used as individual or team scoring tool
- Captures agreement among members
- Captures how well alignment issues are addressed on project
- Results can lead to action



Example: FEP Toolkit, Vrs. 2.0



Conclusions…..

Nine Rules of the Game

1. Defined Front End Planning process
2. Scope definition tools
3. Existing conditions definition
4. Contracting strategy

Nine Rules of the Game

5. Alignment
6. Familiarity with project type, technology or location
7. Team building
8. Experienced and capable personnel

The most important rule of all… "Leadership at all Levels"

9. Leadership
   - Executive
   - Project
     - Owner
     - Contractor

Tying it all together

- Great leadership
- A sense of urgency or purpose
- Intensive planning
  - Front end and other
  - Process
- Excellent communication
- Innovation
- Resources

Questions?

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