



# Florida Department of TRANSPORTATION

## CDOT/FHWA Peer Exchange

### Risk Based Cost Estimation in Florida DOT

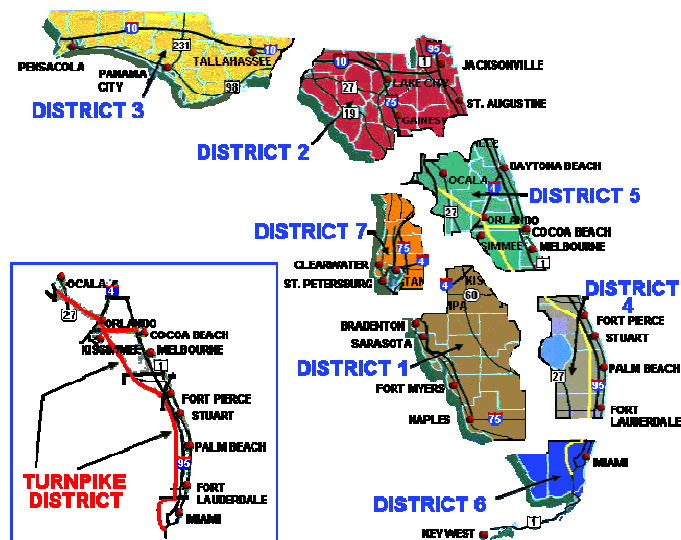
Double Tree Denver-Aurora  
13696 East Iliff Place  
Aurora, Colorado

Phillip "Greg" Davis, P.E.  
State Estimates Engineer

Program Management Office  
May 10-11, 2016

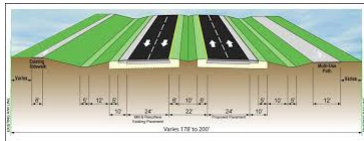
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## FDOT Organization



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## Estimating Systems



SUMMARY OF QUANTITIES AND ESTIMATES									
NO.	DESCRIPTION	UNIT	QTY	UNIT PRICE	TOTAL PRICE	TAXES	NET PRICE	PERCENT	TOTAL
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Long Range Estimating System  
for Conceptual Cost Estimates

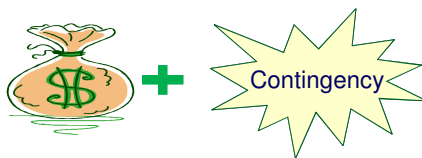
Design Quantities and Estimates  
for Final Design Cost Estimates

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## Traditional vs Risk-Based

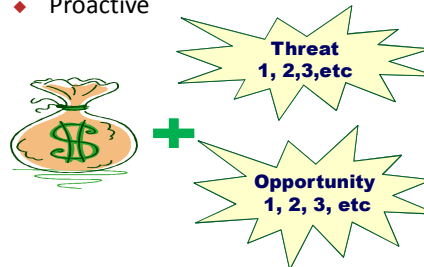
### Traditional Estimating

- ◆ Contingency is intended to include all risk known/unknown
- ◆ Little control of cost and schedule
- ◆ Reactive



### Risk-Based Estimating

- ◆ Risk are clearly identified and quantified in estimate
- ◆ Reasonable control of cost and schedule
- ◆ Proactive



## FDOT History

- Major Project Cost Estimate Review
- FHWA Risk Management Training
- Pilot Projects
- Risk Management Practice
- State Risk Management Team

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## Statewide Risk Management Team

Kurt Lieblong, PE, CVS  
State Value Engineer

Rob Quigley, PE  
State Project Management  
Engineer

Greg Davis, PE  
State Estimates Engineer

Tim Brock  
District VE/Utilities  
Administrator

Frank Chupka, PE  
District Court Engineer

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## Regional Risk Management Teams

- **Membership in each District consists of :**
  - District Value Engineer
  - District Estimates Engineer
  - Design Project Manager
  - Construction Project Manager
- **Monthly Teleconferences with SRM Team**
- **Identify Projects for Workshops**
- **Support Workshops with Staff & Facilities**
- **Change Culture by Promoting Risk Management**

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## Project Selection Guidelines – Risk Analysis

- **Complex project or total project cost greater than \$500 Million – Consultant-led Independent Risk Analysis Workshop**
- **Total project cost between \$100 - \$500 million - Risk Analysis Workshop using commercial risk modeling program**
- **Projects not requiring a formal workshop - Risk Analysis Modeling Tool by HDR**
- **Qualitative Risk Analysis - Risk Based Graded Approach Worksheet**

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## Tools & Strategies

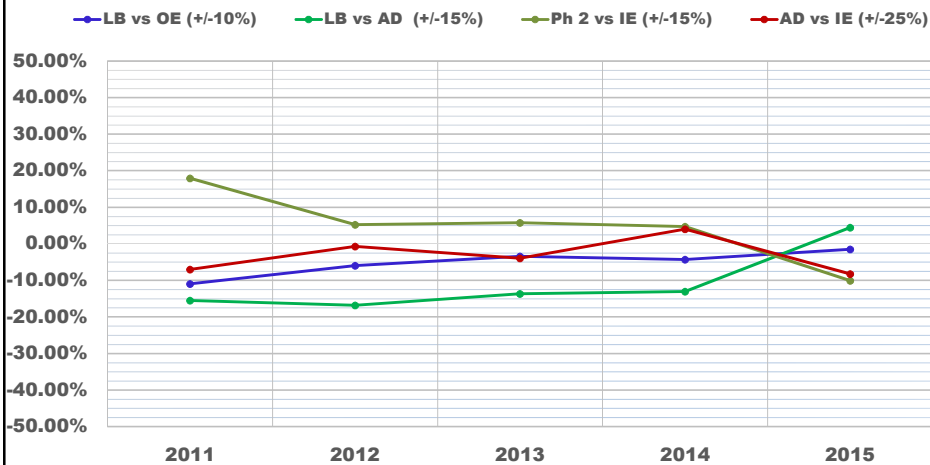
- Risk Analysis Self-Modeling Software
  - Project Manager at their desk
  - Consult with SME as needed
  - Project – 95% / Cost – 45%
- Risk Analysis Workshops
  - Consultant Led
  - Regional Team Support
  - Commercial Software
  - Projects – 5% / Cost – 55%



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## Performance Measures

### Statewide



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# Monthly Bid Analysis



Florida Department of  
TRANSPORTATION

MONTHLY BID ANALYSIS  
REPORTING FY 2016

• Comparing low bid to adopted and low bid to estimate. All estimates are from the 7-31-15 adopted plan and rounded to the nearest \$0.1M through YTD lettings.

Data	Source	D1	D2	D3	D4	D5	D6	D7	TE	CO	SW
# of Letting YTD PRODUCTION (above)		59	53	63	24	33	36	27	6	1	302
Adopted Plus Adds & Advances in \$M	A	227.0	341.3	175.2	95.9	203.8	148.2	53.9	216.2	2.4	1,463.9
Apparent Low Bids in \$M	B	204.8	315.2	172.3	81.1	181.5	127.5	57.5	193.5	2.0	1,335.6
Low Bid +Over or -Under Adopted in \$M	(B-A)	-22.2	-26.1	-2.9	-14.8	-22.3	-20.7	3.6	-22.6	-0.4	-128.3
% Diff Low Bid To Adopted +Over or -Under	(B-A)/A	-10%	-8%	-2%	-15%	-11%	-14%	7%	-10%	-18%	-9%
Official Estimate in \$M	D	229.8	343.2	186.9	96.4	193.7	139.1	59.3	215.1	2.4	1,465.8
Apparent Low Bids in \$M -Same as B	E	204.8	315.2	172.3	81.1	181.5	127.5	57.5	193.5	2.0	1,335.6
Low Bid +Over or -Under Estimate in \$M	(E-D)	-25.0	-27.9	-14.5	-15.3	-12.2	-11.6	-1.7	-21.5	-0.4	-130.3
% Diff Low Bid To Estimate +Over or -Under	(E-D)/D	-11%	-8%	-8%	-16%	-6%	-8%	-3%	-10%	-18%	-9%

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## What is Risk?

❖ Project Management Institute (PMI) Says:  
 “An uncertain event or condition that, if it occurs, has a positive or negative effect on the project’s objectives.”



## Risk Analysis Workshops

- 2 to 3 day structured event
- Identify and quantify threats and opportunities
- Identify risk management strategies
- Collaborative team approach!



## Who participates in a Risk Workshop

- Project Manager and Design Team
- External Subject Matter Experts
- Internal and External Stakeholders
- Disciplines
  - Construction
  - Bridge & Structures
  - Environmental
  - Right of Way
  - Geotechnical
  - Construction
  - Utilities
  - Local agencies
  - Others depending on project scope



## Objectives of a Risk Workshop

- Identify project risk to account for uncertainty in scope, cost and schedule
- Assess project risks by quantifying impacts to cost and schedule:
  - Likelihood (probability) of occurrence
  - Impact (if it occurs)
- Analyze the project risks through modeling to develop a baseline risk assessment.
- Produce a Risk Register for future monitoring of identified project risks.

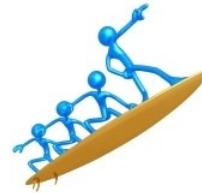
## Project Team Roles in Workshops

- Provide Project Information:
  - Project location maps, drawings, etc.
  - Project cost estimate and backup
  - Design and construction schedule or flow chart
  - Develop comprehensive list of risks, typically using starter risk list
- Workshop Support:
  - Provide information on project history and key decisions as these items come up in discussion
  - Provide input on risk identification, quantification and mitigation



## Workshop Preparation with Project Team

- Risk Analysis Process Overview
- Project Overview & Identify Risk Areas
- Develop Project Starter Risk List
- Review Base Cost Estimate
- Create a flowchart of the project schedule
- Assign tasks to the project team members
- Set the agenda for the workshop



## FDOT Risk Starter List

Functional Area	Risk Name	Include Risk	Comments
		84	
Contracting and Procurement	Changes in Contract Packaging	1	Assumption is Segment 1 then separate contract for 2/3, low likelihood of change. Currently assuming a 2 month gap between projects, may reevaluate the staggering of projects based on estimated construction duration
Contracting and Procurement	Other Issues Related to Contract Language (Warranties, Liquidated Damages, DBE, Insurance/Bonding, etc.)	1	
Contracting and Procurement	Delays in Ad/Bid/Award Process due to Addenda or Bid Protests	1	
Contracting and Procurement	Lack of Qualified Bidders	1	
Contracting and Procurement	Other construction projects in region limit supply of labor, bid costs are higher as a result	1	Potential issue, \$600 M in lets in D2, twice of normal
Contracting and Procurement	Contractor Non-Performance	1	
Contracting and Procurement	Labor and/or Productivity Disruptions	1	probably not a major concern - review vs. base schedule
Structures & Geotech	Changing Geotechnical Conditions (Due to New Information)	1	Segment 1, all design geotech complete (Drilling complete, analysis is in and reports are being completed), very close to final in 90% submittal; Segment 2 not all borings are complete, have some issues accessing properties due to hunting season, there have been issues raised by one property owner about damage to property during drilling. Segment 3, have everything except for OH sign geotech and need some borings at north end for local access road.

# Base Cost Variability Review

## Common Terminology

### Base Costs

#### Base Cost Estimate:

The Base Cost represents the cost which can reasonably be expected if the project materializes as planned. Base Costs are initially estimated by the Project Team and reviewed and validated during the Risk Workshop by the Cost Team and Subject Matter Experts.

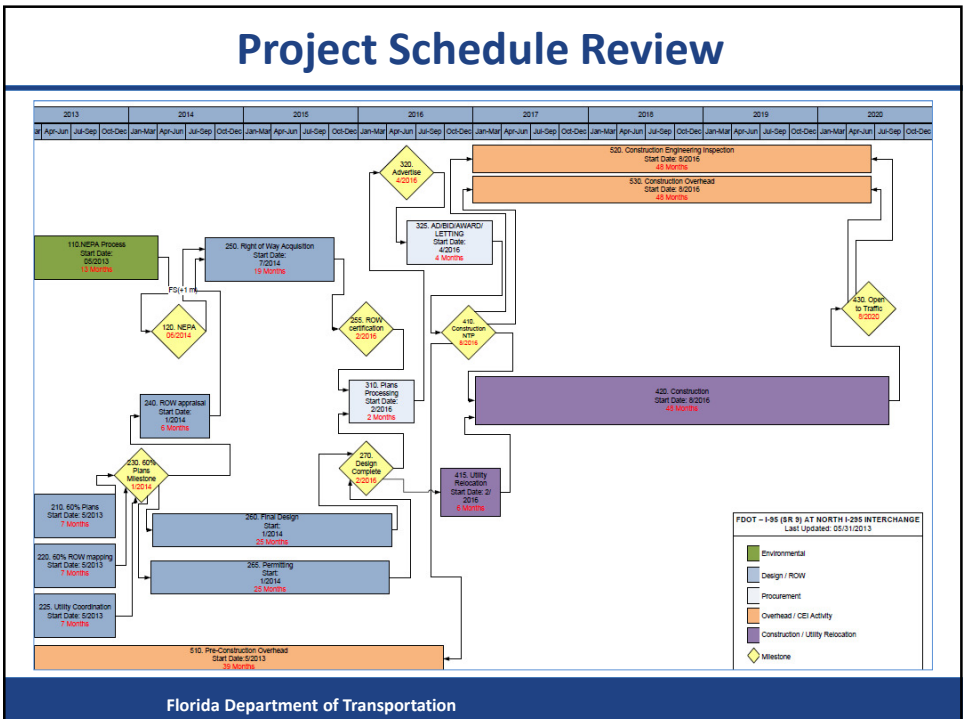
#### Base Cost Uncertainty:

An estimate of the error or tolerance within the quantity or unit price of an item. The level of uncertainty is directly related to its position in the project life cycle: the earlier in the project development process, the greater the uncertainty; the closer to completion, the less uncertainty.

Cost Category	Activity	Base	Low	High	
DB Construction	DB Construction	\$229.08	-14%	7%	
	Lift Bridge - Structural W/ Fenders	\$134.80	-14%	5%	
	APPROACH SPANS - Substructure	\$9.46	-15%	5%	
	APPROACH SPANS - Substructure	\$21.10	-11%	9%	
	Lift Bridge Mechanical	\$14.59	-10%	10%	
	Demolition	\$11.00	-20%	5%	
	Lift - 22 percent Highway	\$3.02	-12%	2%	
	Electrical	\$9.00	-10%	10%	
	Architectural (Control Room/Machine Room)	\$6.22	-10%	10%	
	Architectural Treatments	\$4.00	-10%	10%	
	Architectural Lighting	\$0.81	-10%	10%	
	Other (Innards, Water, Central Flexi-float,	\$1.56	10%	10%	
	Traffic Police Allocation	\$0.54	-5%	10%	
	Misc. (Field Office & Equipment, Public Involvement, Maintenance & Operation, etc.)	\$1.01	-10%	10%	
	Utility Relocation (Utility Estimate Cost)	\$0.00			
Hard Costs	Mobilization (3 percent)(Construction Items	\$6.87	-14%	7%	
	Design/Build Engineering (4 percent of CN \$)	\$9.44	-10%	10%	
	Escrow Warranty (1.5 percent CN Costs)	\$3.54	-10%	10%	
	Construction Inspection	\$2.00	0%	75%	
	Construction QC	\$3.00	0%	75%	
	<b>Total DB Contract (Hard Costs)</b>	<b>\$253.97</b>	<b>-13%</b>	<b>8%</b>	
	Soft Costs	Preliminary Engineering Design (PEP Development for Design-Build)	\$3.00	-10%	0%
		District Construction RE Services and Eng	\$1.30	0%	50%
		Owner's Rep	\$0.30	-10%	10%
		Construction Phase Services (2 percent)	\$5.08	-10%	10%
Total Engineering - non-DB (Soft Costs)		\$9.68	-9%	12%	
<b>Project Sub Total Project Costs</b>	<b>\$263.65</b>	<b>-13%</b>	<b>8%</b>		

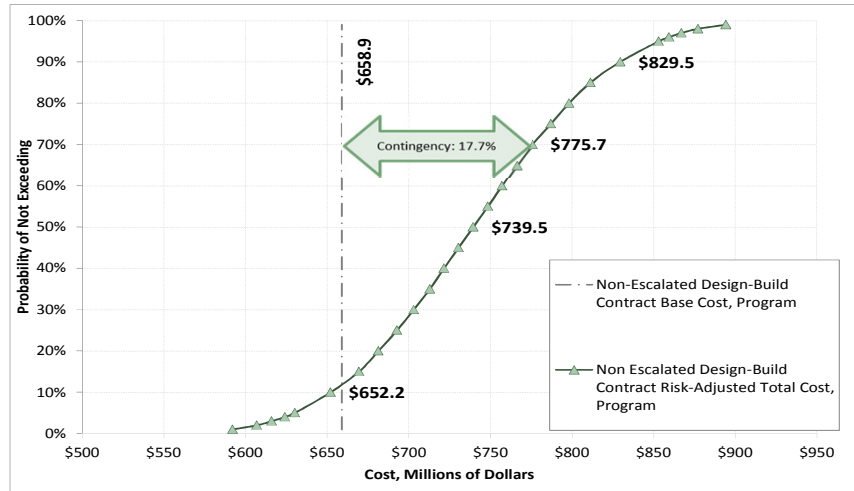
Florida Department of Transportation

# Project Schedule Review



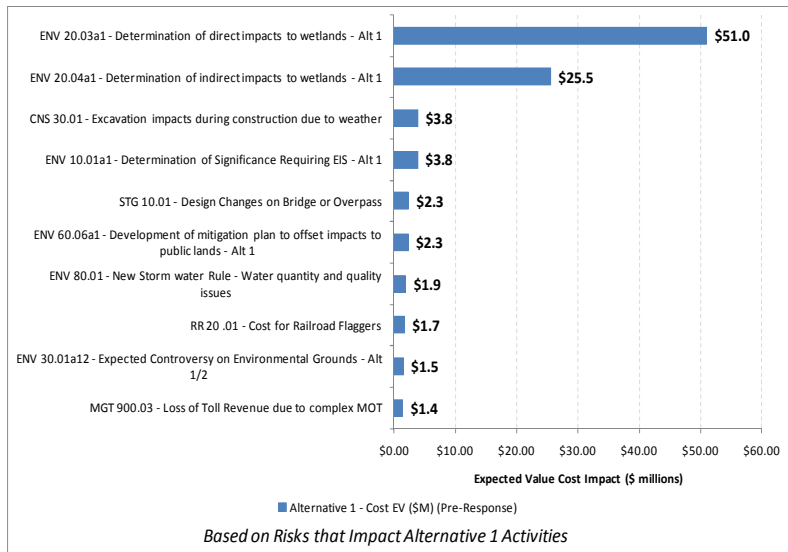
Florida Department of Transportation

## Baseline Risk Assessment Results



**FDOT** Florida Department of Transportation

## Baseline Risk Assessment Results



Florida Department of Transportation

## Risk Register

Risk		Pre-Mitigation (Data Date = 01-Feb-12)				Mitigation			
ID	T/O	Title	Probability	Schedule	Cost	Score	Response	Title	Total Cost
CNS 10.01	T	Traffic Management - baseline solution does not work	L (25%)	N (0)	L (\$60,0...	8	Reduce		\$0
CNS 10.03	T	Maintaining local access	VH (80%)	N (0)	L (\$60,0...	9	Reduce		\$0
CNS 90.01	T	Delay in obtaining temporary permit	VL (10%)	H (80)	N (\$0)	4	Reduce		\$0
CNS 900.03	T	Removal of existing bridge	VH (80%)	N (0)	H (\$300,...	36	Reduce		\$0
CTR 40.01 A	O	Competitive Market Results in Lower Bid Prices - Scenario 1	VH (75%)	N (0)	VH (\$5.0...	72	Enhance		\$0
CTR 40.01 B	O	Competitive Market Results in Lower Bid Prices - Scenario 2	M (50%)	N (0)	VH (\$5.0...	40	Enhance		\$0
DES 10.01	T	Changes in Profile	M (50%)	VH (80)	VH (\$75...	40	Accept		\$0
DES 10.02	T	Changes in Design Standards	VL (5%)	N (0)	VH (\$75...	8	Reduce		\$0
DES 20.01	T	Changes in Design - Wider Trail	VL (10%)	VH (100)	VH (\$2.2...	8	Reduce		\$0
ENV 30.02	T	New permits or new information required	L (25%)	N (0)	L (\$66.6...	8	Accept		\$0
ENV 40.02	T	Unanticipated Cultural or Archaeological Findings	VL (10%)	H (86)	N (\$0)	4	Accept		\$0
ENV 60.02	T	Additional wetlands mitigation area needed	M (50%)	N (0)	VH (\$1.5...	40	Reduce		\$0
ENV 60.03 A	T	Additional wetlands mitigation area needed (Schedule)	VL (10%)	VH (60)	N (\$0)	8	Reduce		\$0
ENV 70.01	T	Design Changes for Ponds	M (50%)	N (0)	M (\$90,...	10	Reduce		\$0
MGT 40.02 B	T	Priorities change on existing program (Bridge Maintenance)	VH (100%)	N (0)	VH (\$1.7...	72	Reduce		\$0
MGT 900.04	T	Threat of Lawsuits	VL (10%)	VH (100)	N (\$0)	8	Reduce		\$0
ROW 900.02	T	Coordination of the removal of the Shipyard Pedestrian Bridge	M (50%)	N (0)	M (\$126...	10	Reduce		\$0
STG 20.01	T	Encountering Unexpected Subsurface Conditions	VH (90%)	VH (90)	VH (\$1.1...	72	Reduce		\$0
UTL 20.03	T	FDOT Utilities Relocation Cost	VL (10%)	N (0)	H (\$250,...	8	Reduce		\$0

- ✓ The Risk Register is the single most powerful Control Tool
- ✓ Incorporate it in your Progress Reports!

Florida Department of Transportation

## Workshop Deliverables

- Final report detailing the results of the workshop
- Final Risk Register for Project Manager to use managing the identified risks

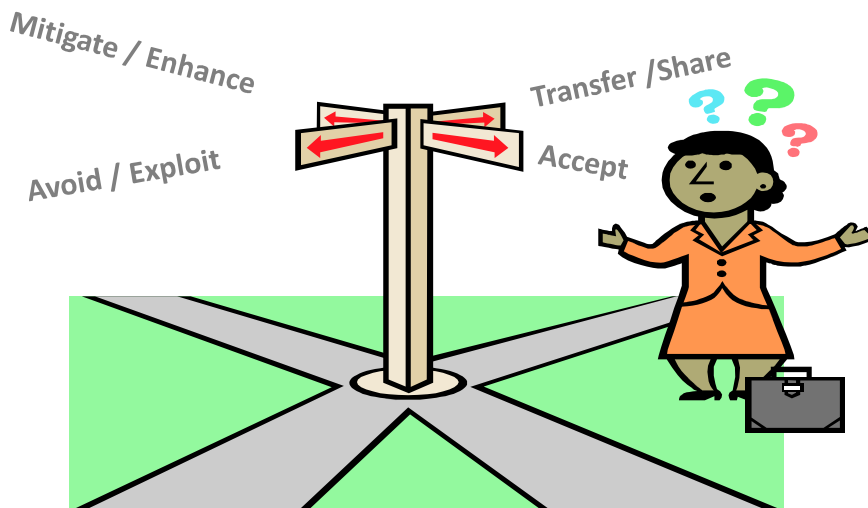


FDOT Florida Department of Transportation

## Risk Management – Outcomes

- Validate project cost & schedule
- Replace project contingency with risk-based estimate
- Create a risk Response plan
  - Identify high cost and schedule risk drivers
  - Develop mitigation strategies
- Manage contingency
  - Reduce contingency as project evolves
  - Allocate excess funds to other projects

## Risk Response



## Risk Management



“Hope is not a Strategy”

## General Lessons Learned

- **Challenges**
- **Strengths**
- **Lessons Learned**
- **Best Practices**

*That's all Folks!*

**Thank you!**



*Any  
Questions?*

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