ICT Project R27-189

Evaluation of QCP and PFP program

IAPA March 16, 2020

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INTERRA Inc

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Research Team

- January 2018: Kick-off meeting
  - IDOT Central Bureau of Materials
  - Illinois Asphalt Pavement Association (IAPA)
  - Federal Highway Administration
  - University of Illinois (UIUC) ICT
  - Arizona State University
  - University of Nevada
  - INTERRA Inc.
- Completed December 2019

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Technical Review Members

- James Trepanier (Chairman)
- Dr. Imad Al-Qadi (PI)
- Jose Rivera-Perez (Graduate Student)
- David Lippert
- John Huang

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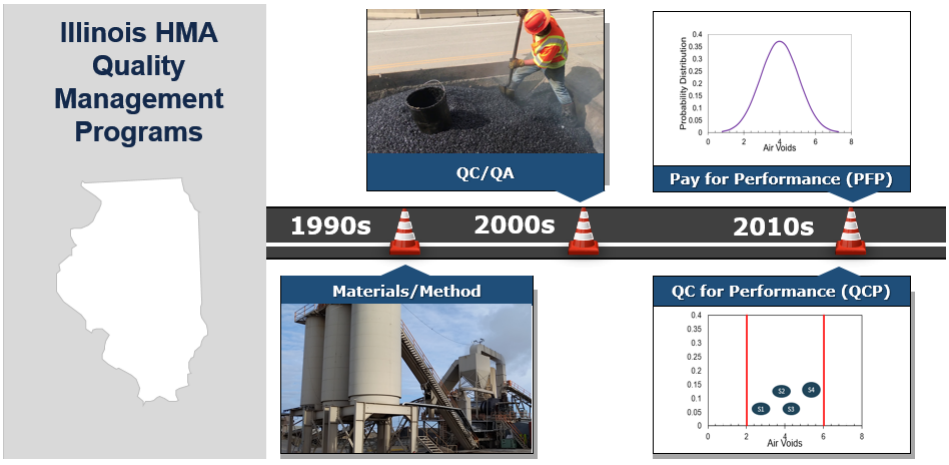

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Purpose of Research
Difference between QC and QA results…
Payment vs Quality

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Were to begin
Questionnaire….QC and QA All Districts and HMA contractors
Review of literature and 2015 thru 2017 test results
QCP and PFP pay factors
MISTIC and Sequel-server for test results
Statewide and District 1 HMA Round Robin results
2018 Site visits…selected Districts and IDOT testing labs
General review of the lab and question/answer section
Observation of jobsite procedures/sampling/ splitting and lab testing

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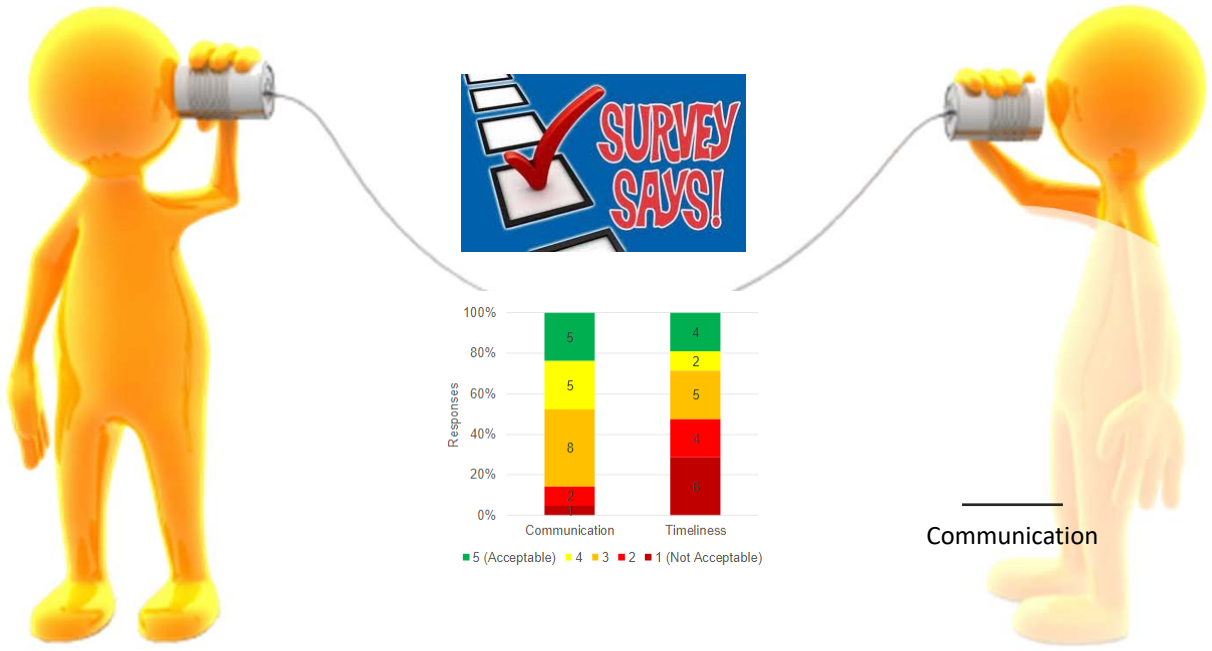

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Review of 2015-2017 Data

ICT report analyzed all the numbers and formulas
Chapter 2, 3 and 4

Research Dilemma:

who's numbers is correct QC or QA?

- Reference: MISTIC
  Sequel Server
  QCQA package

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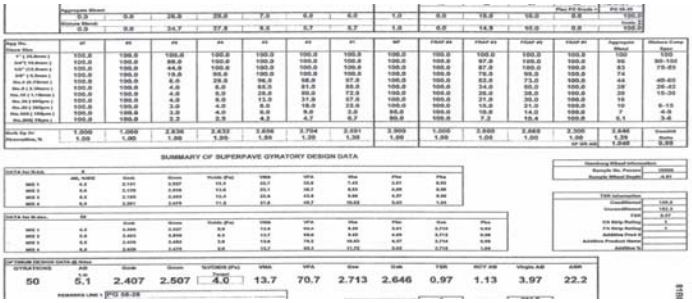

Voids: Gmm and Gmb
VMA: AC% and Gmb

DATA for N-des.	50									
		Gmb	Gmm	Voids (Pa)	VMA	VFA	Vbe	Pbe	Gse	Pba
MIX 1	4.5	2.389	2.527	5.5	13.8	60.4	8.29	3.61	2.710	0.93
MIX 2	5.0	2.403	2.510	4.3	13.7	69.0	9.45	4.09	2.712	0.96
MIX 3	5.5	2.419	2.493	3.0	13.6	78.2	10.63	4.57	2.714	0.98
MIX 4	6.0	2.428	2.478	2.0	13.7	85.3	11.72	5.02	2.718	1.04

OPTIMUM DESIGN DATA @ Ndes										
GYRATIONS	AB	Gmb	Gmm	%VOIDS (Pa)	VMA	VFA	Gse	Gsb	TSR	RCY AB
	5.10			Target						
50	5.1	2.407	2.507	4.0	13.7	70.7	2.713	2.646	0.97	1.13

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Thank You to everyone that helped (2018)

- District 1: 5 different contractors spread to cover the entire district
- District 2: 1 contract
- District 5: 1 contract
- District 6: 1 contract
- District 8: 2 different contractors
- District 9: 1 contract

Total: 11 projects

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General Understanding of Testing Programs

- Method: IDOT production control and sample testing (Design)
- QC/QA: Contractor controlled production and IDOT sample testing

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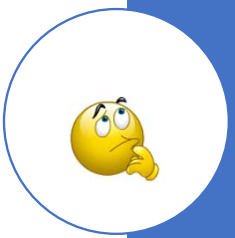
General Understanding of Testing Programs

- PFP: Contracts of > 8000 tons of a single mix
  QC does production control and test mix and cores
  QA tests mix and cores for pay factor
  Challenges are allowed
- QCP: Contracts < 8000 tons of a single mix
  QC does the production control and test mix
  QA test mix and cores for step pay factor
  No Challenges

Test variables: Voids, VMA and Density



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2018 Site observations

- Plant and QC and QA lab condition
- Mix sampling (MTV, Quartermaster, augers, mat with/without plates)
- Blending and splitting
- Density sampling
- Security of samples and Identification
- Lab procedures (QC and QA)
- Test results review

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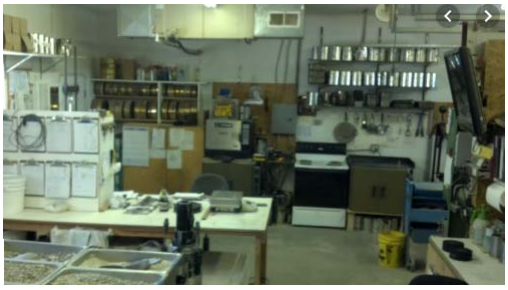
Plant and Lab conditions



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Must comply to Il Mod. T248

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Samples and security

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Asphalt Forensics

- Past Projects QC vs QA
- Production
  - Ingredients
  - Handling
  - Rates
  - Dust controls
- Testing procedures
  - Mix Design
  - Round Robin
  - Equipment
  - Techniques

Note: review of Gmm, Gmb, AC% and minus #200

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Production

- Ingredients: Aggregate Supplier moved location in the quarry
- Handling: Small confined stockpiles
- Mix design vs production

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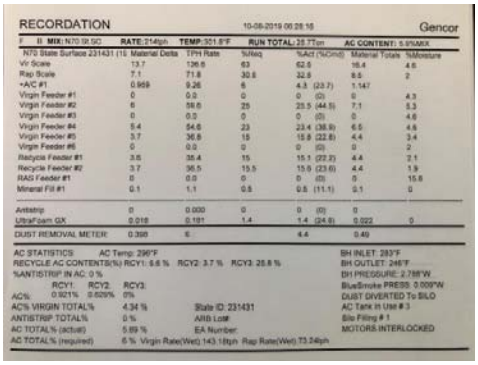
Production Issues

- Reading Dataloggers vs Interpolations of the report
- Use of positive dust control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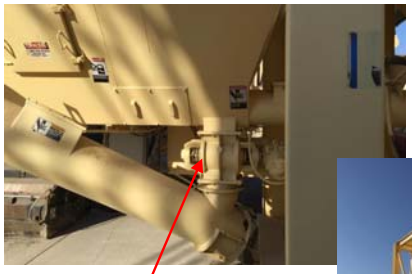
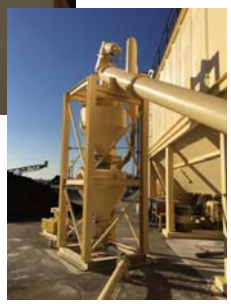
Gencor





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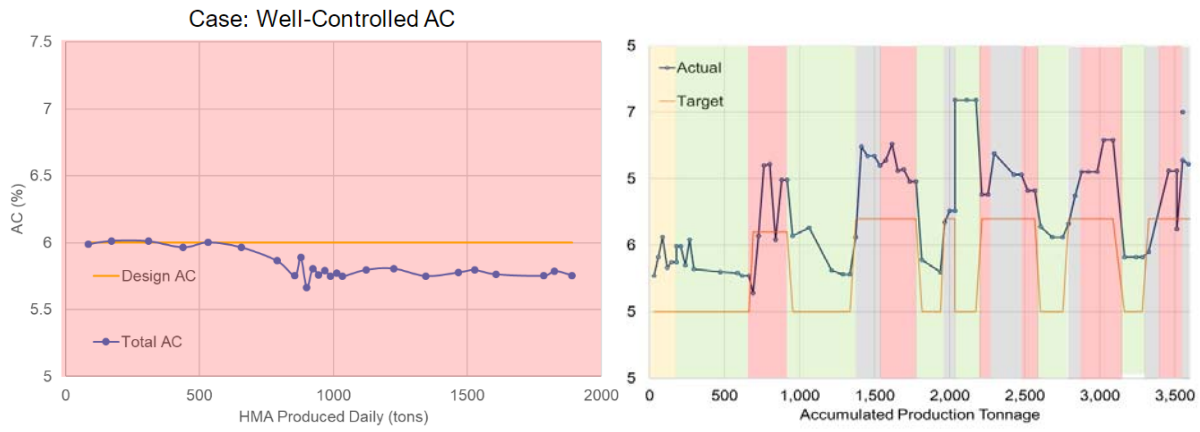
Production (switching and hot stops)



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Testing (2018 Site Visit)

- Mix Design
- MISTIC/Sequel Server
- QCQA Package
- Round Robin

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Lab Observations (Testing):

Splitting and re-blending

Re-heating

Gyratories

AC determination

Test sizes

Process on cores

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Urxqg#Urelq

Lab Information

Lab #	Lab Name
BMPR	BMPR
Dist 3	District 3
Dist 1	District One
1	Allied-Franklin Park
2	Ampe-Mt. Prospect
3	Ampe-Carpentersville
4	Austin Tyler
5	Builders-Elburn
6	Builders-Elk Grove
7	Builders-Gilchrist
8	Builders-Wheeling
9	CTL-Warrenville
10	Curran-DeKalb
11	Curran-McHenry
12	D-Construction-Hazelcrest
13	D-Construction-Rockdale
14	Dix-Kane
15	Gallagher-Joliet
16	Gallagher-Thornton
17	Geneva
18	Gerke
19	Interra
20	K-Five-Elmhurst
21	K-Five-Hodgkins
22	K-Five-Markham
23	K-Five-Naperville
24	K-Five-Romeoville
25	MAT
26	Mirti
27	Mirti Ltd
28	Reliable-Ogden-Lisle
29	Ogden Ave Materials
30	Pagent-Dolan-Antioch
31	Pagent-Dolan-Waukesha
32	Peter Baker-Lakemoor
33	P.T.Feto
34	STATE Testing

Gmm

	Gmm 1	Gmm 2	Gmm Dif	Gmm Avg	Z-Score	Rating
	2.466	2.463	0.003	2.465	0.8	5
			0.000	#DIV/0!	#DIV/0!	#DIV/0!
	2.457	2.455	0.002	2.456	0.7	5
1	2.456	2.454	0.002	2.455	0.8	5
2	2.448	2.450	0.002	2.449	1.8	3
3	2.458	2.462	0.004	2.460	0.0	5
4	2.454	2.456	0.002	2.455	0.8	5
5	2.460	2.462	0.002	2.461	0.2	5
6	2.457	2.458	0.001	2.458	0.3	5
7	2.462	2.460	0.002	2.461	0.2	5
8	2.459	2.457	0.002	2.458	0.3	5
9	2.454	2.458	0.004	2.456	0.7	5
10	2.453	2.456	0.003	2.455	0.8	5
11	2.457	2.458	0.001	2.458	0.3	5
12	2.464	2.466	0.002	2.465	0.8	5
13	2.469	2.463	0.006	2.466	1.0	5
14	2.448	2.451	0.003	2.450	1.7	3
15	2.457	2.455	0.002	2.456	0.7	5
16	2.463	2.459	0.004	2.461	0.2	5
17	2.462	2.459	0.003	2.461	0.2	5
18	2.453	2.451	0.002	2.452	1.3	4
19	2.459	2.460	0.001	2.460	0.0	5
20	2.461	2.458	0.003	2.460	0.0	5
21	2.462	2.465	0.003	2.464	0.7	5
22	2.466	2.468	0.002	2.467	1.2	4
23	2.462	2.464	0.002	2.463	0.5	5
24	2.462	2.461	0.001	2.462	0.3	5
25	2.458	2.458	0.000	2.458	0.3	5
26	2.458	2.458	0.000	2.458	0.3	5
27	2.474	2.473	0.001	2.474	2.3	2
28	2.467	2.465	0.002	2.466	1.0	5
29	2.456	2.456	0.000	2.456	0.7	5
30	2.445	2.448	0.003	2.447	2.2	2
31	2.471	2.473	0.002	2.472	2.0	3
32	2.457	2.461	0.004	2.459	0.2	5
33	2.472	2.473	0.001	2.473	2.2	2
34	2.462	2.460	0.002	2.461	0.2	5
			Low:	2.447		
			High:	2.474		
			Avg:	2.460		
			STD:	0.006		

Gmb

	Gyratory	Height 1	Height 2	Avg. Ht.	Gmb #1	Gmb #2	Gmb Dif	Gmb Avg	Z-Score	Rating
	Pine AFG2	116.7	116.9	116.8	2.336	2.331	0.005	2.334	1.0	5
	Troxler 4140			#DIV/0!			0.000	#DIV/0!	#DIV/0!	#DIV/0!
	Pine AFG2(PFP	116.4	116.4	116.4	2.388	2.385	0.001	2.386	0.1	5
1	Pine AFG2A5	116.1	116.4	116.3	2.336	2.388	0.008	2.362	0.7	5
2	Pine 5060-03	116.3	117.0	117.0	2.381	2.384	0.003	2.383	0.6	5
3	Pine AFG81A	117.5	117.7	117.6	2.387	2.381	0.006	2.384	0.4	5
4	Pine AFG81A	117.4	117.1	117.3	2.391	2.391	0.000	2.391	1.0	5
5	Troxler 4141	117.1	117.5	117.3	2.390	2.383	0.001	2.390	0.4	5
6	Pine G2	116.7	116.5	116.6	2.292	2.295	0.003	2.294	1.0	5
7	Pine G2	116.9	117.4	117.2	2.308	2.307	0.001	2.308	0.1	5
8	Pine Af G2A5	116.2	115.9	116.0	2.290	2.400	0.010	2.295	1.1	4
9	Pine Af G2	116.2	116.7	116.5	2.290	2.300	0.010	2.295	0.6	5
10	Pine Af G81a	116.0	116.9	116.9	2.295	2.295	0.000	2.295	1.1	4
11	Pine Af G81	117.0	116.9	117.0	2.293	2.294	0.001	2.294	1.0	5
12	Troxler 4141	116.9	117.0	117.0	2.379	2.380	0.001	2.380	1.0	5
13	Troxler 5850	117.3	117.2	117.3	2.382	2.375	0.007	2.379	1.1	4
14	Pine	115.5	115.9	115.7	2.380	2.380	0.000	2.380	1.0	5
15	Pine Af G2A	117.6	117.7	117.7	2.304	2.303	0.001	2.304	0.4	5
16	Pine Af G2A	117.0	116.9	117.0	2.293	2.292	0.001	2.293	0.9	5
17	Pine Af G2A	117.7	117.6	117.7	2.303	2.305	0.002	2.304	0.4	5
18	Troxler 4141	117.2	116.9	117.0	2.303	2.305	0.002	2.304	0.4	5
19	Pine Af G2	117.7	117.8	117.8	2.377	2.377	0.000	2.377	1.4	4
20	Troxler 5850	116.6	116.6	116.6	2.296	2.299	0.003	2.298	1.6	3
21	Troxler 4141	116.4	116.4	116.4	2.391	2.391	0.000	2.391	0.6	5
22	Troxler 4141	117.2	117.2	117.2	2.387	2.388	0.001	2.388	0.1	5
23	Troxler 4141	116.9	117.0	116.9	2.390	2.390	0.000	2.390	0.4	5
24	Troxler 4141	117.1	117.7	117.4	2.393	2.386	0.003	2.392	0.7	5
25	Pine Af G2A	117.5	117.5	117.5	2.377	2.372	0.005	2.375	1.7	3
26	Pine Af G81A	116.5	116.4	116.5	2.376	2.373	0.003	2.375	1.7	3
27	Troxler 5850	116.6	116.9	116.9	2.386	2.373	0.013	2.380	1.0	5
28	Pine Af G81(5P	117.5	117.8	117.7	2.373	2.376	0.003	2.376	1.3	4
29	Troxler 4141	117.5	117.8	117.7	2.374	2.378	0.004	2.376	1.6	3
30	Pine AFG2A5	116.6	116.6	116.6	2.393	2.398	0.006	2.396	1.3	4
31	Pine AFG2A5	117.0	116.7	116.9	2.390	2.394	0.004	2.392	0.7	5
32	Pine	116.4	116.6	116.5	2.402	2.406	0.004	2.404	2.4	2
33	Troxler 5850W2	118.2	118.2	118.2	2.384	2.380	0.004	2.382	0.7	5
34	Pine AFG81A	117.8	117.5	117.7	2.371	2.376	0.005	2.374	1.9	3
			Low:	115.7			Low:	2.374		
			High:	118.5			High:	2.404		
			Avg:	117.1			Avg:	2.387		
			STD:	0.6			STD:	0.007		

Voids

	%	Z-Score	Rating
	2.9	0.3	5
	#DIV/0!	#DIV/0!	#DIV/0!
	2.9	0.3	5
1	2.8	1.0	5
2	2.7	0.8	5
3	3.1	0.3	5
4	2.5	1.3	4
5	2.9	0.3	5
6	2.6	1.0	5
7	3.0	0.0	5
8	2.6	1.0	5
9	2.6	1.0	5
10	2.4	1.5	4
11	2.6	1.0	5
12	3.4	1.0	5
13	3.5	1.3	4
14	2.9	0.3	5
15	2.9	0.3	5
16	2.8	0.5	5
17	3.1	0.3	5
18	2.8	0.5	5
19	3.4	1.0	5
20	2.5	1.3	4
21	3.0	0.0	5
22	3.2	0.5	5
23	3.0	0.0	5
24	3.2	0.5	5
25	3.4	1.0	5
26	3.4	1.0	5
27	3.8	2.0	3
28	3.6	1.5	4
29	3.3	0.8	5
30	2.1	2.3	2
31	3.2	0.5	5
32	2.2	2.0	3
33	3.7	1.8	3
34	2.8	1.3	4
	2.1	Low:	
	3.8	High:	
	3.0	Avg:	
	0.4	STD:	

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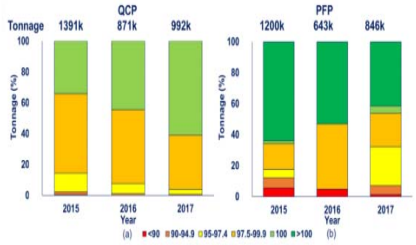
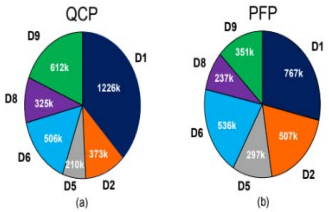
Cliff notes on QCP and PFP (2015-2017 data): Findings

- More QCP projects than PFP
- PFP has higher pay reductions than QCP project
- Over the last three seasons Contractors increased their pay on QCP
- Density was the major reason for reduction (especially on PFP) compared to the other components in pay factor calculations it is followed by air voids and VMA





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"Cliff" notes and Hi-Lights of 2018 site visits

- Most QC managers understood the ins and outs of the programs (ones visited)
- QC staffs knew their responsibilities, some better than others
- Some QC departments had unique practices that improved on their production and pay factors
- Consistency and communication
- Experienced QA personnel does make a difference
- QA tried to follow the intent of the program, while still looking out for the best interest of the Department

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Practical Tips for Construction

- Pre-pave have the inspectors attend meeting…..discussion on where splitting is going to happen and how cores are to be labeled/secured
- Random Numbers….
  Do's and don'ts

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Practical Tips

- Record the time and tonnage on when the HMA sample was taken

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Construction

- Look at the location where the splitting is being preformed….is it safe and level? If not tell someone and take pictures

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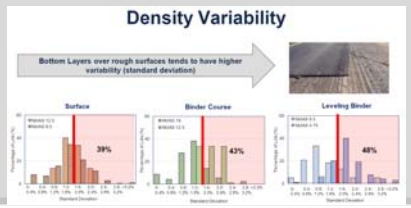
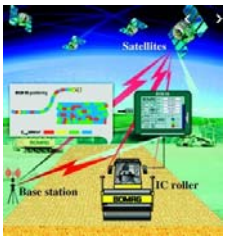
Construction (Density)

- Innovations are coming
  - Rollers
  - Intelligent Compaction
  - Infrared scanning
  - WMA and rejuvenators
  - Longitudinal joint sealants/RPE





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Materials

- Consistency
- Experience
- Mix design
- Forensics (pictures of DL)
- Plant and jobsite visits still needed

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Report recommendations

- Limit mix switches
- Positive dust control
- Stockpile handling
- Cold feed control
- Sampling location
- Sampling, blending, splitting and reheating
- Gyratory monitoring (round robin)
- Training

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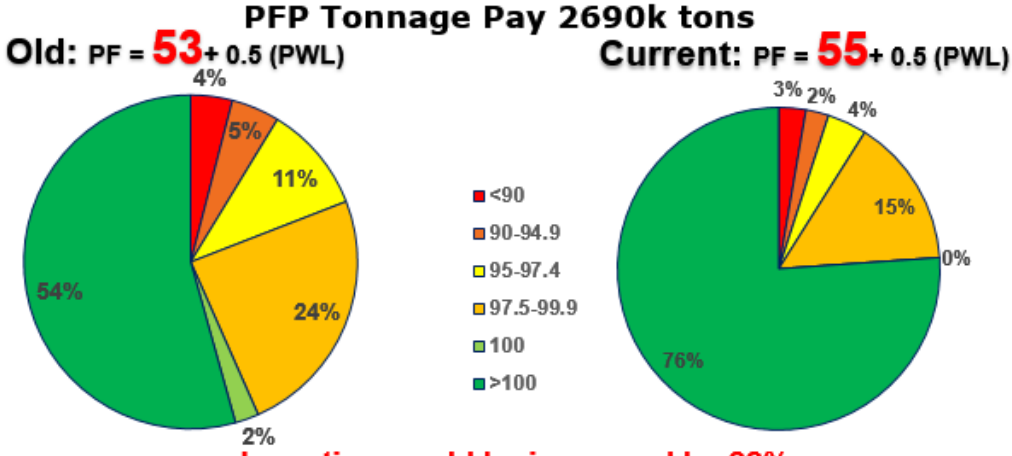
Illinois Center for Transportation
University of Illinois at Urbana-Champaign

New PFP Pay Factor Helps Contractors!

- **Recalculated Pay Factors.**



Incentive would be increased by 22%

"Where Excellence and Transportation Meet" 18

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Summary

- **~80% of the results, according to the Mann Whitney, are in agreement between contractors and districts**
  - The variability and loss of pay in those cases are mainly related to production and construction issues
- **For the results that don't agree, the major issue driving the differences is the G_{mb} test results:**
  - Possible sources: Gyratory compactor, reheating, and sample test weights

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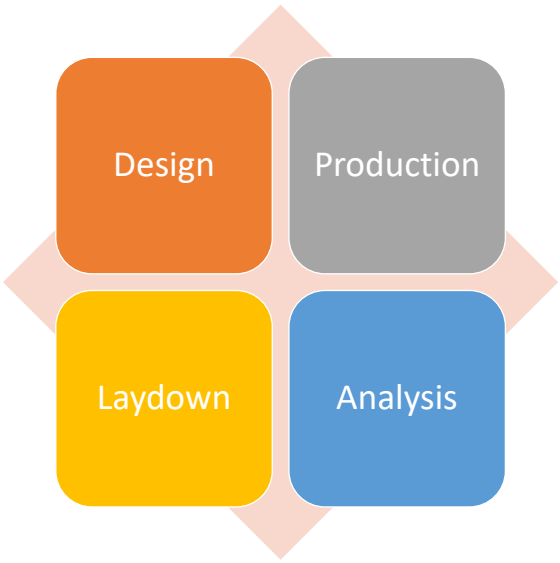
Understanding Risk



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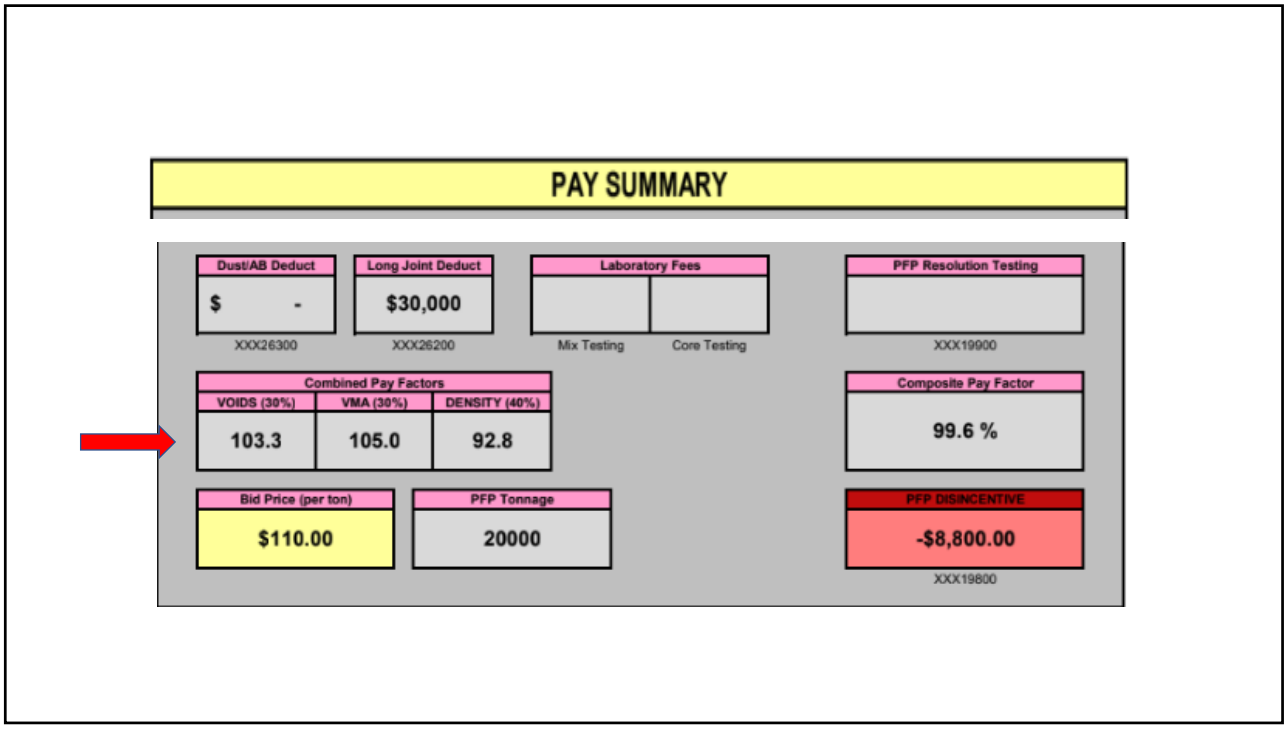

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Good, Bad, and Ugly

Voids (Production)
Density (site conditions)
VMA (Design)

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VMA (Risks)

- Aggregate source
  - Consistency
  - Communications
  - Replenishing timing
- Blend of Aggregate
  - Hitting the minimum
  - Dust
- Recycled products
  - In house
  - purchase

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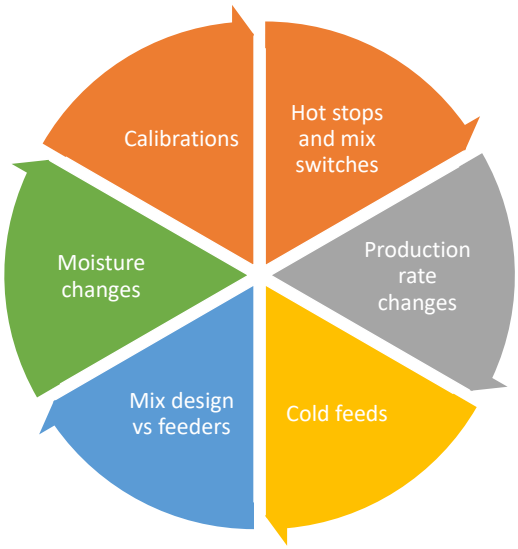
S urg x fwlrq

Practices that may have payment risks



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Reducing risk during Laydown

- Rate of paving
- Trucking & Mix handling
- Equipment and Compaction
- Communication
- Sampling/Blending
- Core handling

Sound Familiar….

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Practical tips on Forensics

- Datalogger Temperature Chart review
- Tonnages and time (take pictures)
- Review test weights vs test results
- Communicate vs pointing of fingers
- Training

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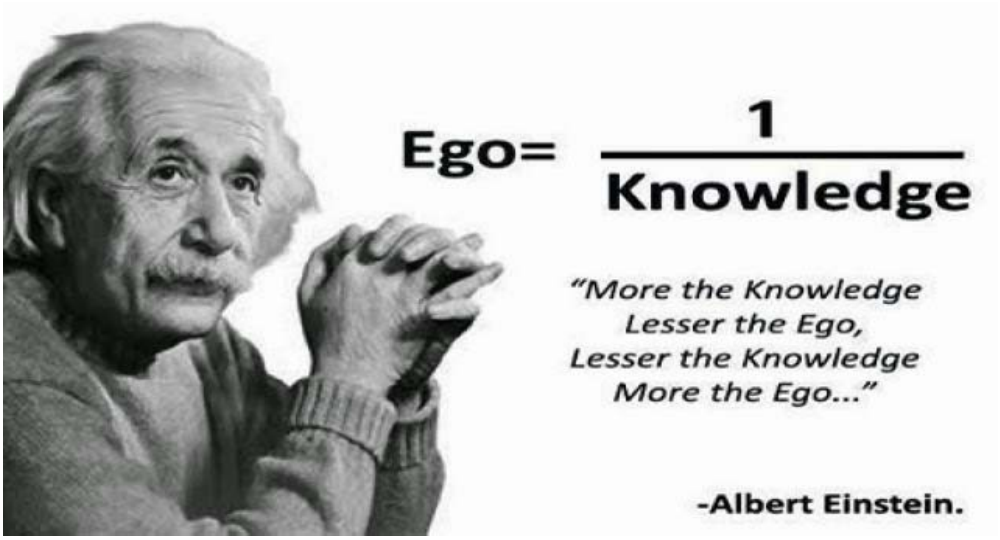
Thank You


Ego= 1 / Knowledge
"More the Knowledge
Lesser the Ego,
Lesser the Knowledge
More the Ego..."
-Albert Einstein.

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