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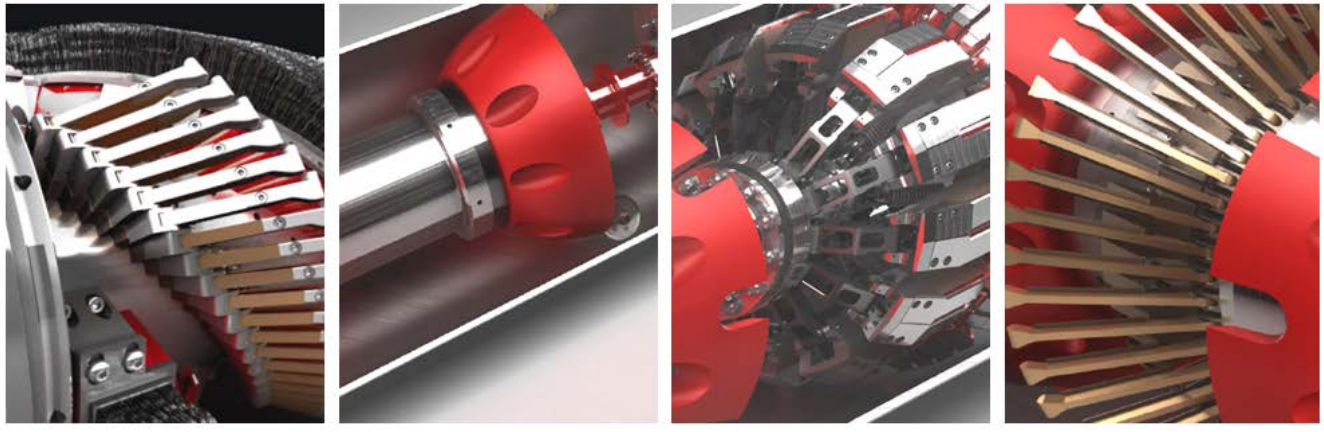
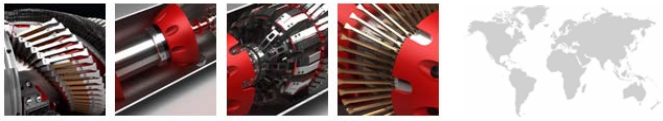


Commercialization of ILI Technologies

PHMSA R&D Forum
Chuck Harris
Manager, Strategic Commercialization
July 18, 2012

www.tdwilliamson.com



Contents

- Commercialization Process
- Stage 4a: Verify
- Stage 4b: Commercialize
- Case Study
- Conclusion

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Commercialization Process

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- **Stage 1**
  - Idea
- **Stage 2a**
  - Business Case
- **Stage 2b**
  - R&D
- **Stage 3a**
  - Prelim Design
- **Stage 3b**
  - Final Design
- **Stage 3c**
  - Mfg and Test
- **Stage 4a**
  - Verify
- **Stage 4b**
  - Commercialize
- **Stage 5**
  - Lifecycle Mgmt

Stage 4a

- **Verify**

Stage 4a: Verify

- Internal pull testing
  - Access to pipe samples with required anomalies
  - Creation of pipe samples with simulated anomalies
  - Validate detection / sizing
- Followed by need for “real-world” testing for system validation
  - Establish expectations
    - Preferred conditions
    - Timing to excavate and receive feedback

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Stage 4b

- **Commercialize**

Stage 4b: Commercialize

- Previous experience with “similar” technology
    - Commercialization of new approach to existing technology can be slowed based on past experience
- Does PHMSA “certify” this technology?
    - Even with the most rigorous internal/external testing and dig feedback, operators concerned with PHMSA “certifying” technology
        - Can slow deployment of proven new technologies that offer advanced solutions
        - Slows access to critical data to improve/enhance characterization/sizing

Stage 4b

- **Commercialize**

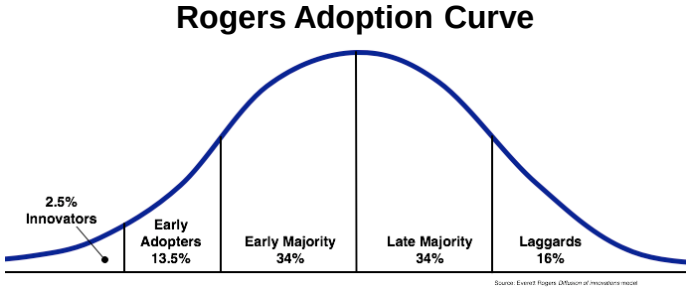
Stage 4b: Commercialize

- Integration into industry Standard Practices referenced by Regulations and incorporated into IMP's
  - Proven new technology included in such Practices would advance adoption
  - Slow process to integrate since no means to update documents outside of prescriptive cycles
    - NACE SP0102-2010
    - API 1160
    - NACE 35100

Stage 4b

- **Commercialize**

Stage 4b: Commercialize



- Innovators/Early Adopters
  - Operator / Supplier partnership
  - Project scoping and planning to set expected outcomes
  - What do I do about the threats I do not know today?
  - Locates “optimal” pipeline and operating conditions outside of integrity program if necessary
    - Product , Velocity, Length, WT, Bends,
  - Provides field results quickly to validate performance

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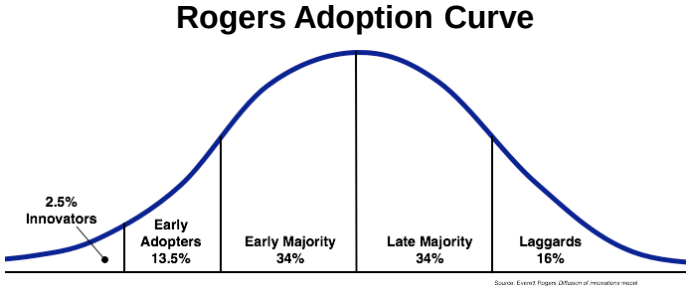
Stage 4b

- **Commercialize**

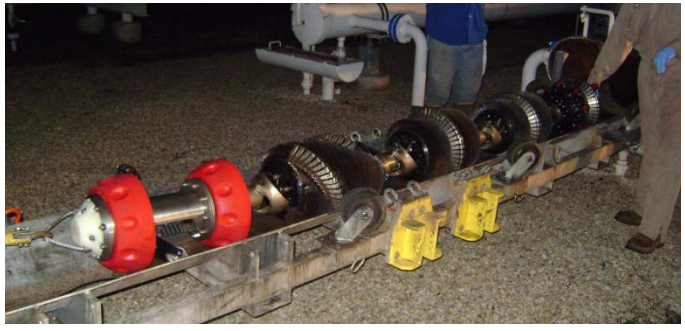
Stage 4b: Commercialize



- Late Majority/Laggards
  - “I don’t have that threat”
  - Does PHMSA “certify” that technology?
  - Do not want all data delivered
  - Can a run be fit into existing inspection program?
  - Not likely to find optimal conditions
  - Slow to validate results which hinders adoption and deployment

Case Study

- 16” Crude Oil Pipeline
  - Problem:
    - Thousands of dents
    - Need ability to prioritize mechanical damage severity
      - Previous failures at dents <2% with metal loss
    - Ran all available technologies without success in identifying mechanical damage
    - Performed run-to-run comparison of all data obtained from inspections and still unable to identify dents with metal loss

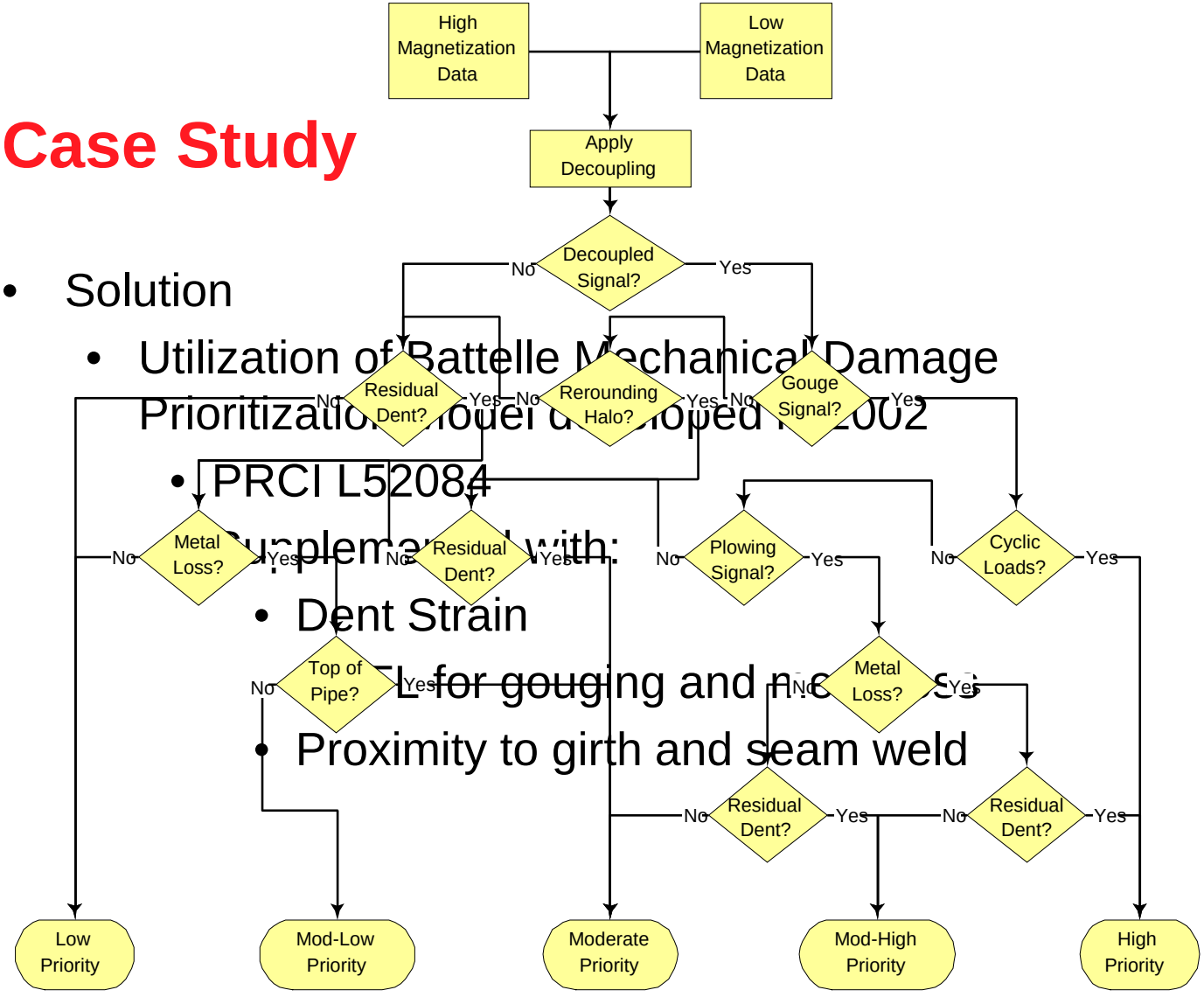


Case Study

- Solution
  - Multiple DataSets, on same tool, to overcome individual technology limitations and provide various views of all detectable features
  - Operator (Koch Pipeline) elected to utilize Multiple DataSet Technology based on belief desired results would be achieved – prioritization of mechanical damage
    - Koch Pipeline invested in the technology
    - Upon tool build, pull tests ensued to validate a model
    - Inspection performed in late 2011 with tool containing Deformation, MFL, SMFL, LFM and XYZ

Case Study

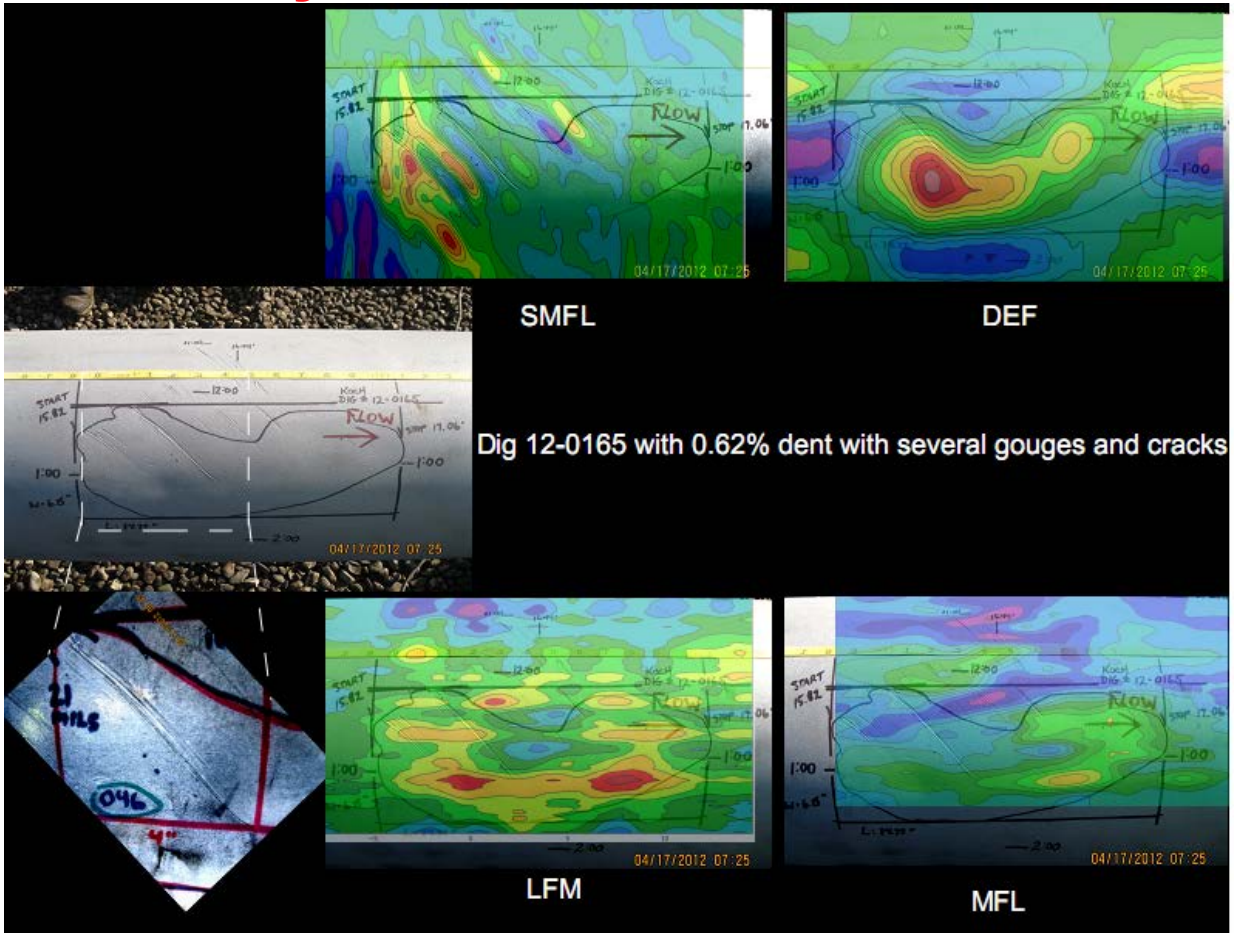
- Solution
  - Utilization of Battelle Mechanical Damage Prioritization model developed in 2002
    - PRCI L52084
  - Supplemented with:
    - Dent Strain
    - EL for gouging and metal loss
    - Proximity to girth and seam weld



Case Study

Dist Start	Dent Depth (in)	Orientation (Deg)	Description	Seam or not	Depth %	Dent Length (in)	Severity Number	Final Severity
563805.8569	0.32	146	Dent w/ Metal Loss - Re-rounded (3.61% Strain)		2.0%	4.24	1	High
659396.4219	0.19	6	Dent w/ Metal Loss (3.03% Strain)		1.2%	2.24	1	High
130172.3133	0.17	301	Dent w/ Metal Loss - Re-rounded (5.72% Strain)		1.1%	2.36	1	High
377391.8188	0.16	299	Dent w/ Metal Loss - Re-rounded, Found in SpirALL (4.75% Strain)		1.0%	4.24	1	High
565775.0268	0.16	334	Dent w/ Metal Loss - Re-rounded (2.27% Strain)		1.0%	3.18	1	High
366167.134	0.15	194	Dent w/ Metal Loss, Found in SpirALL (1.47% Strain) Cycled		0.9%	3.30	1	High
679479.7892	0.14	352	Dent w/ Metal Loss - Re-rounded, Found in SpirALL (1.67% Strain)		0.9%	11.43	1	High
286669.7504	0.14	65	Dent w/ Metal Loss - Re-rounded (2.67% Strain)		0.9%	1.53	1	High
274771.2529	0.12	103	Dent w/ Metal Loss - Re-rounded, Found in SpirALL		0.8%	3.06	1	High
281119.0863	0.47	173	Re-rounded (8.7% Strain)		2.9%	4.95	2	Moderate High
145897.5576	0.38	150	Re-rounded (8.56% Strain)		2.4%	5.42	2	Moderate High
82737.50682	0.24	352	Cycled		1.5%	4.71	2	Moderate High
604442.564	0.15	23	Re-rounded	Seam	0.9%	1.06	2	Moderate High
317119.5096	0.15	327	Re-rounded	Seam	0.9%	2.00	2	Moderate High
389412.3769	0.15	194	Dent w/ Metal Loss, Found in SpirALL (1.88% Strain)		0.9%	4.83	2	Moderate High
202455.0887	0.13	3	Re-rounded	Seam	0.8%	1.65	2	Moderate High
575501.0933	0.13	266	Cycled		0.8%	1.53	2	Moderate High
619295.5526	0.4	150	Re-rounded (4.58% Strain)		2.5%	5.42	3	Moderate
564414.8644	0.39	162	Re-rounded (5.37% Strain)		2.4%	4.71	3	Moderate
599695.4015	0.39	154	Re-rounded (4.7% Strain)		2.4%	6.95	3	Moderate
605422.7802	0.37	144	Re-rounded (3.03% Strain)		2.3%	4.95	3	Moderate
287642.8391	0.35	163	Re-rounded (4.5% Strain)		2.2%	3.65	3	Moderate
654564.5542	0.35	141	(2% Strain)		2.2%	4.48	3	Moderate
632760.8802	0.32	130	Cycled (3.3% Strain)		2.0%	3.65	3	Moderate
475118.7453	0.23	356	Re-rounded (5% Strain)		1.4%	2.12	3	Moderate
62031.35495	0.23	281	Re-rounded (2.65% Strain)		1.4%	3.30	3	Moderate
465704.099	0.21	321	Re-rounded		1.3%	1.41	3	Moderate
425597.8694	0.17	24	Re-rounded		1.1%	2.00	3	Moderate
121592.4458	0.16	316	Re-rounded		1.0%	2.71	3	Moderate
413966.4564	0.16	175	Re-rounded	Seam	1.0%	2.36	3	Moderate
325555.1375	0.15	33	Re-rounded		0.9%	4.59	3	Moderate
599471.0623	0.13	337	Re-rounded		0.8%	2.00	3	Moderate
434338.2514	0.13	45	Re-rounded		0.8%	2.12	3	Moderate
551561.8431	0.13	144	Cycled (2.38% Strain)		0.8%	4.01	3	Moderate
474250.7626	0.1	337	Re-rounded		0.6%	4.36	3	Moderate
363526.537	0.08	224	Cycled		0.5%	3.06	3	Moderate
142303.7616	0.01	284	Re-rounded		0.1%	0.82	3	Moderate
605031.3181	0.23	154	Re-rounded (3% Strain)		1.4%	2.59	4	Moderate Low
598349.445	0.23	169	Re-rounded		1.4%	2.71	4	Moderate Low
67242.64924	0.22	146	Re-rounded		1.4%	4.01	4	Moderate Low
432175.6281	0.21	159	Re-rounded		1.3%	6.83	4	Moderate Low
125388.8254	0.2	139	Re-rounded		1.3%	1.88	4	Moderate Low
442481.8584	0.19	146	Re-rounded		1.2%	6.60	4	Moderate Low
177801.1426	0.17	153	Re-rounded		1.1%	2.71	4	Moderate Low
223890.7645	0.16	127	Re-rounded		1.0%	3.42	4	Moderate Low
80958.45209	0.15	153	Re-rounded		0.9%	4.12	4	Moderate Low
195467.1257	0.15	138	Re-rounded		0.9%	5.18	4	Moderate Low
414568.2678	0.12	176	Re-rounded		0.8%	4.83	4	Moderate Low
61580.10436	0.09	200	Re-rounded		0.6%	2.12	4	Moderate Low
575503.2139	0.04	223	Re-rounded		0.3%	1.06	4	Moderate Low
575499.6501	0.04	196	Re-rounded		0.3%	0.71	4	Moderate Low
142072.992	0.02	231	Re-rounded		0.1%	0.35	4	Moderate Low

Case Study



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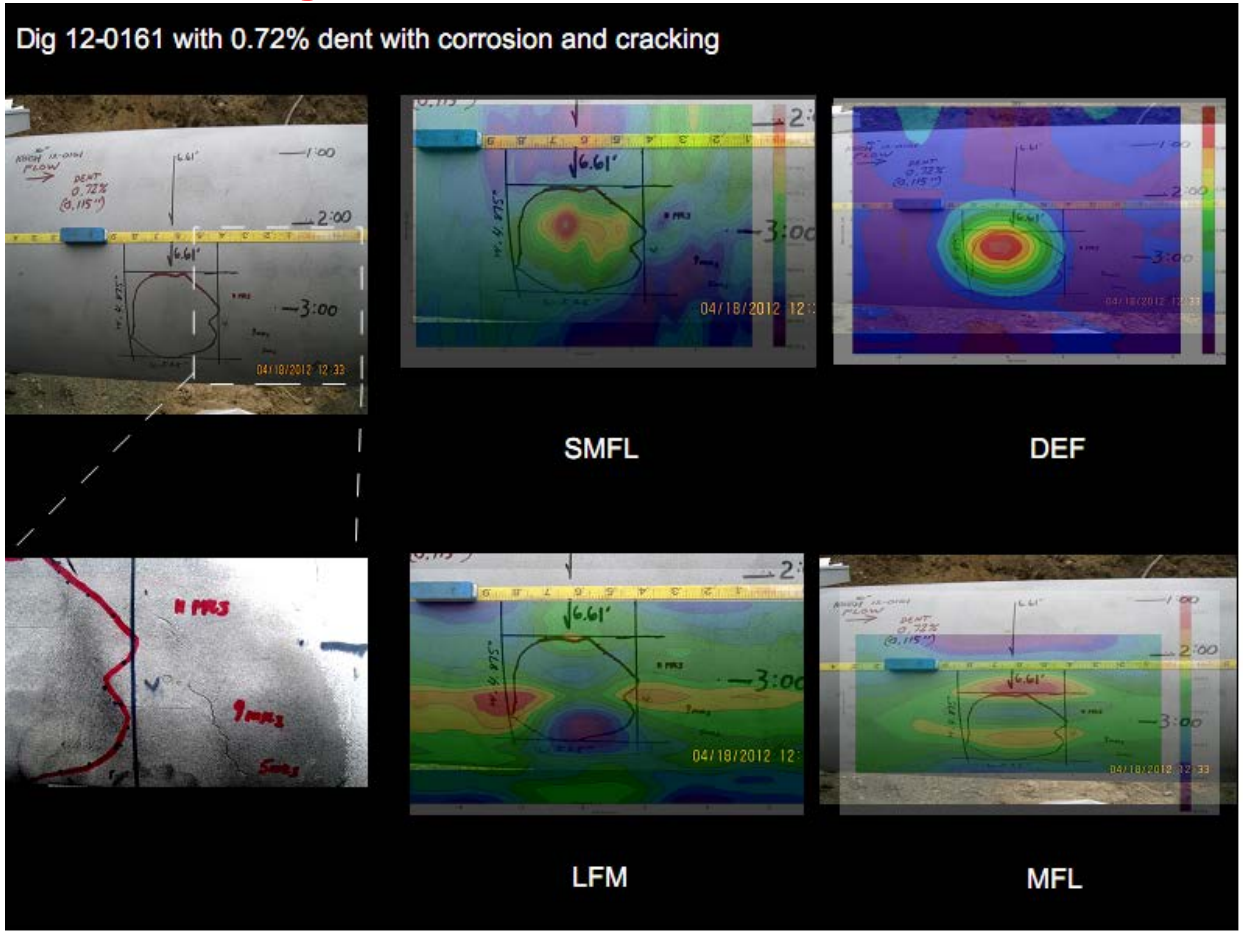
Case Study



Conclusion

- Successful commercialization starts with a close relationship between innovators/early adopters and service provider
- Standard Practice update process is not favorable to integration of new technology
- Regulatory pressures can negatively impact development and thus deployment
- PHMSA is not expected to certify a supplier, but endorse innovation to advance adoption