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THE BENEFITS OF CONSENSUS STANDARDS – A PIPELINE CASE STUDY

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ABSTRACT

The pipeline industry has implemented a process for acquiring data and information necessary to support technically-based standards and regulations through technical studies and research and development (R&D). This process enabled the development of ASME B31.8S based on the technical facts gathered, drawing upon all stakeholders including Federal and State regulators, pipeline operators, manufacturers and suppliers and members of the public.

This paper describes the process being used by the gas pipeline industry to develop standards such as B31.8S and provides examples of the benefits derived from standards. It examines in detail the benefits that the pipeline industry and regulators derived from the timely development of ASME B31.8S – Integrity Management of Gas Pipelines and the process used to support the standards' development.

The Office of Pipeline Safety developed a cost/benefit analysis to support the final rule on Integrity Management in High Consequence Areas. The OPS analysis indicates that the net cost for the gas pipeline industry to implement this program is now $4.7 B over the next 20 years as compared with the proposed rule based on the Pipeline Safety Improvement Act of 2002 which they estimated to cost $10.9B over the same period

OPS has incorporated B31.8S into its regulations, which has significantly simplified them, yet through prescriptive requirements, has provided an equal or better level of safety as envisioned by Congress.

While the timely development played a major role in the distillation of the regulations, B31.8S cannot take credit for the full $6.2B savings to the industry. The estimated savings provided by B31.8S to the industry will be described. Industry management and the regulators are encouraged to fully support the continuing development of standards for the pipeline industry utilizing the model developed by the gas pipeline industry.

INTRODUCTION

Many facets of our daily lives depend on standards. Standards influence the products we use, the foods we eat, how we communicate, our means of travel and especially for pipeliners, the design construction, operation and maintenance of infrastructure including; the exploration, production, transportation and distribution of energy products such as oil and natural gas.

The National Research Council, part of the National Academy of Sciences in the U.S. defines a standard as "a set of characteristics, or quantities that describes features of a product, process, service, interface, or material."

"Standards, Conformity Assessment, and Trade Into the 21st Century" by the National Research Council (1995) states there are seven categories of functions for standards and most standards serve more than one function.

They are:

Commercial Communication - Standards convey information about a product or service to both buyers and sellers that reduces the amount of work either party may be required to do. Standards reduce the transaction costs for buyers and sellers.

A pipeline example would be the construction of a new pipeline segment. Identifying that the line shall be built in accordance with B31.4 or B31.8 reduces transaction costs and tells the bidders a great deal about what is required.

Technology Diffusion - A standard may record technological advances in a form that others may reproduce and use. A good, recent example of this in pipelines is the Direct Assessment Process. The gas pipeline industry in particular has performed significant research and development on the Direct Assessment process. The individual technologies utilized are not new, but the process is now technologically based and NACE is developing a series of Standard Recommended Practices for External Corrosion Direct Assessment, Internal Corrosion Direct Assessment and Stress Corrosion Cracking Direct Assessment, which both Pipeline Operators and Service Providers can use and the regulatory community incorporates by reference.

Production Efficiency - Standardization of parts, processes and products enables economies of scale in production. Several pipeline examples of this are the qualification of welders to API 1104 and nondestructive testing personnel to ASNT TC-1A. Once qualified to these standards, specific pipeline operator requirements are either minimal or fully satisfied and do not require requalification each and every time.

Enhanced Competition - When some or all the features of different providers' products or services conform to one standard, comparison is easier and competition sharper.
Buying pipe to API 5L is a good example of this function.

Compatibility - Standards defining interfaces enable products to work or communicate with each other. The most significant examples of this in the pipeline industry are the PIPELINE OPEN DATA STANDARD (PODS) & INTERAGTED SPATIAL ANALYSIS TECHNIQUES (ISAT). Both are open data standards that permit the use of a variety of software/hardware to be utilized in the pipeline system.

Process Management - Manufacturers and Service Providers not only design products and services to conform to standards, they also organize the processes themselves in accordance with standards. ISO 9000, the quality assurance standard is one example. API 1163, Qualification of ILI Systems, provides the processes for ILI Service Providers to manage the qualification of their inspection systems.

Public Welfare - Standards are an important mechanism for promoting societal goals, such as protection of health, safety and the environment. The most recent example of such a pipeline standard is ASME B31.8S, Managing Systems Integrity of Gas Pipelines, the primary case study in this paper.

In the U.S. alone, there are more than 90,000 active standards for all varieties of activities. Of these, over 40,000 are "private sector' standards developed by Scientific & Professional Societies, e.g., ASME, Trade Associations, e.g. NEMA (National Electrical Manufacturers Association, and Standards Developing Membership Organizations, e.g. ASTM and NFPA. ASME alone has over 700 active standards.

This paper describes specific benefits derived from standards and provides a case study of B31.8S, Integrity Management of Gas Pipelines, and the benefits the gas pipeline industry and the public will derive from this consensus standard.

In this age of industry consolidation and cost cutting, support for the development and continuity of industry standards has been significantly reduced. This paper presents a cost/benefit analysis that suggests that supporting effective standards development is a sound management strategy. Senior pipeline management should encorage their personnel to be active on standards activities and also reward them appropriately for those activities when warranted.

INDUSTRIAL COST-BENEFIT EXAMPLES

The following are some examples from other industries where the benefits of standards have been quantitatively or qualitatively described. There are limited examples available that provide specific cost benefit analyses. In these examples, a significant benefit to the effected industries was the acceptance of the standard by the regulator.

ASTM recently performed a Benefit-Cost Analysis of standards developed for the Light Sport Aircraft community (Ref. 1). The FAA has adopted the standards in question.

ASTM calculated that the value of services provided to the industry and the FAA is the contribution of the approximately 100 participating members in the development of the standards. The total benefit of time, travel etc. was calculated to be $1.1MM.

In addition, the report estimates that the specific industry will gain more than $120MM over the next 18 to 24 months alone through the use of the standard.

ASTM Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites – E 1739 is known as "RBCA". It has proven to be a sturdy framework for merging the benefits of risk-based decision making with the other elements of the corrective action process at petroleum contaminated sites. Leaking underground storage tanks were the major issue that EPA had to deal with and uses RBCA for these sites as just one example. The benefits derived from E 1739 to date include:

- More efficient resource management
- Billions of dollars saved over 20 + years
- Streamlined process that led to faster cleanups
- Provided a mechanism for consistency and accountability
- Has provided a forum for all stakeholders.

Cost savings are the most prominent benefit of RBCA. Several states did analyses and concluded that; Iowa would save between $194MM and $352MM; Florida costs for remediation would decrease by 64%; South Dakota estimated site closure costs to have decreased by 42%. More than 40 states have adopted RBCA and if similar cost savings apply in each, the national savings are in the billions of dollars.

Note that in each of the above cases, the regulator, FAA and EPA, accepted use of the standard. OMB Circular A-119 "Federal Participation in the Development and Use of Voluntary Standards", requires regulatory bodies to utilize industry consensus standards wherever possible in their regulations because it is cost effective to do so and results in more practical regulations.

PIPELINE CASE STUDY

Managing Integrity of Gas Pipelines, ASME Standard B31.8S provides an excellent and recent example of the benefits that may be derived from timely and cooperative development of an industry consensus standard.

ASME B31.8S provides both a performance based and a prescriptive process for implementing integrity management in gas pipelines. It defines "potential impact areas" on the basis of research performed on actual gas pipeline failures. Integrity management programs are to be developed in response to 9 threat groupings to pipelines. The 9 groups of threats are derived from the basic 25 threats that are listed in the incidence reports forms from OPS, the threats that have actually caused pipeline failures over the past 20 years. These 9 threat groups are placed into 3 categories: stable threats, time independent threats and time dependent threats. The prevention, mitigation and repair processes required in the standard are dependent on the category of threat. So, for example, performing an in-line inspection to prevent third party damage, a time independent threat, is not effective, but patrolling, etc. are effective preventive measures.

The standard provides specific timing for responses to time dependent threats based on the results of prior research performed in this specific area.

Non mandatory Appendix A provides the prescriptive actions that must be taken for the 9 threat categories in order to implement an integrity management program, if the Operator does not have certain data/information about the segment(s) to be managed.

B31.8S development was initiated in April of 2001 and was completed and approved by January of 2002 and was published in May of 2002. A dedicated group of 24 volunteers from industry and the regulatory community worked very hard to complete this comprehensive standard. The schedular urgency arose from the fact that Congress was writing a revised Pipeline Safety Act and OPS was going to implement an integrity rule for gas pipelines similar to the one issued for liquid pipelines and the industry wanted this standard published so that Congress would issue a gas industry relevant Pipeline Safety Act and OPS could fully utilize the standard, thus making the "gas integrity rule" more effective for the industry. (Table 1– Significant Dates)

Table 1
Significant Dates

B31.8S Published	5/02
HCA Rule Issued	8/02
PSIA	12/02
Gas NPRM	1/03
Final Gas Rule	12/03

The overall process that was utilized by the gas pipeline industry and its regulators that culminated in the development of the standard and then a regulation based on the standard is shown in fig. 1. The industry, which is broadly defined as the Pipeline Operators, Service and Equipment Providers and Federal and State Regulators met for over a year prior to the development of the standard, to discuss the issues that required further development, the results of those developments and what should an integrity management program look like. As a result, 20 R&D reports were included in B31.8S that formed the technical basis for the standard.

Two cogent examples of such work were:

1. GRI-00/0189 Model for Sizing High Consequence Areas Associated With Natural Gas Pipelines – this research report formed the basis for Potential Impact Zones in Section 3 of B31.8S and the modified definition of HCA's.
2. GRI-01/0085 Schedule of Responses to Corrosion Caused Metal Loss Revealed by Integrity Assessment Results – this research provided the data to develop Figure 4 of the standard – Timing for Scheduled Responses – Time Dependent Threats. The plot provides how much time is permitted before another examination is required if an anomaly already exists, based on operating pressure and MAOP.

The technical basis for the standard enabled industry groups to provide Congress sufficient information to modify the Pipeline Improvement Safety Act of 2002. Initially Congress wanted to duplicate the liquid integrity rule for gas pipelines, basically, in-line inspect everything every 5 years. Gas pipelines transport a compressible fluid and therefore may have significant diameter restrictions and are not as readily piggable as liquid lines. A gas rule similar to the liquid rule would have cost the industry many billions of dollars to retrofit the pipelines and would have resulted in untold numbers of customer shut-offs to modify and inspect the lines.

There was sufficient lead time from the publication of the standard to the final rule making it possible to incorporate the standard into the rule. (On the basis of our experience, OPS needs 6 to 9 months lead time to be able to incorporate a standard into a regulation.) As a result, the standard provided significant cost savings to the Regulator and the industry.

COST BENEFIT ANALYSIS

INGAA, AGA and some members of the Gas Pipeline Safety Committee1 (including most of the authors of this paper), were heavily involved in convincing Congress to write a gas industry specific Pipeline Safety Act. (The PSIA was being drafted post Bellingham and Carlsbad and Congressmen were under pressure to produce a law that would reduce the number and consequences of accidents.) Having an industry integrity management standard was very useful in convincing Congress that replicating the liquid rule was not viable and would cause extreme hardship for gas customers and the industry without concomitant benefits. The final PSIA '02 was a significant change from the originally proposed legislation. The benefit the standard provided in shaping the PSIA and the cost savings achieved are not readily quantifiable and are not

[1] The Pipeline Safety Committee of the Interstate Natural Gas Association of America – INGAA is composed of approximately 25 transmission and distribution pipeline company personnel who are responsible for pipeline safety and regulatory affairs.

Table 2

Element	NPRM Analysis	Final Analysis		
		Transmission Cos.	LDC's	Basis
Total Mileage	292,000	225,000	57,000	2002 Annual Reports
HCA Mileage	36,854	14,970	10,000	Industry Estimates adjusted for revised HCA definition
Cost to Pig	$3,210/mi.	$3,668/mi.	$9,600/mi	
Cost to Pressure Test	$5,274	$29,700	$40,000	
Cost to Direct Assess	$4,800	$15,000	$29,000	
Overtest Mileage	200%-pigging 25%-hydro	725%-pigging 30%-hydro	100%-pigging 0-hydro,D.A.	

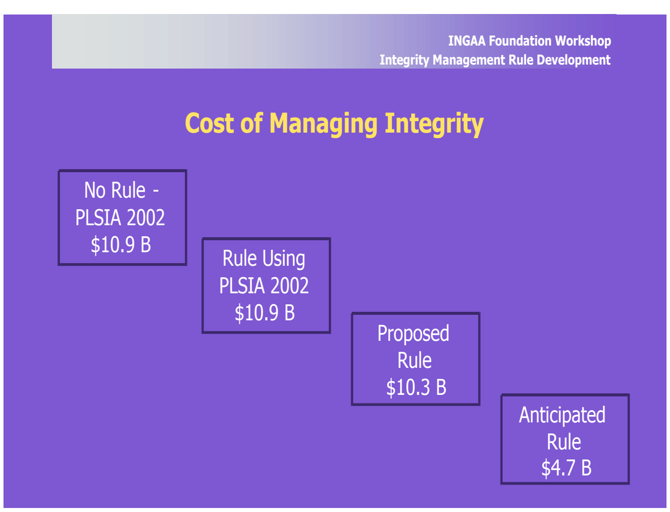
included in this analysis. The benefits were large and the standard had a significant positive affect on the Congressional staff that developed the final act. The baseline inspection period was extended from 7 to 10 years and the reinspection interval was increased from 5 to 7 years. The research efforts also showed that shutoff valves were not cost beneficial and therefore should only be required on a case by case basis. The final PSIA required OPS to issue a rule by 12/17/03 or the PSIA would be the effective IM regulation for gas pipelines. OPS issued the gas IMP rule on 12/15/03, extensively referencing B31.8S.

U.S. regulators are required to issue cost benefit analyses for every significant rule they wish to issue.

OPS had a cost benefit analysis developed for this most significant rule making for the gas transmission pipeline industry in over 20 years. Industry provided some input to the analysis. We will use the OPS analysis for the basis of our evaluation of how much money will be saved by the use of the standard in the regulation. (The cost benefits are based on actual miles and present day inspection costs and a definitive rule and standard. The analysis therefore should be within +/- 10%, not including inflation.)

The OPS Cost Benefit Analysis made a number of assumptions and some of these are listed in Table 2. (Mileage and inspection/testing costs were provided by industry. Costs are average industry costs incurred for these inspections at this time.)

Summing up all of the elements involved in an Integrity Management Program, the operating costs for a 20 year period would have been as shown below.



The total reduction in implementation costs for the final rule equal $5.6 billion for a 20 year period. There are 12,000 fewer miles to be tested due to a refined definition of an HCA that also saves $430 million in capital costs for modifying lines to make them piggable.

The major savings are derived from:

1. Testing required for 32% fewer miles of HCA, both baseline and retesting
2. Inspection intervals extended
3. Prevention & mitigation methods in lieu of some testing in low pressure systems
4. Lower capital expenditures to modify some lines to make them piggable.

The total operating and capital savings equal $6 billion. As with any major endeavor, a number of organizations and factors were all part of realizing these savings.

The Pipeline Industry through INGAA, AGA APGA and OPS all played a significant role in shaping the final rule and gaining the benefits of reduced costs with no loss of integrity. GTI, PRCI & OPS r&d efforts that resulted in the 20 technical reports that formed the basis of the standard were also key to the success of getting the rule modified.

The process utilized, Fig.1, provided the technical bases for the standard and technical justifications for modifying the regulation. The aforementioned organizations utilized the technical justifications and the standard to modify the regulation.

Of the $6 billion saved, fully 70% of the savings can be attributed to the B31.8S standard and the research reports that formed the basis for the standard. This is based on the specific elements of the cost/benefit analysis that were changed due to the standard and its technical bases.

The 4 savings areas listed above are all predominantly results of the standard. The Potential Impact Areas of B31.8S were derived from the GRI 00/0189 report that resulted in a revised definition of HCA's. This reduced the number of miles to be tested by 12,000 and also the number of miles that required modification resulting in $430 million in capital savings.

The inspection intervals extension was a compromise between the longer intervals in B31.8S- 10 to 20 years, and the PSIA requirement-7 years. OPS provided "Confirmatory Direct Assessment" (CDA-See B31.8S Rev. 1 for details on CDA) as an acceptable interim inspection process. CDA is a 4 step process of inspection to verify the assumptions used in setting assessment intervals for time dependent threats. Thus an operator can utilize the inspection intervals in B31.8S as long as there are CDA inspections made in the intervening 7 years.

The use of prevention and mitigation methods in lieu of some inspections under certain circumstances were partly the result of B31.8S requirements, but also OPS's ability to incorporate CDA into the regulation.

The use of Direct Assessment (D.A.) methods will save significant capital dollars by not requiring modification of some pipelines, especially LDC lines, to make them piggable.

NACE has issued several D.A. standards that have enabled OPS to treat D.A. as an equal inspection technology to ILI and Hydro testing. These savings, while large and conditionally quantifiable, have not been included in this analysis.

Improved safety and integrity of pipelines will also produce a number of direct, but as yet, unquantified benefits. These include:

A reduction in accidents, deaths and injuries to the public and pipeline workers

A potential increase in the public's confidence in pipelines, making infrastructure enhancements more effective in the future.

An increase in regulatory confidence (decrease in public/political pressure) which could result in allowing the industry to increase maximum operating pressures to 80% of SMYS

These benefits have also not been included in this analysis.

Conclusion

The timely publication of B31.8S is expected to save the industry $4.2 Billion over a 20 year period.

For the 282,000 total existing transmission miles, that is a savings of $14,900/mile or $745/mile/year.

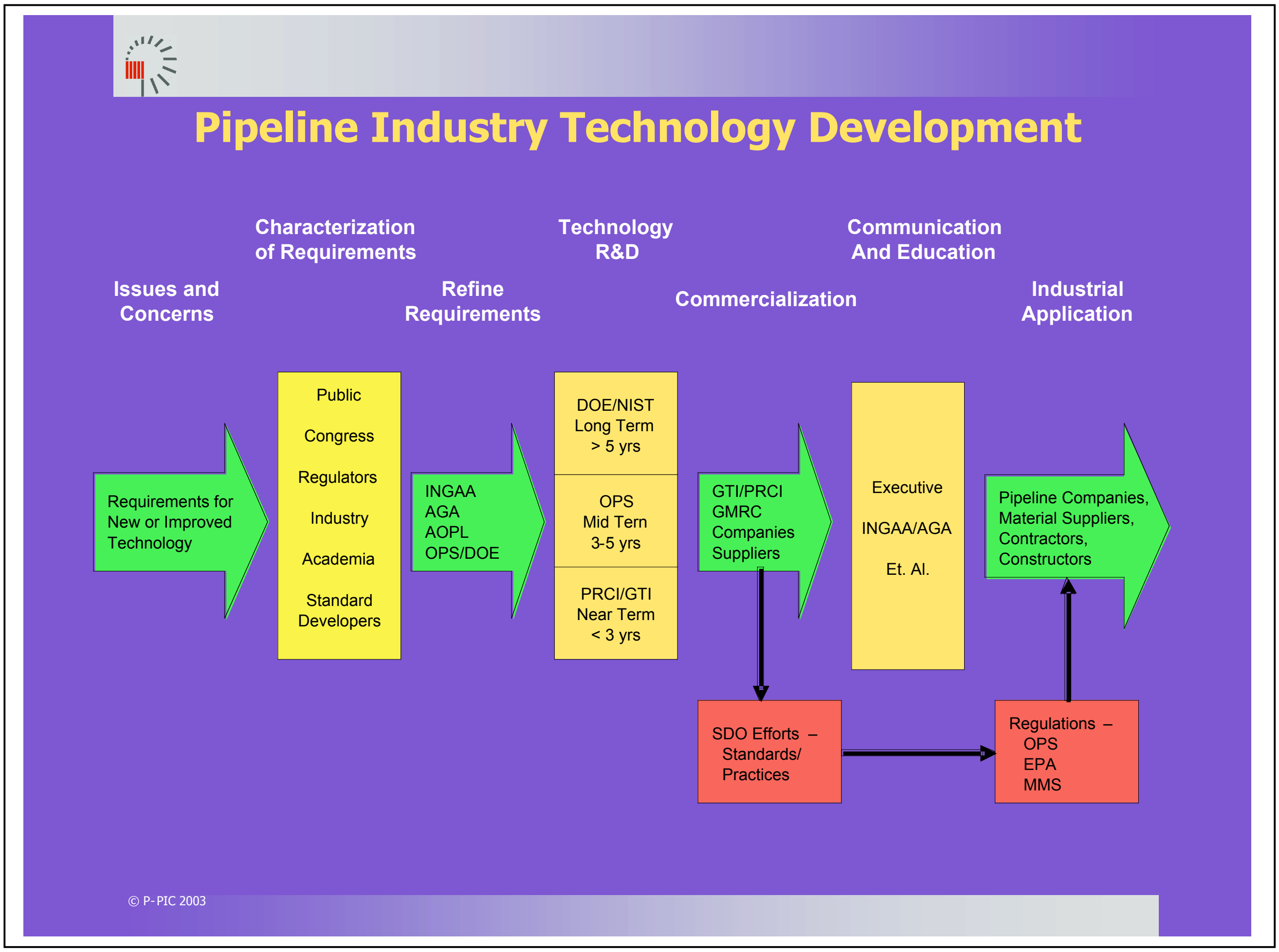
Pipeline personnel can determine the value of their participation in the development of the standard to their systems by multiplying the above numbers by the number of miles in their system. For every 1,000 miles in a system, the Operator will save $745,000/year in operating and capital expenses.

The as yet unquantified benefits include fewer accidents, deaths, injuries and perhaps a greater confidence in the pipeline industry by the public and regulators, with the concomitant benefits of higher allowable operating pressures and reduced permitting times for new infrastructure.

Clearly, developing effective standards on a timely basis pays.

The process for developing and implementing a standard, as embodied in Figure 1, is an effective process and should be supported by the entire industry.

Fig. 1
Pipeline Industry Technology Development



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