MAXIMISING POTENTIAL

Jenny Hudson and Ellie Lynch, EN Engineering, LLC, USA, present the recommended framework to get the most from your ILI data.

As pipeline integrity standards and recommended practices become more robust in the US, a number of advanced tools are being introduced for efficient inline inspection (ILI) of the nation's oil and gas pipelines. Many of these tools are capable of gathering extensive data on pipelines. But what is an operator to do with all this data? This article underscores how the Plan-Do-Check-Act (PDCA) process promotes continuous improvement, specifically when applied to ILI and the resulting data.

Recommended Practices and Standards

The ANSI/API Recommended Practice 1173, published in July 2015, establishes a pipeline safety management systems (PSMS) framework for pipeline operators in the US. The standard establishes a holistic

approach of PDCA to reveal and manage pipeline risk while presenting a practice for continuous improvement of safety and integrity for the pipeline's life cycle. The process of PDCA was influenced by several industry documents, including ASME B31.8S (Managing System Integrity of Gas Pipelines).

API 1173 encourages an increased focus on quality management systems (QMS) that are continuous instead of linear. Recognising the direct correlation between pipeline safety management and quality, in 2017 a recommended practice for steel pipeline construction quality management system was published. This recommended practice in QMS follows the PDCA framework, offering detailed sections on all four aspects.

In the US, the pipeline industry is proficient at the 'Plan' and 'Do' aspects of PDCA. API 1173 and other standards now draw industry attention to 'Check' and 'Act'. With respect to operators who are focused on the day-to-day operations of their business, the nuances of data analysis and comparisons may not be a core competency. This is where an outside resource providing data and integrity management services can offer expertise in ILI data analysis, as well as across the full PDCA cycle. ASME B31.8S provided the industry with an outline for what would become the QMS for the integrity of pipelines. Operators and their integrity management services consulting firms have been following these standards since their inception. With a laser focus on integrity management, engineering firms that provide this service are staffed with experts who have been drawing upon and applying PDCA for years.

Plan-Do-Check-Act

There is a big push in the industry for robust ILI tools. These tools are as varied as the pipelines in which they travel, but they are just one aspect of managing risk to a pipeline. Understanding how these tools and their resulting data should best be applied to each pipeline can be a daunting task for operators who may not have in-house data expertise or regularly use ILI as an assessment technique. An experienced integrity management consultant can help establish a cohesive PDCA process that takes into account the uniqueness of the operator's system as well as individual lines. An effective PDCA process is just that, a continuous cycle where data gathered and lessons learned from one ILI project are applied to future runs.

Here are some of the more critical steps and considerations of the PDCA cycle for an ILI project.

- Plan:
  - Incorporate lessons learned from the last continuous improvement cycle.
  - Compile, integrate, and review threat information.
  - Select ILI tool(s).
  - Develop line-specific and project-specific procedures, including contingency and communication plans.
- Do:
  - Perform ILI run.
  - Perform validation digs.
  - Perform repair digs (as applicable).
- Check:
  - Analyse ILI results.
  - Compare validation digs against ILI tool results.
  - Confirm tool performance.
  - Perform run-to-run comparisons.
- Act (or adjust):
  - Determine new ILI reassessment interval.
  - Identify modifications to processes and procedures.
  - Use data for risk assessment.
  - Identify lessons learned.

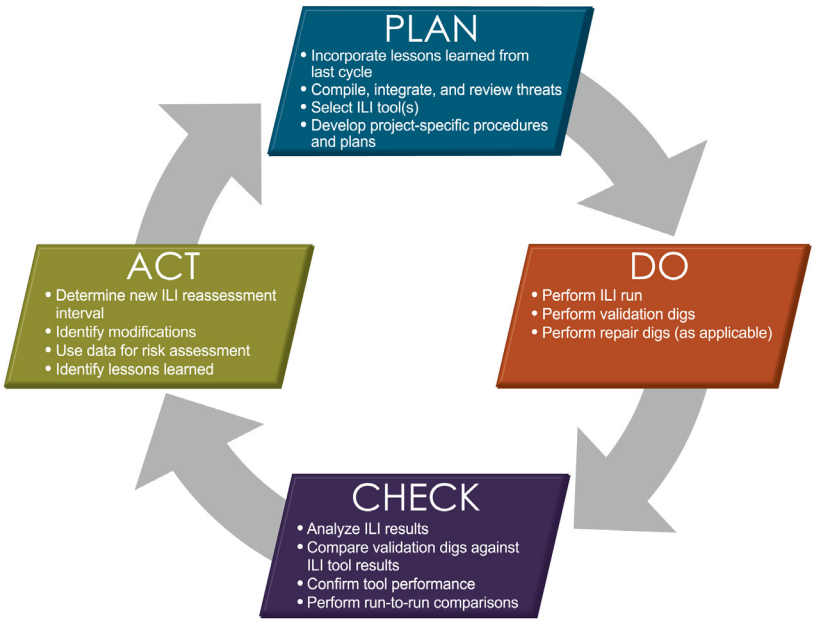

Figure 1. PCDA cycle. ©EN Engineering, LLC.

Plan better

Planning the ILI cycle includes more than just a programme-level approach. The operator's overarching integrity management programme should already have established processes and procedures. PDCA brings the details of the programme to a project level, taking into account line-specific test procedures, contingency plans, communication plans, and data evaluations.

Each ILI project is unique. The operator should consider the specific issues for a given ILI project and address them through their quality management system. A consulting firm with considerable experience in designing ILI runs and evaluating the resulting data will work with the operator to develop plans and procedures unique to each project. This should include comprehensive data review, evaluating data integrity, and identifying project-specific tools based on the unique threats for each line. Conditions like the specific integrity threats, flow rate, dual diameter lines, and a need for temporary launchers and receivers all contribute to the uniqueness of the line, and thus the uniqueness of its ILI.

Even logistics should be addressed during the planning phase. When specifying ILI tools, it is important that the nominal portion of the barrel before the reducer is longer than the tool being used. The plan needs to take into account whether there will be staff available during the run. Even traffic conditions and train schedules should be reviewed. If above ground markers (AGMs) will be placed at major roads and railroad tracks, an extra tracker may be necessary.

Planning an ILI requires a firm grasp of the vast range of ILI tools, their capabilities and limitations, as well as recent updates available for such tools. Additionally, planning requires a solid understanding of each line's configuration to ensure passage of the ILI tool. Design service groups have considerable experience in retrofitting lines to accommodate the passage of ILI tools. Prior experience can also feed into the planning phase of PDCA. Lessons learned from each project should be incorporated into the overall programme, and the cycle starts all over again.

Do more

Some integrity management consultants offer comprehensive services when it comes to ILI. While they may not run the actual ILI tools, they can provide field personnel to perform a number of onsite services, such as monitoring tool speeds, selecting AGM locations, and collecting data along the runs. Once the ILI run is performed, an integrity management firm can also recommend locations for verification and repair digs, manage dig programmes, provide guidance on metallurgical issues, and assist the operator with repair decisions.

Here are examples of real conditions and lessons learned during ILI runs. In below-freezing temperatures tool operation was affected, requiring longer start-up time to warm up batteries. At a 90° elbow shortly after launch, the ILI tool got stuck – resulting in the field team waiting extra time down line. It is important to verify that the tool fully leaves the launcher barrel. Careful attention should be paid when a combination brush/magnet cleaning train is inserted into the barrel with too much force. When one such tool ran nose up, instead of nose forward, into the line it burned through the drive cups and became stuck.

Check with confidence

Some pipeline operators may be less adept at the 'Check' and 'Act' phases of PDCA. These are the areas where an outside resource can provide considerable assistance. Once the data has been gathered, high-level analysis should consider questions such as:

- Did the data reveal what was expected?
- Was the line condition worse than anticipated?
- Were there active threats found that were not previously considered a threat, such as internal corrosion?

To get the most out of your ILI data, the following conditions with your GIS and data analytics should be achieved:

- Correlation of ILI data with other data sets, such as close-interval survey, coating condition assessments (Direct Current Voltage Gradient or Alternating Current Voltage Gradient), and depth of cover.
- Integration of direct examination observations and results.
- Year-over-year comparisons and recommendations for mitigation activities.
- Standardisation and integration of all data and information into the operator's enterprise GIS system.

As operators make the paradigm shift toward a cycle approach to ILI inspection, more data will be generated over the long term. Having more data provides the operator with a better understanding of the pipeline system and the foundation for better, risk-based decision making. Having an expert analyse the data is also beneficial. It takes considerable time to correlate different ILI runs, due to slippage and other calibration issues. Comparing current data with previous data can help the operator identify historic trends that may be occurring, or to help determine the root cause for a particular issue. For example, when integrated with other data sets such as cathodic protection data and coating quality data, the cause for an external corrosion anomaly identified during an ILI run can be better determined.

Act for the long term

Due to the prescriptive nature of regulations in the US, there may be a tendency to 'pig and dig' at a set interval, rather than align all available data sets and make risk-based decisions stemming from the data. A robust PDCA cycle moves the operator away from these prescriptive impulses and onto a path for continuous improvement that is data-driven rather than calendar based. In addition to a prescriptive mindset deterring operators from taking a holistic approach to their ILI cycle, some may also be limited by internal resources. Outside integrity management service providers work well with operators who have limited internal resources and can act as an extension of your in-house professionals – even embedding their staff with your team.

Operators should take time to review project results and identify lessons learned. Many times operators are

eager to move on to their next responsibility, without identifying and applying the lessons learned. Operators should pose post-ILI questions to determine whether field procedures were clear, are modifications to the process needed, and did anything unexpected occur during the inspection? The ILI vendor role in the process should also be evaluated by confirming that the ILI data was provided in a timely manner and in the desired format, and whether adjustments to the contract language are in order. Lessons learned may include review of contingency plans. For example, if the ILI tool got stuck, how did the team respond and what will the protocol be for future events?

The benefits of taking a long-term, continuous improvement approach to ILI and its resulting data are numerous. Robust data analytics help the operator understand their system more fully. A skilled data analytics expert will integrate the data with other data sets, evaluate the threats and risks, and recommend preventive and mitigative measures. The operator, in turn, can apply this information to more effectively make risk-based decisions relating to the repairs and additional inspections of their lines.

Painting a full picture of the operator's system takes time. The more data generated over time, the better one's understanding of the system and trends. Each piece of data adds another colour to the picture; each year adds more dimension and depth. With a long-term approach, operators can compile many years of data to correlate with several aspects of one pipeline and the surrounding environment. Ultimately, the operator can tie the pipeline data into their overall system. An archive of detailed data over the long term will help individual operators – as well as the industry – better understand failure modes so more reliable systems can be built in the future.

Summary

Having a solid PDCA cycle in place does not guarantee a perfect ILI run. PDCA provides a framework to help manage and control the ILI process and provides for a better response, should issues arise. Additionally, PDCA provides a mechanism for continuous improvement so similar issues can be avoided in the future. Integrity management consultants are experienced at PDCA and are capable of providing consulting in all PDCA aspects of the ILI cycle. Look for an integrity management firm that includes the following:

- Design group that understands retrofits and design changes.
- Integrity management team that understands code and compliance.
- Metallurgical staff that can consult on metallurgical issues and repair decisions.
- GIS and analytics teams that automate the data integration and provide the resulting data analytics.

Remember, ILI is not a one-time occurrence. In the context of PDCA, it is a cycle of continuous improvement for maintaining safe and efficient pipelines.