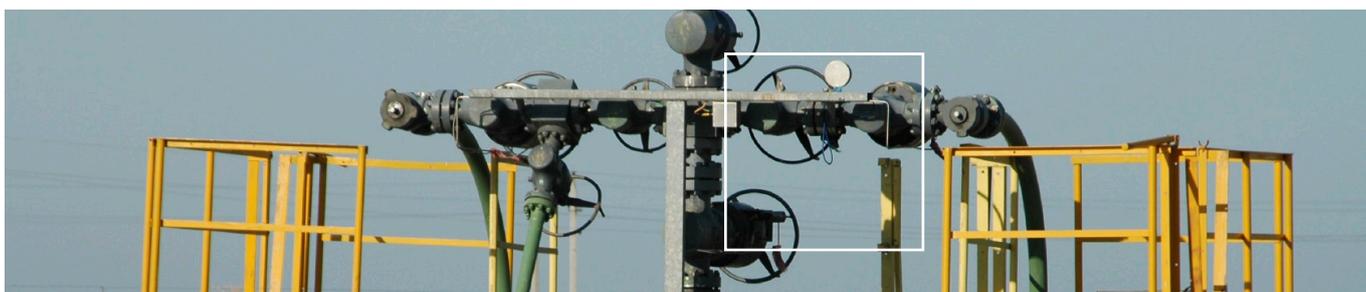


Managing Well Integrity

Well Integrity Needs the Same Level of Care and Attention as Asset Integrity



Successful well integrity management is a critical and evolving theme across the oil and gas industry. The Macondo incident, the Elgin field leaks and other, less prominently reported incidents demonstrate that even sophisticated energy companies are not able to “get it right” all the time.

Well integrity has always been a concern to senior management in the E&P industry but until the Macondo incident it did not attract the same level of attention as asset integrity for process units. Since then, well integrity has topped the worry-list of all senior managers, and with good reason. Well integrity failure can have a major adverse impact on:

- Asset revenue, cashflow and profitability, as well as liabilities from safety and environmental damage
- Withdrawal of a company’s “license to operate”
- Shareholder value; partly due to reputational damage

Industry research indicates that a large number of wells are affected by integrity problems. The severity and frequency of well integrity problems strongly depends on the region, the fluids handled and the age of the wells. Globally it is estimated that 38%¹ of oil and gas wells are affected by integrity issues, varying from 45% in the Gulf of Mexico to 18% in the Norwegian Continental shelf.

This situation can only get worse as wells age, as more wells are drilled and operated in harsher environments, and as water-cut increases. Of course, with wells being designed to have at least two barriers, even if one fails it only means that the safety factor is reduced – though perhaps to an unacceptable level. It does not mean that there has been, or even will be, a leak, simply that the operator has to monitor the well’s condition very closely and to act quickly if a further fault is detected.

When well integrity issues are discussed, the tendency is to focus on the immediate technical issues at hand (for example the corrosive effect of Calcium Bromide used in well

completions in HPHT applications in the Elgin Field). But there are also softer issues— though just as pressing— which we believe have often received insufficient attention, particularly the presence of effective related processes and the existence of organizational structures, such as dedicated Well Integrity groups, which are able to deliver those processes.

Challenges for senior management

Having drilled a well that meets all design requirements and complies with all necessary standards, the concern is then to ensure that it is maintained to a high standard of integrity:

1. Are there appropriate and effective business processes in place to manage well integrity?
2. Is the organization aligned with these processes?
3. Do people have the right level of accountabilities, interfaces and competencies to deliver these processes?

To address these concerns, Arthur D. Little advises its clients to adopt a systematic and continuous approach to diagnosis and improvement, ensuring that they are prepared to manage well integrity successfully.

1. Well Integrity Management Organizations

An organization that manages well integrity activities will typically be engaged in the six operating functions (Figure 1 overleaf).

These functions will be executed by various organizational entities, such as Operations, Field Maintenance, Asset Integrity Assurance, Production Engineering, Well Integrity Assurance, Well Services, Drilling & Workover, HSE, Planning & Contracts, Logistics, and so on. The actual structural grouping of such Well

Figure 1. Iterative Well Integrity Functions



Integrity-related organizational entities vary from one business to another. In fact there is a full spectrum of potential designs, with some companies having a single, integrated, dedicated Well Integrity Assurance team performing all related functions, whilst in others such a single focal team is lacking entirely. Some employ a half-way alternative in which a Well Integrity team exists but only as a technical authority, responsible just for periodic audits.

None of these models or configurations are perfect, but companies should aim for a fit-for-purpose model that resolves the issues summarized below.

- Operations cannot take full ownership of the asset (i.e. down-hole and subsurface as well as topsides and export facilities) as Well Integrity does not report to them
- Operations own the risks realized from loss of well integrity, but the organizational design impedes their influence over prioritization of rig-use for workovers
- Organizational design does not allow easy access to technical support and knowledge sharing amongst the stakeholders with an interest in well integrity
- Organizational design creates conflicts of interest, which prevents the Well Integrity group from providing an independent assurance function
- The well integrity management processes and functions are split between many organizational entities creating poor alignment

These organizational concerns are often driven by:

- Incremental evolution of organization, with the “bolting on” of new units to existing business on an ad-hoc basis
- Building of organizations around individuals to suit pragmatic needs rather than aligning units with processes
- Selection of organization options without using coherent, criteria-based scoring mechanisms

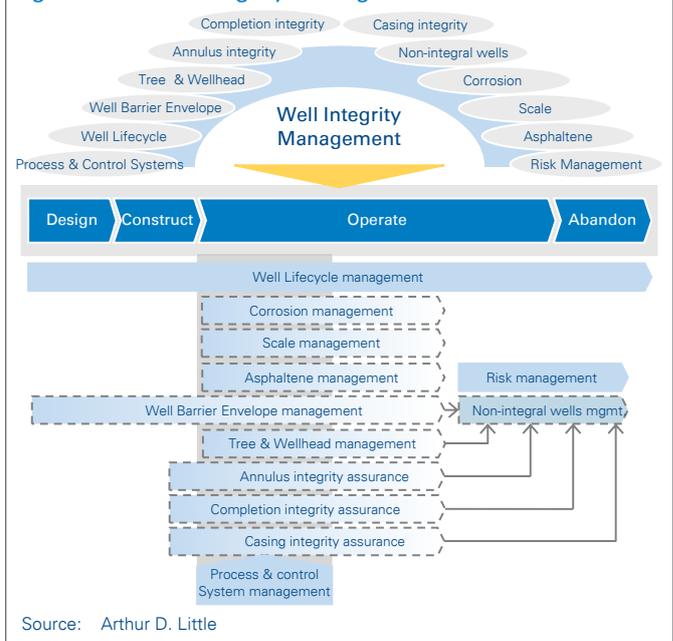
Ineffective or dysfunctional well integrity organizations may be just as damaging as having no effective well integrity processes. More specifically the consequences could involve:

- Scheduling of rigs for workovers not always being given top priority due to a lack of ownership of necessary processes and control of the relevant teams
- Inability to meet well integrity targets as managers do not control key processes due to misalignment between the organization and relevant well integrity processes
- Staff under-motivated as they lack unhindered access to internal technical support and are unable to realize the benefits of knowledge-sharing
- Decisions which favor production rather than well shut-in, overruling safety concerns relating to well integrity
- Creation of delivery inefficiencies and related adverse cost implications; for instance, a decentralized well integrity assurance unit may not be a very cost effective way of serving multiple assets, in contrast with a centralized service delivery model with proper service level agreements
- Major re-organization efforts required to reflect minor functional changes as the organization lacks flexibility

2. Well Integrity Management Processes

Typically well integrity management processes must span the well’s full life cycle as illustrated below (Figure 2).

Figure 2. Well Integrity Management Processes



We often find that companies with well integrity management concerns either do not have clear processes or have failed to implement them properly. Alternatively, they may have valid processes but these may not have been updated for many years,

or may not even be compliant with industry standards such as ISO/TS-16530 “Well Integrity Technical Specifications” and “NORSOK Standard D-010”, thus reducing their overall effectiveness.

Partly because some regulatory regimes are not stringent enough, the reason for these process-related concerns also reflects the fact that, until Macondo, well integrity assurance has often not had the same level of attention given to it as asset² integrity assurance, which has attracted significant effort over many years. Well integrity processes are therefore still evolving in many organizations, with only those having a portfolio of very old wells, or wells with other integrity issues, having generally recognized the importance of setting up coherent well integrity management processes.

Such a lack of effective well integrity processes will reduce the confidence of the Asset Owner (Operations Group) when taking over wells from Drilling Groups after either drilling or workover and could significantly increase the number and frequency of workovers, thus impacting revenue and costs.

In extreme cases this might lead to an uncontrolled release of hydrocarbons, resulting in regulatory agency penalties and a detrimental impact on shareholder value.

3. Accountabilities, interfaces and competencies

Organizations typically define organizational accountabilities and responsibilities using “RACI³” charts and detailed interface documents. When these are effective they communicate to all stakeholders what is expected from them and hold people to account for key functions and activities.

But when these RACI’s and interface definitions are unclear and incomplete in terms of scope or demarcation of responsibilities, they might create Well Integrity issues:

- When multiple stakeholders from different authority lines are involved, the scope of work distribution and demarcations of responsibilities can become unclear. This creates opportunities for misinterpretation and ultimately the omission of responsibilities
- Stakeholders have two reporting authorities – a line manager for non-well integrity activities and a process owner for well integrity activities. This causes conflicts in priorities, objectives, interest, and so on
- Well integrity roles are either not implemented or are implemented by another organizational entity on the basis that the designated group lacks capability
- Many companies lack the detailed interface documents which describe the different interactions, activities and deliverables between stakeholders

- In organizations without a central guiding authority even the definition of RACI (or equivalent) can vary, resulting in further uncertainty
- When allocating responsibilities, especially in cases where more than one unit may appear suitable, a robust evaluation of their suitability is not always carried out

The causes of the above issues are often:

- Lack of active engagement among all relevant stakeholders when RACIs are developed, preventing effective understanding and agreement. Staff have to adopt fixed RACIs resulting in poor implementation
- Lack of a robust competency framework to assess competencies of well integrity practitioners
- Lack of well integrity performance metrics that link the performance of relevant staff to their performance appraisal, motivating them to work as a team

Such issues relating to accountabilities, interfaces and competencies can have the same consequence as the absence of processes and organization. For example, well components may not be inspected for mechanical integrity due to poor clarity about responsibility, resulting in accelerated corrosion and long-term impairment of well integrity.

Identify improvement recommendations

Arthur D. Little has implemented successful initiatives to improve delivery of effective well integrity management in various settings.

Our organizational design recommendations, applying industry best practice and tailor-made, pragmatic solutions, have usually involved the **adoption of a single, dedicated Well Integrity organization**, for the following reasons:

- Having a dedicated group to steward this function improves the organization’s focus on well integrity assurance
- Well integrity is a critical function, whose failure could significantly impact business value
- Having a dedicated group increases external stakeholder confidence in effective well integrity management

Process-related recommendations have generally included:

- **Changing existing processes**, to make them more effective and aligned with global best practice
- **Introducing new processes** to improve well integrity management performance

In a recent engagement we developed a process for managing the risks associated with change, ensuring a robust response in a changeable environment. For another client we recommended a

² e.g., top-sides process equipment

³ RACI: Responsible, Accountable, Consulted, Informed

new process for capturing, storing and disseminating the various lessons learned during well integrity management activities.

Accountability and interface recommendations usually reflect:

- Update well integrity RACI matrices to reflect new or modified organizational structure and process outlines
- Demarcate responsibilities according to specific well barriers
- Develop a detailed interface document. Ideally an interface document will list various details:
 - **What** deliverable(s) will be provided
 - **When** will it be provided
 - **How** this deliverable will be communicated
 - What **authorization** is required from managers
 - Who will **moderate** when there is a conflict
 - How will the company **monitor and audit** the interface process
- Proactively manage interfaces with all relevant internal and external stakeholders who are affected
- Build cross-functional core teams to give full coverage of multiple stakeholder issues. To support this Arthur D. Little provides specific performance metrics⁴ for well integrity issues, which can be linked to staff performance appraisals
 - **Well anomalies:** Number of well anomalies versus time and/or versus cumulative production or injection
 - **Response time:** Mean time taken to address anomalies
 - **Decision/action cycle time:** Mean time-to-repair, replace or abandon
 - **Non-conformance** to the well integrity management system (e.g. those identified during compliance audits)
 - Percentage of **wells operating under a dispensation**
 - Percentage of **wells compliant** with preventive corrective tasks, annular pressures MAASP⁵ and monitoring plans
- Provide guidelines for a periodic competency assessment program for all staff involved in well integrity management

Well integrity improvement

The successful management of well integrity is a critical and evolving theme. The Macondo incident and the Elgin field leaks in the UK North Sea, plus the many other less prominently reported incidents, demonstrate that even sophisticated energy companies are not able to “get it right” every time, all the time. We have demonstrated to our clients that Arthur D. Little’s approach to the strengthening of well integrity capabilities can be of substantial help in assuring senior management that the integrity of wells will be successfully managed on their watch.

Contacts

Stephen Rogers

Partner

Global Head Energy Practice

rogers.stephen@adlittle.com



Authors

Srinivasaraghavan Suresh

Key contributions from:

Nick White, Stephen Rogers

Arthur D. Little

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⁴ based on ISO standards

⁵ MAASP: Maximum Allowable Annulus Surface Pressure