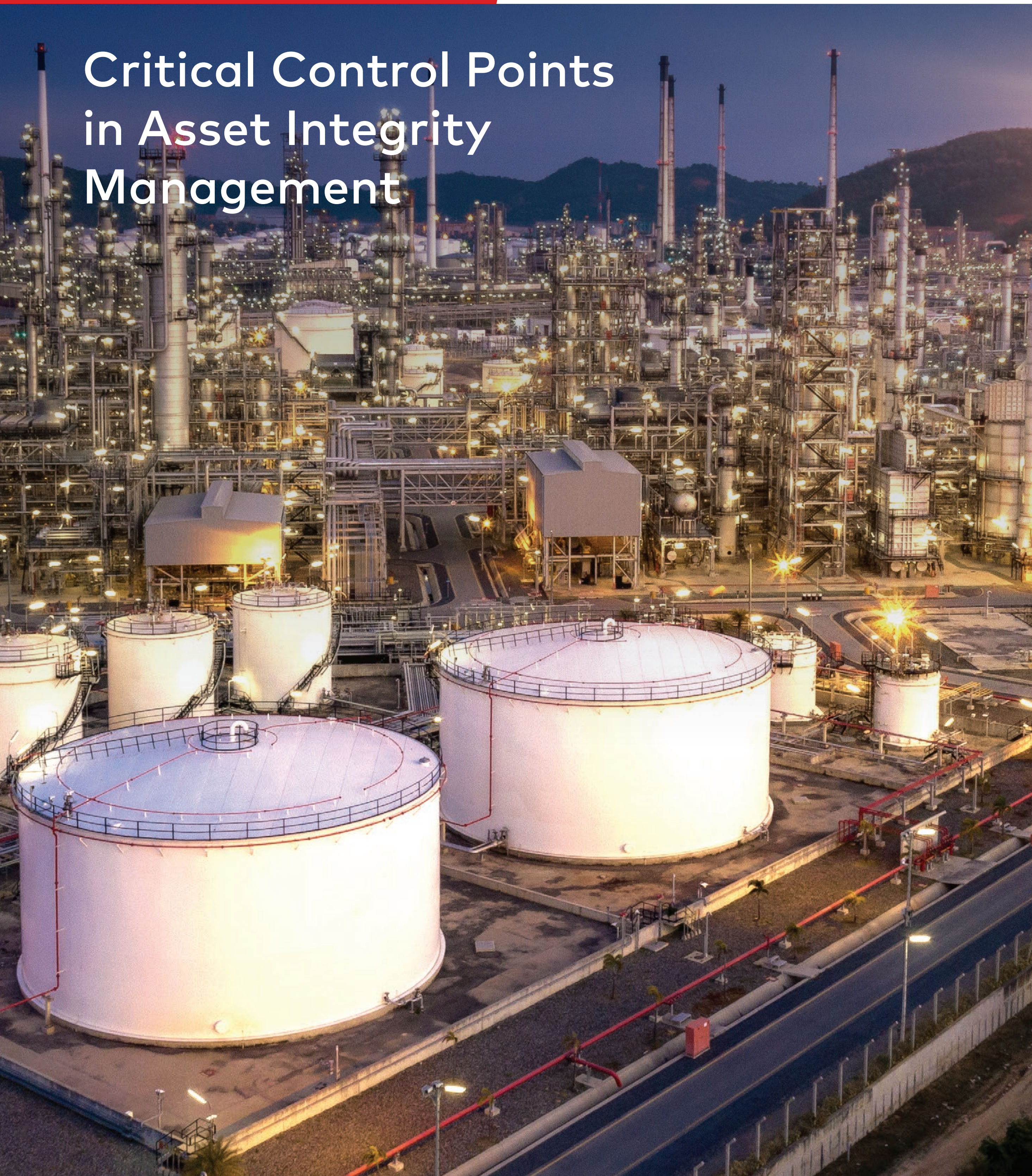
Critical Control Points in Asset Integrity Management



dss+

Protect. Transform. Sustain.

Critical Control Points in Asset Integrity Management

Executive Summary

Business competitiveness is continuously on the increase and this has forced stakeholder value propositions to focus on intrinsic value that support longer-term sustainable performance rather than shareholder value. In other words, purpose has become paramount. With purpose comes a responsibility to act in good faith, and reduce impacts on the public, communities and employees. To achieve this, companies now need robust systems to support operational excellence, integrated operational and business risk management as well as performance optimization of the production systems, with the ultimate goal of preventing accidents and maximizing financial and social outcomes of the company concurrently.

Effective Process Safety Management (PSM) is particularly critical in protecting people, communities and assets, and thus delivering upon the financial and social contract with stakeholders. It is also an inherent part of operational excellence and operational risk management because of the statutory and business continuity risks that poor PSM poses. Fortunately, PSM has evolved into a mature technical model and there is now opportunity for companies that have learned how to implement a successful PSM framework to leverage the same management systems and controls towards performance optimization.

This paper deals particularly with the controls that are required in Asset Integrity Management (AIM), a sub-component of PSM. It describes the high level rationale, framework, and critical control points that must be enforced to assure asset integrity. It then concludes on an Asset Integrity Management System (AIMS) that is used in dss+ as an implementation framework to assure all controls are in place and to establish and sustain continuous improvement protocols for the system.

Background

Corporate governance has shifted away from a shareholder-driven, short-term focus on financial performance. Stakeholders are now central to the drive and demand for long-term intrinsic value. The most successful companies approach governance through "wisdom"[1] in the assessment of emerging threats, challenges, and opportunities to intrinsic value. These companies also do not shy away from their Environmental, Social and Governance (ESG) responsibilities.

1 Grove H and Lockhart J, Evolution of Corporate Governance towards Intrinsic Value, Corporate Law and Governance Review, Volume 1, Issue 1, 2019

The importance of preserving long-term intrinsic value is reflected in market sentiment and investment trends across the world. In the USA, for example, the share of managed funds with direct or indirect ESG strategies has increased from approximately 30% in 1995 to 88% in 2018 ($13 trillion out of $14.7 trillion)[2].

Although intrinsic value involves a complex set of political, economic, socio-cultural and technological factors, most industrial firms are also faced with direct physical threats from the facilities that they run. The consequences of process safety accidents, for example, may result in any combination of fatalities, destruction of facilities, environmental damage, reputational damage, or even direct criminal prosecution. Striking examples of major accidents include the estimated $65 billion in costs that BP incurred as a result of the Deep water Horizon spill in 20103 and the more recent explosion at the Philadelphia Energy Solutions refinery that resulted in the company filing for bankruptcy protection[4].

In response to such events, institutional and industry-led efforts have led to robust frameworks for Process Safety Management (PSM). The wisdom of adopting a robust PSM strategy is imperative not only to the minimization of business continuity risks, but also to the optimisation of asset performance opportunities.

However, risks can only be successfully managed if the PSM system functions effectively. In our experience as dss+, companies tend to have well-clarified procedures, but they fail to adequately consider the human factor. In order to successfully reduce risk to operations and protect the mechanical integrity of equipment, companies need a combination of leadership support, resources, administrative discipline, a strong safety culture and the capabilities to sustain the improvements. Doing so will provide opportunities to make operations more efficient and reduce cost – an imperative in the current context.

2 US SIF Foundation, Report in US Sustainable, Responsible and Impact Investment Trends 2018

3 Reuters, BP Deepwater Horizon costs balloon to $65 billion, January 16, 2018, http://www.t.ly/5BV3

4 Reuters, Philadelphia Energy Solutions files for bankruptcy after refinery fire, http://www.t.ly/pk5k

Process Safety Management

Together with shifts in corporate governance, and possibly because of it, PSM in the industrial sector also had to adapt to changing attitudes towards risk. This is reflected in the efforts to strengthen controls, such as regulation and legislation, over the last few decades. It is also evident in the extensive adoption of PSM practices in companies.

Global regulatory frameworks [5,6,7,8,9] for PSM conform nominally to a consistent set of technical requirements that are comprehensively described by industry bodies[10]. The dss+ framework for PSM is fully aligned with regulatory requirements across the world and is shown in Figure 1.

While the technical requirements of PSM is well understood and specified in regulations, there is a complex set of human and management system factors that has a determining influence on successful implementation of a PSM plan, reaching well beyond the punitive threats that come with legislation.

5 US Federal Government, 29 CFR Part 1910, Occupational Safety and Health Standards with specific reference to Section 119 on Process Safety Management of Highly Hazardous Materials

6 Directive 2012/18/EU of the European Parliament and of the Council on the control of major-accident hazards involving dangerous substances, 2012

7 UK HSE, Control Of Major Accident Hazards Regulations 2015 (COMAH)

8 India, The Manufacture, Storage and Import of Hazardous Chemical Rules, 1989

9 People's Republic of China, Guidelines for Process Safety Management of Chemical Corporations, AQ/T 3034-2010

10 CCPS, Guidelines for Risk Based Process Safety, Wiley-Interscience, 2007

Figure 1: dss+ Risk-Based PSM Foundation Blocks

The history of industrial accidents repeatedly illustrates that accidents occur mostly because of the failure in the performance of PSM systems. Concern over the performance of PSM systems is also expressed in industry views.

The 2018 Petrotechnics[11] survey on Process Safety found that, although 83% of company leaders agree that Process Safety is embedded within management structures at the highest level, 86% of the participants acknowledge that there are gaps between the intended and actual implementation of the PSM plans.

The implementation challenge is not unique to PSM, but also holds true for other business plans and strategic objectives. A company that has difficulty with the implementation of a well-defined practice, such as PSM, is most likely also dealing with the more generic challenge of overall operational excellence and optimization of performance. Operational excellence is, however, not a static concept and the only means of ensuring sustained performance is through a leadership-led culture of commitment to discipline and continuous improvement in all aspects of the business, including PSM.

For this purpose, PSM must be integrated in a leadership-led approach to governance and management, such as the dss+ Production System (DPS) that has been adopted and refined in dss+ as a basis for driving operational excellence (see Information Box 1).

Information Box 1: dss+ Production System (DPS)

dss+ leadership acknowledged in 2006 that the company was not recognized as a top-quartile performer amongst peers. As an owner operator of more than 200 sites, there was great incentive for dss+ to develop a program to drive improvements. A program was initiated to develop the dss+ Production System to the specification:

"An integrated management system that fully develops people and organizational capability for effectiveness and creativity in utilizing assets and eliminating all waste"

The DPS was rolled out in 2007 across all of dss+ sites. By 2015, dss+ the DPS initiative was pulling in over $1 billion a year out of the business. PSM is fully integrated within the DPS framework defined in the Technical Model.

11 Petrotechnics, Process Safety and Operational Risk Management Survey, 2018

PSM often receives focused attention outside this more generic context of operational excellence, because of the urgency invoked by the severe consequences and risks that process safety poses on a business continuity scale.

Asset integrity is recognized as one of the longest established PSM elements and is arguably the element that is the greatest in terms of scope, complexity and resource requirements. Asset Integrity should not be distinguished in any other way from other elements or from the general contexts of PSM described in this section, as root causes of major accidents have been found in all of the sub-elements of PSM.

A myopic focus on asset integrity may increase a risk of accident stemming from another PSM element.

Asset integrity of PSM critical equipment poses disproportionate risk to companies and demands robust management controls. Our field experience has illustrated that management should be mindful of barriers to transparency when it comes to AIMS performance management and KPI reporting (see Information Box 2).

Information Box 2: Case Study on Overdue Inspection, Test and Maintenance Activities

An industry example of overdue inspection, test and maintenance activities is shown in the graphs below. Although there was no signal in the Key Performance Indicators (KPIs) for the maintenance department or in any other site PSM KPIs, there was evidence in the Computerized Maintenance Management System (CMMS) of a very large number of overdue ITM activities, including 2,776 activities on PSM critical equipment.

Reasons that led to the accumulation of this huge risk to the facilities include the following:

Governance and Management

- Lack of independence in the reporting and verification of management KPIs
- Management KPIs not clearly defined
- Lack of focus on the risk of overdue ITM activities on PSM critical equipment
- An organizational culture that biased towards illustrating 100% compliance.

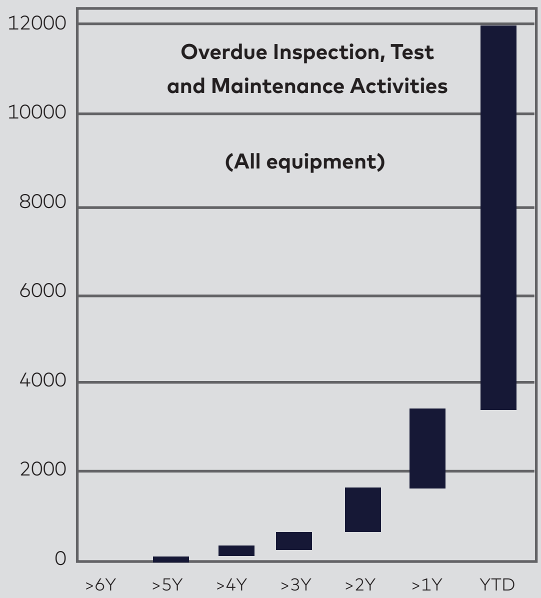
Asset Integrity Management System

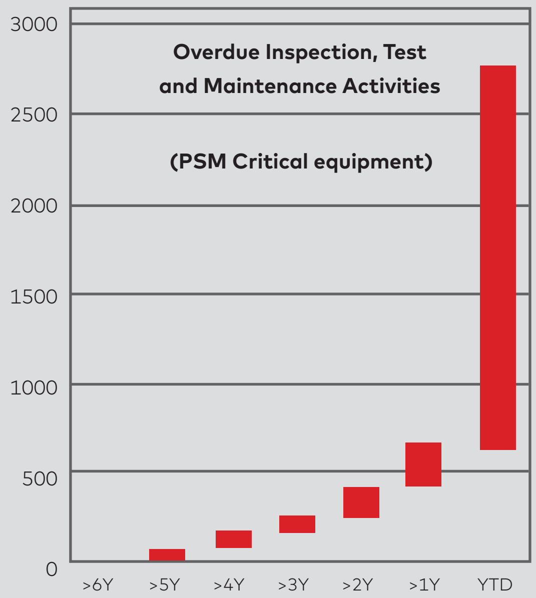
- Poor implementation of administrative procedures for planning and scheduling of ITM activities
- Inadequate implementation of CMMS resulting in poor data quality and control
- Ineffective deficiencies management system
- Inadequate deferral management of ITM activities on PSM critical equipment
- Ambiguities and loopholes in procedures exacerbated by a poor safety culture.

Human Factors

- Compliance culture in KPI reporting
- Conformance reported to schedule instead of plan
- General good practices in PSM and safety culture compromised in favour of procedural loopholes
- Bad practices not mitigated by a mature safety culture and adopted throughout operations
- Non-compliance with procedure.

It is evident from the causes listed above that the failure to manage asset integrity risks for this asset was due to a low maturity in operational culture (see Information Box 1) and not necessarily because of a lack in understanding of which ITM actions needed to be taken to ensure asset integrity





Asset Integrity Management

The integrity of equipment in an industrial plant is important from two perspectives:

- The minimization of risks associated with malfunction of the equipment
- The optimization of the overall equipment effectiveness.

These two aspects of asset integrity are complementary in terms of benefits and scope as illustrated in Figure 2 below. It is a relatively small step to extrapolate best Asset Integrity Management (AIM) practices on safety-regulated equipment to overall equipment effectiveness and performance. Process safety performance is a sub-set of overall equipment performance as illustrated in Figure 2.

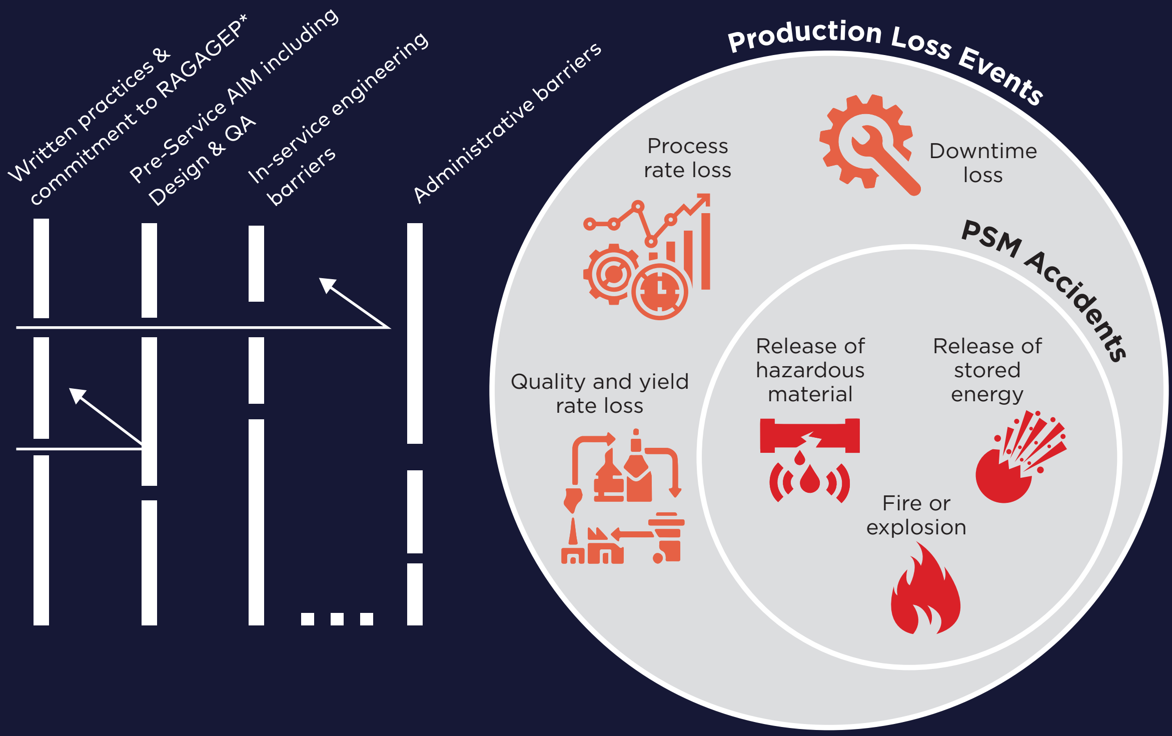


Figure 2: Swiss Cheese representation of loss prevention barriers illustrating overlapping objectives between minimization of downside risk and optimization of equipment performance

A comprehensive Asset Integrity Management System (AIMS) must be adopted as a written practice covering all aspects and control points in a Plan-Do-Check-Act management system. Though the technical details of execution is important, they are typically included in site specific implementation practices. The area that requires more attention is the identification of essential control points and protocols in AIMS

* Recognized and Generally Accepted Good Engineering Practice

PSM Critical Equipment

Any piece of physical equipment has degradation modes with one or more associated failure modes. In turn, each failure mode has a foreseeable Consequence of Failure (CoF). For the purpose of PSM, criticality is based on the CoF and it is thus important to evaluate and understand the potential CoF for each failure mode. This is an essential step to ensure that in-service degradation with unacceptable CoF may be managed based on the specific unacceptable failure mode.

Examples are given below for CoF related to three different failure modes of a pump. The criticality would depend of the criticality of the function. For a pump in hazardous service, loss of containment is a critical function.

Loss of performance would be critical for a fire-water pump:

- Pump seal leak: loss off primary containment
- Pump impeller damage: loss of performance
- Pump shaft failure: release of energy (may also result secondary consequences).

In this context, PSM critical equipment is considered as equipment for which AIM is either:

- Obligatory by regulation, or
- Mandatory to company directives because of a failure mode with an unacceptable CoF.

Failure modes with the potential to cause a fatality through the release of hazardous chemicals or through the release of stored energy are generally considered as PSM critical regardless of whether they are mandatory by regulation. In most cases, companies would also include other consequences as criteria under criticality such as capital loss, loss of production, environmental damage, reputational damage, etc. These are in addition to the health and safety considerations that are regulated by labour legislation.

Companies that are in the process of strengthening their AIM practices may have to follow a phased risk-based approach to PSM critical equipment.

Information Box 3: Equipment Criticality Criteria are based on Consequence of Failure

Equipment criticality is determined by consequence only. The integrity of all mitigation barriers that are put in place to avoid occurrence for the unacceptable failure mode, must still be assured through the lifetime of the equipment. The risk is only confirmed as acceptable while the integrity of all the mitigation barriers is assured, including asset integrity assurance through a robust ITM program.

This assures that controls on Higher-Hazard Processes (HHP) are prioritized because of the disproportional risk associated with such processes. HHP are also governed by specific regulations that are aimed at avoiding catastrophic release of controlled substances that may lead to toxic, reactive, flammable, fire or explosion hazards. PSM controls for HHP must always be ensured without any compromise to avoid disproportional threats to the intrinsic value of a business, but operational excellence can only be achieved once the safety and production aspects of Lower-Hazard Operations (LHO) are also controlled and optimized.

A maintenance and reliability program with a specific focus on critical failure modes, as associated with PSM critical equipment, offers further opportunities for optimization of the program. dss⁺ field experience in PSM assessment has shown us that this link is often not established in the program, neither in the maintenance strategies nor in the information carried in the Computerized Maintenance Management System (CMMS).

Information Box 4: What Percentage of Equipment Should be PSM Critical?

AIM practitioners should not be concerned about the percentage of overall equipment that is PSM critical.

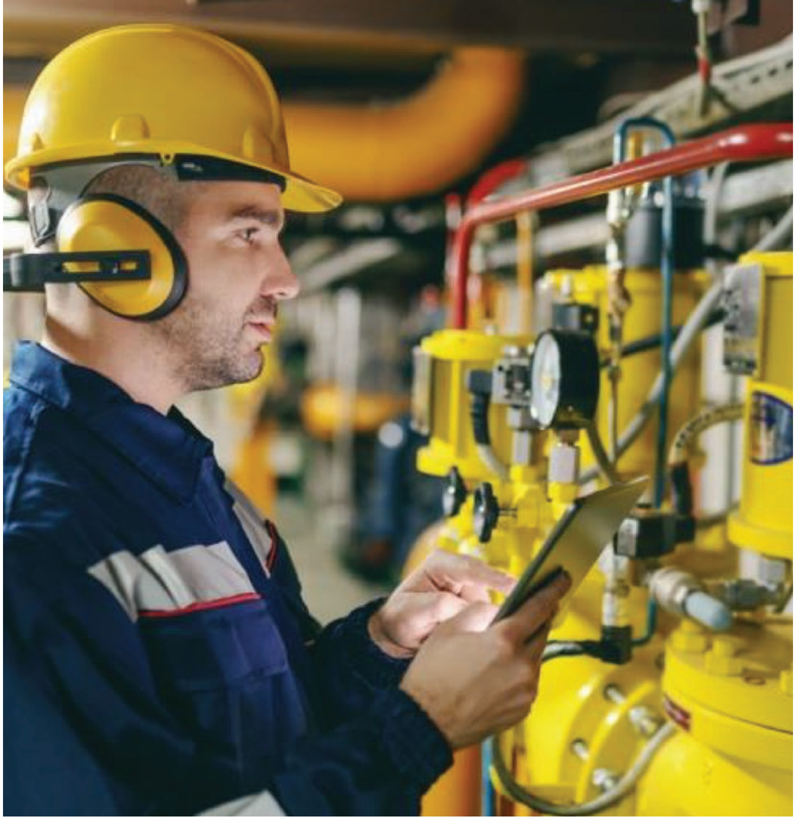
Firstly, equipment with failure modes that have unacceptable safety consequences should not be removed from the PSM critical list under any circumstances, especially not because the list appears too long. This practice is not allowed by regulation and not supported by leadership of any company that is in pursuit of excellence in safety culture.

Secondly, the percentage of equipment on the list depends largely on the equipment taxonomy and philosophy to which the master asset list adheres, e.g. piping as circuits (as opposed to individual lines), rotating equipment packages (as opposed to sub-systems and components), as well as the principles according to which non-process equipment is included in the register.

The further optimization in Inspection, Test and Maintenance (ITM) effort comes with an understanding of PSM critical failure modes i.e. focusing ITM efforts on avoiding those critical failure modes and not on the general condition of the equipment.

For example, consider internal corrosion in a pressure vessel in non-hazardous service. A pinhole leak in the vessel caused by local corrosion may have low CoF, while general wall loss in the same vessel may lead to a catastrophic burst of the vessel and and consequential high CoF (including a blast wave and projectiles that threaten personnel safety and may cause secondary damage to surrounding plant in hazardous service).

Asset Integrity Assurance



Since failure of PSM critical equipment can lead to accidents with unacceptable consequences, such failures must be avoided throughout the service life of the equipment. This is ultimately the primary objective of asset integrity.

Pre-Service Integrity Assurance
Asset integrity starts at the design stage where the process service conditions of the facilities are matched with mechanical design requirements against Recognized and Generally Accepted Good Engineering Practices (RAGAGEP). RAGAGEP is used as a generic term for statutory and industry codes, standards and practices (e.g. ASME, API, ISO, EU, ASTM, etc.) that are acknowledged as best practice in the industry.

Although pre-service aspects of asset integrity are generally considered to fall under the PSM element of asset integrity, there are strong and direct links between pre-service asset integrity and other PSM elements including:

- Process Hazard Analysis (PHA): PHA has direct design level influences on the required performance specifications of the plant configuration and equipment;
- Process Safety Information: the documented repository of the process materials, process technology, and equipment (e.g. fabrication QA/QC information, materials of construction, basis of design, safety systems and interlocks, performance criteria, etc.);
- Pre-Service Safety Review (PSSR): assuring that the plant configuration conforms to the basis of design and is ready for safe start-up).

The combination of all these pre-service aspects defines the performance basis against which the equipment must be maintained to be fit for service, while giving the assurance that the plant is installed to specifications.

In-Service Integrity Assurance
Degradation of equipment occurs under a range of threats, not all of which are service related. In order to ensure that the equipment remains fit for service against the performance specifications that are required to avoid failures, an ITM program is required to verify equipment performance standards and to address deficiencies before they can lead to failures.

A self-explanatory schematic of the ITM workflow is presented in Figure 3 with essential control points related to in-service integrity assurance numbered from 1 to 9 and described below.

1. Process Safety Information (PSI) must include performance criteria and acceptance limits for the equipment e.g. minimum allowable wall thickness, Safety Integrity Level (SIL) classification, valve stroke time, etc.

2. All PSM critical equipment will have a preventive ITM strategy as assurance against critical failure modes and the strategy will include execution due dates to ensure that the required activities are completed before the date at which failure is foreseeable in accordance with RAGAGEP.

3. All ITM activities on PSM critical equipment must be executed before or on the planned due date. If this cannot be done, for whatever reason, the equipment will be removed from service unless technical justification can be provided that the due date may be extended without increasing the risk of failure. Such deferral must be approved by an assigned authority.

4. Quality Control (QC) of Maintenance, Reliability and Operations (MRO) materials entering the warehouse must be performed to ensure that design specifications are met.

5. Training and competence of maintenance personnel must be managed to ensure ITM tasks are executed to the required codes and specifications.

6. ITM activities will be recoded and reported in reports and/ or check sheets against which the execution of field work and conformance to performance specifications may be verified

7. Deficiencies, whether discovered during the execution of ITM activities or during plant Operational Surveillance, will be evaluated against acceptance limits that are defined in the Process Safety Information.

8. Any deficiency that exceeds acceptance criteria limits will be considered as not fit for service (FFS) unless it is analyzed in accordance with RAGAGEP and found to be fit for service. Fitness for service analysis will include remaining life assessment to determine the amount of time remaining before corrective actions must be taken and to inform intervals for any condition monitoring that may be followed as a mitigation action (see point 9 below).

9. Corrective actions, such as repairs, will be conducted in accordance with RAGAGEP and subjected to quality assurance and control.

10. The ITM program will consider actual findings to adjust the frequency and scope of activities as required to ensure avoidance of critical failure modes. Learning from experience demands reliability engineering studies including:
    - Risk based inspection assessment in consideration of observed degradation rates and mechanisms, as well as operating excursions (physical and chemical);
    - Reliability studies in consideration of failure rates and observed equipment condition including bad actor analysis to identify high impact and generic areas of poor equipment performance;
    - Root cause analysis to evaluate strategies for mitigation of the observed degradation.

11. Equipment with deficiencies that have useful remaining life according to FFS assessment may be returned to service provided that corrective actions are designed and scheduled for execution prior to the end of the safe remaining life.

The expansive scope of equipment and maintenance procedures that must be managed in industrial plants makes reliance on a Computerized Maintenance Management System (CMMS) essential in the reliable management of controls and data including:

- Planning, scheduling, and deferral management of activities;
- Maintenance routines, check sheets and bill of materials for Plant Maintenance (PM) tasks;
- Recording and tracking of data required for reliability studies and bad-actor analysis (e.g. mean time between failures).

The successful implementation and use of a CMMS rely only partially on the quality of the electronic system and is highly dependent on the proficiency and discipline of the personnel that use it. These factors of success can be controlled by appropriate change management processes to assure the system configuration is aligned with AIM needs at initial installation and also in terms of training and coaching to use the system to its full potential.

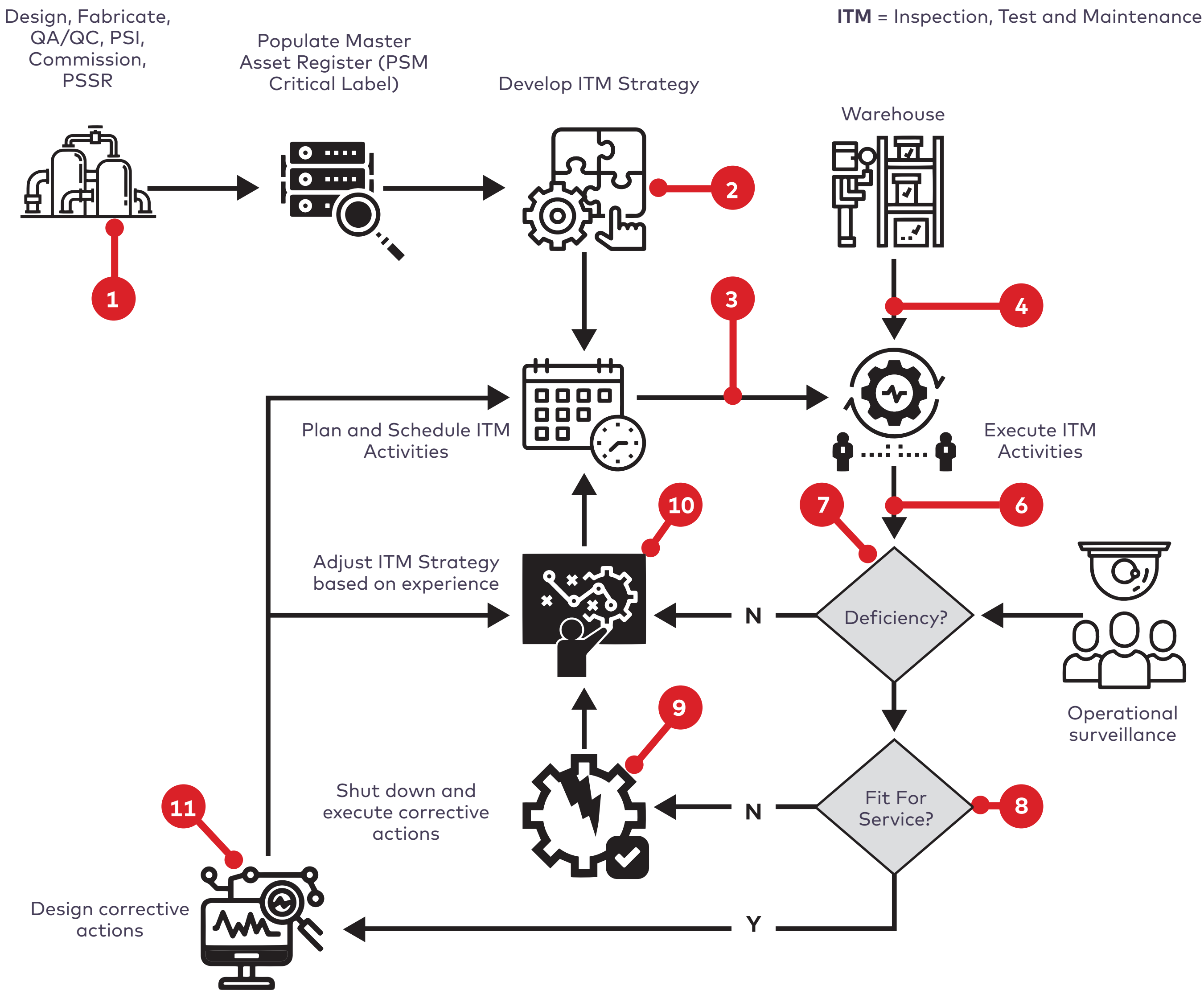


Figure 3: In-Service Asset Integrity Management Workflow

Administrative Elements AIM

In addition to the pre-service and in-service AIM activities covered above, there are a number of administrative elements to AIM that are essential to a robust program including:

- Written practices: the AIM program must be a written practice with all essential activities captured in procedures, maintenance routines, check sheets, plans, etc. and with all results captured in writing to allow assessment and verification;
- Quality control of maintenance, reliability and operations (MRO) materials: all MRO materials on PSM critical equipment must be verified against the bill of materials and specifications for the equipment as entered in the Process Safety Information;
- Training of ITM personnel: it is essential for quality control of ITM services to ensure that personnel are trained and certified to RAGAGEP requirements and to OEM practices;
- Audits: in general, auditing of PSM falls under Performance Management of the PSM program. However, it is essential that AIM activities be audited against the specific control points listed in the previous section as well as the administrative controls listed in this section.

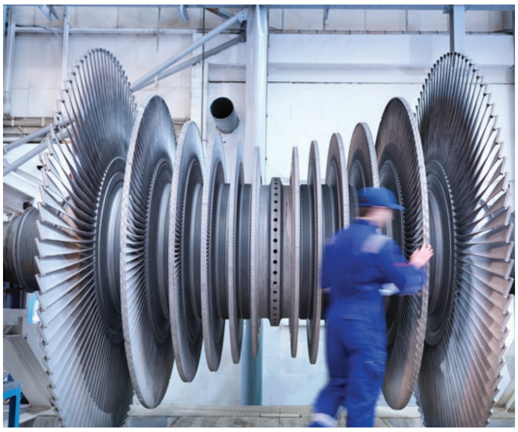
Information Box 5: Can all failures on PSM Critical equipment be avoided?

The notion that "industrial plant is large and complex and, as a result, industry accepts that failures are inevitable", is sometimes encountered in companies with a low safety culture maturity. This notion is false for PSM critical equipment.

RAGAGEP and legislation covering PSM of hazardous plants are designed and formulated to assure that such equipment does not fail. While the AIM controls require knowledge and discipline to achieve such assurance, they are readily achievable in an organization that commits to robust knowledge-driven controls.

However, for an organization with low levels of conformance to AIM controls, it is more important in the short-term to ensure full compliance on the most critical categories of equipment (e.g. multiple fatalities with off-site potential) before expanding controls to cover the balance of PSM critical equipment (e.g. single on-site fatality). While it goes against safety culture principles to distinguish between equipment criticality based on the potential for single vs multiple fatalities, this practice is sometimes adopted during early stages of a safety culture transformation to assure resources are prioritized for an urgent response towards the highest risks.

A safety culture transition is, however, not complete before the AIM program is not running with high levels of compliance across all PSM critical equipment because this is imperative to eliminate foreseeable fatalities or serious injury in the workplace.



dss+ Technical Model for Asset Integrity Management

Combining all elements of AIM discussed above, the dss+ technical model for Asset Integrity Management System (AIMS) is depicted in Figure 4 below.

AIMS Policy & Strategy is the Tier 1 written management system practice that defines the scope, organizational roles and responsibilities, equipment specific integrity assurance strategies, as well as administrative controls and requirements for all AIMS activities (e.g. deferral management, document control, audit requirements, etc.).

Design and Quality Assurance of new equipment covers the requirements for ensuring that new equipment is designed, fabricated, installed and commissioned to the required specifications and that the equipment is fully incorporated into the AIMS ITM programmes together with training requirements and spares management as may be required.

Inspection, Test and Maintenance deals with the development of integrity assurance programs for equipment groups and individual equipment tags. The ITM plan is designed to prevent critical failure modes through strategies such as preventive maintenance, risk based inspection, condition monitoring, corrosion management, etc. ITM activities are implemented through a CMMS and serve as the primary in-service asset integrity barrier to functional failure of production facilities.

Deficiency Management provides assurance that equipment deficiencies that are discovered through the ITM program or through operational surveillance are assessed and that monitoring activities and corrective actions, including repairs, are planned and executed. These actions must be taken before the deficient condition deteriorates to a point where functional failure is foreseeable.

Reliability Engineering is an essential part of continuous improvement and covers the analysis of reliability data to identify bad actors (where ITM activities indicate there are elevated threats levels to degradation and failure), perform root cause and trend analysis and to challenge the efficacy of the current ITM program. This allows risks to be identified in time and adjustments to be made to optimize the program.

Quality Control of Spares and Materials gives assurance that spares and materials that are used on site conform to specifications. It involves a program of receiving inspections to verify specifications and of warehouse practices to assure the equipment is preserved while in storage and that the correct materials are released for use on site.

Practices and Procedures refer to the comprehensive set of written instructions covering administrative and technical procedures and routines involved in the AIMS program.

Training and Competence is essential as a quality control element to ensuring that all work is performed by trained and qualified personnel. It covers initial and refresher training as well as certification of personnel involved with ITM activities.

Performance Management is at the core of continuous improvement in any management system in order to verify performance of the system through management review, KPI reporting and audits.

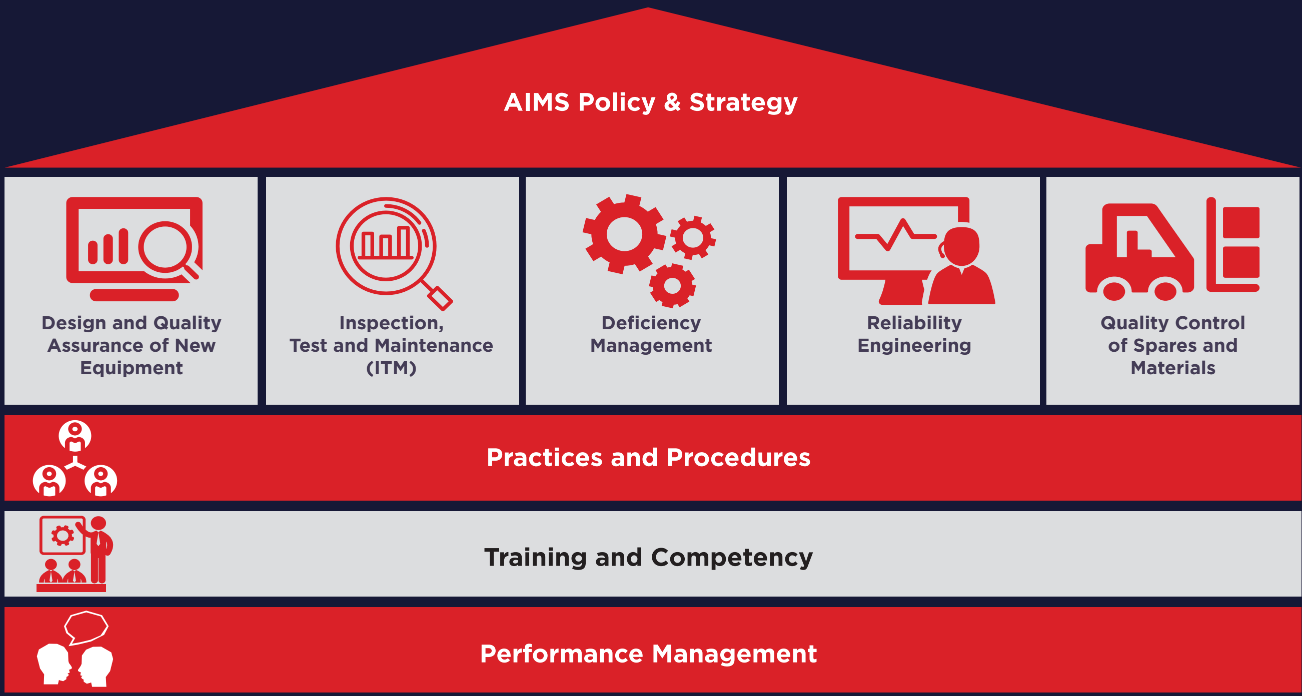


Figure 4: dss+ technical model for our Asset Integrity Management System (AIMS)

Implementation Roadmap for AIMS

Most companies already have various elements of the dss+ technical model in place, whether formally or informally. However, there are often significant gaps in the control and performance of the system. For such cases, a structured approach is needed to upgrade the system.

dss+ experience shows that gaps in the control and performance of management systems are almost fully associated with the maturity level of the operational models in a company (using the DPS in Information Box 1 as benchmark). Because of the different levels of maturity uncovered during dss+ assessments, we acknowledge that there is no common implementation model that is suitable for all companies. A leading measure of successful transformation, therefore, remains the establishment of continuous improvement processes in a company, a process that is closely associated with improvements in cultural maturity (see Information Box 6).

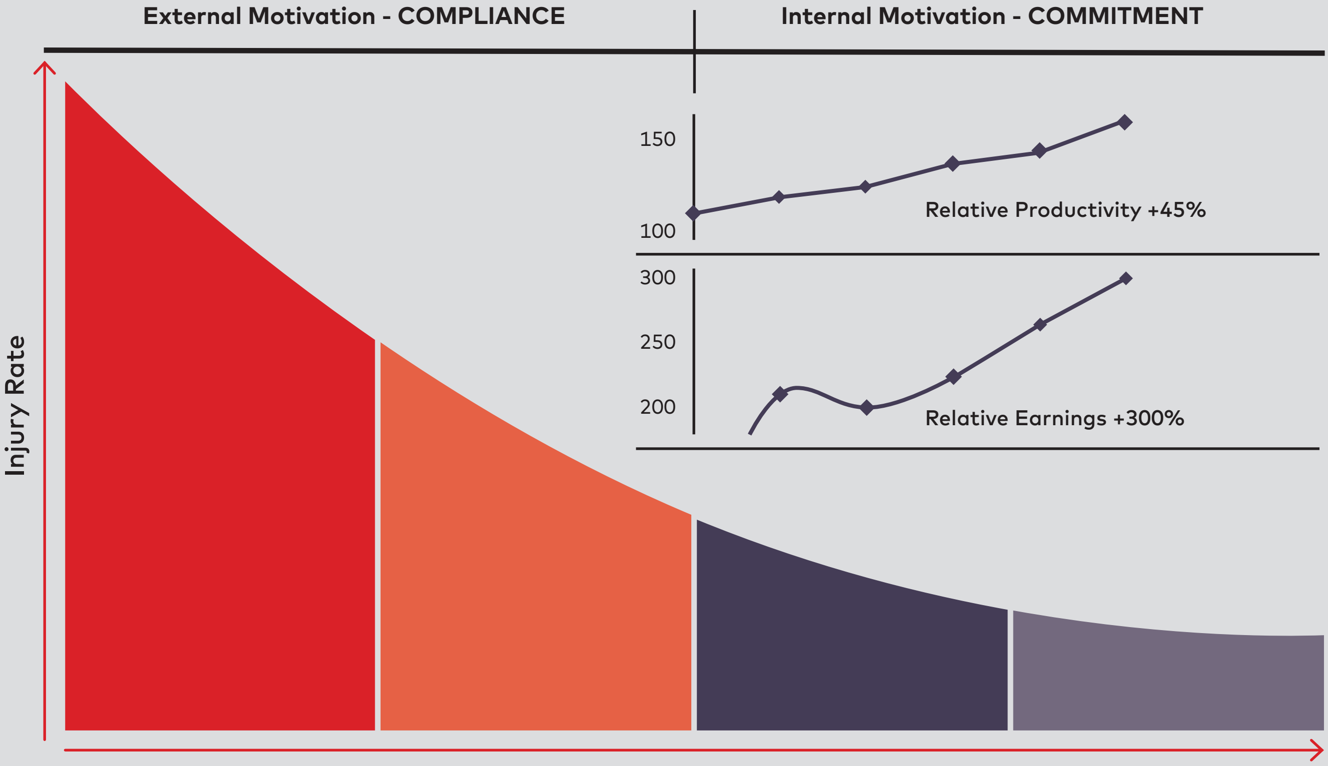
dss+ has an established delivery program for upgrading AIMS and for developing capacity to maintain the system into the future.

Information Box 6: Cultural Maturity and the Bradley Curve

A renewed drive by dss⁺ leadership to improve safety performance in the mid-1990s led to the establishment of a discovery team to develop an implementation model for company-wide implementation. Inspired by leading practices in high performing organizations and work teams, as well as dss⁺ owner-operator experiences across more than 200 sites, the team formalised the concept of the Bradley Curve of cultural maturity.

The principle is well supported by field information gathered and is relatively simple in concept – organizations that rely on teams that are fully integrated and draw on interdependent relationships to drive quality and conformance outperform those who rely on individuals who respond to their instincts in performing their daily jobs.

While the original context of the Bradley Curve for cultural maturity has a focus on safety culture, dss⁺ recognized that the same culture also drives all other aspects of operational excellence. The discovery team reported improvements of 45% and 300% for relative productivity and relative earnings respectively as companies transition towards high-levels of cultural maturity at the Interdependent side of the curve.



Natural Instinct
Reactive
- Safety by natural instinct
- Compliance is the goal
- Delegated to safety manager
- Lack of management involvement

Dependent
Supervision
- Management commitment
- Condition of employment
- Fear/Discipline
- Rules/Procedures
- Supervisor control, emphasis and goals
- Value all people
- Training

Self
Independent
- Personal knowledge, commitment & standards
- Internalization
- Personal value
- Care for self
- Practice & habits
- Individual recognition
- Personal mastery

Team
Interdependent
- Help others conform
- Being other's keeper
- Networking contributor
- Care for others
- Organizational pride
- Team mastery

Conclusion

In our experience at dss+, we have seen that many companies have rather detailed, well-thought out PSM and asset integrity policies, processes and procedures. However, accidents and failures continue to take place.

In this paper, we have detailed the elements and controls that are required in an effective AIMS system, as well as continuous improvement protocols for the system. By pursuing these recommendations, it is possible for industrial companies to overcome some of the gaps that can lead to failure or an accident.

dss+ has proven that robust implementation of the suggested system/controls is dependent on an organizational culture where interdependent teamwork and high ethical standards contribute to continuous improvement processes. The same organizational culture also supports other operational excellence objectives so that successful implementation will not only provide process safety assurance, but also improve financial performance in terms of metrics such as productivity and earnings.

Feel free to get in touch with our Middle East Process Safety Management and Asset Integrity Management or Operational Excellence Teams to discuss your specific organization challenges.

A white paper on **Critical Control Points in Asset Integrity Management** is available at this link: www.consultdss.com/asset-integrity-management-controls.

About dss+

dss+ is a leading provider of operations management consulting services with a purpose of saving lives and creating a sustainable future. dss+ enables organizations to build organizational and human capabilities, manage risk, improve operations, achieve sustainability goals and operate more responsibly.

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