Executive Summary
The importance of alarm management to preventing process plant incidents is well recognized. Human factors are held responsible for 40% of incidents causing loss or injury in the process industries, according to the Abnormal Situation Management® (ASM) Consortium. Poor performance of alarm systems has the potential to be a significant contributory factor. The average number of alarms received daily by an operator in the oil and gas industry, at 1200, is more than eight times the level recommended by EEMUA (144). In the petrochemicals industry that rises to 10 times the recommended level at 1500 a day – more than one a minute. The implications for safe operations are clear.

It is not just a question of safety however, research from the ASM® Consortium and others clearly show that operating outside defined limits contributes to abnormal situations and equipment failures by as much as 76%, contributing to a $20 billion annual cost of unplanned downtime. Those employing best practice, meanwhile can reduce this unplanned downtime by 50%, accelerate recovery from abnormal situations by 80% and increase process throughput by up to 8%.

Industry leaders are therefore seeking a more effective alarm system to not just prevent incidents but to drive value. They want to move the operator beyond a traditional reactive function in which they engage in constant fire-fighting, to become proactive agents with the time and information to deliver better outcomes for the business.

This does not mean abandoning the metrics and reporting traditionally associated with alarm management. These remain vital. Rather, it means integrating operations management with alarm management to drive increased value. This empowers operators to not just effectively handle alarms, but minimize deviations from operating limits, understand when critical alarms are about to fire, and subsequently predict and in many cases, prevent abnormal situations.
Contents

Three Foundation Pillars of Improvement ................................................................. 3
  Alarm Management .................................................................................................. 3
  Operations Management ........................................................................................ 5
  Alarm Rationalization ............................................................................................ 5

A Staged Process ........................................................................................................ 6

Honeywell’s Unified Program .................................................................................... 7

Component Parts ........................................................................................................ 8

Conclusion .................................................................................................................. 9
Three Foundation Pillars of Improvement

The approach is based on three core building blocks that together deliver sustainable improvement:

- Traditional alarm management is first, focusing on putting in place effective infrastructure (such as the master alarm database and alarm response manual) and working to reduce alarm noise, such as nuisance and chattering alarms. This enables operators to focus on their real process problems and challenges.
- Operations management integrates key constraints such as safe operating limits, production envelopes, and conformity to integrity operating windows. It also focuses on issues such as operator workflows and optimizing shift handovers to increase efficiency and reduce operator error.
- Finally, the process focuses on alarm rationalization. Traditionally, conducted as part of the initial alarm management improvement program, by delaying rationalization it is possible to avoid the need to repeat what is often a time-consuming and lengthy process as goals become clearer as the project progresses.

Tackling all three of pillars with a unified approach, businesses can drive not only safety and ensure regulatory compliance but promote better plant availability and throughput, delivering real business value. It also delivers value beyond that achieved by any of the individual components: the benefits from the unified approach are greater than the sum of its parts. Nevertheless, it is worth considering these parts and each pillar in turn.

Part 1: Alarm Management

At one level alarm management is both well understood and defined. It is, as EEMUA 191 puts it, “the process by which alarms are engineered, monitored and managed to ensure safe, reliable operations”.

Most will be familiar with this. However, it is worth pausing to note that the link with operations is here at the outset. Industry best practice is a combination of good alarm management aligned to an effective operational workflow. Typically the focus of alarm management is on alarm and noise reduction, but reliable and effective operations are a critical factor in this definition.

Key Investment Drivers

Moving beyond the definition, we can identify three sets of core driver groups behind the desire to improve alarm management:

- **Primary drivers** mainly comprised of regulatory compliance and safety concerns. Regulations and alarm reporting requirements are typical motivations for investment in alarm management. Closely related to this is site safety. The reduction in alarm noise is intended to allow operators to identify and respond to critical alarms correctly and to document these actions in the knowledge base to inform other operators if and when the situation re-occurs, what the effective response should be.

- **Secondary drivers** focus on improving operations. Reducing trips and downtime, for example, has always been an aim of alarm management. Operations want sustained throughput and quality by improving the reliability and availability of equipment.

- **Tertiary drivers** include operator knowledge retention – a key issue given ageing workforces in many parts of the world and industries. Alarm response manuals and master alarm databases, for example, play a key role in ensuring that when an alarm comes in, the operator knows what to do, as well as what causes it and the consequences of taking no action (or in some cases the wrong action). Other drivers include reducing maintenance costs, and also reduced insurance premiums; insurers of many facilities now require proof that an effective alarm management solution is in place before providing cover.
**Components**

There are, broadly, two main components of the alarm management solution. The first is the software, this includes the reporting, metrics, and improvement tools that track performance, key performance indicators and adherence to standards and best practice; the master alarm database and alarm response manual – the central repository for all alarms; along with fully auditable change management tools to track an alarm points complete history; as well as more advanced functionality like dynamic mode and state-based enforcement solutions, which can actively change the alarm settings based on the plant's current operating mode, reducing standing alarms and limiting the need for complex alarm suppression logic.

These rely on the second component: appropriate infrastructure being put in place, such as the alarm philosophy document, which defines how the alarm system is going to perform; the improvement plan; and asset benchmarking and assessment. Alarm rationalization is also traditionally considered part of this. However, as stated, in many cases it makes sense to leave this until later in the process. The ANSI/ISA Alarm Management Lifecycle (below) captures the role and interaction of these various components as well as showing the typical entry points into the alarm improvement process.

**The inadequacy of traditional Alarm Management**

However, along with these, there are a number of other challenges not typically associated with the alarm management improvement program but closely related to its drivers. These include managing the critical limits and integrity operating windows – effectively seeking to minimize deviations from the operating plan. This has a significant impact on equipment reliability, maintenance costs, product quality and safety, bringing best practice to the reality of operations management.

Similarly, secure shift handovers are an increasing focus in the industry. Operations need to ensure critical information from each shift is passed over to the next in a controlled, safe and efficient way.
Part 2: Operations Management

Operations management encompasses five key functions:

- Active monitoring and documentation of critical limits, integrity operating windows and deviations from both
- Enabling operators to stay within safe and profitable production envelopes
- Capturing shift observations and details of bad acting alarms, safety bypasses, long-term standing alarms and overrides
- Securing shift handover processes to reduce operator error and hand over time
- Aligning to adopted best practices from the ASM, ISA, IEC, EEMUA and the American Petroleum Institute.

When alarms sound they must be correctly documented so it is understood why they fired and the impact. This is just as true when it comes to integrity operating windows as it is when considering safety and compliance. The first two items in the list above deal with this.

The next two depend on the shift log which ensures all shift activities and alarms are securely captured, recorded and transferred between shifts, whether it is details of alarms, health and safety issues, activities in the field, safety bypasses, inhibits or long-standing alarms. Finally, the solution will track and drive conformity with whatever best practice or standard the operation has adopted.

Part 3: Alarm Rationalization

Alarm rationalization is traditionally considered along with alarm management. However, if possible it is better left until later in the process, after the core implementation of alarm and operations management. This is because only once the alarm system is generally under control and the bulk of the noise removed does it really become clear where rationalization will bring most value.
A Staged Process

In practice, sustainable improvement is a continual process, achieved step-by-step and depending on the specific business’s timetable, resources and current level of alarm management maturity.

The below image shows the ambition: to move from a situation (the red line) with a high level of daily alarms with large spikes in the number of alarms during alarm floods to a much lower and more consistent number of alarms (the dark green line).

As can be seen, there will be several intervening steps. As stated, getting the infrastructure, such as the alarm philosophy document right is an essential prerequisite of a successful program. However, the biggest reduction in the number of alarms will occur with the implementation of an effective alarm management solution – as indicated by the big gap between the red line and the one below it. A 60% to 80% reduction in alarms within three months is not an uncommon return on investment.

This is because in most circumstances 15-20 alarms make up the majority of alarm noise. These alarms can usually be identified and dealt with fairly easily allowing a rapid return on investment. However, for continued improvement each phase of the process must be worked through:
1. Alarm Management (Phases 1 and 2)
   - **Infrastructure**
     - Create an alarm improvement plan
     - Develop an alarm philosophy
     - Understand the drivers and ensure buy-in from all stakeholders
   - **Identify and eliminate bad actors (Alarm Noise)**
     - Focus on areas of biggest risk and greatest return
     - Generate standards compliant KPI assessment reports with quantifiable deliverables
     - Fix 3 alarms/week for as much as 60% reductions in bad actors over a three month period

2. Operations Management (Phases 3 and 4)
   - **Integration**
     - Embed KPI Reports into organizational workflows
     - Deliver alarm help directly to operator stations
     - Integrate alarms and operational issues for secure shift handovers
   - **Monitoring critical limits and operating windows**
     - Monitor and document deviations of critical limits and excursions from operating plans
     - Integrate into shift handovers
     - Operate within desired production envelopes

3. Alarm Rationalization (Phase 5)
   - Determine causes, consequences and corrective actions for each alarm
   - Determine if each alarm is a real alarm (requiring an operator response). Should it be an Alert instead?
   - Develop “Smart” alarming to pro-actively engage operations
   - Deploy predictive and dynamic alarm management techniques
Honeywell’s Unified Improvement Program

While each phase should be worked through under a unified program, these are all tightly integrated. Alarm help should be delivered directly to the operator console, for example; KPI’s reach the right person to take action, whether on the process layer or business layer; and the process for documenting critical limits and boundary management is similar, using the same tools to define the optimum operating window and ensure operations stay within it as is used to document and manage critical alarms.

Key Component Parts

DynAMo Alarm Management
Once the alarm infrastructure discussed earlier is in place, the first part of the solution is the alarm management software – DynAMo Alarm Management, as an example, comprises of three key parts essential to delivering on this phase pillar of the improvement plan:

- **Metrics and Reporting** – the KPI and improvement tool that captures, stores, measures and analyses real time alarms and operator actions. Users benefit from customizable, role-based dashboards giving them the KPIs they need at a glance. It includes the alarm and event historian, automated alarm assessment and alarm KPI reporting.

- **Documentation and Enforcement** – allow users to create and maintain the master alarm database for the control system. This includes the alarm help, set-point enforcement and model-based alarming. It also includes tools for structured management of change and a framework/tools to assist with alarm rationalization.

- **Alerts and Notifications** – the smart alarming tool. Enabling users to configure specific conditions to monitor, it can also alert operators to process conditions where notifying the operator is useful but an alarm is not appropriate. Alarms will deal with process safety related incidents, alerts - with process optimization or performance issues.

With DynAMo Metrics and Reporting software (below), the user can immediately see how the plant is performing (top left), graded against whatever standard has been chosen – whether ISA, EEMUA or any other. The open alarms (top right) are also immediately apparent, along with the breakdown in terms of critical and maintenance alarms, their priority and the number of events.

The display can be tailored for each function, and allows users to drill down from the top level view. Users can call up more detailed reports, such as the top ten alarms and alarm counts, as well as flood analysis and consequential alarm analysis that enable them to build dynamic alarm suppression, for example. An alarm performance overview report, meanwhile, is designed to satisfy insurers’ demands for information to provide cover.
DynAMo Operations Management
The similarities and unified nature of the solution are apparent when looking at the Operations Management.

It features two component parts:

- **Operations Monitoring** for monitoring and documenting critical deviations and managing alarm, equipment and environmental limits. It ensures conformance with defined production envelopes and integrity operating windows as well as providing a limit repository - the central location for all an organizations limits - and an operator instruction tool designed to allow the business to send production plans and targets directly to operations.

- **Operations Logbook** (considered below), which integrates alarm metrics into the daily workflow, as well as securing the shift handover in-line with documented best practice.

**Conclusion**

The benefits from alarm management and operations management, as well as the requirements for good shift handovers are all recognized. Less appreciated at times have been the overlaps in these spaces and the scope for synergies.

Underpinned by a rigorous infrastructure that takes disciplines such as drafting the alarm philosophy document serious, modern solutions can improve each of these areas. Visualization, analysis and reporting tools can significantly improve the effectiveness of operators and help move them to a proactive footing. Abnormal situations can be anticipated and prevented, and, where this is not possible, dealt with safely in line with best practices. Operations, meanwhile, benefit from the same approaches in which limits are defined and monitored and captured in at-a-glance displays. Users are able to increase throughput, efficiency and reliability and reduce maintenance costs and risks to safety.

However, by bringing these solutions together in a unified program, users gain even greater benefits. Not only do users get a consistent, familiar interface, but information is automatically exchanged between the parts of the program. Alarm limits, in the DynAMo example, can be automatically integrated into the Operations Monitoring solution; the Operators Logbook is automatically populated with the information needed for a secure shift handover; and observations captured during the shift inform the knowledge base underpinning alarm management and operations management solutions.

In short, a single, unified solution moves operators from reactive alarm responses to proactive management of the process. It does so by recognizing the available synergies and the fact that alarm and operations management have always been closely tied disciplines.

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**For More Information**
Learn more about how Honeywell's award winning DynAMo Alarm and Operations Management software can deliver operations integrity to your assets, by visiting our website [http://hwll.co/DynAMo](http://hwll.co/DynAMo) or by contacting your Honeywell account manager.

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