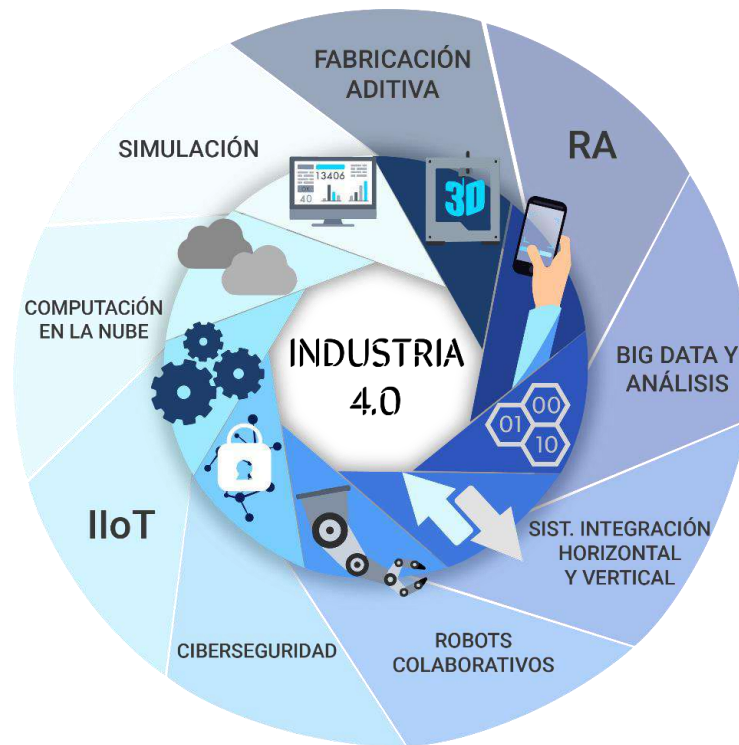


Aplicación de minería de datos en gerenciamiento de alarmas – Caso de estudio

Jairo Ramirez Mongui

Jenny Carolina Saldaña Cortes

Retos en la industria 4.0



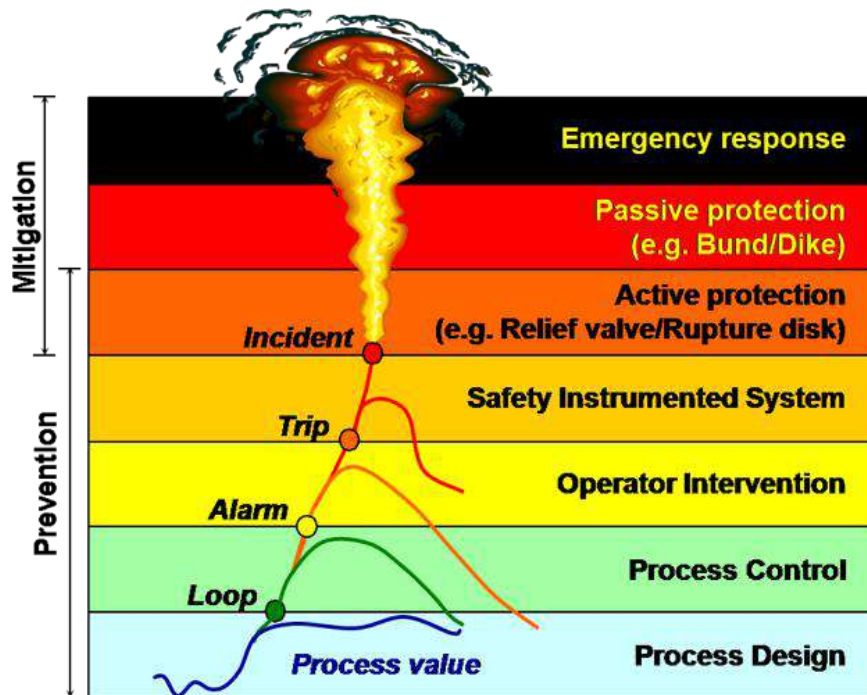
<https://www.miticotechnology.com/index.php/transformacion-digital/industria-4-0>

Sistema de alarmas

- Es una colección de hardware y software que detectan un estado de alarma, que indica y comunica el estado a los operadores y almacena cambios del estado de alarma (ANSI/ISA 18.2)

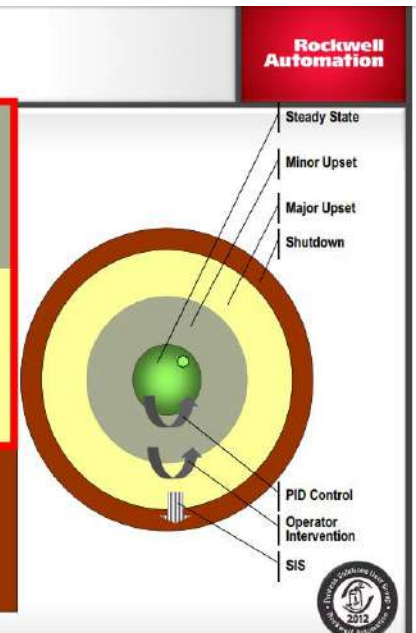


Capas de protección



Layers of Protection

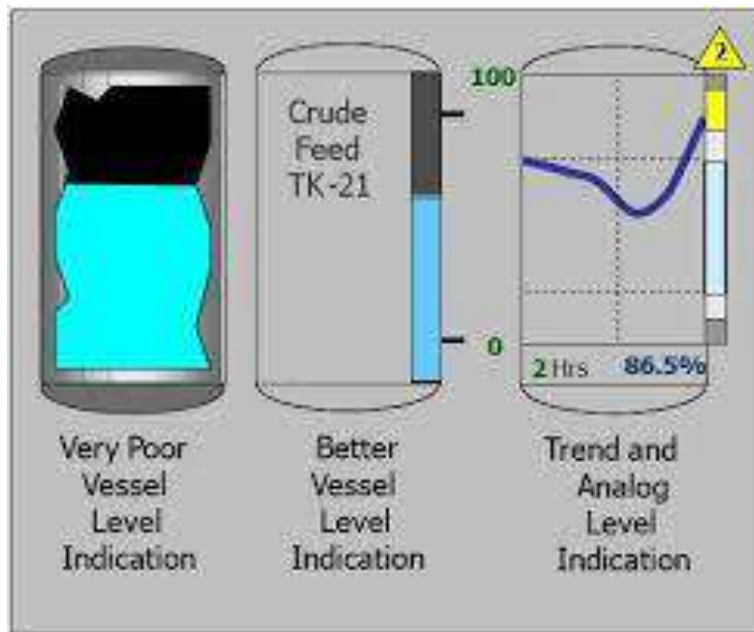
- 1) PID Control – First line of defense
 - Steady state operation
 - Transition handling
 - Minor disturbances rejection
- 2) Operator Intervention
 - Operator HMI
 - Alarms
 - Dependent upon severity of event & operator competence
- 3) Safety Instrumented System
 - Last automated line of defense
 - Safe unit shutdown
 - No immediate point of return



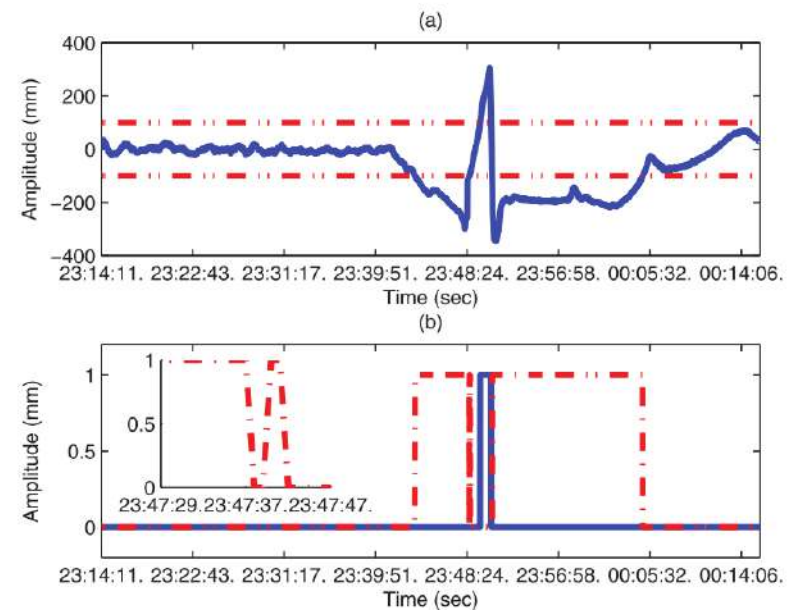
T. Stauffer and P. Clarke, “Using alarms as a layer of protection,” in Proc. 8th Global Congr. Process Safety, Houston, TX, USA, Apr. 1–4, 2012

https://www.rockwellautomation.com/resources/downloads/rockwellautomation/pdf/events/automation-fair/2012/psug/ed19-alarmmanagement_psug2012.pdf

Alarma

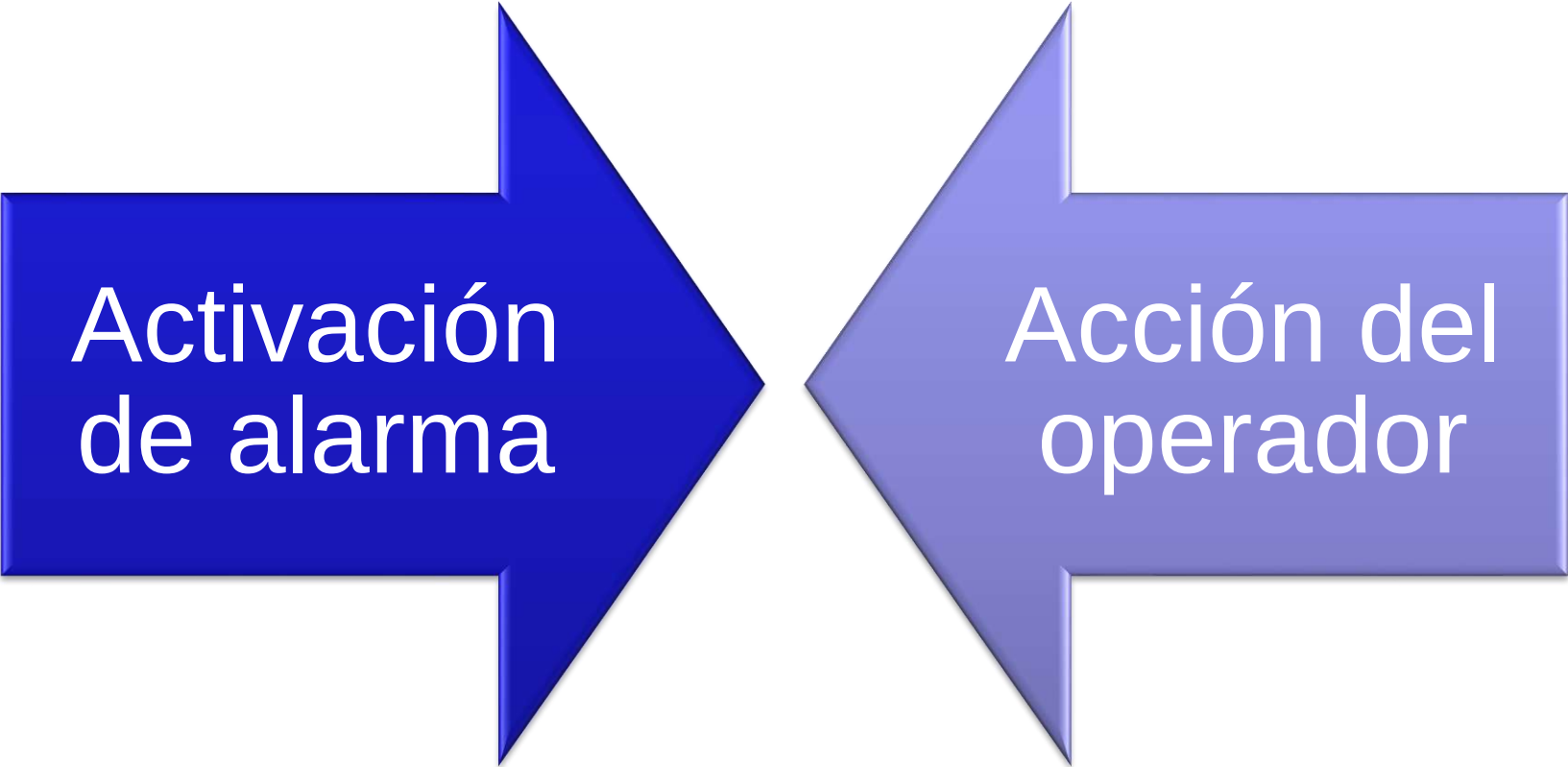


<http://www.crossmuller.com.au/the-high-performance-hmi/>



(Wang, Yang, Chen, & Shah, 2016)

¿Que es una alarma?



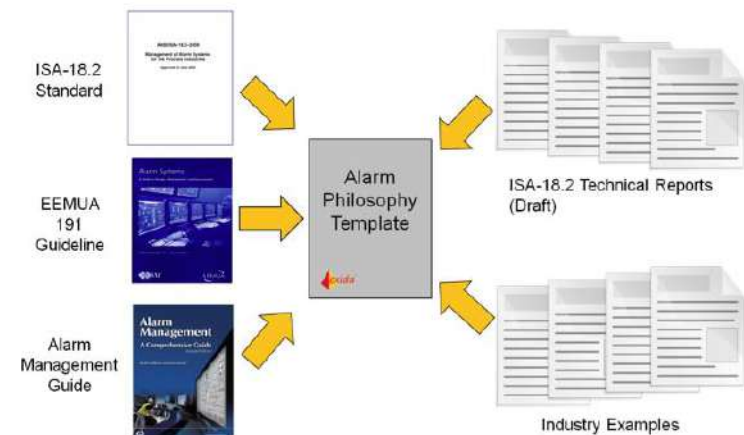
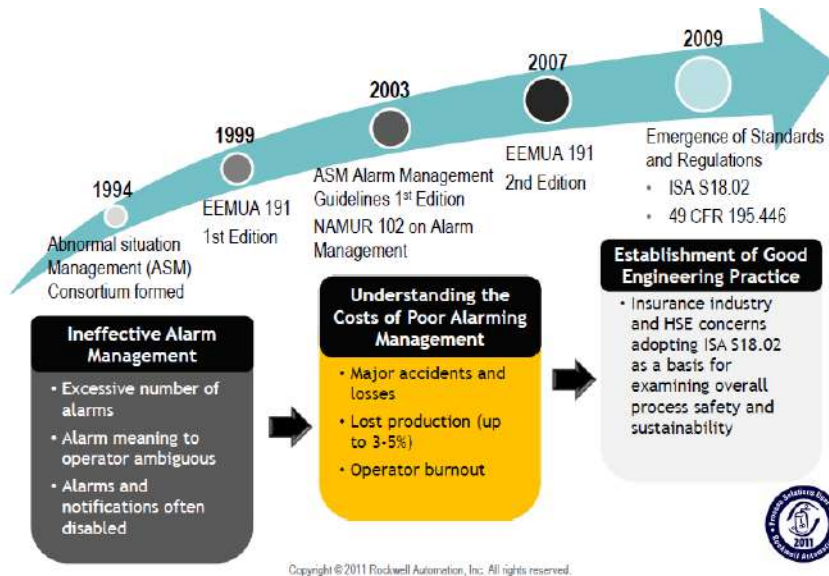
Activación
de alarma

Acción del
operador

Normas

- The nuclear Regulatory Commission from the United States: [NUREG/CR – 61056684](#)
- Engineering Equipment and Material User Association: [EEMUA-191](#)
- The Standardization Association for Measurement and Control in Chemical Industries: [NAMUR-NA-102](#)
- The USA-based Electric power Research Institute: [EPRI-1010076](#)
- The International Society of Automation and the International Electrotechnical Commission: [ANSI/ISA-18.2](#) and [IEC-68682](#)
- The American Petroleum Institute: [API-1167](#)

Normas



https://www.rockwellautomation.com/resources/downloads/rockwellautomation/pdf/events/automation-fair/2011/psug/afpsug11_ed16.pdf

<http://www.exida.com/Alarm-Management/Detail/alarm-philosophy>

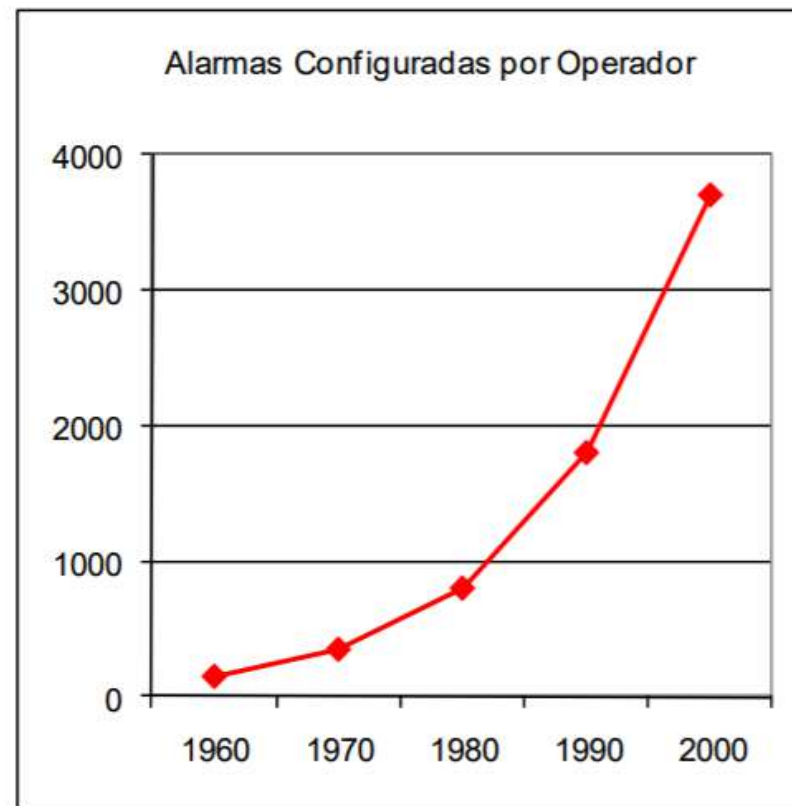
Estudios

- The European Commission's Community Research and Development Information Service supported the Fifth Framework Programme titled "Advanced decision support system for chemical/petrochemical manufacturing processes (2001–2004)"
- The Australian Research Council supported a project titled "Alarm management: silence is golden (2003–2007)"
- The Western Australia Energy Research Alliance supported a project titled "Adaptive optimization learning applied to real time alarm management (2008–2012)"
- Japan Society for the Promotion of Science formulated the 143rd Committee on Process System Engineering that supported a project titled "Alarm management (2009–2011)"
- The Natural Sciences and Engineering Research Council of Canada supported a strategic grant titled "Development of an advanced technology for alarm analysis and design (2009–2012)."
- The National Natural Science Foundation of China is supporting a project titled "Alarm design and removal methods and applications for highly efficient and safe operation of large-scale industrial systems (2015–2019)."

Tendencia de alarmas



Incremento de alarmas configuradas



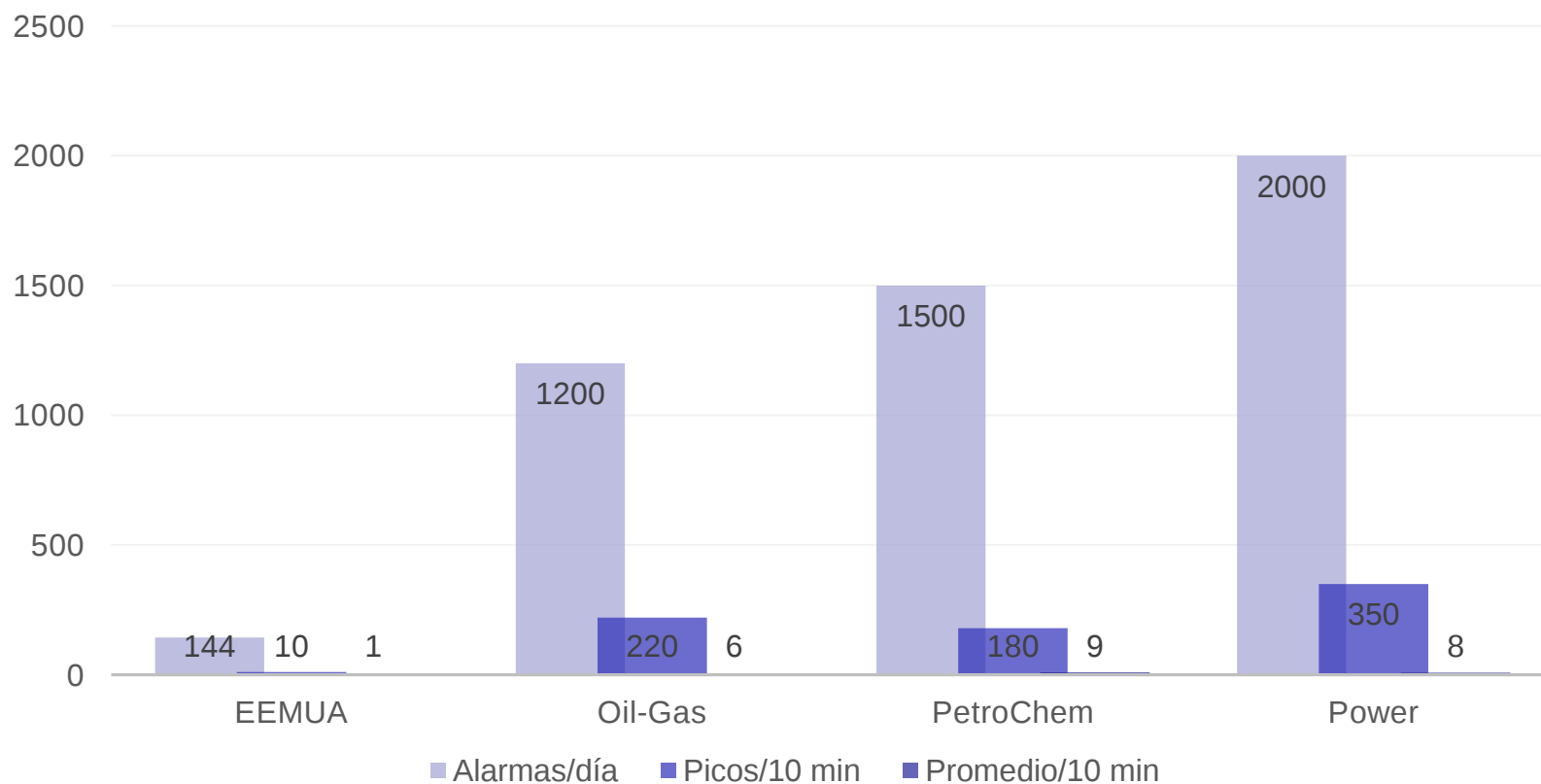
(Hollifield, 2011)

Refinería de Texaco Milford Haven

Metric	Target Value	
Annunciated Alarms per Time:	Target Value: Very likely to be Acceptable	Target Value: Maximum Manageable
Annunciated Alarms Per 10 Minutes per Operating Position	~ 1 (average)	~ 2 (average)
Percentage of hours containing more than 30 alarms	< 1%	
Percentage of 10-minute periods containing more than 5 alarms	< 1%	
Maximum number of alarms in a 10 minute period	10 or less	
Percentage of time the alarm system is in a flood condition	< 1%	
Percentage contribution of the top 10 most frequent alarms to the overall alarm load	1% to 5% maximum, with action plans to address	
Quantity for chattering and fleeting alarms	Zero, action plans to correct any that occur	
Stale Alarms	Less than 5 present on any day, with action plans to address	
Annunciated Priority Distribution	3 priorities: ~80% Low, ~15% Medium, ~5% High or 4 priorities: ~80% Low, ~15% Medium, ~5% High, <1% "highest" Other special-purpose priorities excluded from the calculation	
Unauthorised Alarm Suppression	Zero alarms suppressed outside of controlled or approved methodologies.	
Improper Alarm Attribute Change	Zero alarm attribute changes outside of approved methodologies or MOC.	



Estudio de la industria



(H.Rothenberg, 2009)

SISTEMAS INTELIGENTES Y GESTIÓN DE ALARMAS



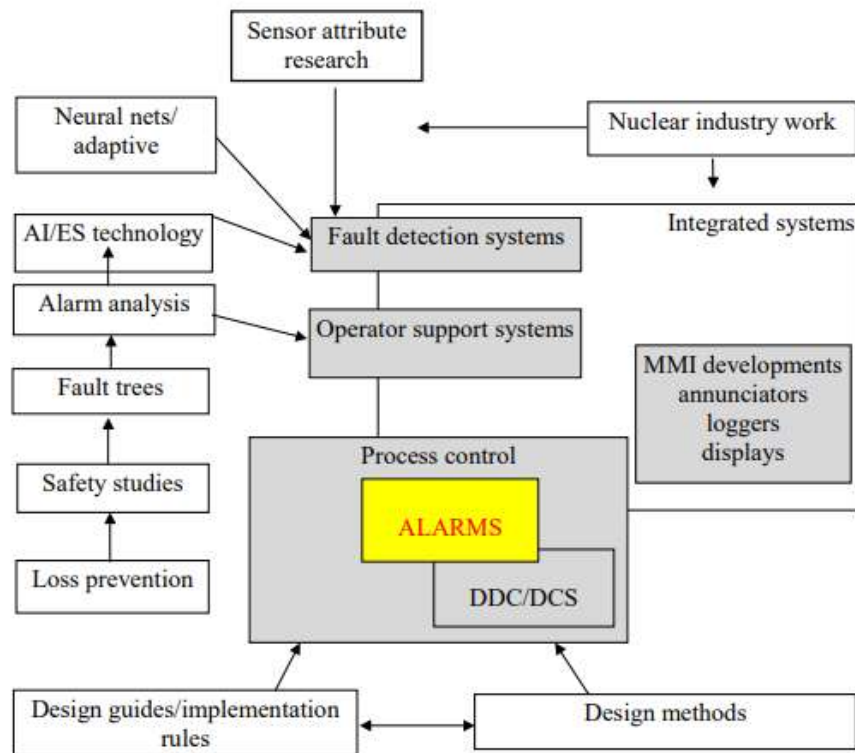
The screenshot shows the Schneider Electric EcoStruxure Power Designer software interface. The top menu bar includes File, Edit, View, Tools, Settings, Data, Help, and Application Settings. The left sidebar shows a project tree with components like Transformer, Breaker, and Protection. The main workspace displays a single-line diagram of a power system with a transformer, a circuit breaker, and a busbar. The bottom status bar shows the project name 'EcoStruxure Power Designer' and the version '1.0.0.0'.

Áreas de investigación actual



(Wang, Yang, Chen, & Shah, 2016)

Áreas de investigación actual



(Bransby & Jenkinson, 1998)

Áreas de investigación actual

Clusterización difusa

- Z. Geng, Q. Zhu, and X. Gu, “A fuzzy clustering-ranking algorithm and its application for alarm operating optimization in chemical processing,” Process Safety Progress, vol. 24, pp. 66–75, 2005

Algoritmos Genéticos

- F.Wen, C. S. Chang, and W. Fu, “New approach to alarm processing in power systems based upon the set covering theory and a refined genetic algorithm,” J. Electric Mach. Power Syst., vol. 26, pp. 53–67, 1998

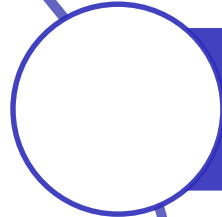
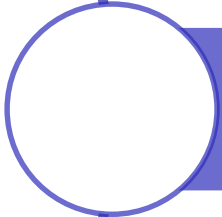
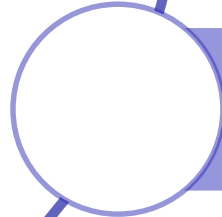
MFM

- F. Dashistrand, “Consequence analysis theory for alarm analysis,” Knowledge-Based Syst., vol. 15, pp. 27–36, 2002

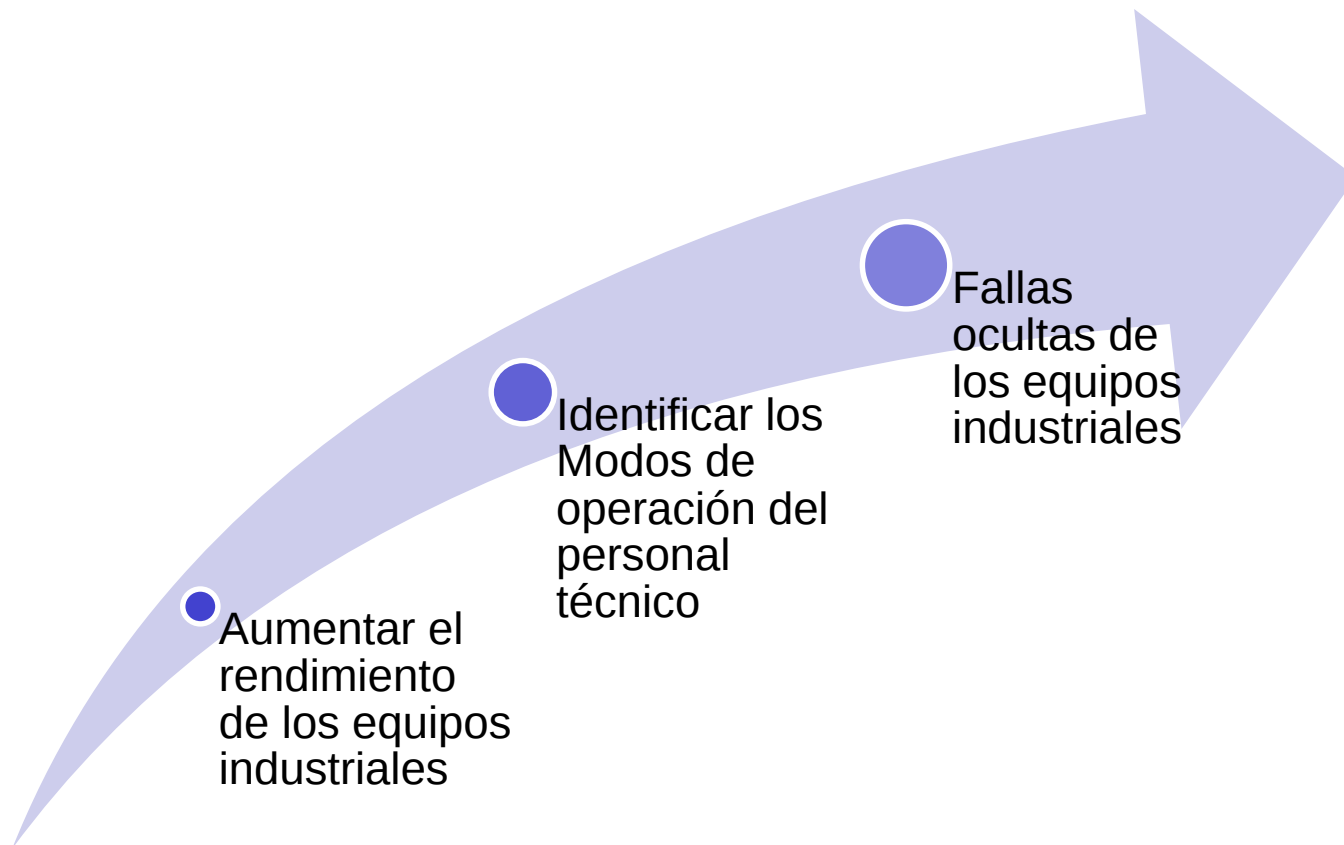
GESTIÓN DE ALARMAS Y GESTIÓN DE ACTIVOS



Importancia del gerenciamiento de alarmas

-  Fallas tempranas de equipos
-  Daño al medioambiente
-  Víctimas humanas

Aplicación en gestión de activos



Proyecto Gradient



- El objetivo principal del proyecto es la investigación para la creación de nuevas arquitecturas que permitan la captura y el análisis masivo de datos en entornos industriales

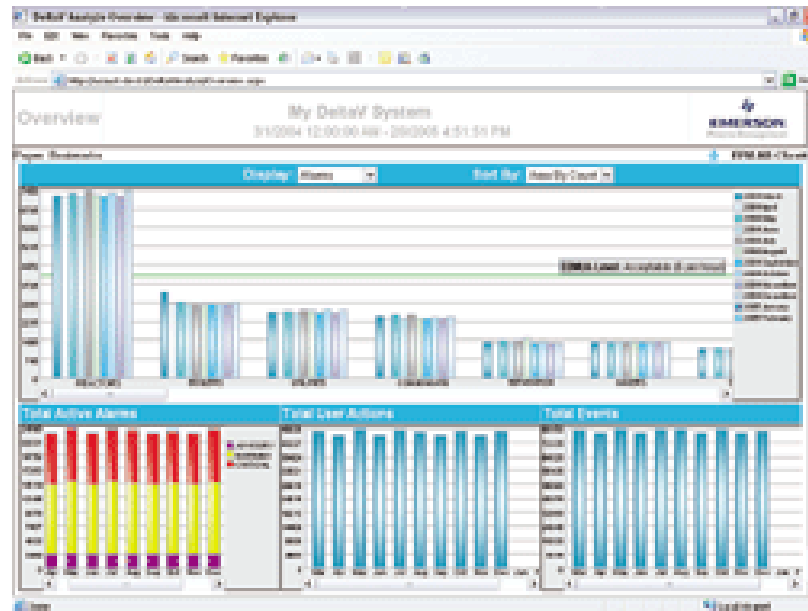
<https://www.gradient.org/proyectos/industria-4-0-arquitectura-la-captura-analisis-datos-industriales/>

¿CÓMO REALIZAR UN ACERCAMIENTO AL GERENCIAMIENTO DE ALARMAS?



Estudio de caso – Excel

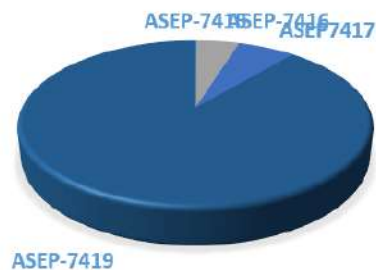
- Análisis de alarmas mediante el DeltaV Analyze



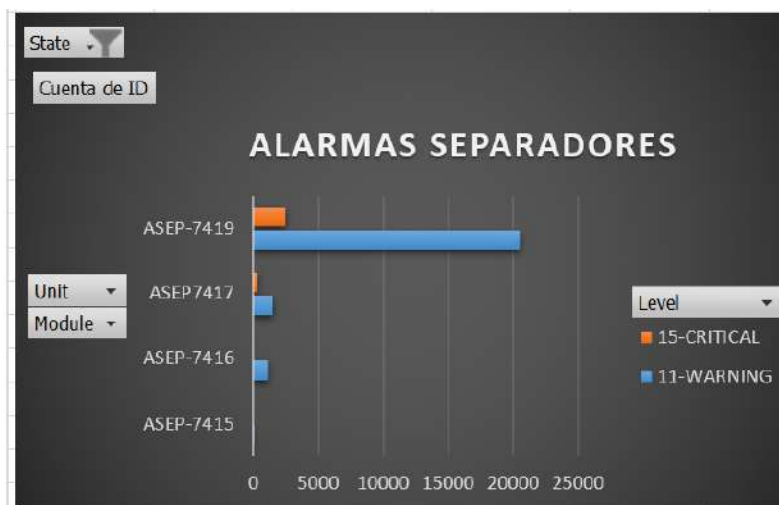
Excel – análisis de información

State ▼
Cuenta de ID

ALARMAS SEPARADORES

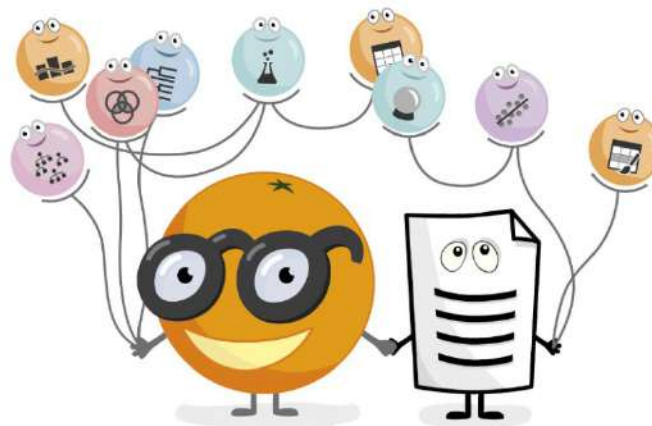


Level ▼

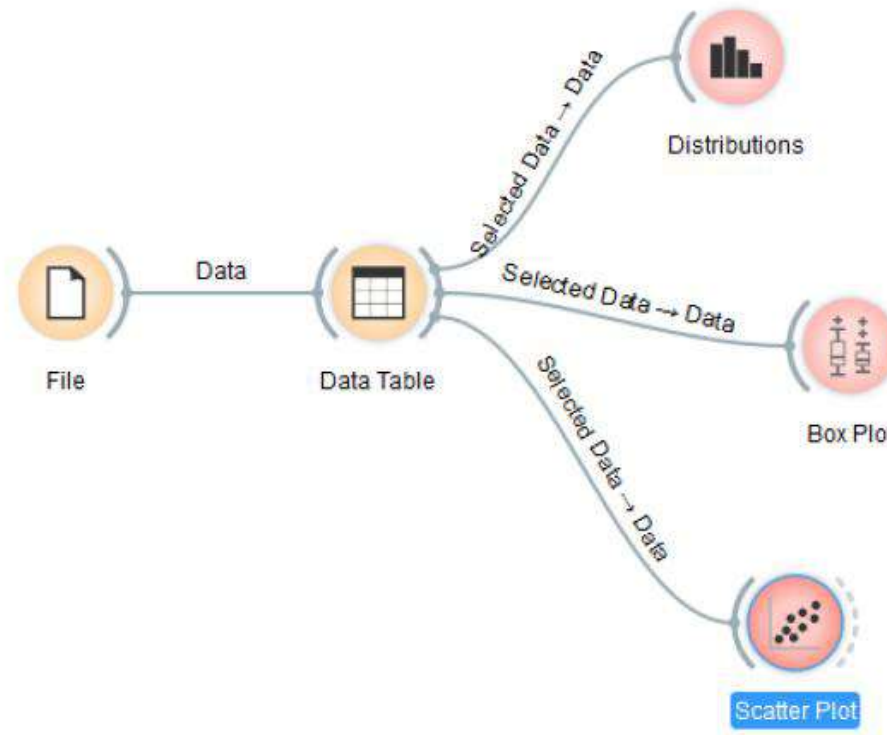


Estudio de caso – Orange Cannvas

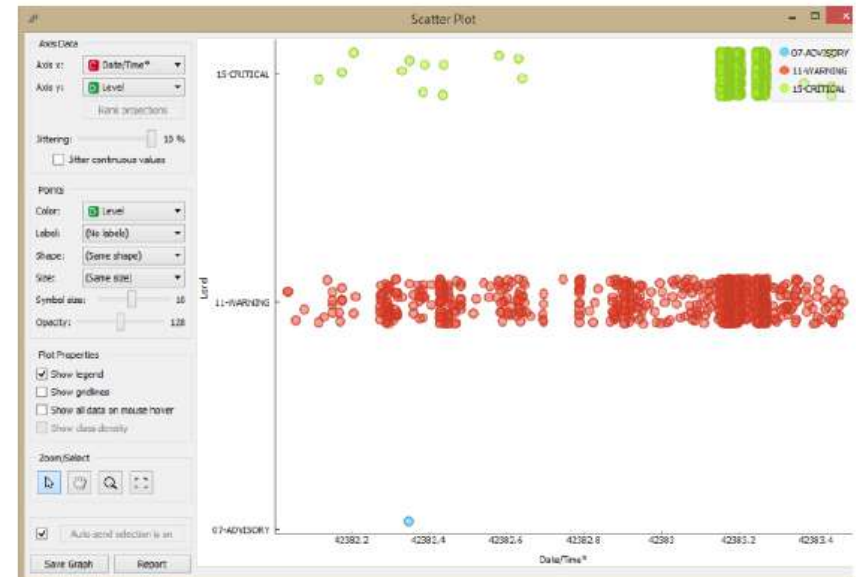
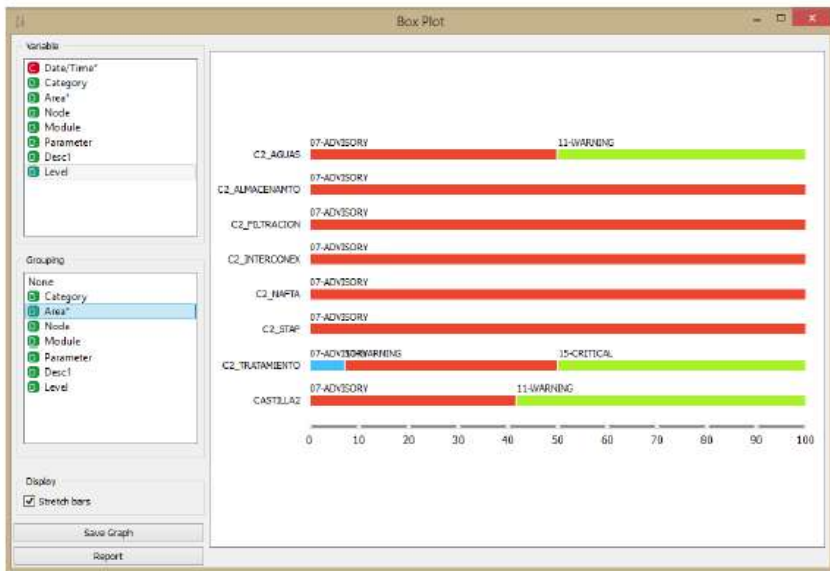
- Software Open Source para aprendizaje de maquina y visualización de información para novatos y expertos



Orange Canvas – Programación visual



Orange Canvas – visualización de la información



Conclusiones

- Los grandes volúmenes de información presentados en las crónicas de eventos de los sistemas de control precisan de análisis más detallados que permitan la identificación de fallos ocultos o de difícil percepción.
- Los análisis de correlación cruzada de las crónicas de eventos muestran la presencia de malos actores dentro de las crónicas de eventos analizadas. Es de precisar que no solo es requerido un proceso de gerenciamiento de alarmas sino de un proceso sistemático de las mismas para detección temprana de fallas.
- El análisis de posibles patrones de falla dentro de las crónicas de eventos crea la posibilidad de proyectar diferentes escenarios de operación para la planta industrial.
- Como tendencia para el análisis de grandes volúmenes de información es requerido herramientas que permitan el manejo de la misma, de una forma flexible y rápida como la presentada en el presente documento.

GRACIAS



PREGUNTAS