ISO 14224 Implementation Case Histories in the Americas

Pipeline, Offshore Drilling, and Oil Production Sectors

Reliability Dynamics

- Tony Ciliberti, Principal Engineer, Reliability Dynamics (USA), ISO/TC 67/WG 4 member
- Thiago Amato, Asset Integrity Engineer, Queiroz Galvão Óleo e Gás S.A. (Brazil)
- Gord Sandercock, Senior Maintenance Management Specialist, Pembina Pipeline Corporation (Canada)
- Ramesh Vora, Senior SAP PM Analyst, Nexen Energy (Canada)

International ISO standardization seminar for the reliability technology and cost area

Statoil Business Centre, Stavanger, Norway,26 April 2016

Reliability Dynamics LLC

Overview

- Registered engineering company, located in Indiana, USA
- Specialize in applying ISO 14224 solutions in corporate software
- Primary product is the *Industry Standard Solution for Plant Maintenance* (ISPM®)

Clients

- Queiroz Galvão - Óleo e Gás (QGOG)
- Pembina Pipeline Corporation
- Nexen Energy
- Maersk Drilling
- Marathon Oil
- Fortis Alberta

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Tony Ciliberti PE
Principal Engineer | Reliability Dynamics

- BS in Chemical Engineering from Texas A&M University, 1987
- Twenty-nine years as a reliability engineer in petrochemical, oil and gas
- Licensed Professional Engineer
- Four years with SAP Americas' National Practice (EAM Solution Architect)
- International/Industry standards involvement
  - ISO TC 67/WG4/PG1 (US expert): Collection and exchange of reliability and maintenance data for equipment
  - ISO TC67/WG4/PT2 (US expert): ISO 20815 Production Assurance and Reliability Management
  - CCPS PERD ERP Subcommittee Chair

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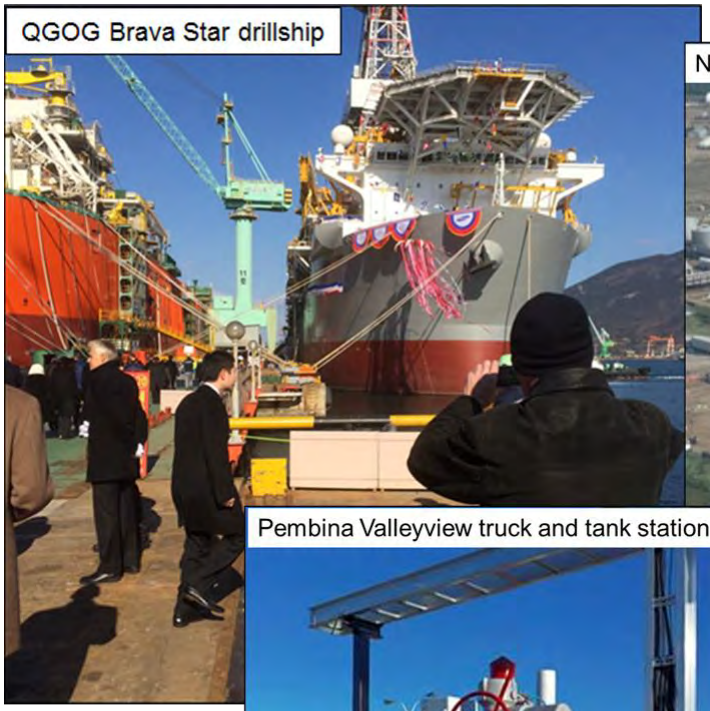
Facilities Overview: Application in Upstream, Midstream, and Downstream



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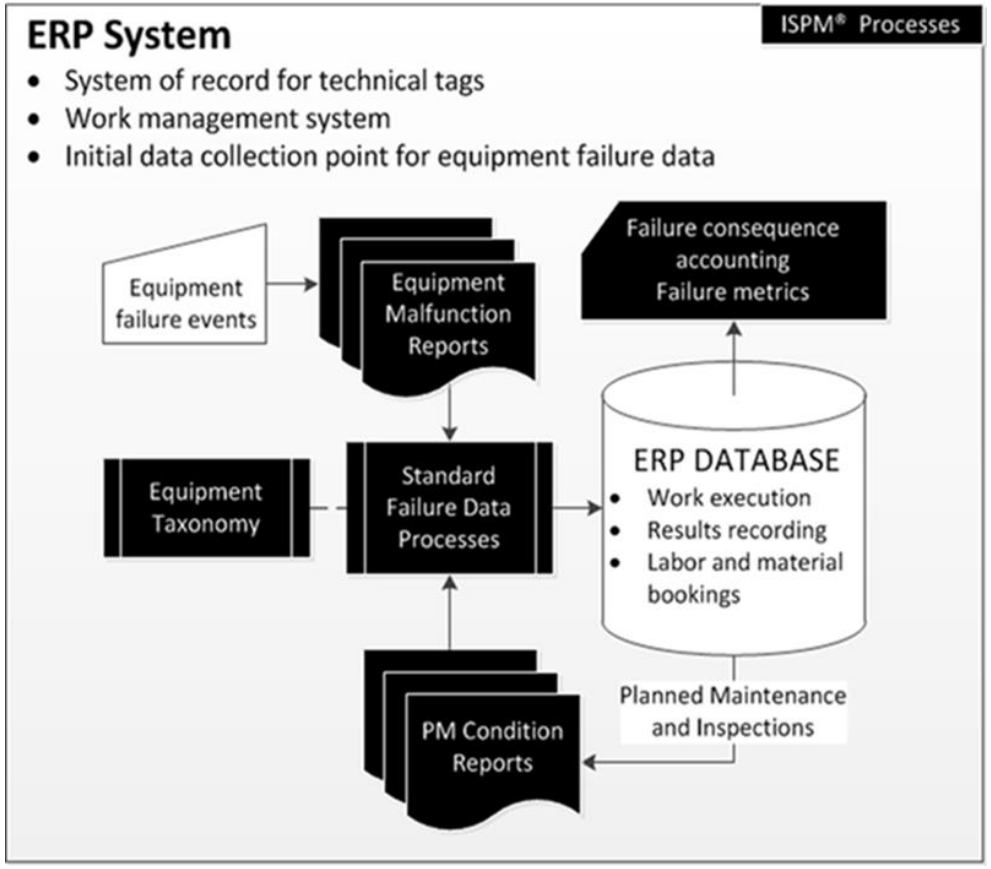
Industry Standard Solution for Plant Maintenance (ISPM®)

- Application of ISO 14224 methods in enterprise software (ERP)
  - Native to enterprise software
  - Built-into work management processes
- Equipment reliability metrics
  - Technical hierarchy
  - Malfunction reporting
  - Consequence accounting
  - PM condition reporting
  - Data quality assurance
  - Data aggregation

If you can't analyze 1000+ things at once, you're not doing it right!



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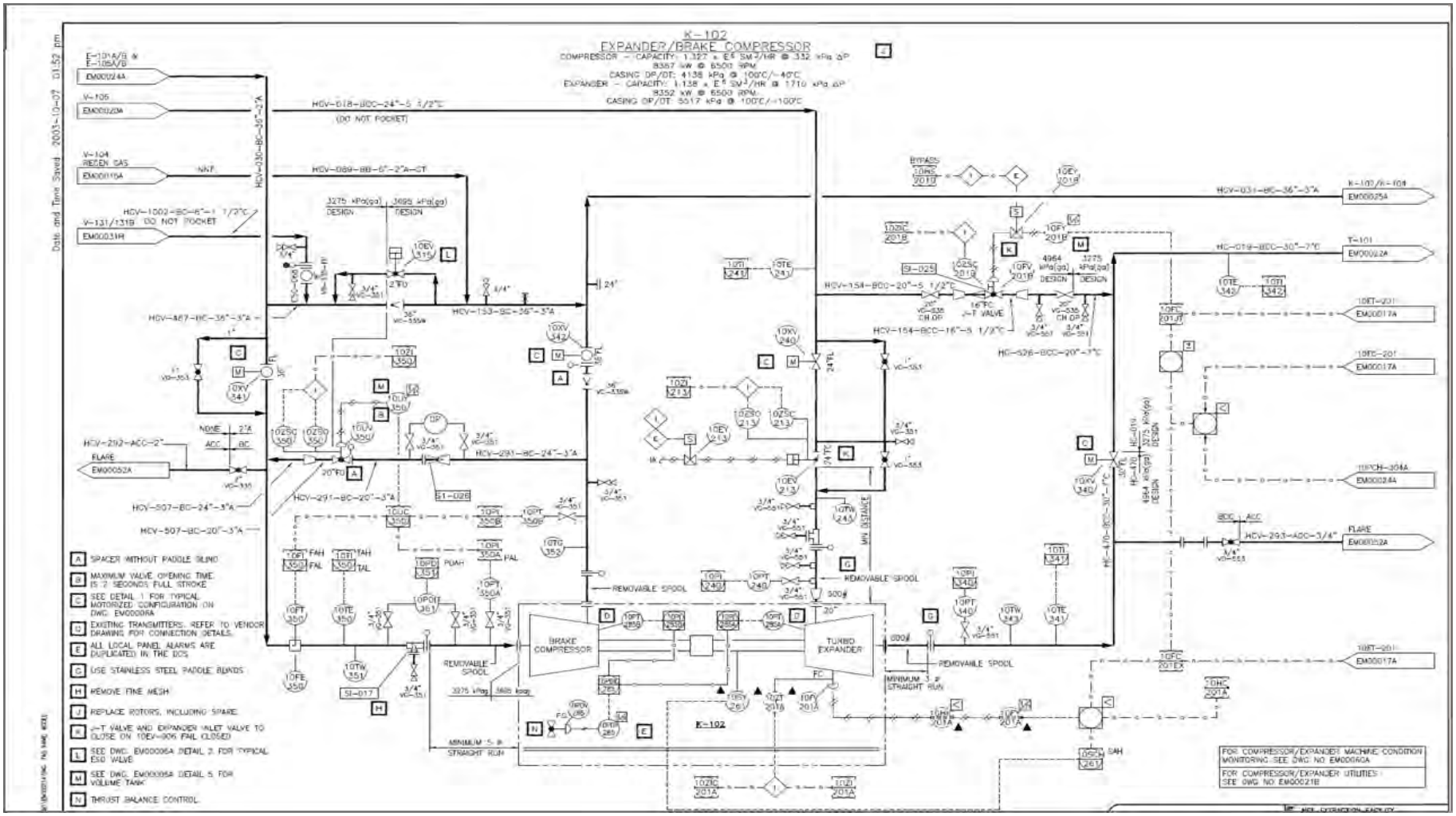
Construction of Technical Structure
Compressor Technical Drawings



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Construction of Technical Structure
Compressor Taxonomy Definition

ISO 14224:2006(E)

A.2.2.2 Compressors

Table A.8 — Type classification — Compressors

Equipment class — Level 6		Equipment type	
Description	Code	Description	Code
Compressor	CO	Centrifugal	CE
		Reciprocating	RE
		Screw	SC
		Blowers/fans	BL
		Axial	AX

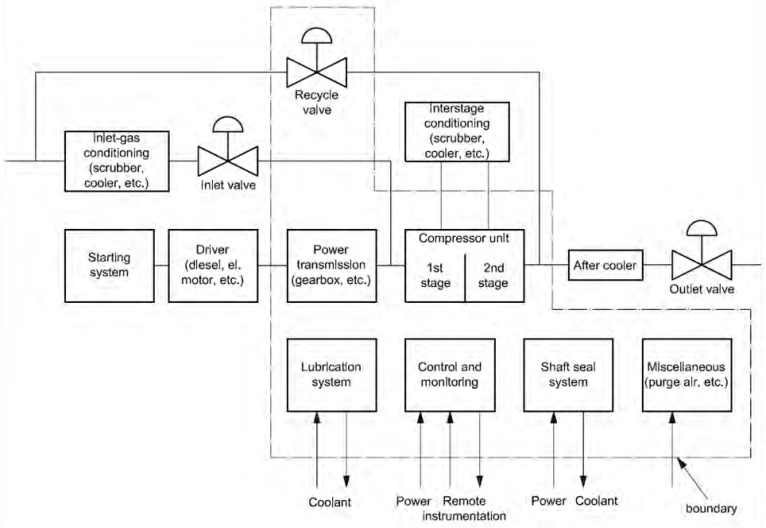

Figure A.2 — Boundary definition — Compressors

Table A.9 — Equipment subdivision — Compressors

Equipment class	Compressors					
Subunit	Power transmission	Compressor	Control and monitoring	Lubrication system	Shaft seal system	Miscellaneous
Maintainable item/Part	Gearbox/ variable drive Bearings Coupling to the driver Coupling to the driven unit Lubrication Seals	Casing Rotor with impellers Balance piston Interstage seals Radial bearing Thrust bearing Shaft seals Internal piping Valves Antisurge system [b] Piston Cylinder liner Packing	Actuating device Control unit Cables and junction boxes Internal power supply Monitoring Sensors [a] Valves Wiring Piping Seals	Oil tank with heating system Pump Motor Check valves Coolers Filters Piping Valves Lube oil	Oil tank with heating Reservoir Pump Motor Gear Filters Valves Seal oil Dry gas seal Mechanical seal Scrubber	Base frame Piping, pipe support and bellows Control valves Isolation valves Check valves Coolers Silencers Purge air Magnetic-bearing control system Flange joints

[a] Specify type of sensor, e.g. pressure, temperature, level, etc.

[b] Including recycle valve and controllers.

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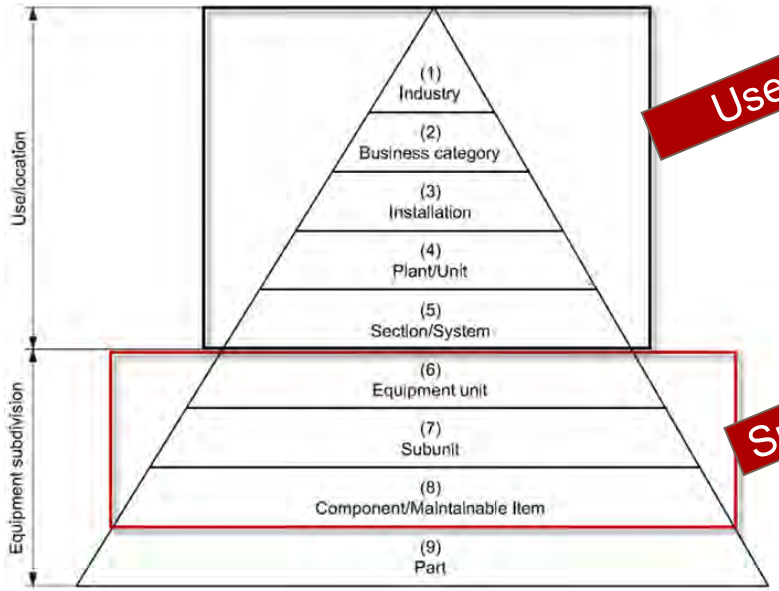
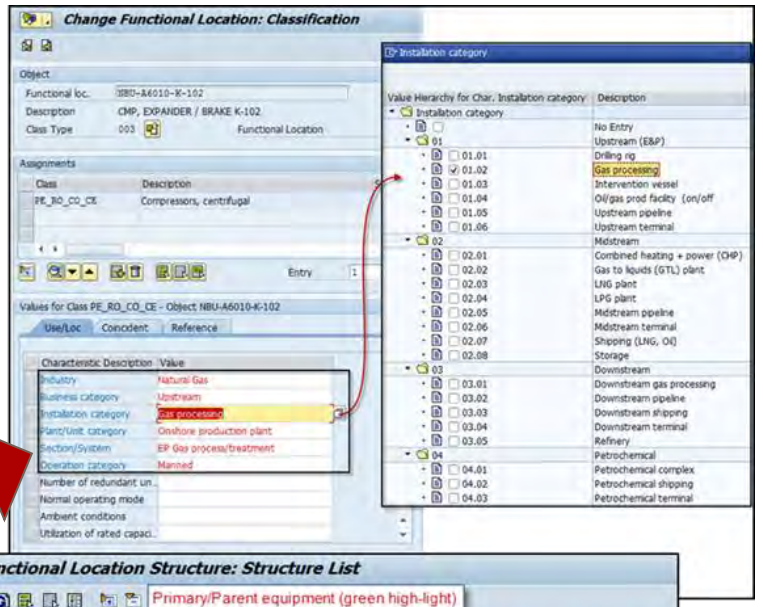
Technical Structure

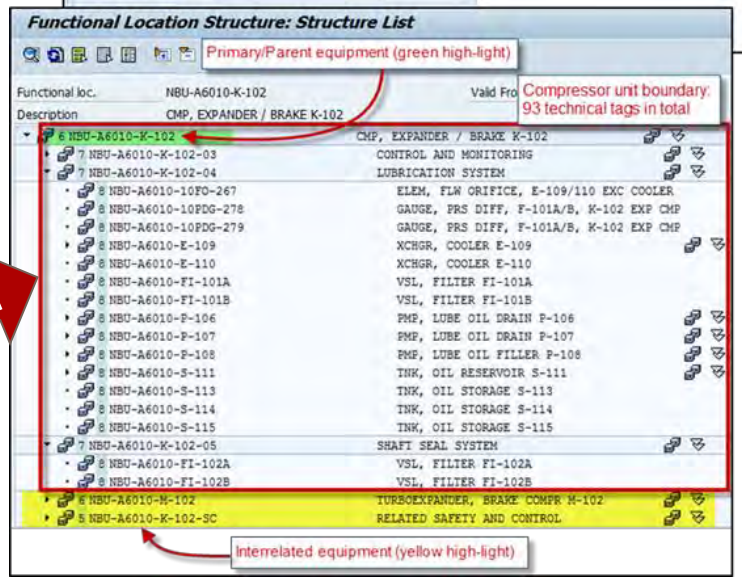
- ERP is system of record for all technical tags
- One unique ID for each tag throughout all systems, records, and in the field
- Equipment interrelationships defined in system



Use/Location

Subdivison





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Malfunction Reporting
Impart Data Quality on Inception

Step	Details	Responsibility
Work Initiation	Problem Report (equipment-level failure notations)	Facility personnel
Approvals and processing	Work approval, planning and scheduling, create statistical records	Operations Superintendent
Execution, repair notes, and close-out	Repair Report (item-level failure notations)	Maintenance Lead Technician
Failure data quality assurance	QA, consequence assessment , and methods feedback	Reliability Engineer

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Malfunction Problem Report (Work Initiation)
Equipment-Level Notations

9.5 Failure data

A uniform definition of failure and a method of classifying failures are essential when it is necessary to combine data from different sources (plants and operators) in a common RM database.

A common report, as given in Table 6 (see also Table 3), for all equipment classes shall be used for reporting failure data. For some equipment classes, e.g. subsea equipment, minor adaptations can be necessary.

The minimum data needed to meet the objectives of this International Standard are identified by (*). However, the addition of certain other data categories can significantly improve the potential usability of the RM data; see Annex D.

Table 6 — Failure data

Category	Data to be recorded	Description
Identification	Failure record (*)	Unique failure record identification
	Equipment identification/Location (*)	E.g. tag number (see Table 5)
Failure data	Failure date (*)	Date of failure detection (year/month/day)
	Failure mode (*)	Usually at equipment-unit level (level 6) (see B.2.6) [a]
	Failure impact on plant safety (e.g. personnel, environment, assets) [b]	Usually zero, partial or total
	Failure impact on plant operations (e.g. production, drilling, intervention) [b]	Usually zero, partial or total
	Failure impact on equipment function (*)	Effect on equipment-unit function (level 6): critical, degraded, or incipient failure [c]
	Failure mechanism	The physical, chemical or other processes which have led to a failure (see Table B.2)
	Failure cause [d]	The circumstances during design, manufacture or use which have led to a failure (see Table B.3)
	Subunit failed	Name of subunit that failed (see examples in Annex A)
	Component/Maintainable item(s) failed	Name of the failed maintainable item(s) (see Annex A)
	Detection method	How the failure was detected (see Table B.4)
	Operating condition at failure	Running, start-up, testing, idle, standby
Remarks	Additional information	Give more details, if available, on the circumstances leading to the failure: failure of redundant units, failure cause(s) etc.

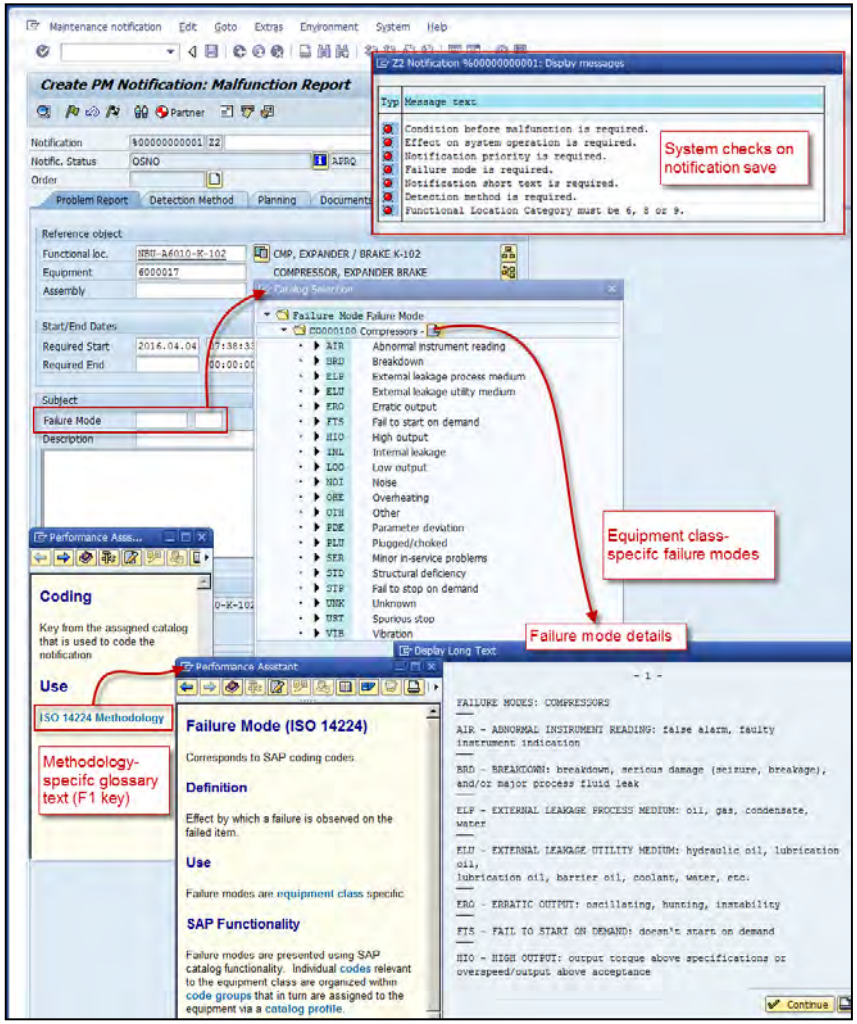
[a] For some equipment categories such as subsea equipment, it is recommended to also record failure modes on taxonomic levels lower than the equipment-unit level.

[b] See example of failure consequence classification in Table B.2.

[c] For some equipment categories and applications it may be sufficient to record critical and non-critical (degraded + incipient) failures only.

[d] The failure cause and sometimes the failure mechanism are not known when the data are collected, as they commonly require a root cause analysis to be performed. Such analysis shall be performed for failures of high consequence, high repair/down time cost, or failures occurring significantly more frequent than what is considered "normal" for this equipment unit class ("worst actors").

(*) indicates the minimum data that shall be collected.



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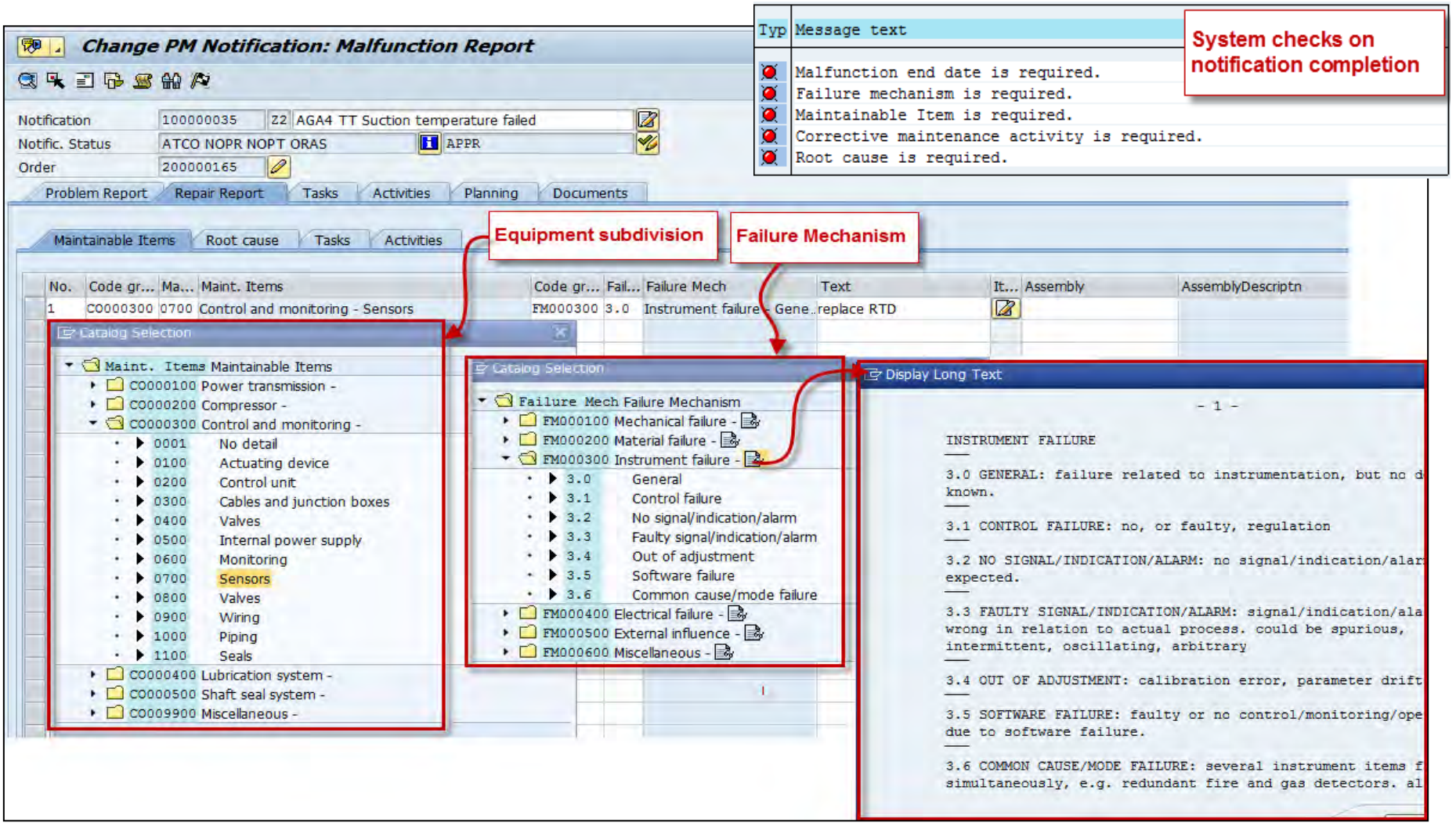
Malfunction Repair Report (Work Close-out)
Component-Level Notations



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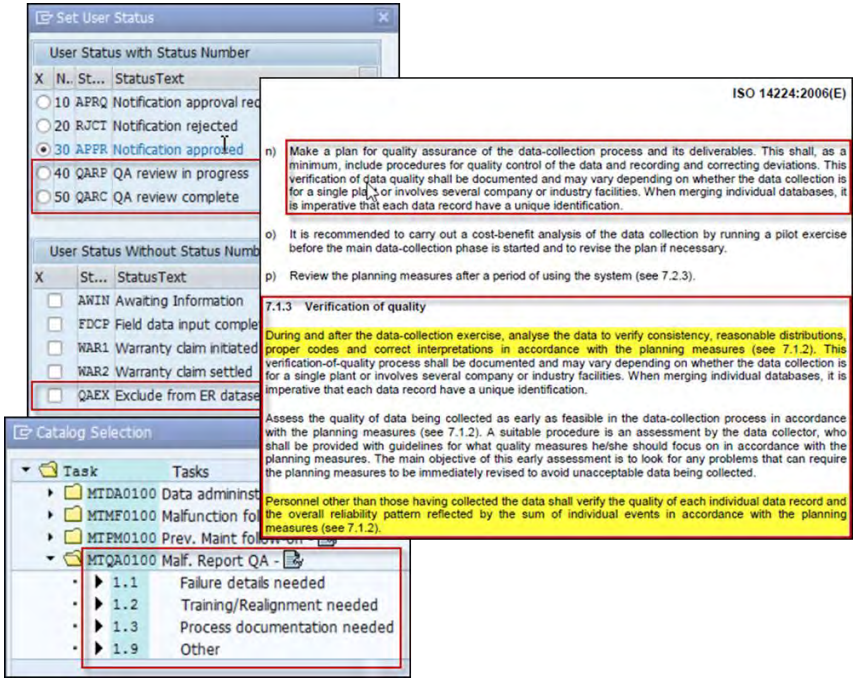
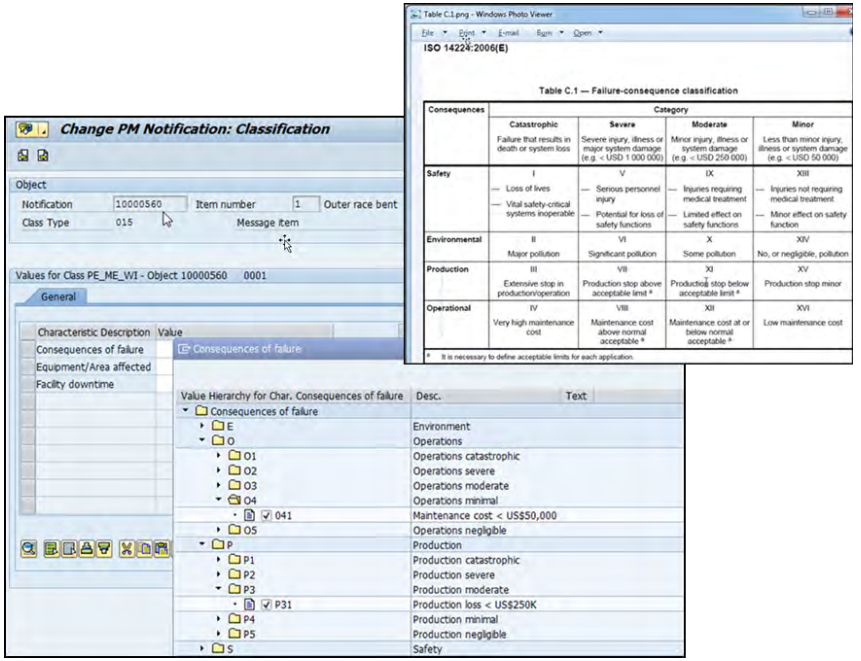
Failure Data Quality Assurance

Failure Event Review



Consequence Assessment



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Data Aggregation

Functional Location Structure: Structure List

Primary/Parent equipment (green high-light)

Compressor unit boundary: 93 technical tags in total

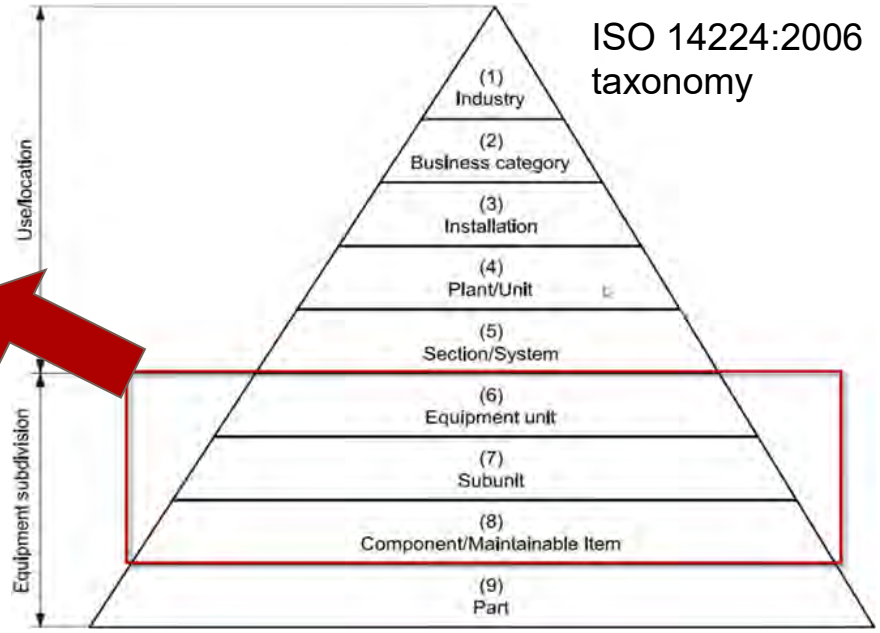
Functional loc. NBU-A6010-K-102 Valid Fro

Description CMP, EXPANDER / BRAKE K-102

6 NBU-A6010-K-102	CMP, EXPANDER / BRAKE K-102
7 NBU-A6010-K-102-03	CONTROL AND MONITORING
7 NBU-A6010-K-102-04	LUBRICATION SYSTEM
8 NBU-A6010-10FO-267	ELEM, FLW ORIFICE, E-109/110 EXC COOLER
8 NBU-A6010-10PDG-278	GAUGE, PRS DIFF, F-101A/B, K-102 EXP CMP
8 NBU-A6010-10PDG-279	GAUGE, PRS DIFF, F-101A/B, K-102 EXP CMP
8 NBU-A6010-E-109	XCHGR, COOLER E-109
8 NBU-A6010-E-110	XCHGR, COOLER E-110
8 NBU-A6010-FI-101A	VSL, FILTER FI-101A
8 NBU-A6010-FI-101B	VSL, FILTER FI-101B
8 NBU-A6010-P-106	PMP, LUBE OIL DRAIN P-106
8 NBU-A6010-P-107	PMP, LUBE OIL DRAIN P-107
8 NBU-A6010-P-108	PMP, LUBE OIL FILLER P-108
8 NBU-A6010-S-111	TNK, OIL RESERVOIR S-111
8 NBU-A6010-S-113	TNK, OIL STORAGE S-113
8 NBU-A6010-S-114	TNK, OIL STORAGE S-114
8 NBU-A6010-S-115	TNK, OIL STORAGE S-115
7 NBU-A6010-K-102-05	SHAFT SEAL SYSTEM
8 NBU-A6010-FI-102A	VSL, FILTER FI-102A
8 NBU-A6010-FI-102B	VSL, FILTER FI-102B
6 NBU-A6010-M-102	TURBOEXPANDER, BRAKE COMPR M-102
5 NBU-A6010-K-102-SC	RELATED SAFETY AND CONTROL

K-102 technical structure

Interrelated equipment (yellow high-light)



ISO 14224:2006 taxonomy

Display Notifications: List of Notifications

FEL notifications are auto-generated at the equipment level when the initial "native notification is generated at a component level. These system-generated statistical notifications enable TRUE equipment-level failure metrics with standard SAP reporting.

Typ	P	Notification	Description	Functional Loc.	Description of functional location	Malfunct. start	MalfStrt	E	CBM	B	Downtime	Unit
Z2	2	100000031	AGA4 TT Suction Temperature	NBU-A6010-K-102	CMP, EXPANDER / BRAKE K-102	2015.02.10	14:20:37	2	1		0.00	H
Z2	1	100000035	AGA4 TT Suction temperature failed	NBU-A6010-K-102	CMP, EXPANDER / BRAKE K-102	2015.02.10	07:49:38	3	1	X	424.17	H
Z5	3	100000113	PRB:LUBRICATION SYSTEM	NBU-A6010-K-102	CMP, EXPANDER / BRAKE K-102	2015.02.13	10:57:20	2	1		0.00	H
Z5	3	100000495	PRB:LUBRICATION SYSTEM	NBU-A6010-K-102	CMP, EXPANDER / BRAKE K-102	2015.04.17	09:25:37	2	1		0.00	H
Z5	3	100000508	PRB:LUBRICATION SYSTEM	NBU-A6010-K-102	CMP, EXPANDER / BRAKE K-102	2015.04.20	09:16:05	1	1		0.00	H
Z5	3	100000660	PRB:LUBRICATION SYSTEM	NBU-A6010-K-102	CMP, EXPANDER / BRAKE K-102	2015.05.21	20:20:54	2	1		0.00	H
Z5	5	100000807	PRB:LUBRICATION SYSTEM	NBU-A6010-K-102	CMP, EXPANDER / BRAKE K-102	2015.06.23	09:03:47	2	1		0.00	H
Z5	5	100000808	PRB:LUBRICATION SYSTEM	NBU-A6010-K-102	CMP, EXPANDER / BRAKE K-102	2015.06.23	09:07:57	2	1		0.00	H
Z5	3	100000925	PRB:LUBRICATION SYSTEM	NBU-A6010-K-102	CMP, EXPANDER / BRAKE K-102	2015.07.20	11:47:00	1	1		0.00	H
Z5	4	100000983	PRB:LUBRICATION SYSTEM	NBU-A6010-K-102	CMP, EXPANDER / BRAKE K-102	2015.07.30	13:41:46	1	1		0.00	H

K-102 aggregated failure data

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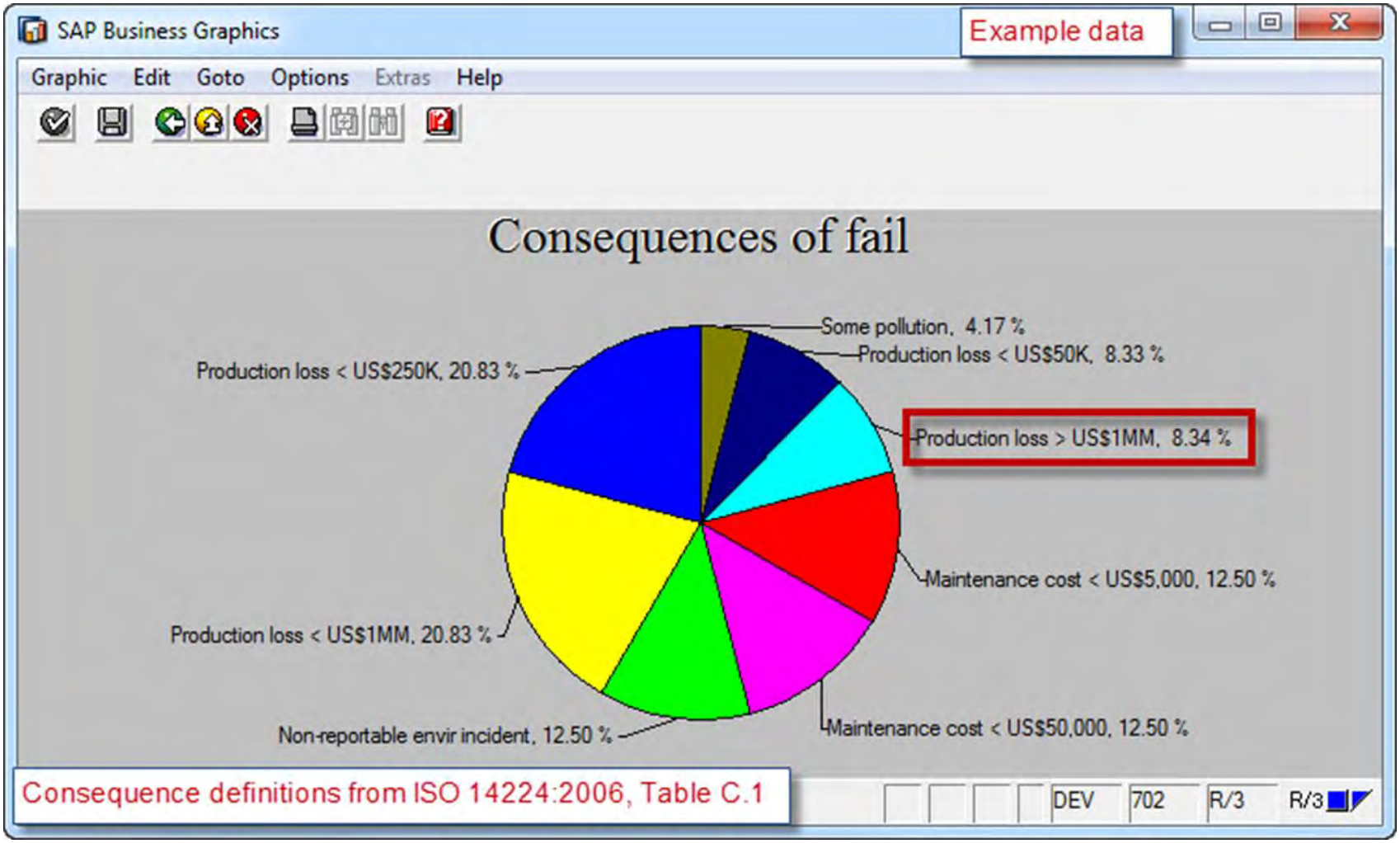
Consequence Accounting
Where is your pain?



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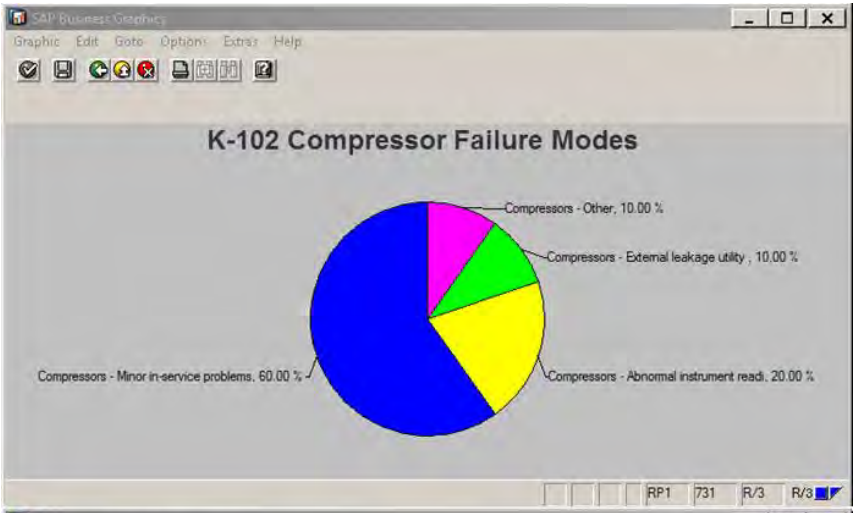
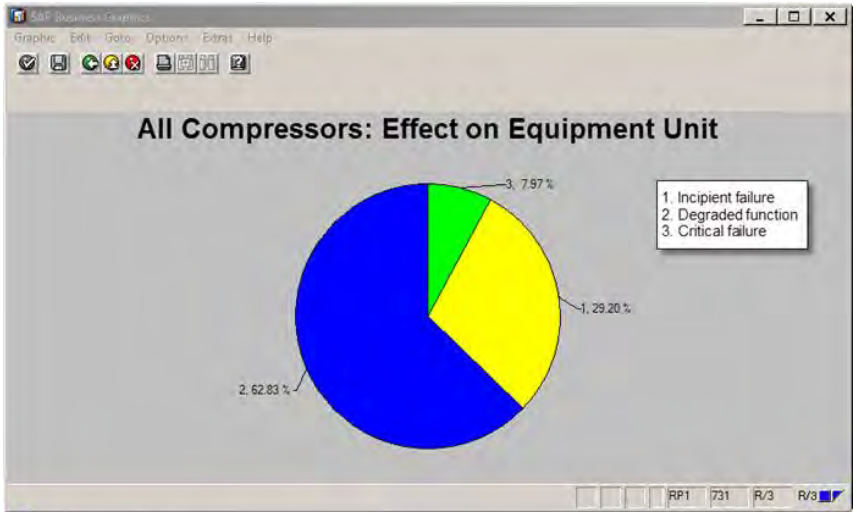
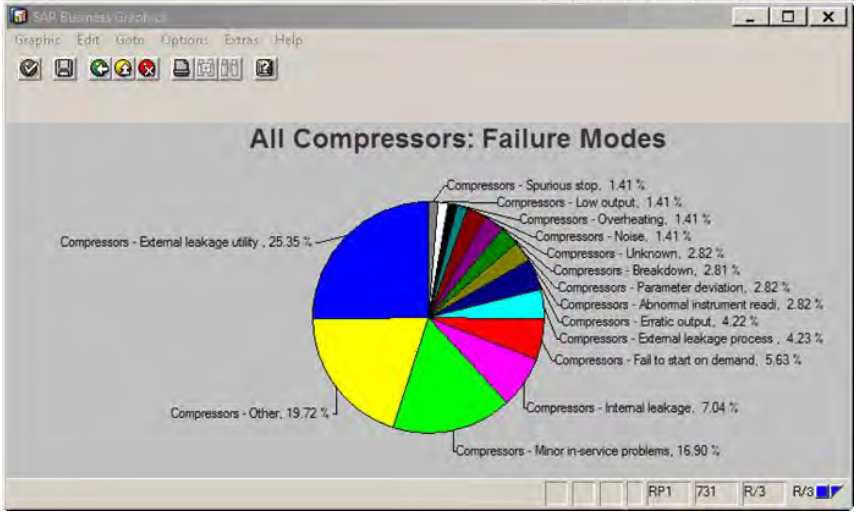
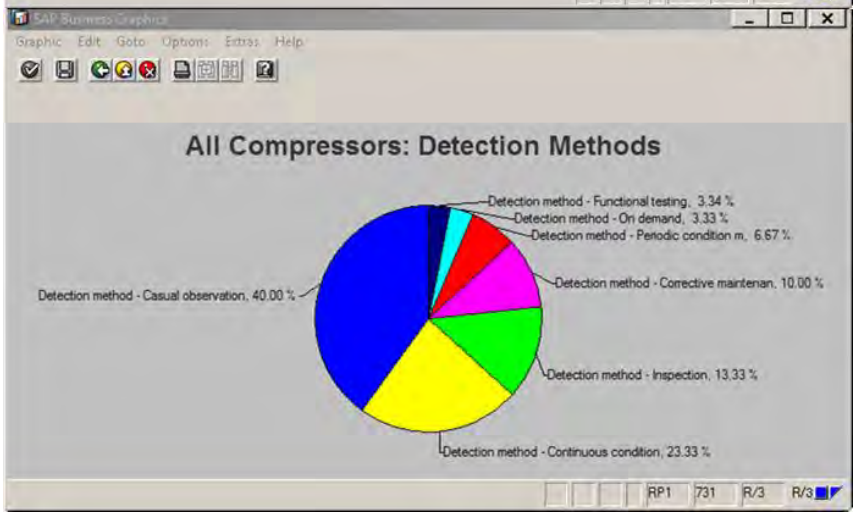
Equipment-Level Analysis









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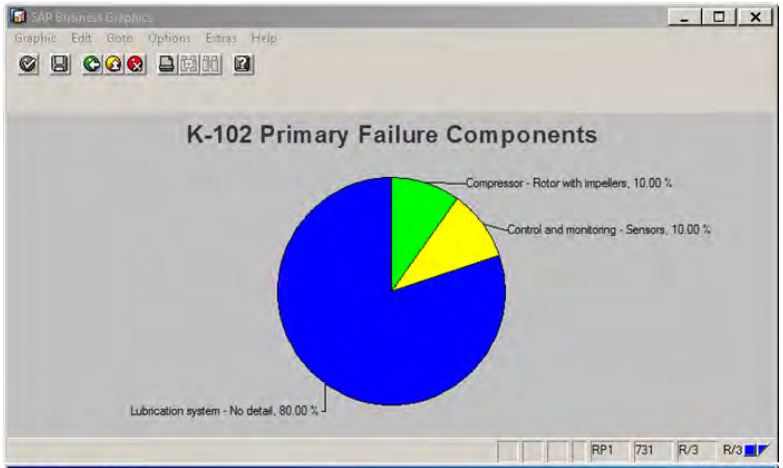
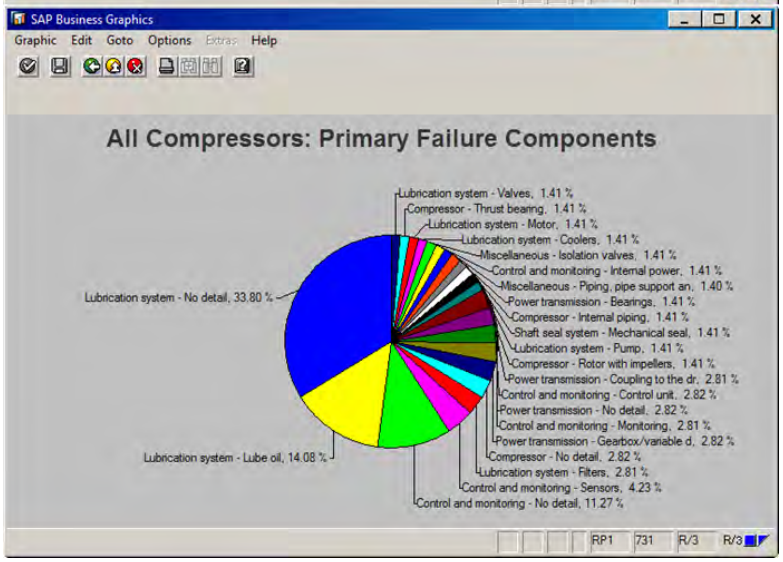
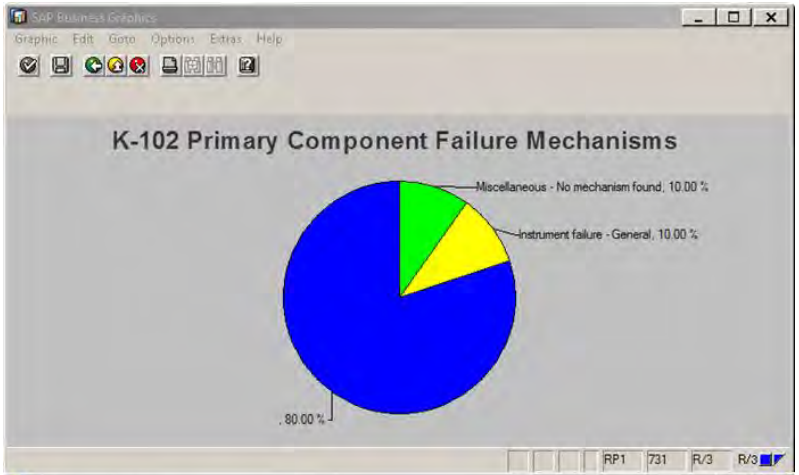
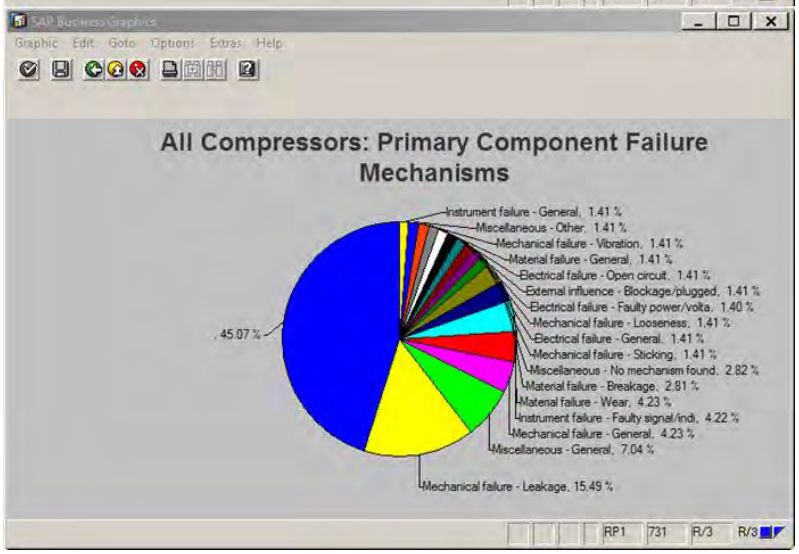
Component-Level Analysis









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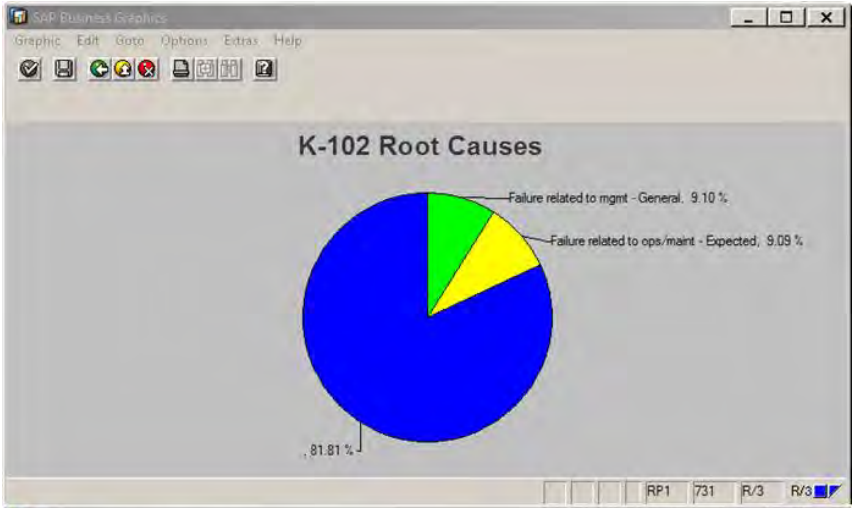
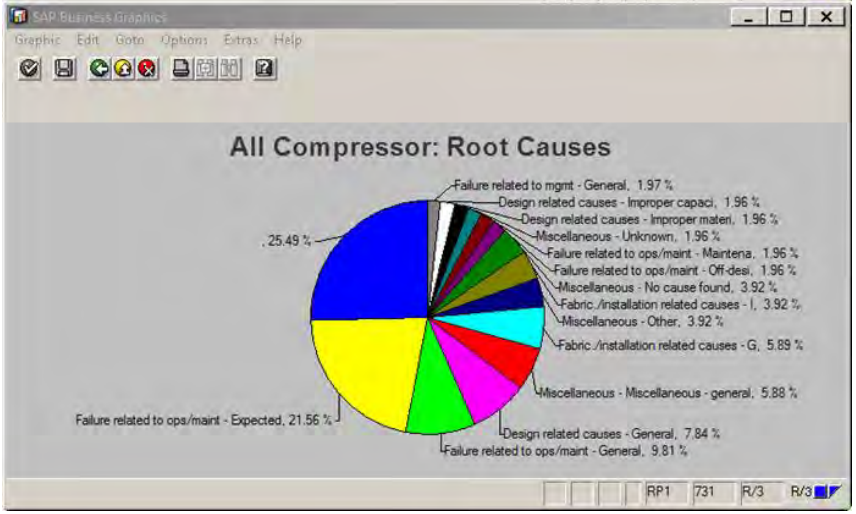
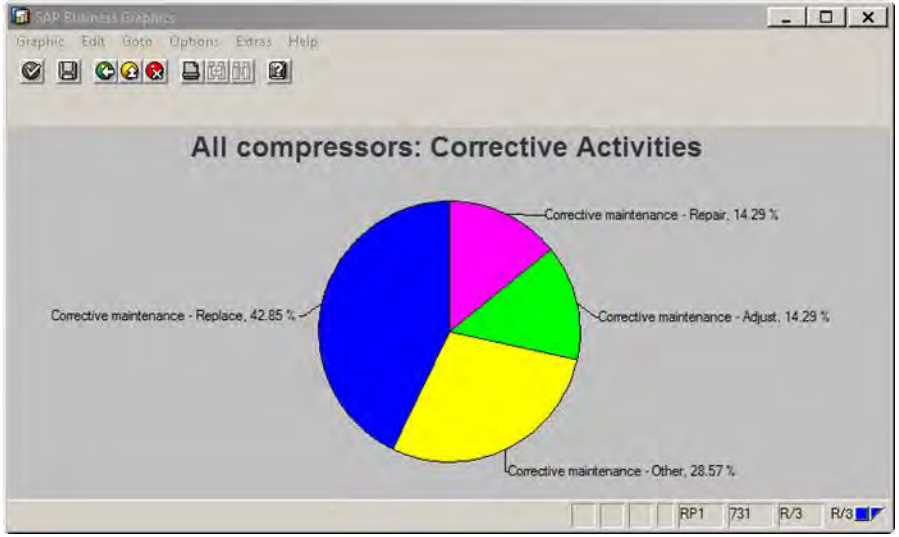
Component-Level Analysis







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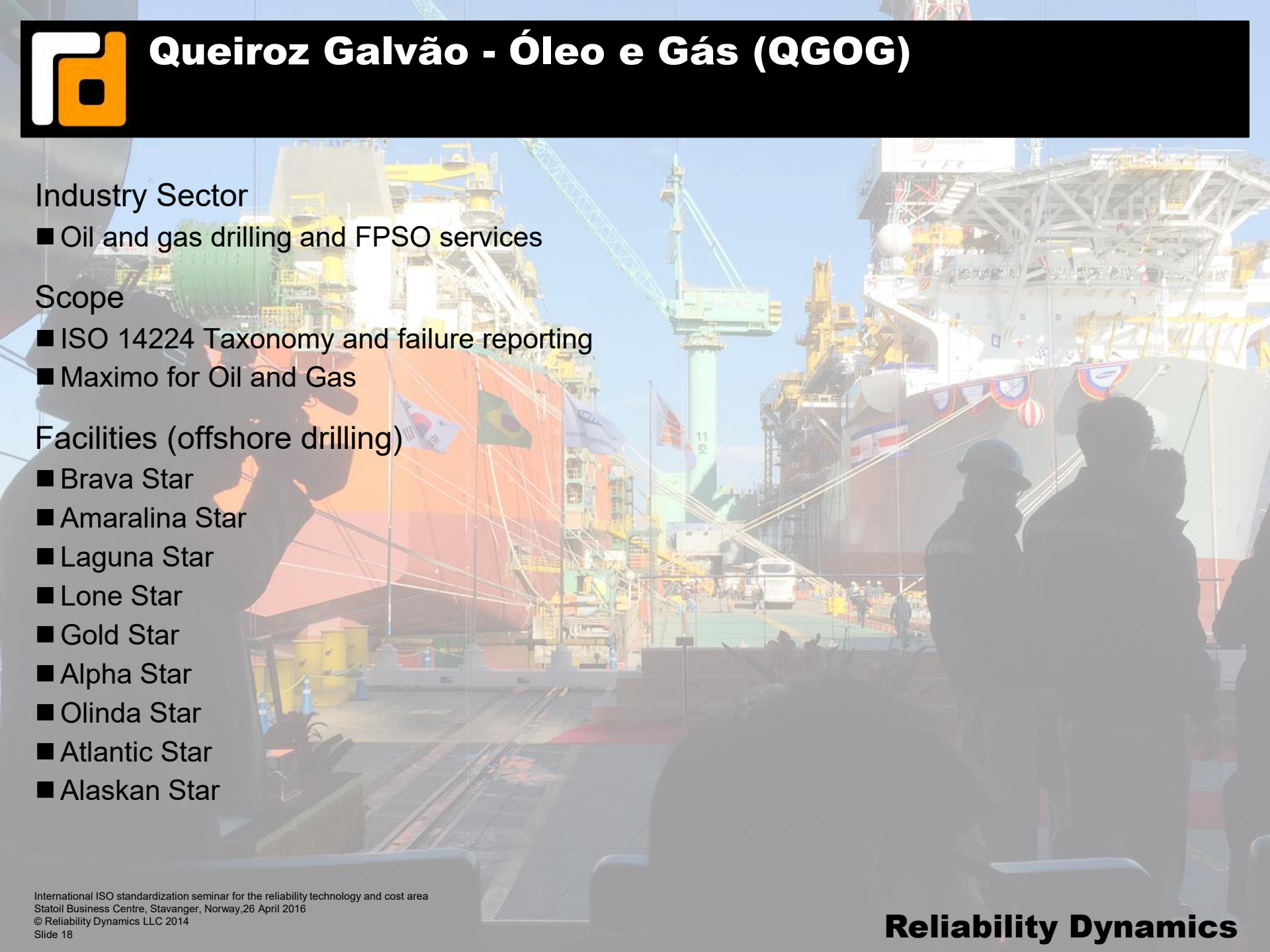

Industry Sector

- Oil and gas drilling and FPSO services

Scope

- ISO 14224 Taxonomy and failure reporting
- Maximo for Oil and Gas

Facilities (offshore drilling)

- Brava Star
- Amaralina Star
- Laguna Star
- Lone Star
- Gold Star
- Alpha Star
- Olinda Star
- Atlantic Star
- Alaskan Star

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Thiago Amato
Corporate Asset Integrity Engineer | QGOG

- BS in Mechanical Engineering, State University of Rio de Janeiro, 2005
- MBA in Maintenance Management, Federal University of Rio de Janeiro, 2008
- MBA in Project Management, FGV, 2015
- Eleven years as maintenance and reliability engineer in the oil and gas sector, including Sparrows BSM, National Oilwell Varco, and Archer the Well Company
- Role with QGOG
  - Corporate maintenance expert and advisor
  - Best practice evaluation and implementation
  - Ops and Maintenance setup for new builds
  - Maintenance process reviews
  - Represent QGOG in rig audits

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QGOG Taxonomy Construction

FL Category	FL Type	Description	Source (Basis and/or Standard Practice)
0	FAL	Enterprise	
1	FAL	Business Area	Onshore/Offshore
2	FAL	Rig ID	Rig ID
3	FAL	SFI Main Group	Xantic SFI Group System: N
4	FAL	SFI Group	Xantic SFI Group System: NN
5	FAL	SFI Subgroup	Xantic SFI Group System: NNN
6	FEL	ISO 14224 Equipment	Convention: [Rig ID]-[Tag number]
7	FAL	ISO 14224 Subunit	Convention: [Rig ID]-[Level 6 Tag number]-[SU]
8	FCL	ISO 14224 Maintainable Item	Convention: [Rig ID]-[Tag number]
U	FAL	Unstructured Equipment	
C	FAL	Collective failure reporting	
G	FAL	Generic Grouping Level	

Legend

1. N = numeric character
2. SU = Two-character Subunit ID
3. [Tag number] = engineering/technical tag for equipment or group

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Equipment Taxonomy Example: Subsea BOP

- Integrates Xantic SFI, ISO 14224 standards into one coherent taxonomy
- All engineering tags are represented with functional and materialized master records
- Engineering tags are structured to match ISO 14424 equipment subdivision

Table A.94 — Equipment subdivision — Blowout preventer (BOP)

Equipment unit	Blowout preventer (BOP)				
Subunit	**Preventers, valves and lines**	**Hydraulic connectors**	**Flexible joint (subsea BOP)**	**Control system**	**Backup control system**
Maintainable items	**Annular preventers** Body Flanges Packing element Hydraulic piston Seals **Ram preventers** Body Flanges Ram block Ram seals Shear blade Piston Seals **Kill-and-choke valves** Actuator Gooseneck house Gate Seals **Kill-and-choke lines** Riser-attached line Couplers Seals	**LMRP and wellhead connector** Body Locking mechanism Piston Main-bore seal ring Seals	Flexible element Housing Flanges	**Subsea** Pod stingers Pilot valves Shuttle valves Accumulators Pressure regulator valves Hydraulic control fluid Seals Piping Hydraulic bundles (pilot lines and main supply) Multiplex cables Rigid hydraulic supply line **Surface** Control panels Surface control unit Hydraulic power unit Pod reels Pod selector valve	**Subsea** Solenoid valves Pilot valves Shuttle valves Accumulators Subsea control unit Battery Transducers **Surface** Surface control unit Transducers

Functional Location Structure: Structure List

Levels above | Expand whole

Functional loc. BVS-3D3101 | Valid From 01/26/2016

Description BOP COMPLETE UNIT

6 BVS-3D3101	BOP COMPLETE UNIT — Primary Equipment
7 BVS-3D3101-04	PRIMARY CONTROL SYSTEM (SURFACE)
8 BVS-3D32206	BOP HYD.POWER UNIT & FLUID MIX SYS
8 BVS-3D32209	TEST HPU FOR ADDITIONAL BOP
8 BVS-3D32301	BOP POD TEST STAND
8 BVS-3D32715	BOP HIGH PRESSURE TEST UNIT
7 BVS-3D3101-05	BACKUP CONTROL SYSTEM
G BVS-3D3101-SC-001	BACK UP SYSTEM - EHBS POD - GROUP
G BVS-3D3101-SC-002	BACK UP SYSTEM - ACOUSTIC POD -GROUP
G BVS-3D3101-IP-001	PRESSURE SWITCHES - GROUP
G BVS-3D3101-ME-011	PRESSURE GAUGES - GROUP
G BVS-3D3101-VA-566	VALVES, SPM - GROUP
G BVS-3D3101-VA-577	CCSV - GROUP
G BVS-3D3101-VA-578	CHECK VALVES - GROUP
G BVS-3D3101-VA-579	PILOT OPERATED CONTROL VALVES - GROUP
G BVS-3D3101-VA-580	RELIEFE VALVES - GROUP
G BVS-3D3101-VA-581	REGULATOR VALVE - GROUP
G BVS-3D3101-VE-055	ACUMULATORS - GROUP
G BVS-3D3101-BP-001	BOP STACK #1, INCL. LMRP, CONNS, FLEX JT
7 BVS-3D3101-01	PREVENTERS, VALVES AND LINES
8 BVS-3D31100	BOP STACK #1, INCLUDING LMRP
8 BVS-3D31100-AP-000	LOWER MARINE RISER PACKAGE #1
8 BVS-3D31100-IP-005	SENSOR, TEMPERATURE/PRESSURE ASSY,LMRP#1
8 BVS-3D31100-IP-006	SENSOR, INCLINOMETER (DUAL AXIS), LMRP#1
G BVS-3D31100-VA-453	VALVES, LMRP #1 - GROUP
8 BVS-3D31100-ME-001	ADAPTER, RISER TYPE FT-HB, BOP #1
8 BVS-3D31100-AP-001	ANNULAR, UPPER, BLOWOUT PREVENTER #1
8 BVS-3D31100-AP-002	ANNULAR, LOWER, BLOWOUT PREVENTER #1
8 BVS-3D31100-PI-001	PIPING, CHOKE FLEX LOOP PIPING, BOP #1
8 BVS-3D31100-PI-002	PIPING, KILL FLEX LOOP PIPING, BOP #1
8 BVS-3D31100-SH-001	HOSE, RIGID CONDUIT "A" FLEX HOSE,BOP
8 BVS-3D31100-SH-002	HOSE, RIGID CONDUIT "B" FLEX HOSE,BOP
8 BVS-3D31100-RP-000	LOWER BOP STACK 18 3/4" 15K #1
7 BVS-3D3101-02	HYDRAULIC CONNECTORS
7 BVS-3D3101-03	FLEXIBLE JOINT
7 BVS-3D3101-04S	PRIMARY CONTROL SYSTEM (SUBSEA)
G BVS-3D3101-BP-002	BOP STACK #2, INCL. LMRP, CONNS, FLEX JT
7 BVS-3D3102-01	PREVENTERS, VALVES AND LINES
7 BVS-3D3102-02	HYDRAULIC CONNECTORS
7 BVS-3D3102-03	FLEXIBLE JOINT
7 BVS-3D3102-04	PRIMARY CONTROL SYSTEM (SUBSEA)

Unit boundary

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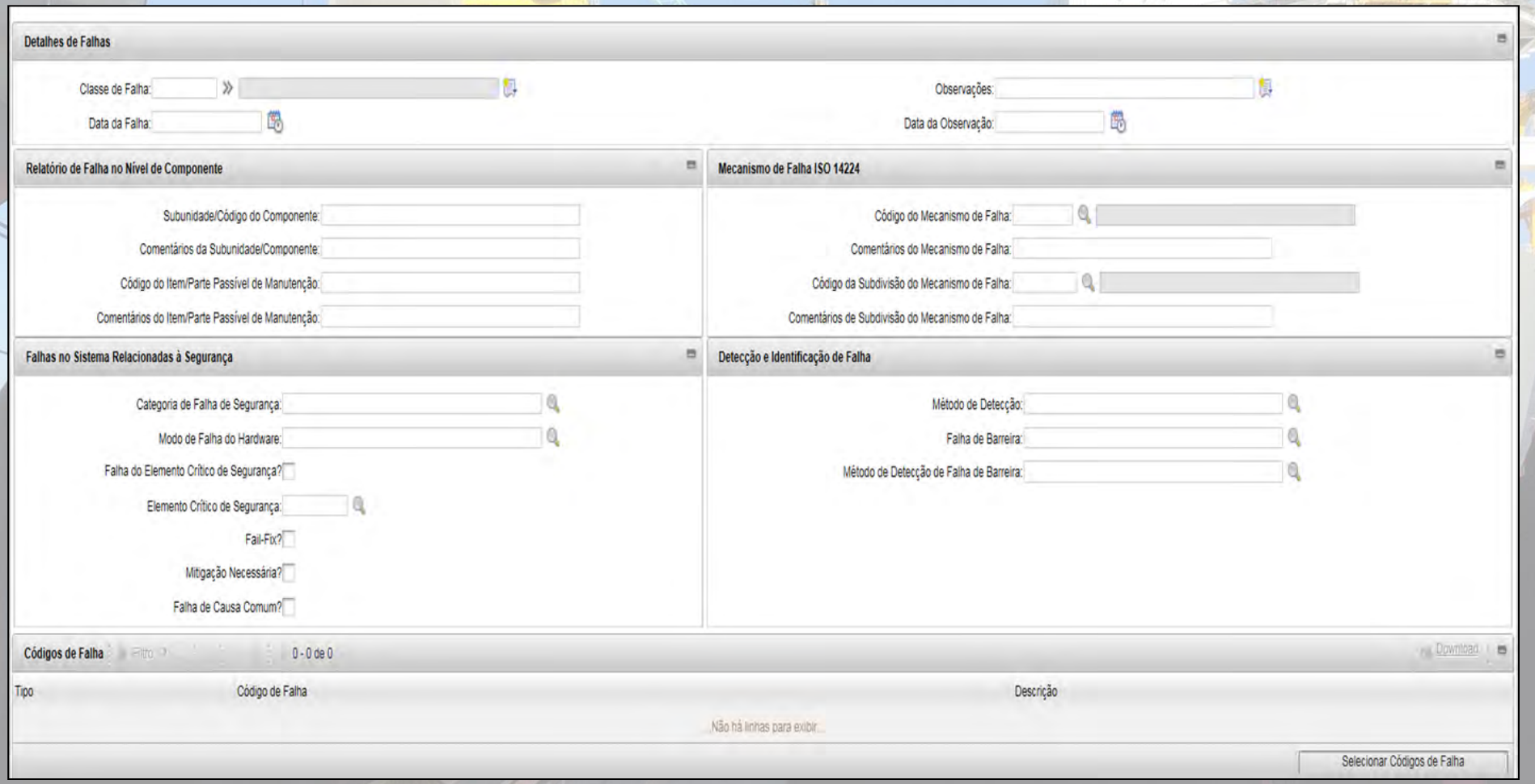
Maximo Malfunction Report



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QGOG Challenges

Technical tags

- Tag lists provided by manufacturer were incomplete
- Many process items were not tagged

MAXIMO O&G

- Load extra failure class into MAXIMO
- Maintainable item is a free text

Translating to Portuguese

- All FL were translated to Portuguese
- All failure classes were translated to Portuguese

Quality Assurance on data reporting

- Old school technicians, need training
- Data recovery program

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Results - Brava Star

Brava Star has over them 8,000 FL already in place

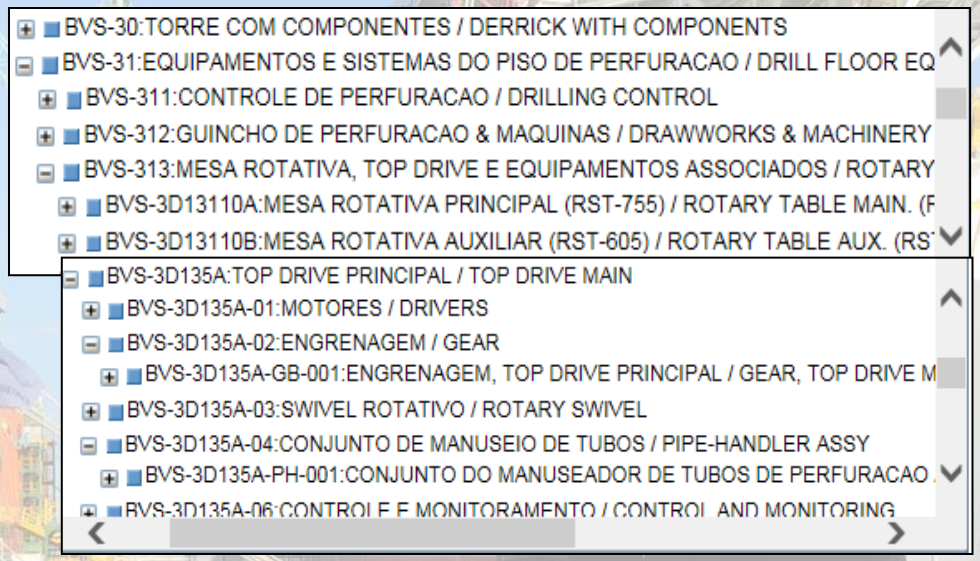
- The Taxonomy structure process is on going on the other rigs
- With extended content, over 80 equipment class definitions
- Every technical tag (assets) has a class ID assigned (5,331 tags)
- 200 failures class into MAXIMO O&G

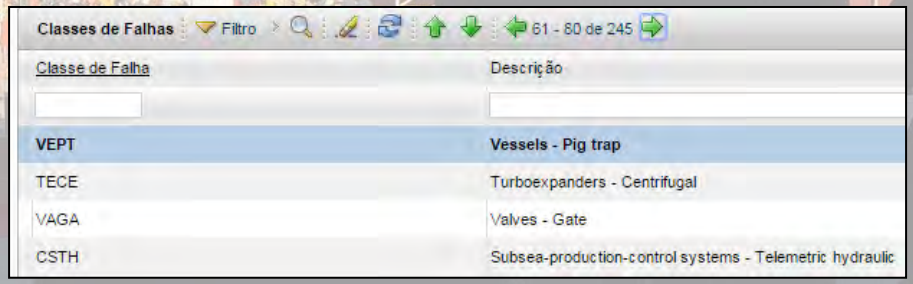
The hierarchy gives flexibility in evaluating failure rates at any point in the structure

- E.g., component, equipment or process level

To ensure data quality:

- QGOG started a training program and developed MAXIMO workflows to ensure information being fed into the system
- Failure data QA being done by Asset Integrity Engineer





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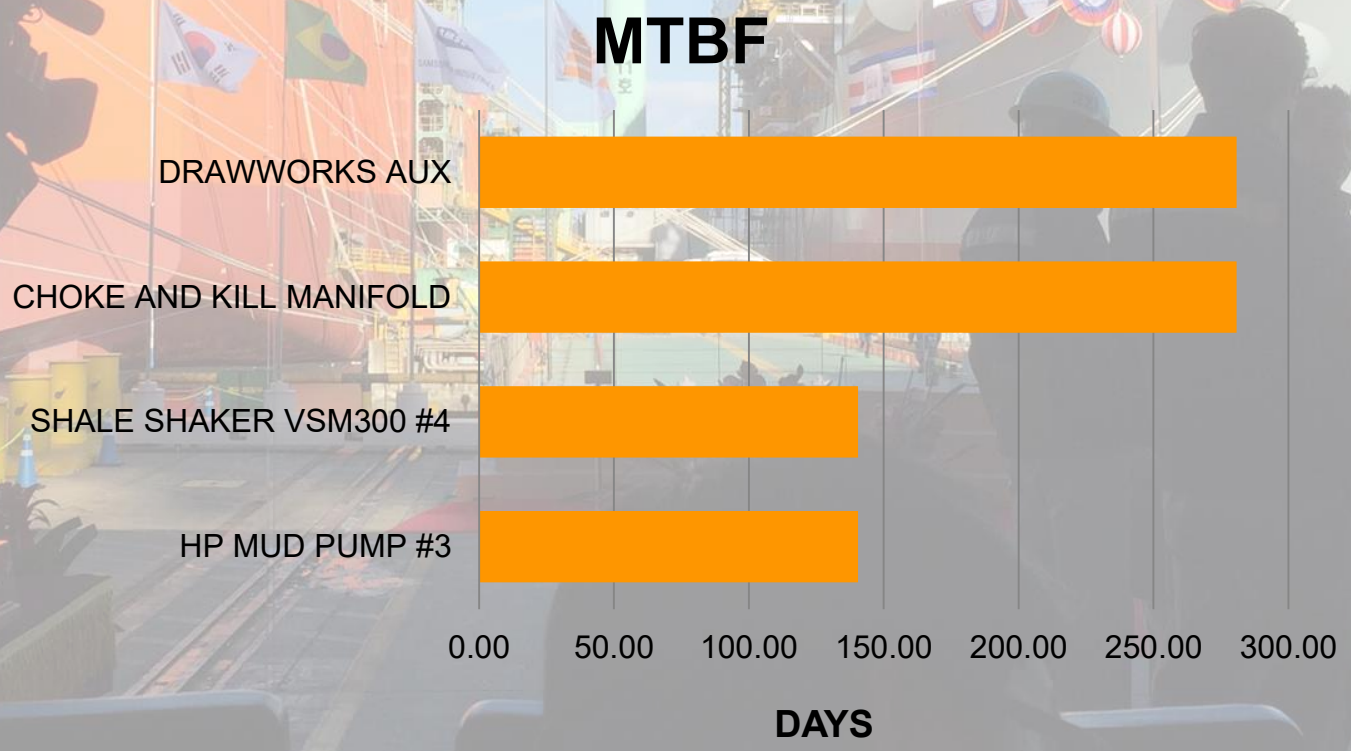
Benefits

QGOG starts collect the benefits

- Base for the root cause analysis process (process being improved)
- Base to KPIs, like MTTR, Availability, WO compliance
- Mapping the unreliable assets (MTBF)



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Thank you all for attending

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Supplementary Content

Equipment Downtime

ID	Failure mode	Failure date	Loss time	Equipment
INL1	Internal leakage	12/12/2015	01:00	HP MUD PUMP #3
INL1	Internal leakage	20/12/2015	03:00	HP MUD PUMP #3
PLU	Vibration	21/12/2015	01:00	SHALE SHAKER VSM300 #4
PLU	Plugged/choked	30/12/2015	01:00	SHALE SHAKER VSM300 #4
INL1	Internal leakage	22/09/2015	06:00	CHOKE AND KILL MANIFOLD
LOO	Low output	27/12/2015	04:30	DRAWWORKS AUX

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Nexen Long Lake Technical Structure

Administrative levels

Functional loc.	LLAK-8400
Description	STEAM GENERATION

3 LLAK-S101	LONG LAKE CENTRAL PROCESSING FACILITY
4 LLAK-8000	SAGD CENTRAL PLANT
4 LLAK-8100	INLET TREATING
4 LLAK-8200	DE-OILING
4 LLAK-8300	WATER TREATMENT SYSTEM
4 LLAK-8400	STEAM GENERATION
5 LLAK-8400-BG	BUILDINGS
5 LLAK-8400-CL	CONTROL UNITS
5 LLAK-8400-CR	CRANES, HOISTS, AND MONORAILS
5 LLAK-8400-FG	FIRE AND GAS DETECTORS
5 LLAK-8400-HB	OTSG STEAM GENERATORS
5 LLAK-8400-HE	EXCHANGERS
5 LLAK-8400-HT	HEAT TRACING
5 LLAK-8400-LI	LIGHTING
5 LLAK-8400-PD	POWER DISTRIBUTION
5 LLAK-8400-PI	8400 PIPING BY COMMODITY
5 LLAK-8400-PU	PUMPS
5 LLAK-8400-P-001	LP BFW BOOSTER PUMPS
5 LLAK-8400-P-002	HP BFW PUMPS
6 LLAK-8400-P-002-A	HP BFW PUMP A
6 LLAK-8400-P-002-B	HP BFW PUMP B
6 LLAK-8400-P-002-C	HP BFW PUMP C
6 LLAK-8400-P-002-D	HP BFW PUMP D
6 LLAK-8400-P-002-E	HP BFW PUMP E
5 LLAK-8400-P-008	STEAM CONDENSATE PUMPS
5 LLAK-8400-P-015	STEAM CONDENSATE PUMPS
5 LLAK-8400-PU-BG-001	BG-001 PUMPS
5 LLAK-8400-PU-BG-006	BG-006 PUMPS
5 LLAK-8400-PU-CH	CHEMICAL TREATMENT PUMPS
5 LLAK-8400-SY	STEAM TRAPS
5 LLAK-8400-TK	TANKS
5 LLAK-8400-TL	TELECOMM
5 LLAK-8400-UP	UPS
5 LLAK-8400-VE	PRESSURE VESSELS
4 LLAK-8500	PRODUCED GAS HANDLING
4 LLAK-8600	TANK FARM
4 LLAK-8700	UTILITIES
4 LLAK-8900	CO-GENERATION

Equipment unit

Functional loc.	LLAK-8400-P-002-E
Description	HP BFW PUMP E

Pump Unit Boundary

6 LLAK-8400-P-002-E	HP BFW PUMP E
7 LLAK-8400-P-002-E-02	PUMP UNIT
7 LLAK-8400-P-002-E-03	CONTROL AND MONITORING
5 LLAK-8400-CM-201	8400-P-002-E HP BFW SUCTION HEADER
5 LLAK-8425-CM-200	8400-P-002-E HP BFW PUMP SUCTION
8 LLAK-8425-FE-200	METER, FLOW
8 LLAK-8425-FIT-200	TRANSMITTER, FLOW
8 LLAK-8425-FV-200	VALVE, FLOW, MODULATING
8 LLAK-8425-PIT-200	TRANSMITTER, PRESSURE INDICATING
5 LLAK-8425-CM-201	8400-P-002-E HP BFW PUMP SUCTION
5 LLAK-8425-CM-202	8400-P-002-E HP BFW PUMP DISCHARGE
5 LLAK-8425-CM-203	8400-P-002-E HP BFW PUMP WARM-UP
5 LLAK-8425-CM-210	8400-P-002-E HP BFWMOTOR BEARING MACHINE
5 LLAK-8425-CM-211	8400-P-002E HP BFW PHASE W MOTOR MONITOR
5 LLAK-8425-CM-212	8400-P-002-E HP BFW MOTOR FILTER DIFFERE
5 LLAK-8425-CM-213	8400-P-002-E HP BFW PUMP
5 LLAK-8425-CM-214	8400-P-002-E HP BFW MOTOR BEARING OIL TO
5 LLAK-8425-CM-215	8400-P-002-E HP BFW PUMP QUENCH WATER
5 LLAK-8425-CM-216	8400-P-002-E HP BFW PUMP QUENCH WATER
5 LLAK-8425-CM-217	8400-P-002-E HP BFW PUMP BEARING OIL TO
5 LLAK-8425-CM-218	8400-P-002-E HP BFW PUMP BEARING OIL TO
5 LLAK-8425-CM-219	8400-P-002-E HP BFW PUMP MOTOR BEARINGS
5 LLAK-8425-CM-221	8400-P-002-E COOLING MEDIUM RETURN
5 LLAK-8425-CM-222	8400-P-002-E COOLING MEDIUM RETURN
7 LLAK-8400-P-002-E-04	LUBRICATION SYSTEM
8 LLAK-8400-E-010-E	COOLER, OIL (HP BFW PUMP LUBE)
8 LLAK-8400-F-001-E	FILTER, HP BFW PUMP OIL
8 LLAK-8400-P-004-E	PUMP, MAIN HP BFW PUMP LUBE OIL
8 LLAK-8400-P-005-E	PUMP, AUXILIARY HP BFW PUMP LUBE OIL
8 LLAK-8400-RS-001-E	RESERVOIR-LUBE OIL-BFW PUMP E
5 LLAK-8425-CM-207	8400-P-005-E HP BFW LUBE OIL
6 LLAK-8400-P-002-E-M	MOTOR, HP BFW PUMP E

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Maersk Drilling
Offshore Drilling Equipment Taxonomy Content Development

Maersk Drilling Extended Taxonomy
File Number EC000100

MAERSK DRILLING

Taxonomy Index — **Page**

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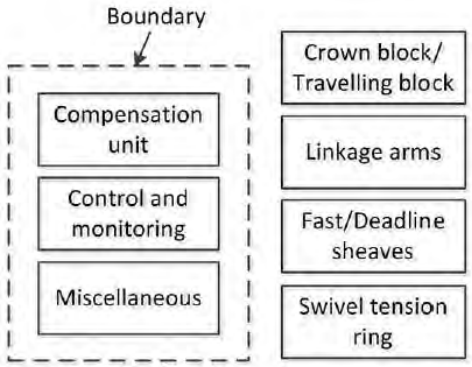
ISO 14224:2006 Extended Taxonomy

MAERSK DRILLING

Equipment Class: Motion compensators

Taxonomy ID: DR_ME_MC

Class Types	Taxonomy ID
Active heave system	DR_ME_MC_AH
Motion compensators, conductor tensioner	DR_ME_MC_CT
Motion compensators, drill-string	DR_ME_MC_DC
Motion compensators, guideline tensioner	DR_ME_MC_GT
Motion compensators, pod line tensioner	DR_ME_MC_PT
Motion compensators, riser	DR_ME_MC_RI



Boundary definition – Motion compensators

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Marathon Oil
ISPM ISO 14224 Solution (SAP)

Marathon Alvheim FPSO

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Preventive Maintenance and Inspections

Program

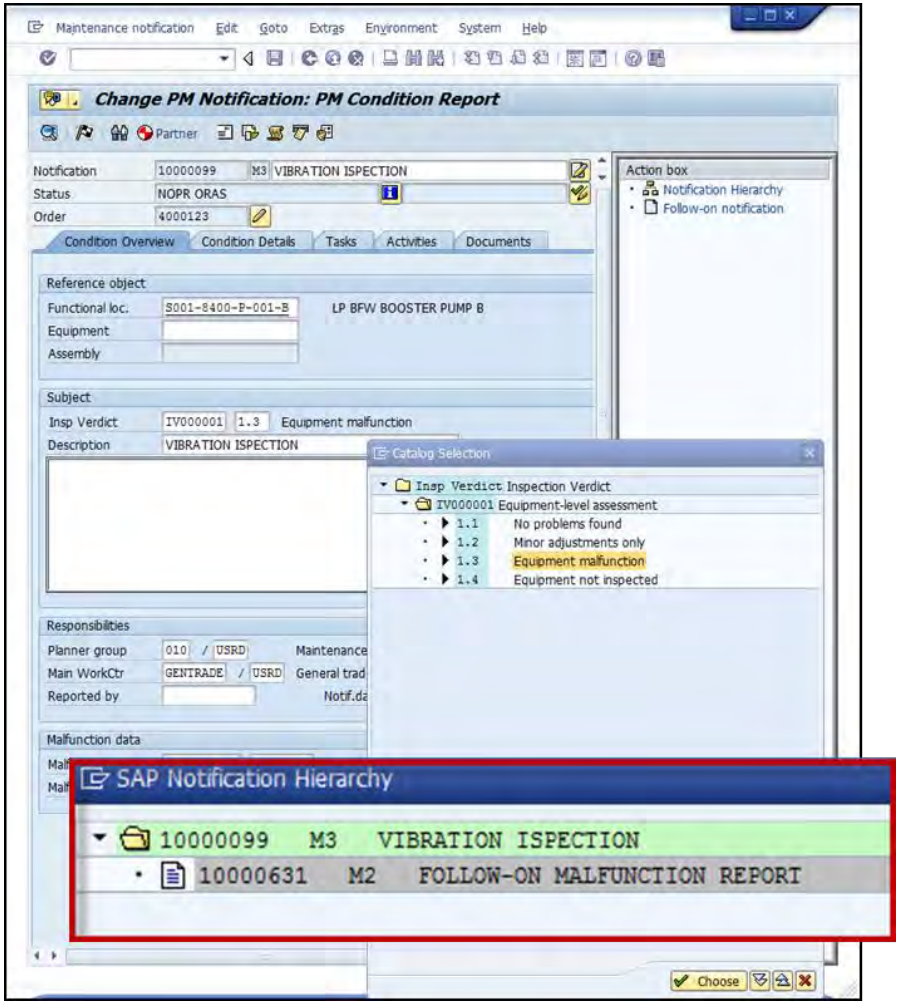
- Administered as administrative or technical tag level
- Results reported at technical tag level

PM Condition Report

- One condition report per technical tag inspected
- Inspection verdict and condition details
- Generated from object list of PM inspection order

Follow-on malfunction report

- Generated for any equipment malfunction verdict
- Linked to PM Condition Report as subordinate object



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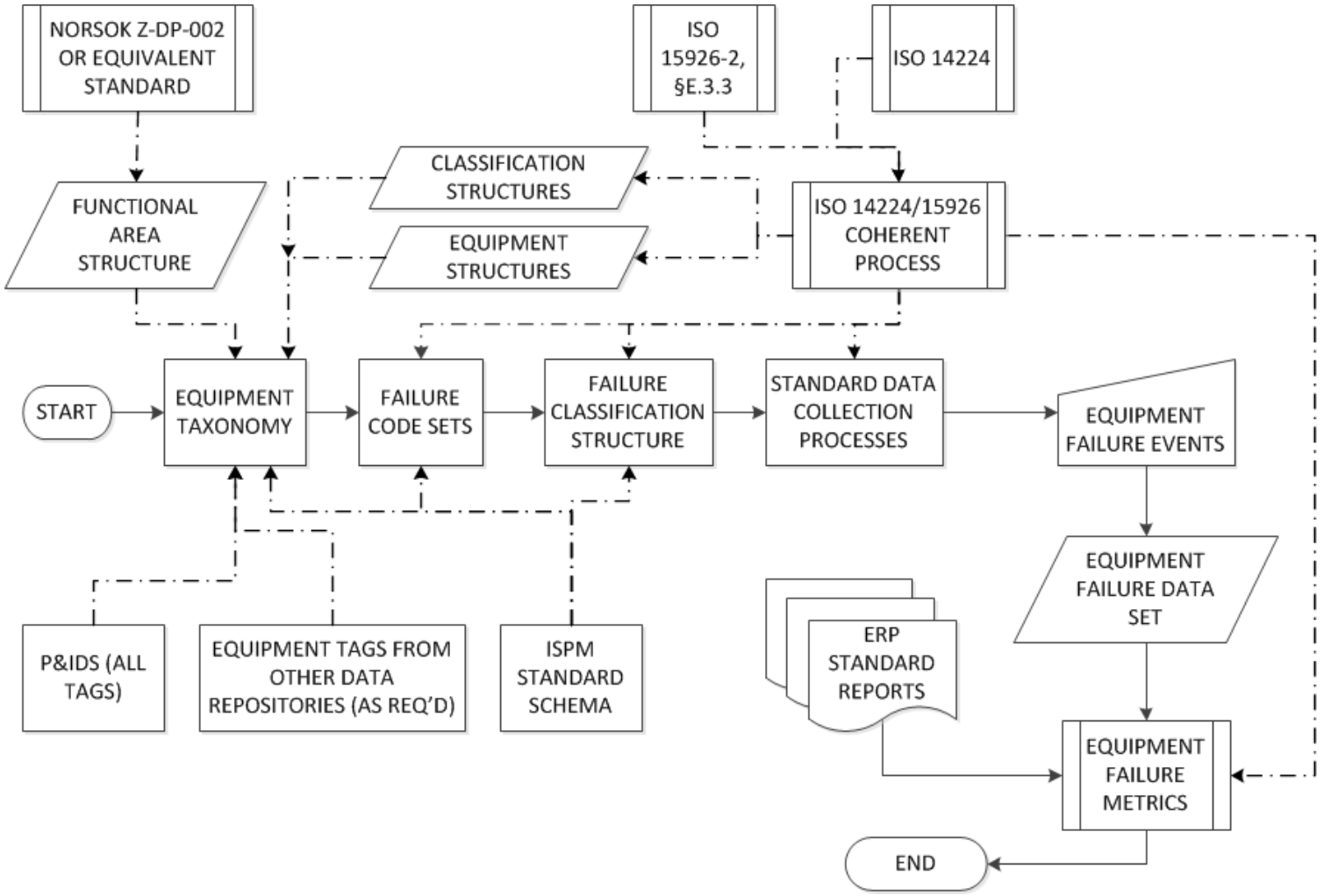
ISPM Solution Details



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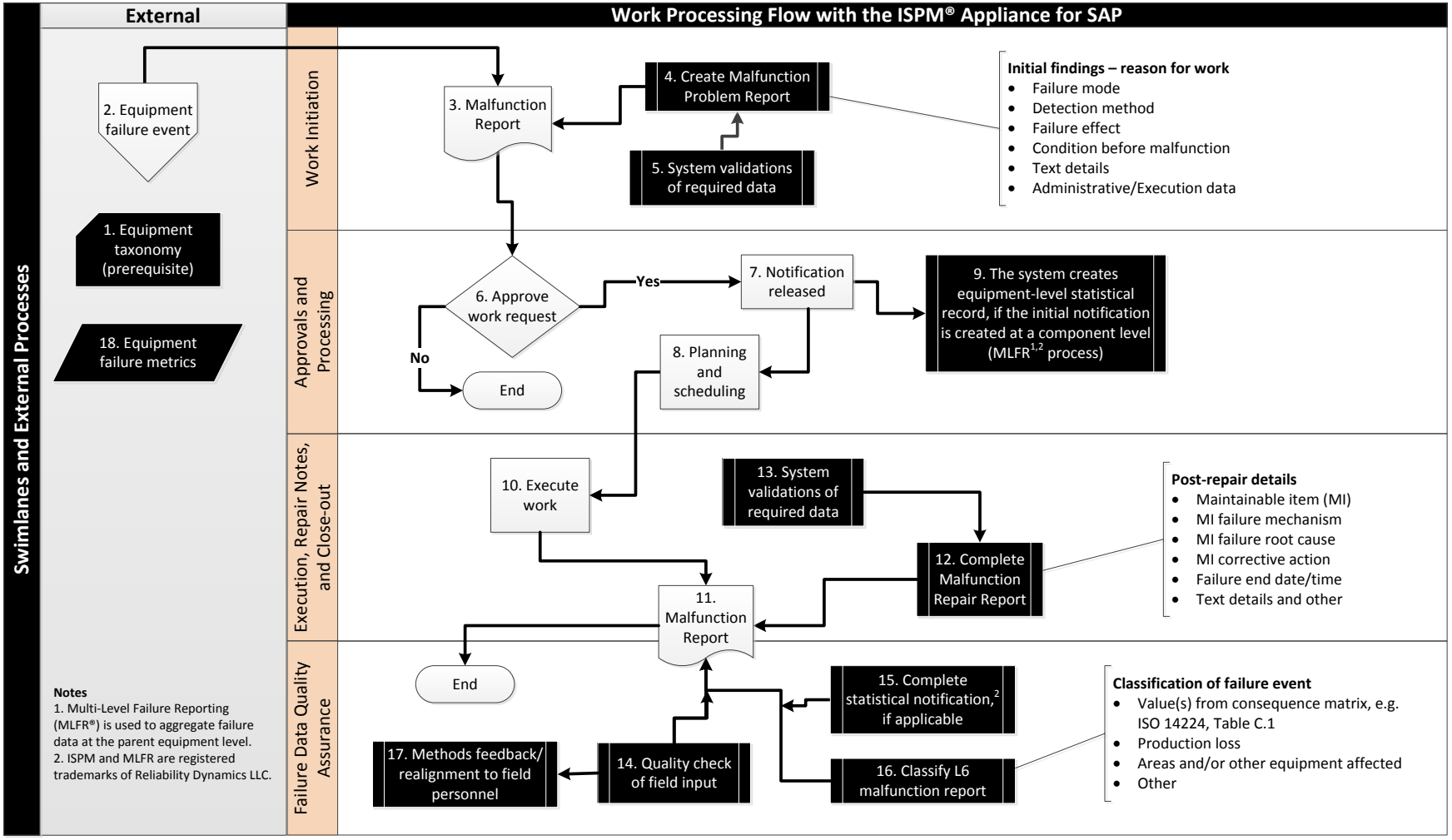
Malfunction Reporting Process



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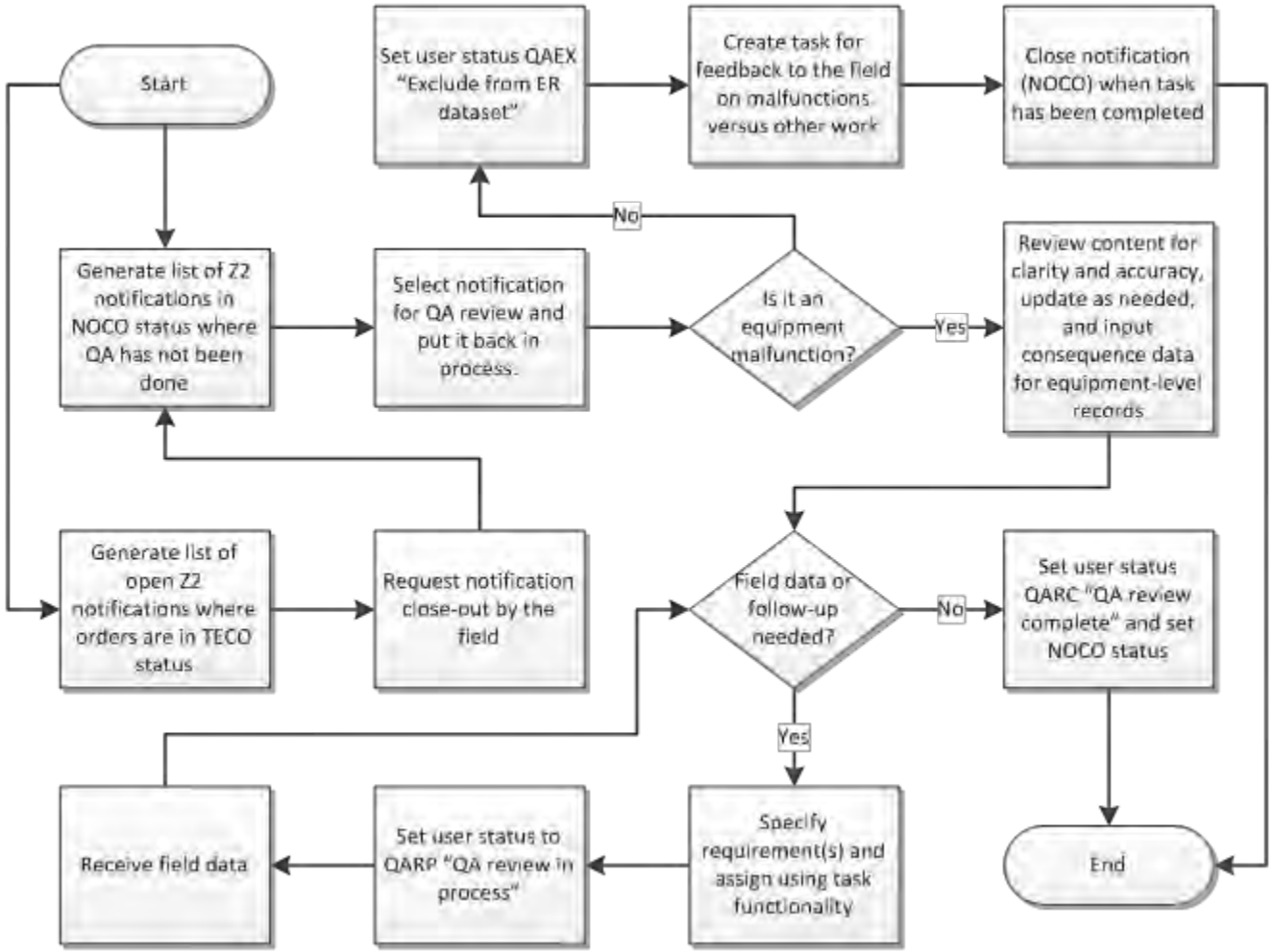
Malfunction Report QA Process Flow



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Failure Data Quality Assurance

- Review malfunction reports to ensure completeness and a clear and concise description of what happened
- Obtain and input failure consequences, area affected, etc.
- Identify “non-malfunction” malfunction reports and set user status to exclude them from the failure data dataset
- Review other ERP data to identify missing failure events, e.g. review materials booked against blanket orders of cost centers, review preventive maintenance and inspection results to ensure follow-on malfunction reporting was done, etc.
- Identify and document follow-on requirements, e.g. preventive maintenance additions, facilities change requirements, SJP requirements
- Circle-back with personnel when issues are found with completion of malfunction reports

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ISPM Differentiators

Technical Structure

- ERP can be system of record for all technical tags
- One unique ID for each tag throughout all systems, records, and in the field
- Technical tag interrelationships defined in a manner the system can interpret
- Standard characteristic sets give operating context for failure events

Malfunction event data collection

- ERP is the work management system
  - Data collected are first-hand
- System validations help ensure a quality dataset
  - Correct taxonomic level
  - Minimum dataset
- Explicit data capture (versus inference on event reconstruction)

Quality assurance

- Ensure each event tells a coherent story
- Eliminate the need for recurrent data mining
- Checks for improper and missing malfunction reports
- Serves as training/realignment to field personnel

Other

- Client relationships allow for questions/improvements to dataset

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