ISO 14224: Collection and exchange of reliability and maintenance data. How to achieve safe and cost-effective design and operations

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for the reliability technology and cost area.
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Objective

› Use of the International Standard ISO 14224:

a) Achieve quality reliability and maintenance data
b) Collect data in a common defined format
c) Appropriate use of the data in decision-making

safe and cost-effective design and operations

«Data is the new gold»

(European Commission, Opening Remarks,

Press Conference on Open Data Strategy, Brussels, 12th December 2011)

› Current general trends

- Renewed focus on value of data/information
- Improved techniques for data collection, management and analysis
- Big data, data mining, machine learning…

«Data collection is an investment»

Keywords:
reliability data, maintenance data, decision-making

Models: Several mathematical models are used with the objective of supporting decision making (output).

Quality reliability and maintenance **data needed** (input).

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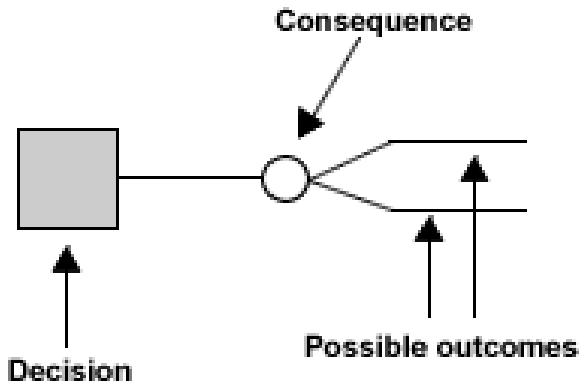
Value of information (VOI) - Reliability and maintenance data

Design or operation related decision-making:

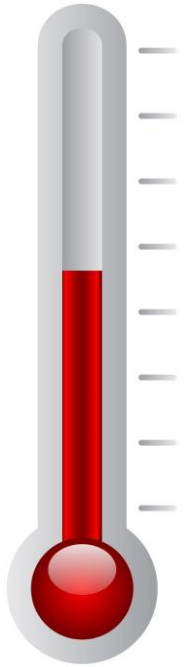
A B C D



E(NPV), E(U)

Decision-making about design and operations

- What is the current level of reliability performance (benchmarking & trending)
- How to meet the level of acceptance (requirements) & beyond
- Selection of equipment and system, and what to improve
- How to minimize number of and severity of critical events
- How to increase operating availability, reduce maintenance costs, etc.
- How to obtain good industry reputation



Guidance for how to achieve quality data

ISO 14224:

Petroleum, petrochemical and natural gas industries - Collection and exchange of reliability and maintenance data for equipment

Editions
First Edition: ISO 14224: 1999
Second Edition : ISO 14224:2006
Third Edition: ISO/FDIS 14224:2016

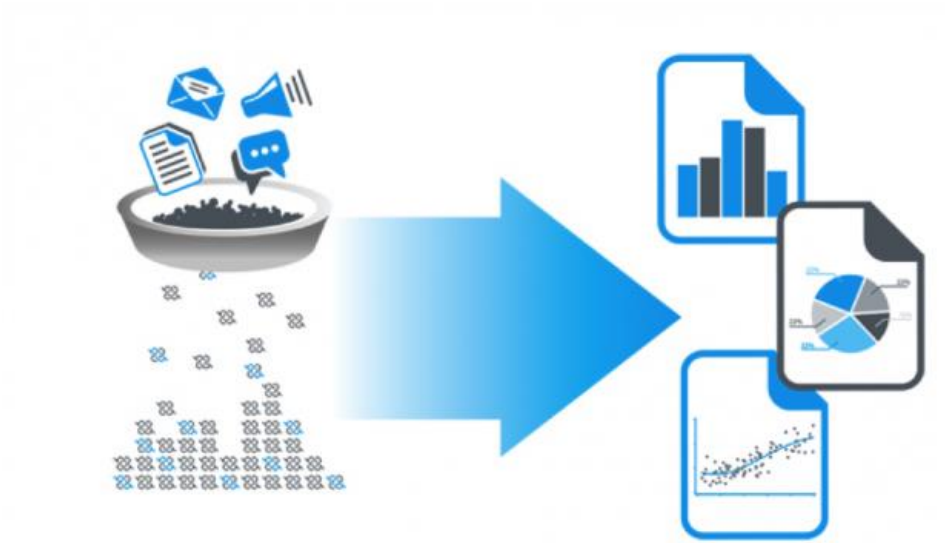


Figure source: http://sngroup.com/wp-content/uploads/2013/03/Data-collection-620x401.png

Scope of the standard

- Describe RM data collection principles – What is to be collected?
- Key definitions (98 in the ISO/FDIS 2016 edition), and basis for communicating equipment experience (reliability language)
- Normative terminology e.g.
  - Failure modes (per equipment class)
  - Failure mechanism and failure cause (generic across all equipment classes)
- Applicable for all types of facilities and operations in petroleum, petrochemcial and natural gas industries (up-stream, mid-stream and down-stream coverage)

Outside scope

- Data on (direct) cost issues
- Data from laboratory testing and manufacturing (e.g. ALT)
- Complete equipment data sheets (only data seen relevant for assessing the reliability performance are included)
- Additional on-service data that an operator, on an individual basis, can consider useful for operation and maintenance
- Methods for analyzing and applying RM data (some principles for calculation of some basic reliability and maintenance parameters are included)
- Recommended values for RM parameters

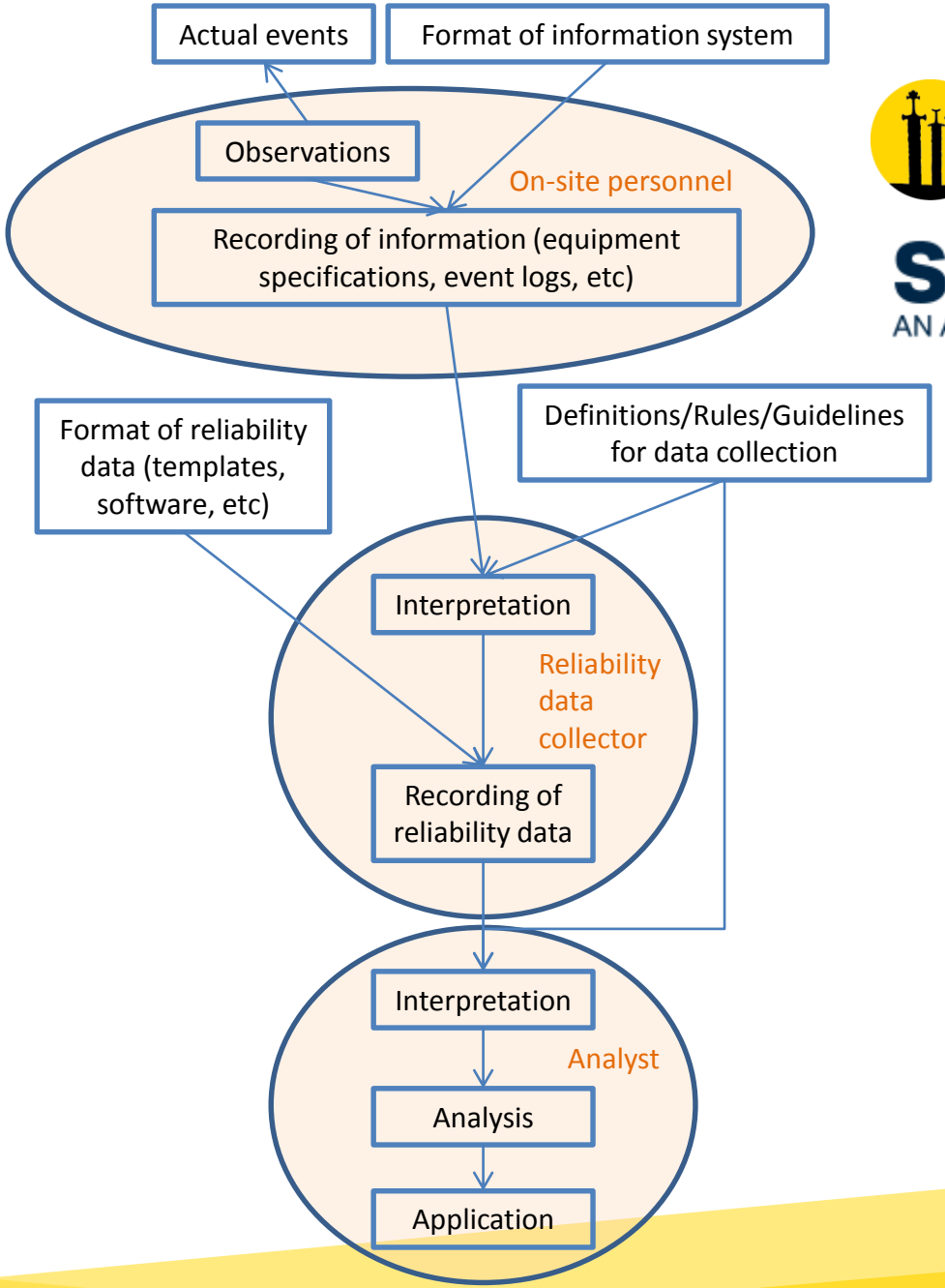
Interpretation

Interpretation is an essential part of the process linking the following elements:

› Information

› Data

› Use



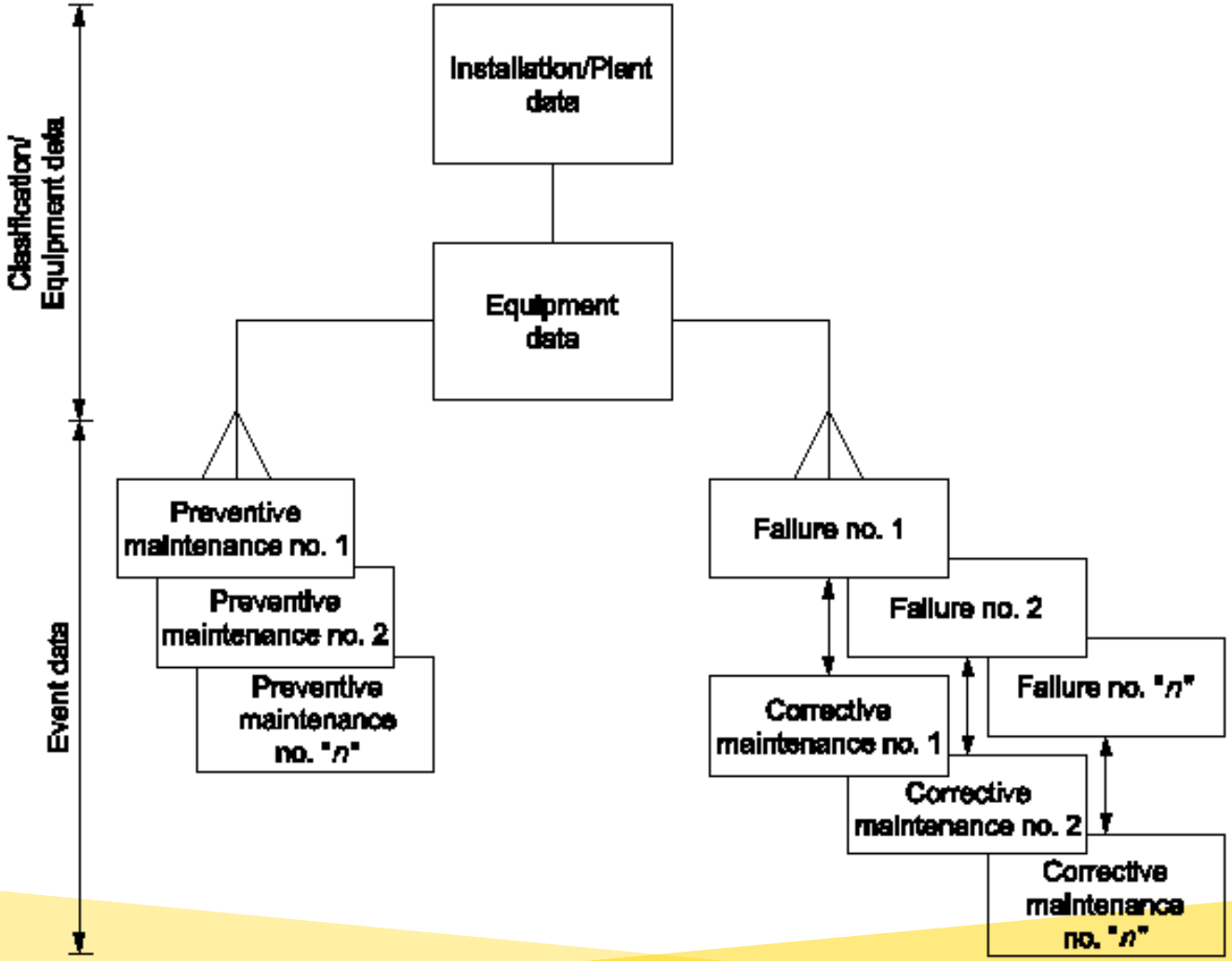
The data collector – an important player

The data should be collected by competent and motivated personnel with involvement from company internal personnel

The collector should have:

- Available relevant documentation
- Available expert personnel
- System understanding
- Data handling understanding
- Analysis understanding
- Quality drive

Associated data collected – Logical structure



ISO/FDIS 14224:2016, Figure 5.

Data collection - Equipment data

ISO/FDIS 14224:2016

Table A.21 — Equipment subdivision — Pumps

Equipment unit	Pumps				
Subunit	**Power transmission**	**Pump unit**	**Control and monitoring**	**Lubrication system**	**Miscellaneous**
Maintainable items	Gearbox/ variable drive Bearing Seals Coupling to driver Coupling to driven unit Belt/sheave	Support Casing Impeller Shaft Radial bearing Thrust bearing Seals Valves Piping Cylinder liner Piston Diaphragm	Actuating device Control unit Internal power supply Monitoring Sensors [a] Valves Wiring Piping Seals	Reservoir Pump Motor Filter Cooler Valves Piping Oil Seals	Purge air Cooling/heating system Cyclone separator Pulsation damper Flange joints

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

Data collection - Equipment data

Table A.22 — Equipment-specific data — Pumps

Name	Description	Unit or code list	Priority
Type of driver	Equipment class, type and identification code	Specify	High
Fluid handled	Type	Oil, gas, condensate, freshwater, steam, sea water, crude oil, oily water, flare gas, fuel gas, water/glycol, methanol, nitrogen, chemicals, hydrocarbon-combined, gas/oil, gas/condensate, oil/water, gas/oil/water, LNG, drilling mud, drilling cement, other	High
Fluid corrosive/erosive	Classify as shown in footnote [a]	Benign, moderate, severe	Medium
Application – pump	Where applied	Booster, supply, injection, transfer, lift, dosage, disperse, cooling, drilling, other	Medium
Pump – design	Design characteristic	Axial, radial, composite, diaphragm, plunger, piston, screw, vane, gear, lobe	High
Power – design	Design/rated power of pump	Kilowatt	High
Utilization of capacity	Normal operating/design capacity	Percent	Medium
Suction pressure – design	Design pressure	Pascal (bar)	Medium
Discharge pressure – design	Design pressure	Pascal (bar)	High
Speed	Design speed	Revolutions per minute or strokes per minute	Medium

ISO/FDIS 14224:2016

Failure data collected for different failure types

(ISO/FDIS 14224:2016, Clause 3: Terms and definitions)

- **critical failure**: failure of an equipment unit that causes an immediate cessation of the ability to perform a required function

- **degraded failure**: failure that does not cease the fundamental function(s), but compromises one or several functions

- **incipient failure**: imperfection in the state or condition of an item so that a degraded or critical failure might (or might not) eventually be the expected result if corrective actions are not taken

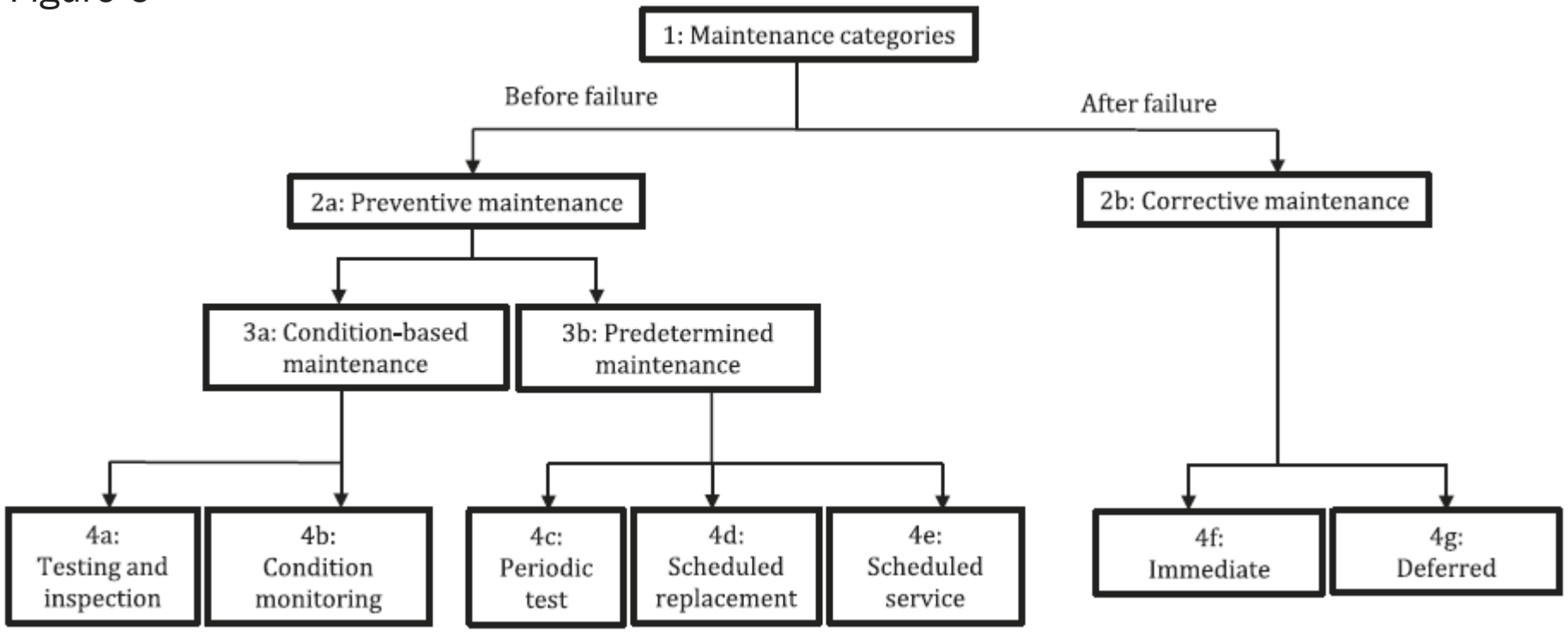
Data collection - Failure data

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]	Qualitative or quantitative failure consequence categorization (see also C.1.10)
	Failure impact on plant operations (e.g. production, drilling, intervention) [b]	Qualitative or quantitative failure consequence categorization (see also C.1.10)
	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 component/maintainable item(s) (see Annex A)
	Detection method	How the failure was detected (see Table B.4)
	Operating condition at failure (*)	Run-down, start-up, running, hot standby, idle, cold standby, testing
	Operational phase at failure [e]	Type of operation at the time of failure
	SIS failure mode classification [f]	Classify the failure for the specific event (DU, DD, SU, SD; see F.2) [g]
Remarks	Additional information	Give more details, if available, on the circumstances leading to the failure: failure of redundant units, failure cause(s) etc.

ISO/FDIS 14224:2016

Data collection – Maintenance data

ISO/FDIS 14224:2016,
Figure 6



ID & date
Activity
Resources used
Duration

Some aspects characterizing high quality data

(ISO/FDIS 14224:2016, Clause 7: Quality of data)

- Completeness of data in relation to specification
- Compliance with definitions of reliability parameters, data types and formats
- Accurate input, transfer, handling and storage of data (manually or electronic)
- Sufficient population and adequate surveillance period to give statistical confidence
- Relevance to the data user's need

Data use: A typical challenge

The conditions or equipment specification do not match historical information available

Exact match: Sparse/no data available	⟷	Similar conditions/specifications: Large data sets available

General experiences

- There must be a clear understanding on possibilities and limitations
- Data collectors should have proper motivation and competence
- Data very relevant for optimising systems
- The benefit of collecting data must be made more visible for the operating and maintenance people
- Get better data on underlying mechanism and cause of failures
- Data collection should be a dynamic and continuous process
- Cost cutting in this industry will probably also result in data quality and availability “cutting”
- Maintenance management systems should be configured for easier reliability data collection
- Quality is more important than quantity!

Thank you!