

MAINTENANCE DATA PROCESSING

A reversed trend in maintenance data processing



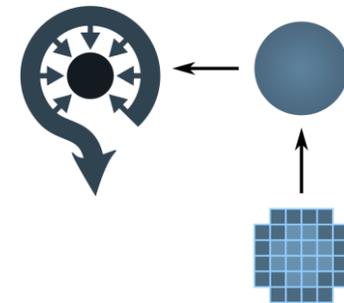
TRENDS IN MAINTENANCE DATA

1. The first digital transformation of maintenance started at the end of the 80's, when the most technologically advanced companies started to transfer maintenance management from paper to computers, mainly databases for material and machine data and maintenance calendars.
2. Then a second large wave of transformation started when CMMS systems appeared, providing resource planning, condition triggered actions, and (in the last 10 years) even insights.
3. We can count the third wave of digital transformation with the appearance of industry 4.0 and the immersion in great amount of data. A massive flow of structured and unstructured data is being created and sent to the maintenance every second; immersing it in a large variety of data.
4. But data is not information. Data has to be collected, processed and understood to make it information.
5. These waves of transformations and the continuous evolution of software solutions had left different players with different systems on different levels of evolution which gap has to be bridged by human data processing.

DATA

CMMS

INDUSTRY 4.0



KEY DEFINITIONS

DATA vs. INFORMATION vs. KNOWLEDGE

DATA	an individual unit, a raw fact that does not carry any specific meaning	
INFORMATION	QUANTITATIVE DATA measured in the form of numeric values, it measures or counts, it's exact and structured	QUALITATIVE DATA collected through human observation. Describes, approximates and compares.
KNOWLEDGE	the meaningful link people make between information and organized experiences offering a framework to evaluate new experiences and information	

PROCESSING

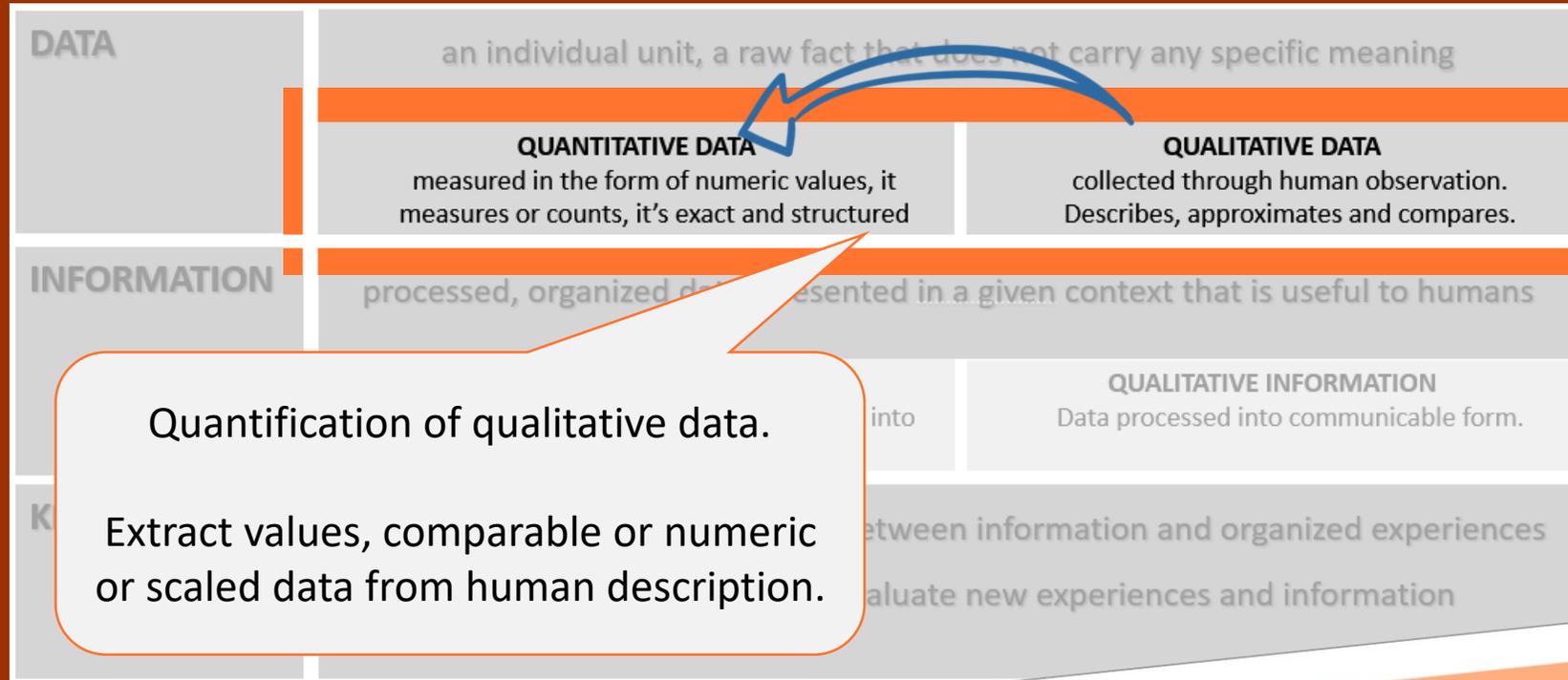
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INFORMATION	processed, organized data, presented in a given context that is useful to humans	
	QUANTITATIVE INFORMATION Quantitative data processed with context into human readable form.	QUALITATIVE INFORMATION Data processed into communicable form.
KNOWLEDGE	the meaningful link people make between information and organized experiences offering a framework to evaluate new experiences and information	

CONVERTING DATA OR INFORMATION

ACTIONS

PROCESSING

Quantification of qualitative data



EXTRACT VALUES OF HUMAN



PROCESSING

Quantitative informization of qualitative data

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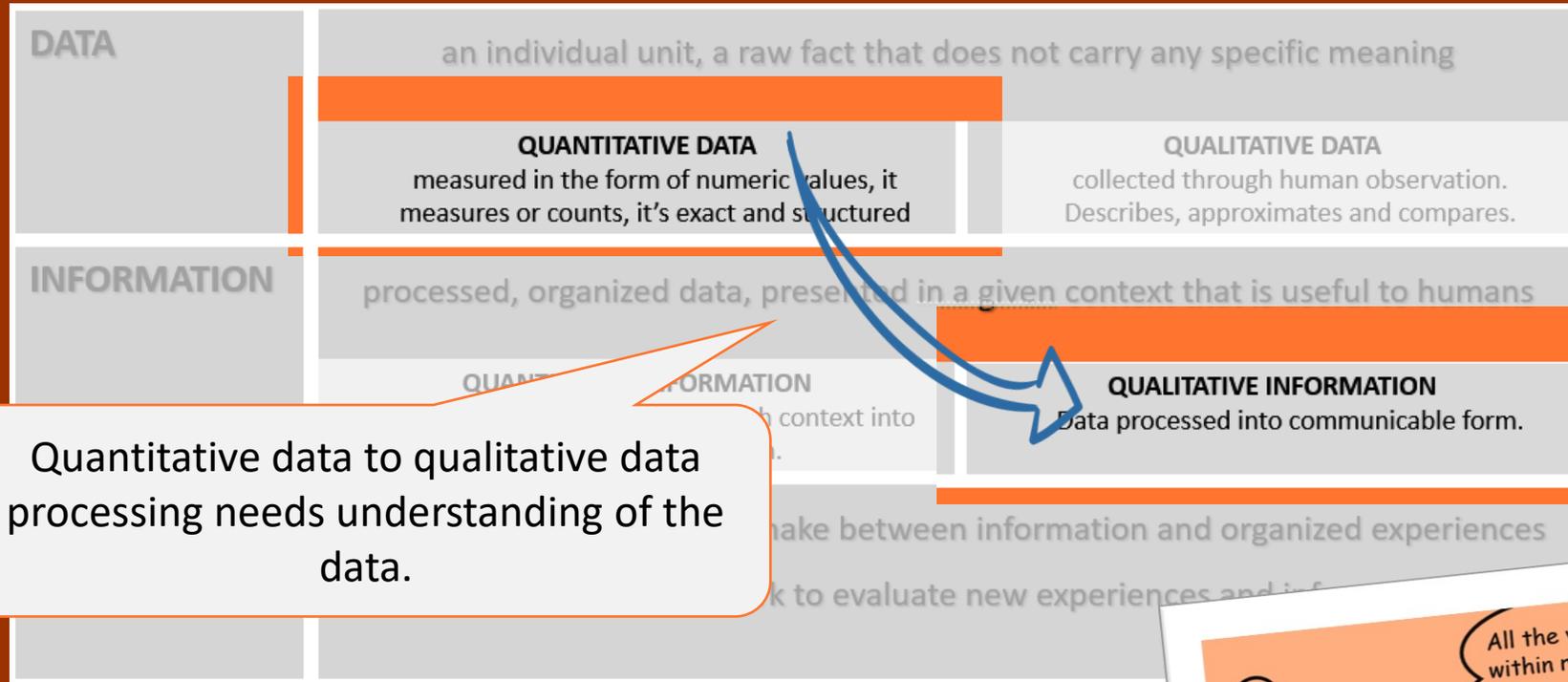


Qualitative data needs to be quantified before processing into quantitative information.

HUMAN DESCRIPTION

PROCESSING

Qualitative informization of quantitative data



UNDERSTAND AND COMMUNICATE

PROCESSING

Qualitative informization of quantitative information

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Broader contextualizing and explaining information.
a.k.a reporting



PROCESSING

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This is how human understanding works. Our input is information and what we remember is data. That's what computers can't do (yet)



MAINTENANCE DATA PROCESSING

Qualitative to quantitative



Reality is an infinite data source



Observes reality



Synthesizes qualitative and quantitative data into **information**



Processes qualitative data.
Organizes data
Synthesizes into information



Communicates qualitative information



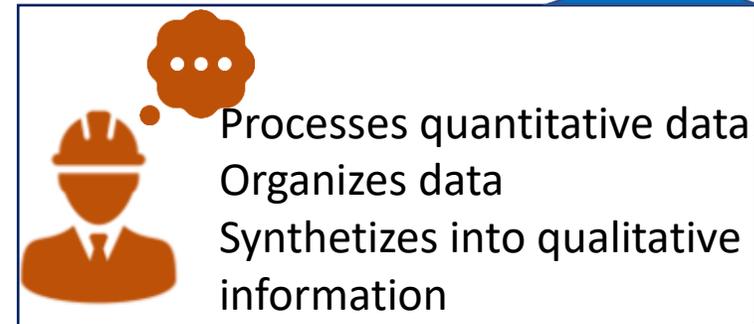
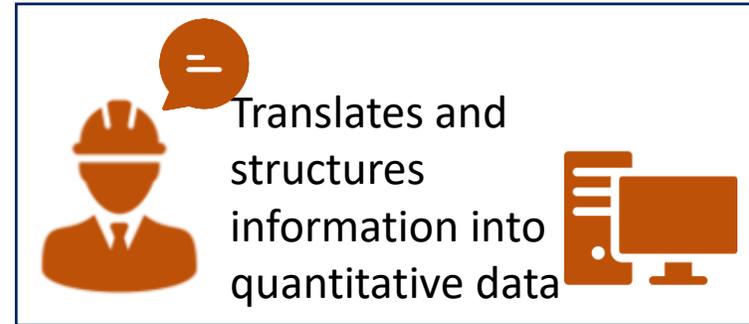
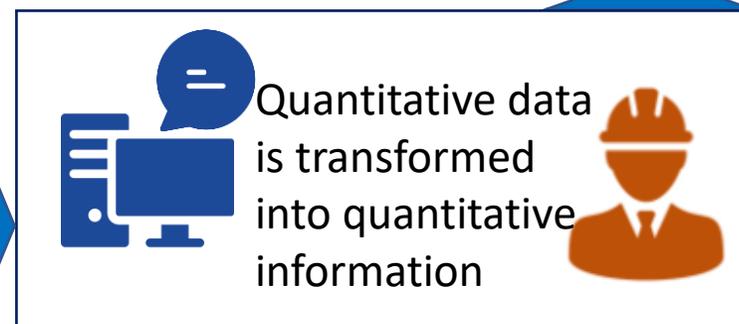
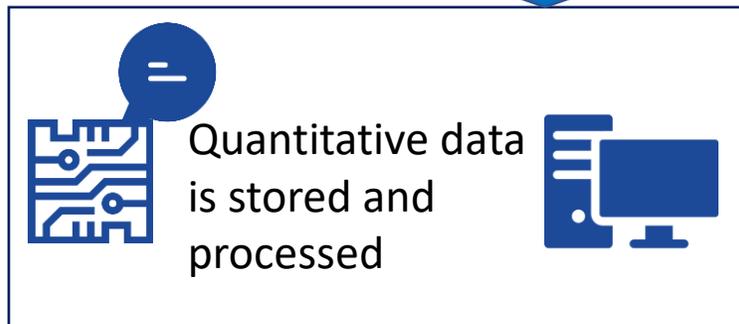
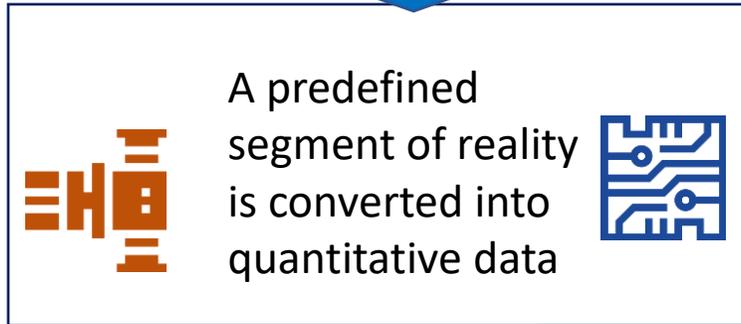
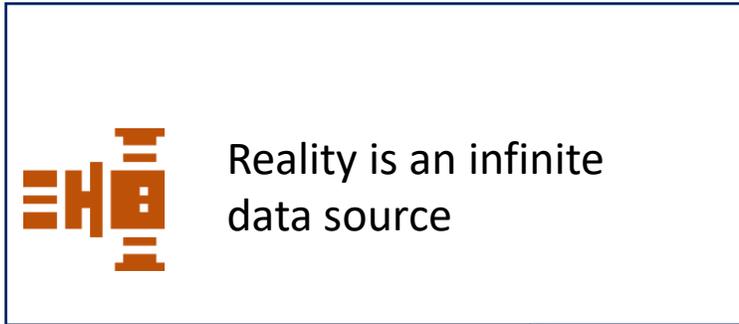
Translates and structures information into quantitative data



Actions

MAINTENANCE DATA PROCESSING

Quantitative to qualitative

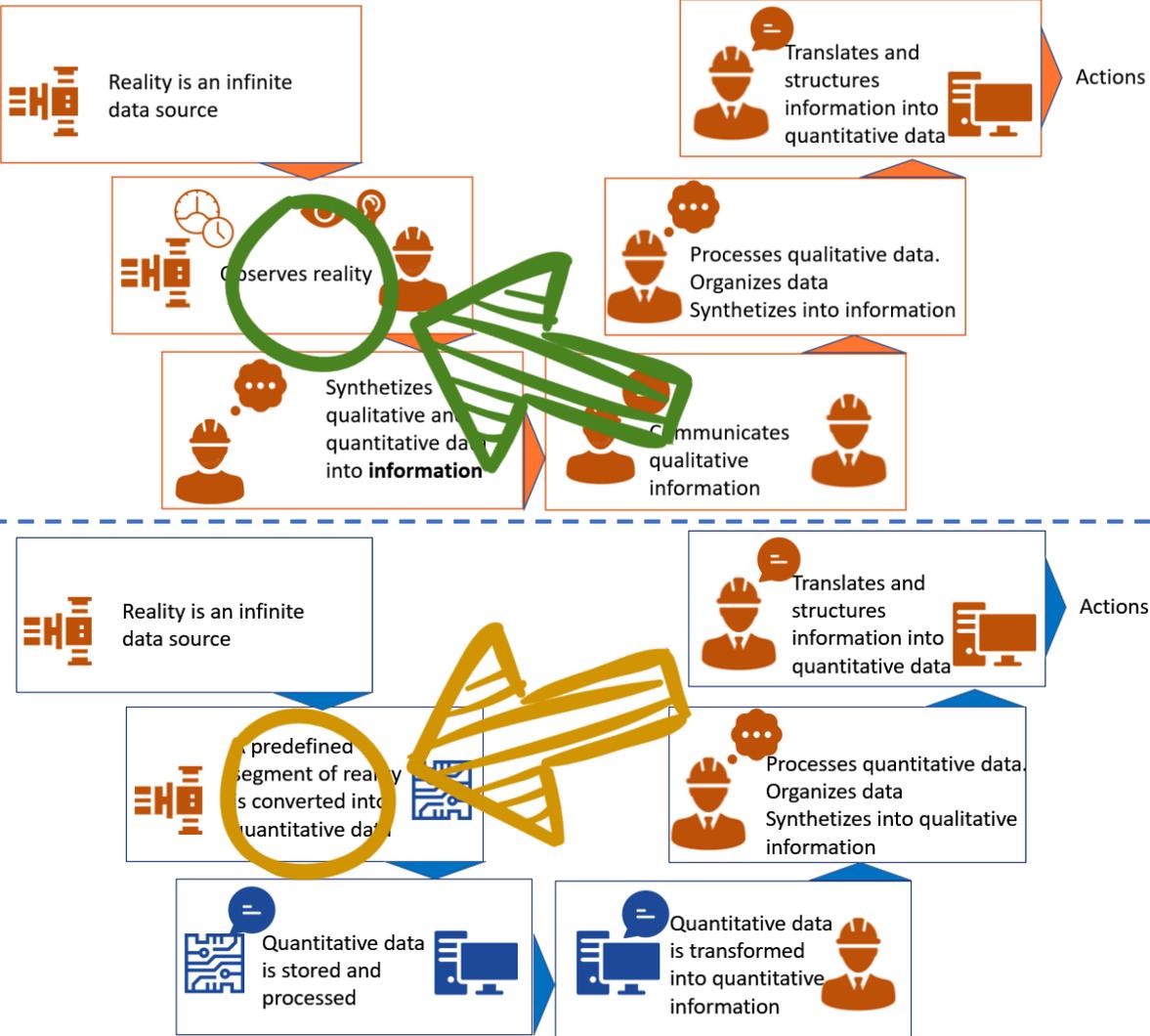


Actions

CHANGE IN TREND

1. Continuous specific data collection

Change analysis



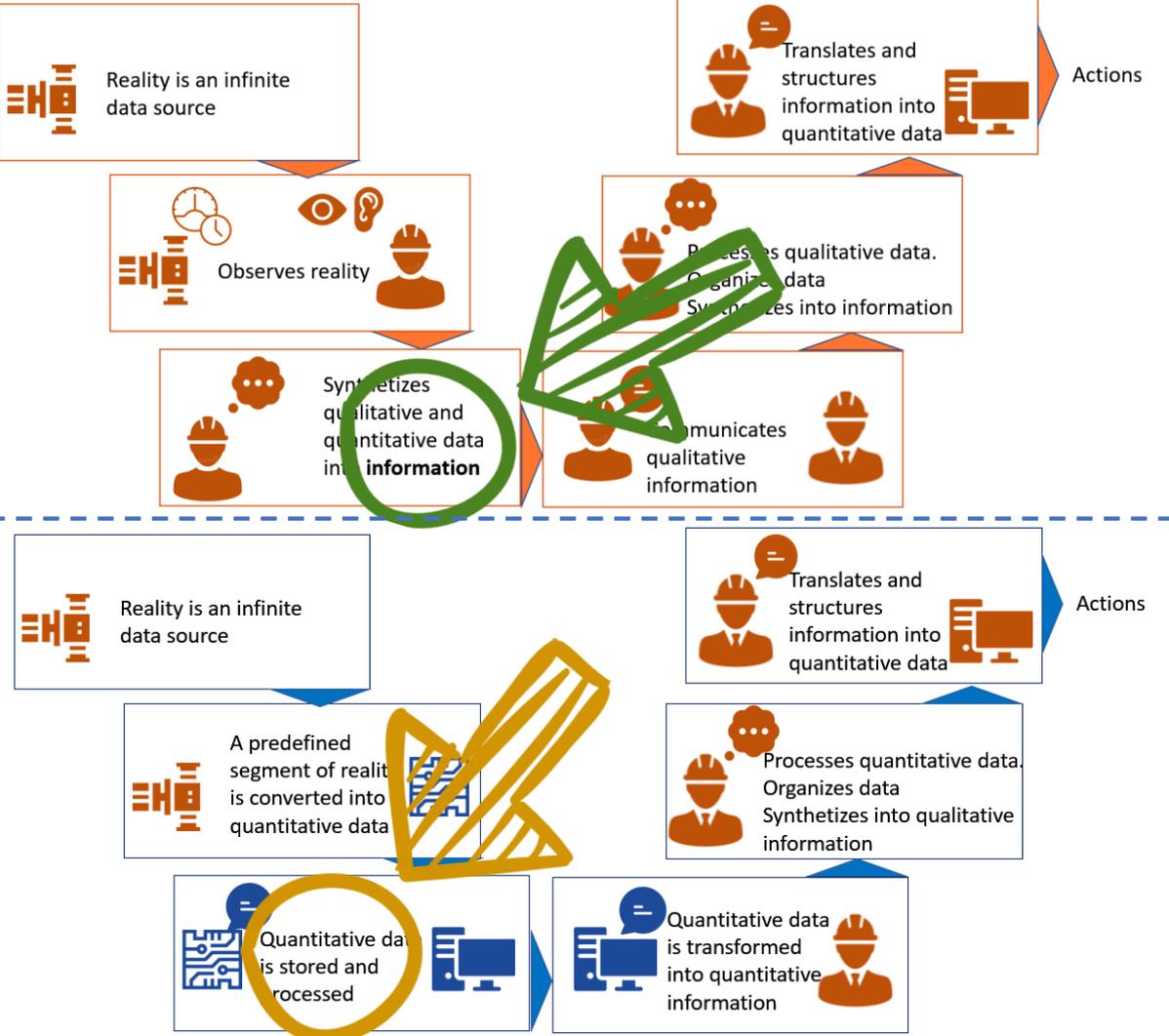
  Human observation –while it’s limited– is holistic, prepared to sense not preseen data of the reality.

  Sensor observation is precise, continuous, but limited to the range and design.

CHANGE IN TREND

Change analysis

- 1. Continuous specific data collection
- 2. Change of information process

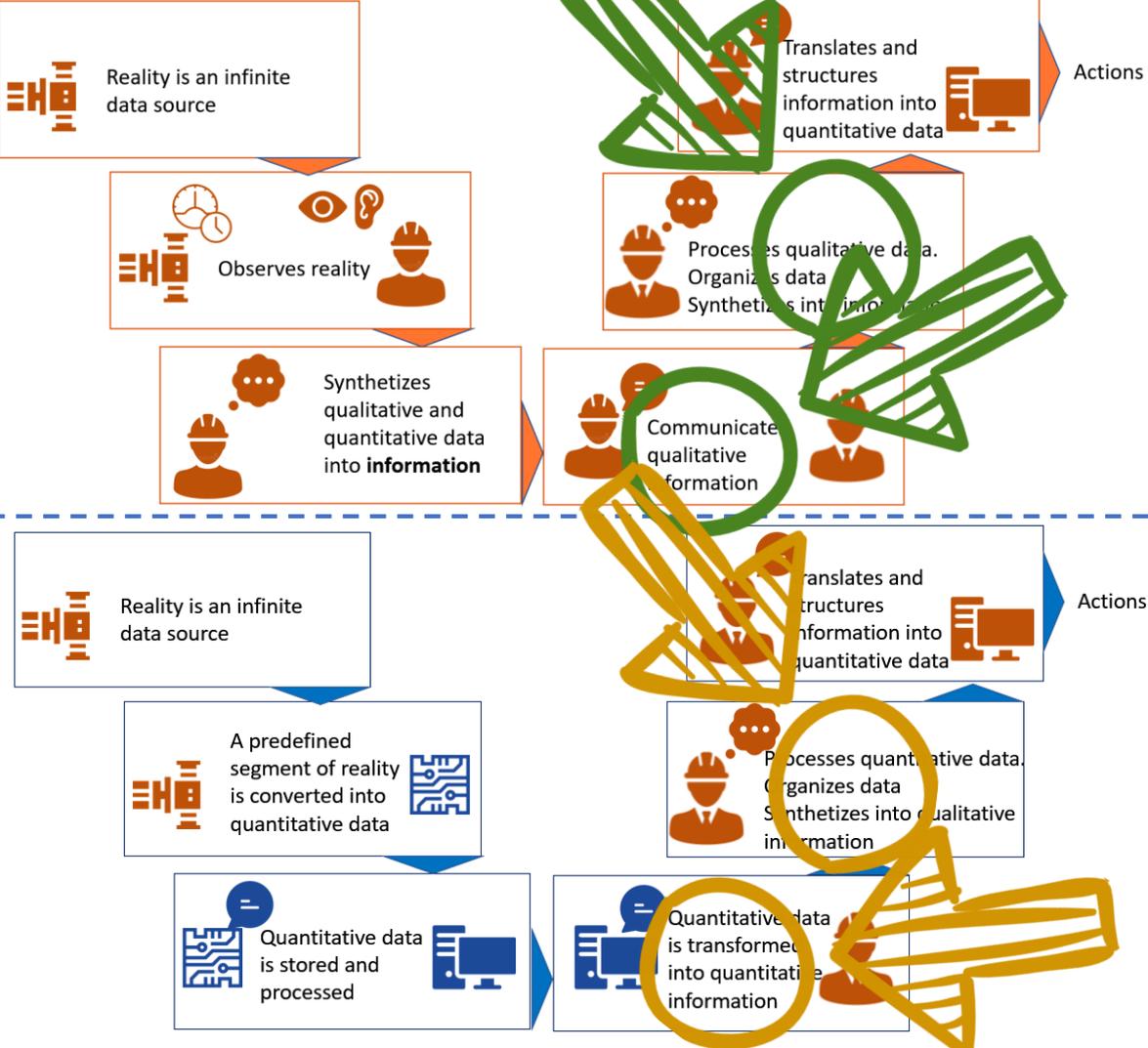


  Data processing is complex, contains a mix of quantitative and qualitative information.

  Quantitative information is stored and processed on numeric level. (no understanding of values)

CHANGE IN TREND

Change analysis



1. Continuous specific data collection
2. Change of information process
3. Change of information quality

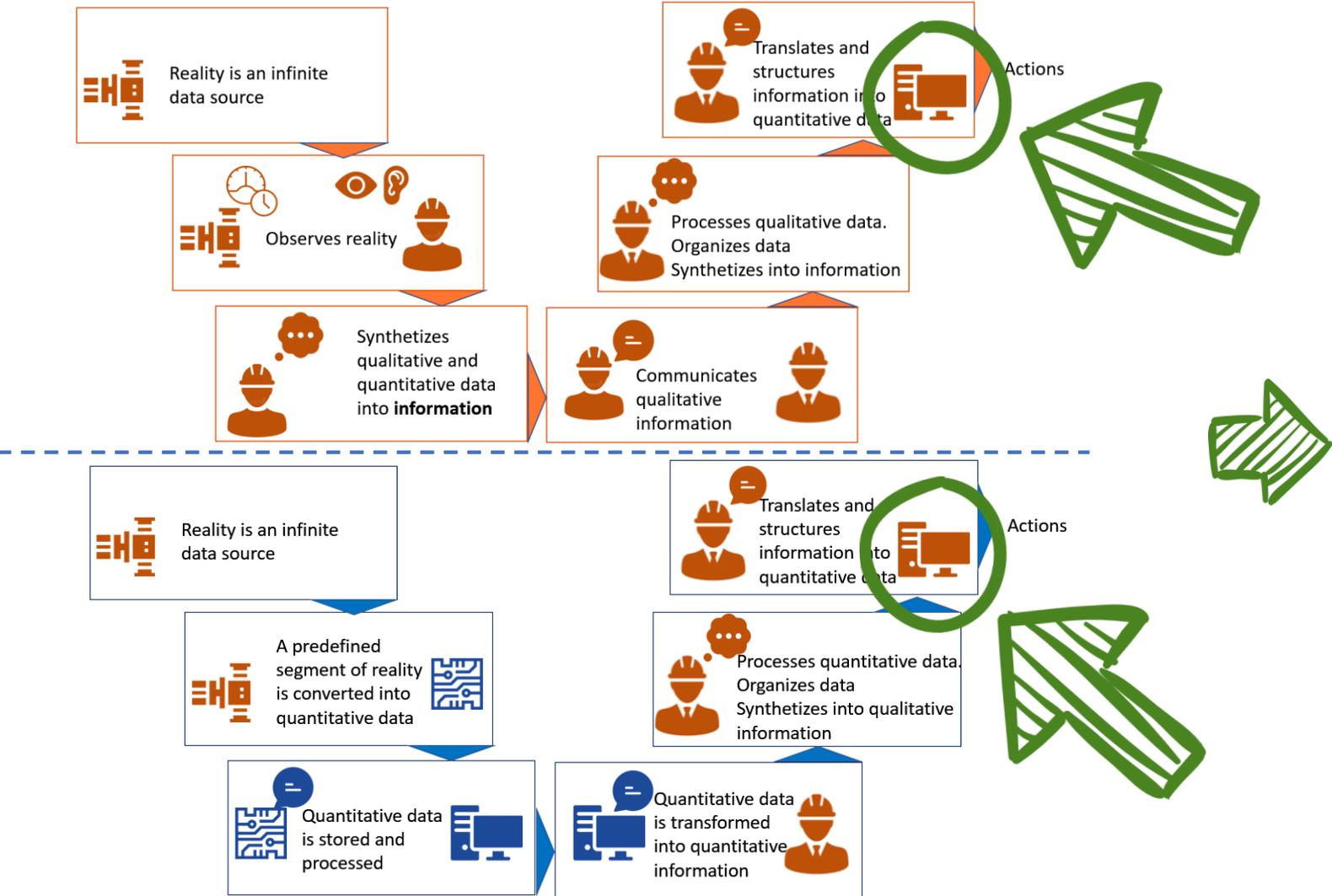
The main data processing step is quantification of qualitative data

The data processing including a human step due to necessity of decision making and transfer to CMMS system has an added level of qualification of quantitative data.

CHANGE IN TREND

Change analysis

1. Continuous specific data collection
2. Change of information process
3. Change of information quality
4. Legacy systems, increased data processing



Legacy systems are in use, that aren't prepared to process the data, using a reasonable human input. The number of parallel systems have increased.

DATA QUALITY

The seven properties of data quality

1	Accuracy
2	Validity
3	Consistency
4	Reliability
5	Completeness
6	Availability
7	Granularity

1. Accuracy

Data must be exact enough to convey the message in the derivate information.

DATA QUALITY

The seven properties of data quality

1	Accuracy
2	Validity
3	Consistency
4	Reliability
5	Completeness
6	Availability
7	Granularity

2. Validity

The amount and variety of data collection is validated by its usefulness for the purpose.

DATA QUALITY

The seven properties of data quality

1	Accuracy
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4	Reliability
5	Completeness
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7	Granularity

3. Consistency

The data must be consistent among all systems, without contradictions, and without different derivate information

DATA QUALITY

The seven properties of data quality

1	Accuracy
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4. Reliability

The data must be reliable, the tolerances and confidence values must be known and taken in consideration.

DATA QUALITY

The seven properties of data quality

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5. Completeness

Data must be complete to ensure correct information. Gaps in data lead to a partial view.

DATA QUALITY

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6. Availability

Data must be available and accessible to create information. Not accessible data is just as good as nonexistent.

DATA QUALITY

The seven properties of data quality

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7. Granularity

Level of detail that the data represents must be fit for the purpose of the derivate information quality.

DATA QUALITY



3

Cons

4

Relia

5

Comp



2. Validity

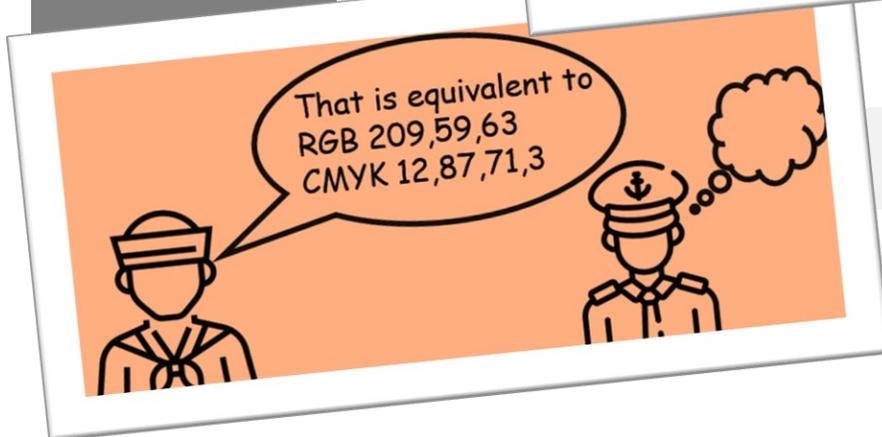
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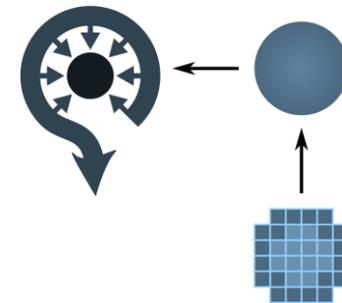
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7. Granularity

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MAINTENANCE DATA PROCESSING

Mixed data source

FLIGHT DEFECT AND MAINTENANCE REPORT
QA006 ISSUE: 2/OCT 07
AMO/A1/CA/1.82
TPM PART 2.19.3 REFERS

QUANTITATIVE DATA (Green annotations):
- FUEL DEFUEL: MWH00052
- DELIVERED: 5040
- AIRCRAFT UPLIFT (KG) X 100: 387
- DELIVERED (Lm) x SG: 394
- BEFORE FUELING: 10800
- AFTER FUELING: 12800
- TOTALS (KGS): 4540
- Y = 3018

QUALITATIVE INFORMATION (Yellow annotations):
- REPORT: 1. REP LH OODS ONLY INSIGNIFICANT PRE-COOLER PRESSURE FLUCTUATIONS ON LAST TWO SECTORS.
- 2. FLO'S PFD NOT ROOT DIM SUFFICIENTLY.

APPLIED KNOWLEDGE (Orange annotations):
- ACTION: 1. NOTED. ADD CLEARED.
- 2. FLO & CAPT PFD INTERCHANGED AND DOWN UNIT BRIGHTER THAN OTHER DU. THEREFORE DIMMING SWITCH OF FLO OK. SAME NORM. PFD. SUSPECT FLO PFD MANUAL REF. TO HAVE RECALIBRATION BY A NEW ONE. OK.

Quantitative data

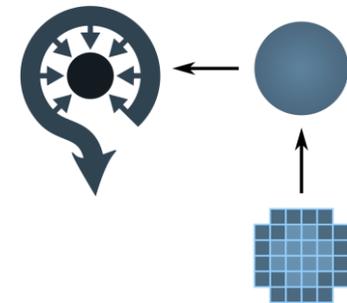


Qualitative information



Applied knowledge





MAINTENANCE DATA PROCESSING

Quantitative information and data source

The screenshot displays the h5pyViewer application with the following components:

- File Tree:** Shows the file structure for 'e14472_00033.hdf5', including 'entry', 'data', 'mcs', and 'pilatus_1'.
- Properties Panel:** Lists attributes for 'pilatus_1' such as 'type: Compound', 'fill time:2', and 'layout:1'.
- Data Table:** A table with columns 'Name', 'Value', 'Unit', and 'Type'. The 'Gain_setting' row is highlighted in blue.
- Heatmap:** A 2D visualization of data with a color scale from 0 to 1000. A yellow circle highlights a specific region.
- Python Shell:** A terminal window showing Python code and output. A yellow circle highlights a specific line of code.

Quantitative data



Quantitative information



SUMMARY

From data collection to action

	Data collection	Maintenance has a variety of new sources from autonomous assets through drones that are generating data in a previously unknown quantity and quality.
	Data processing	Maintenance is immersed in quantitative data that have to be made into qualitative or human readable information
	Information	Processing the data to information has become impossible without pre-processing it to quantitative information.
	Connection	Connecting the quantitative information with our legacy CMMS systems remains a human chore, putting great responsibility on the data processing
	Actions	the ultimate goal of the data collection: converting it into information and bringing it down to the level of decisions, actions and reactions

A reversed trend in maintenance data processing



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