Presenting:

Industry 4.0 Oil Condition Monitoring

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Industry 4.0.

IoT – From Product to Service
Musikhuset Aarhus
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Background

Opportunities exist to improve operational performance of assets.

Current practice relies heavily on subject matter expertise to improve operational performance.

Scalable decision making solutions have become commercially attractive.

IIOT is an enabler to improved decision making but this often lacks invaluable contextual information.

Existing condition monitoring methodologies are ripe for improved IIOT integration.

Oil Condition Monitoring (OCM) has long been the staple diet for a maintenance engineering practitioner.

OCM is normally performed on discrete systems by subject matter experts.

I4.0 OCM is based on a five year journey towards a fleet based asset management approach underpinned by quantitative and qualitative data analytic decision making.

Monition: An Introduction

- The Monition Way (M-TAC):
  - ✓ Assessment and Consultancy (Criticality etc.)
  - ✓ Reliability Services (RCM, RAM, APT, RPM, RCA etc.)
  - ✓ Condition Monitoring (VA, Motion Amplification etc.)
  - ✓ Laboratory Testing Services (Oil Condition Monitoring etc.)
  - ✓ Lubrication services (Lubricant selection etc.)
  - ✓ Energy Services (Gas and air leak, heat loss, steam etc.)
  - ✓ Corrective Services (Laser shaft alignment etc.)
  - ✓ Training Services (accredited courses etc.)

i4.0 is essentially…

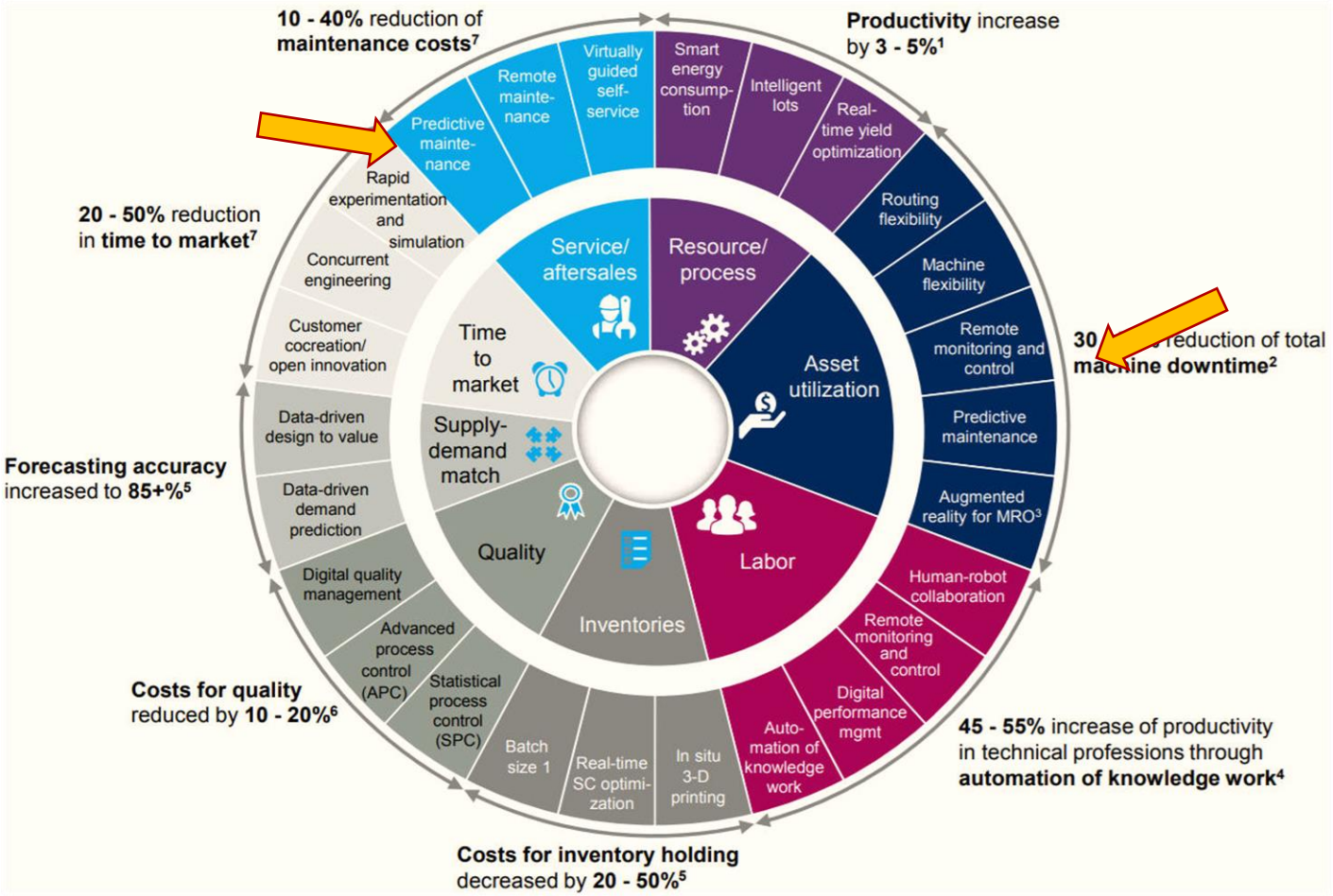
Connectivity

Industry 4.0 (i4.0) – a Maintenance Perspective (Maintenance 4.0)

- Promising opportunities through:

  - ✓ **Improved asset utilisation (30-50% reduction of total machine downtime) by:**
    - Predictive maintenance,
    - Augmented reality for MRO,
    - Remote monitoring and control,
    - Machine flexibility, Routing flexibility

  - ✓ **Improved service/aftersales (10-40% reduction of maintenance costs) by:**
    - Predictive maintenance
    - Remote maintenance
    - Virtually guided self-service



Source : McKinsey & Company (2016)

The Journey

Lab Testing

Machine Condition Analysis using Oil Analysis

Biomon Project

Assessment of bio-oils.

Classification and profiling against machine/wear characteristics.

Intellioil

Intelligent diagnostics of data from any lab, rule based algorithmic interpretation based on rulesets.

Janus

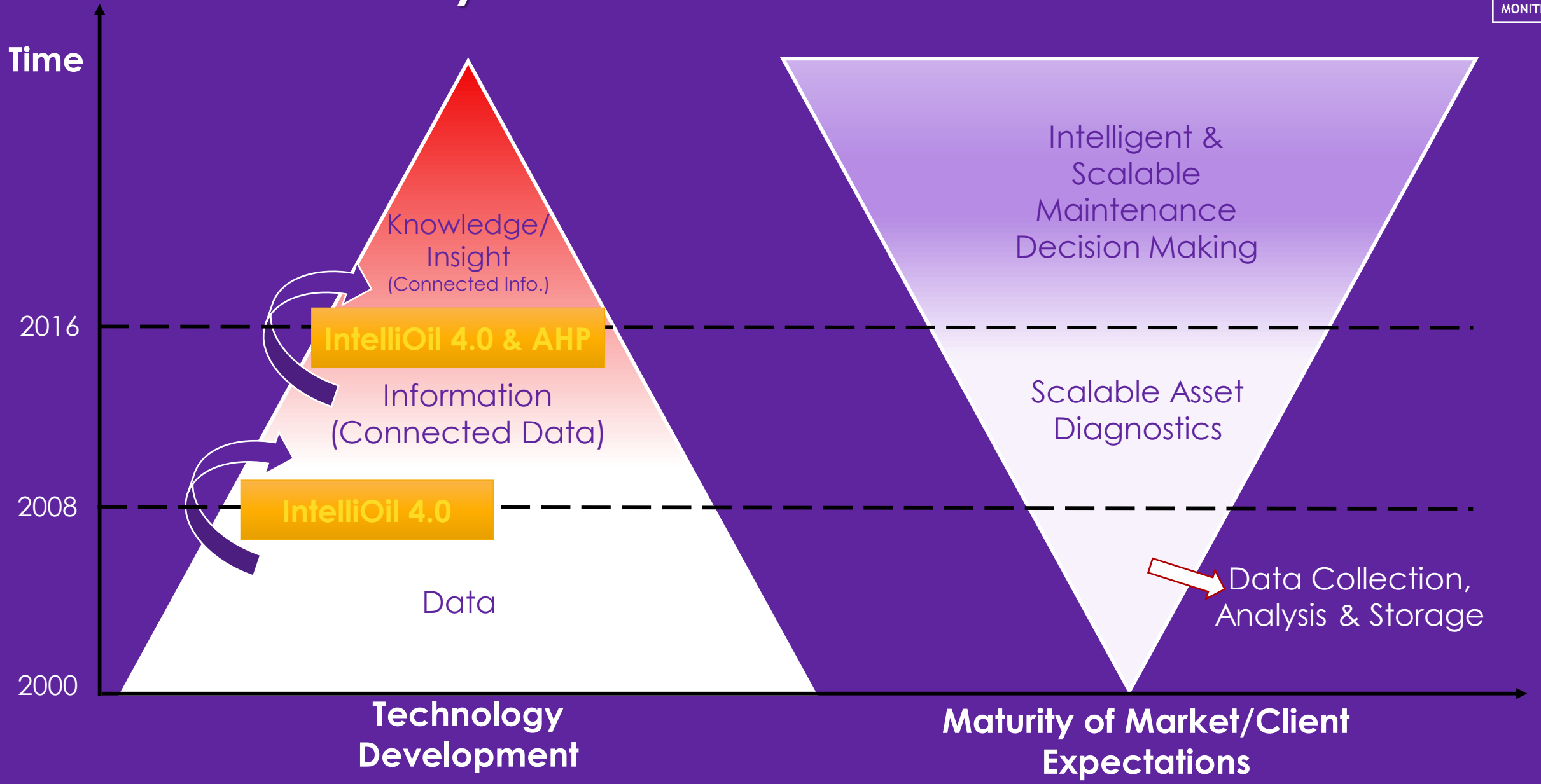
Data Learning platform utilising decision making algorithms, putting collected data into context.

Provides INSIGHT.

Lab Testing: Oil Condition Monitoring

- Oil Condition Monitoring (OCM) is a well known Condition Monitoring (CM) technique which enables understanding of the health condition of industrial assets, particularly the rotatory equipment.
- By analysis of the oil used by assets, OCM identifies small problems and recommends proper maintenance actions before these problems cause a failure, with potentially massive cost and health & safety implications.
- Macro parameters include: Wear, Chemistry, Contamination and Visual. Each macro parameter consists of a variety of sub (micro) parameters.

Monition's Industry 4.0 Vision for OCM



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The Biomon Project

- Reviews biodegradable lubricants, assessing point at which they are no longer biodegradable.
- Classification of each type of machine asset and profile against wear characteristics
- Builds on the insight achieved through standalone oil analysis and lubricant condition assessment.

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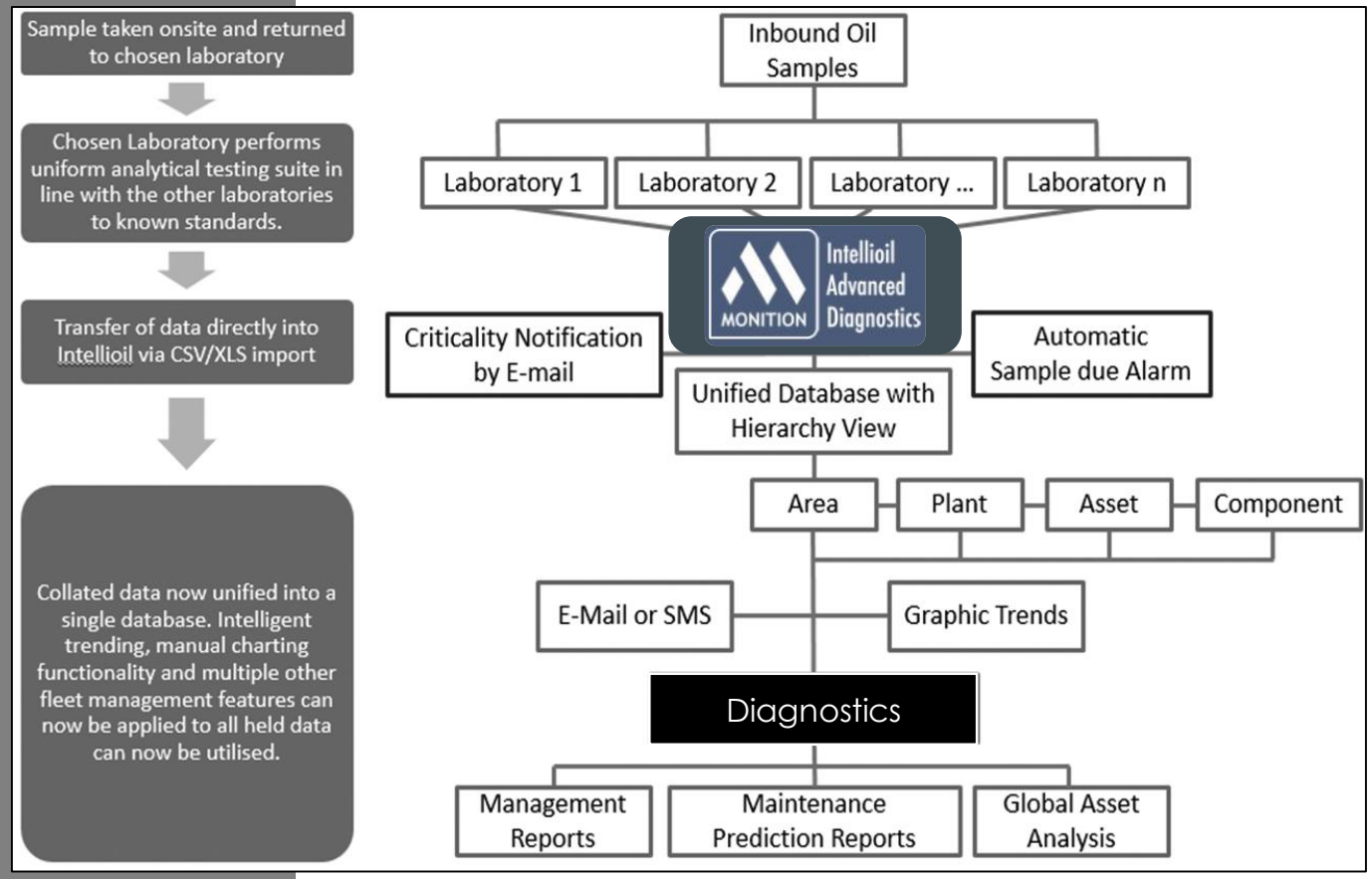
Moving from OCM Data to Information – IntelliOil 4.0 Platform

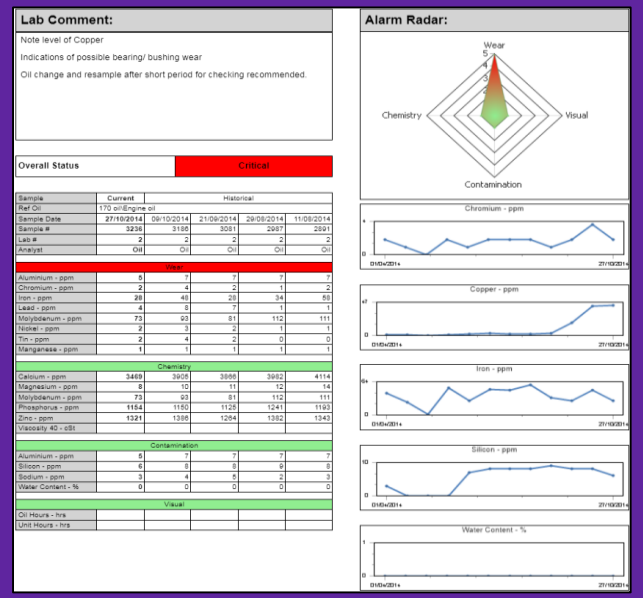
- Oil Condition Monitoring using the Monition integrated oil data analysis and web-based reporting platform (IntelliOil 4.0)
- Product overcomes limitations of oil analysis data from a single lab, taking data from any lab, interpretation achieved via rule-based algorithms.



Moving from OCM Data to Information – IntelliOil 4.0 Platform

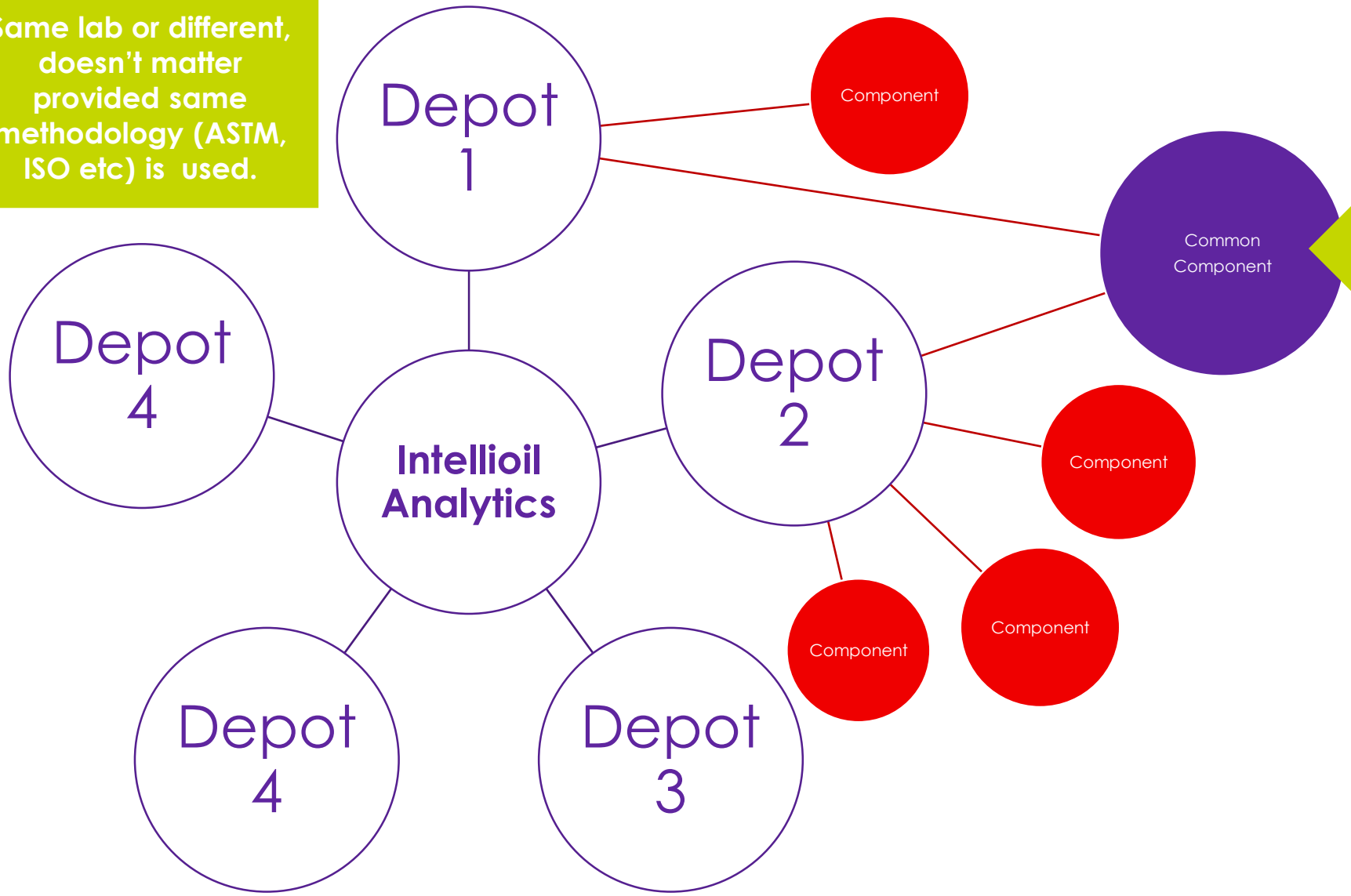
- Scalability – IntelliOil 4.0 dashboards provide an overview of the health status of assets (Asset Diagnostics) in different levels. These include component, machine, plant and area (Fleet).

- A typical IntelliOil 4.0 report demonstrates the conditions of micro and macro analytical elements of an oil sample in a rule-based traffic light alarm format, along with a maintenance action which is recommended by an analyst/technician.



Gaining Insight

Same lab or different, doesn't matter provided same methodology (ASTM, ISO etc) is used.



Enables comparative analysis – same component, different usage, location, conditions.

"What's different?"

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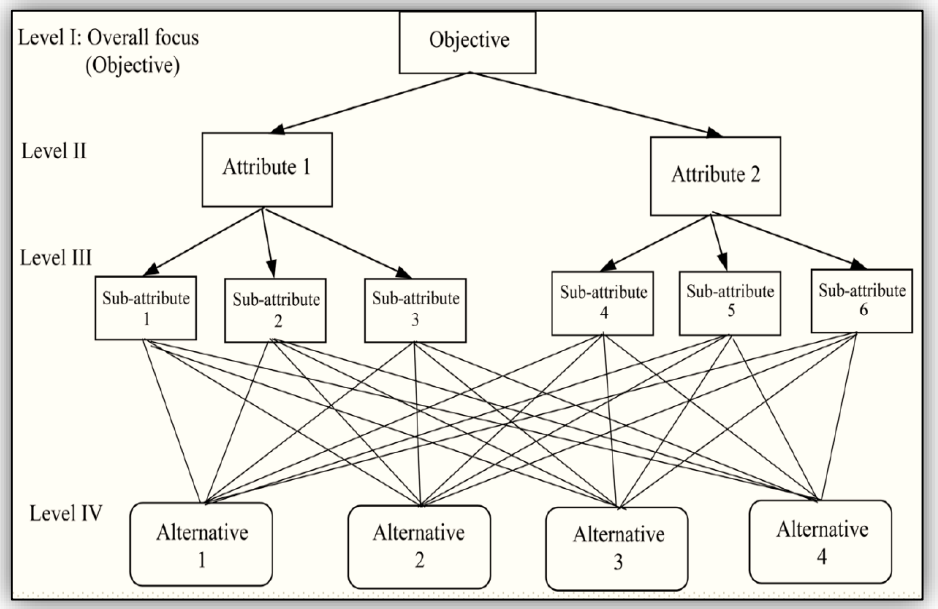
AI/Data Learning platform utilising decision making algorithms, putting collected data into context.

Provides INSIGHT.

Moving from OCM Information to Knowledge/Insight

Pairwise comparison enables making consistent oil analysis decisions but contributes to standardisation, transparency and traceability of decision making, through a 6-stage process

1. Define decision problem: Goal, Criteria, Alternatives
2. Development of a tree structure for problem
3. Formation of pairwise comparison matrices
4. Calculation of local importance weights
5. Checking inconsistencies for all matrices
6. Calculation of global weights (synthesis)



Sample Date	02/04/2013
Overall Status	Low Critical
Wear	
Aluminium - ppm	4
Cadmium - ppm	0
Chromium - ppm	0
Copper - ppm	2
Iron - ppm	7
Lead - ppm	6
Nickel - ppm	0
Silver - ppm	0
Tin - ppm	0
Titanium - ppm	0
Vanadium - ppm	0
FW - idx	0

Chemistry	
Barium - ppm	0
Calcium - ppm	3276
Magnesium - ppm	10
Molybdenum - ppm	39
Phosphorus - ppm	984
Potassium - ppm	2
Zinc - ppm	1078
Viscosity 40 - cSt	71.8
Contamination	
Aluminium - ppm	4
Silicon - ppm	5
Sodium - ppm	2
Water Percent - %	0
Visual	

Where has this helped us?

Windfarms

Rail and Bus Fleets

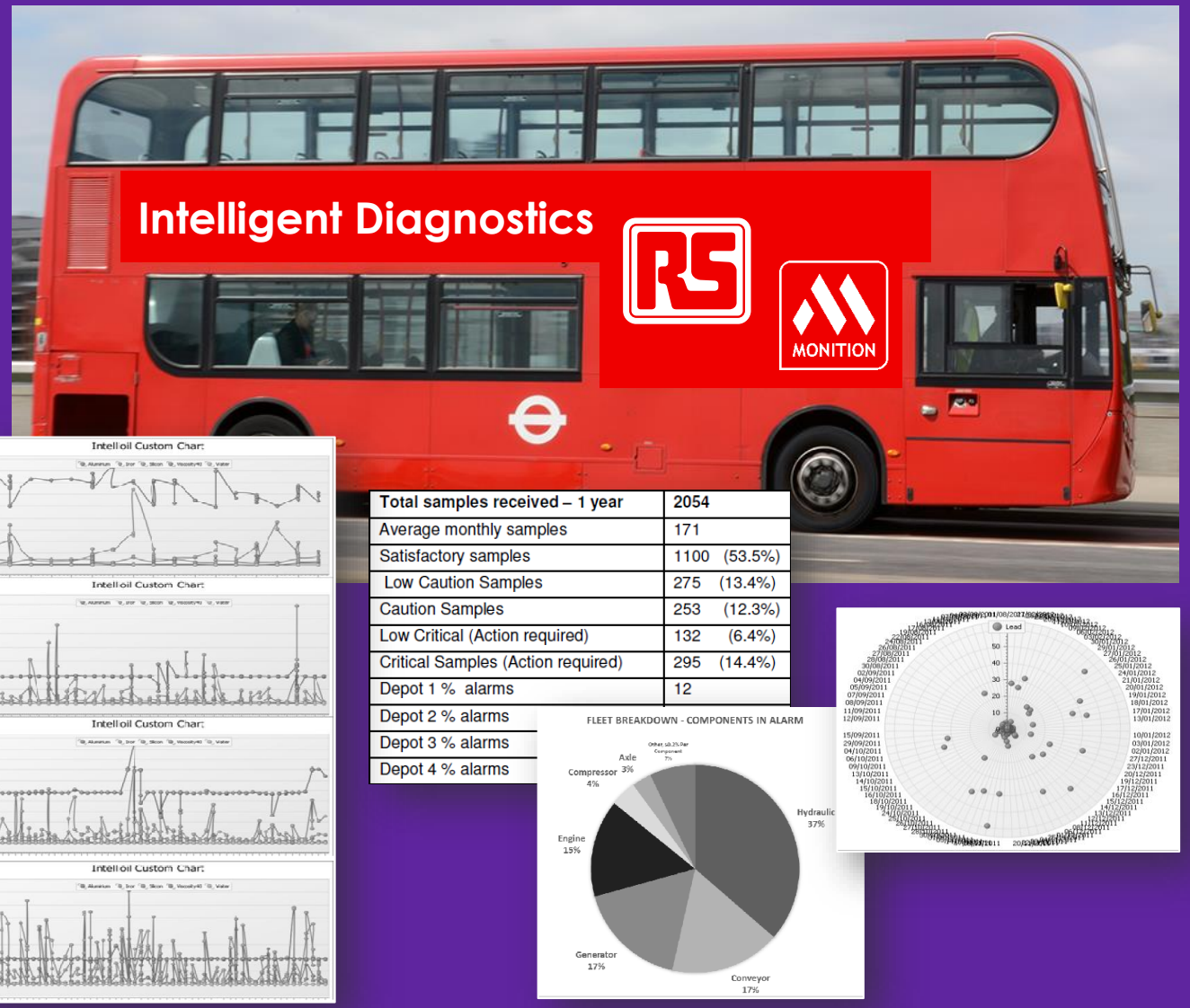
Oil Exploration

Case Study of Application

Where this has been applied:

Fleet: Automotive

- Modelling based on maximizing asset lifespan dependent on routes serviced, fleet condition/age and environment.
- Optimisation against the findings of these models based on drivers, be it normalization, financial savings or downtime mitigation.
- Industry-specific factors are drawn into the decision making process for optimal outcomes.

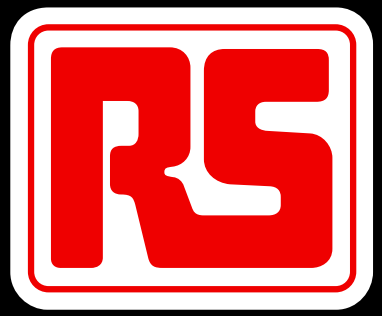


Total samples received – 1 year	2054
Average monthly samples	171
Satisfactory samples	1100 (53.5%)
Low Caution Samples	275 (13.4%)
Caution Samples	253 (12.3%)
Low Critical (Action required)	132 (6.4%)
Critical Samples (Action required)	295 (14.4%)
Depot 1 % alarms	12
Depot 2 % alarms	
Depot 3 % alarms	
Depot 4 % alarms	

So What does this Mean?

The impact of human error and variability can effectively be limited as part of the decision making process – greatly improved consistency based on the parameters at hand.

- Standardised outcomes based on the data presented, irrespective of source.
- Machine learning – the ability to build self-determined alarm sets based on a variety of factors, not just "localised" data. Data sources and methodologies can even be validated/qualified, and even more importantly traceable.
- The ability to draw on historical data basing from potentially unlimited sources to draw universally consistent outcomes.
- Pooled resource – the ability to draw on the experience of many experts to find an optimal outcome.



Thank You

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