mcT

Petrolchimico

Milano, 25 novembre 2015


SKF
®

Autonomous Maintenance

ottimizzazione del processo manutentivo nel petrolchimico e ruolo delle nuove tecnologie

mcT 2015 - Milano 25/11/2015

Angelo Addati

Agenda

- the SKF Group:
  - A truly global company,
  - SKF Technology areas,
  - SKF in the Petrochemical industry: mcT 2013, 2014, 2015.
- Autonomous Maintenance: the process
  - The TPM and the AEO framework,
  - How to get to a modern maintenance strategy,
  - How AM fits the overall maintenance process.
- Autonomous Maintenance: smart technologies
  - Check lists on paper, on palm,
  - Check lists on tablet,
  - What's around the corner.

1

the SKF Group

SKF – a truly global company

• Established	1907
• Sales 2014	SEK 70,975 million
• Employees	48,593
• Production sites	around 165 in 29 countries
• SKF presence	in over 130 countries
• Distributors/dealers	15,000 locations
• Global certificates	ISO 14001 OHSAS 18001 certification ISO 50001

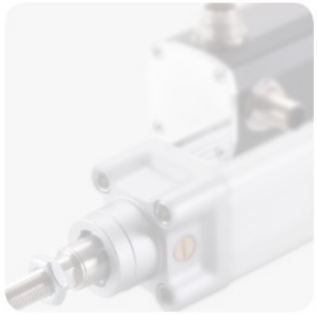
SKF technology areas

Bearings and units

Seals

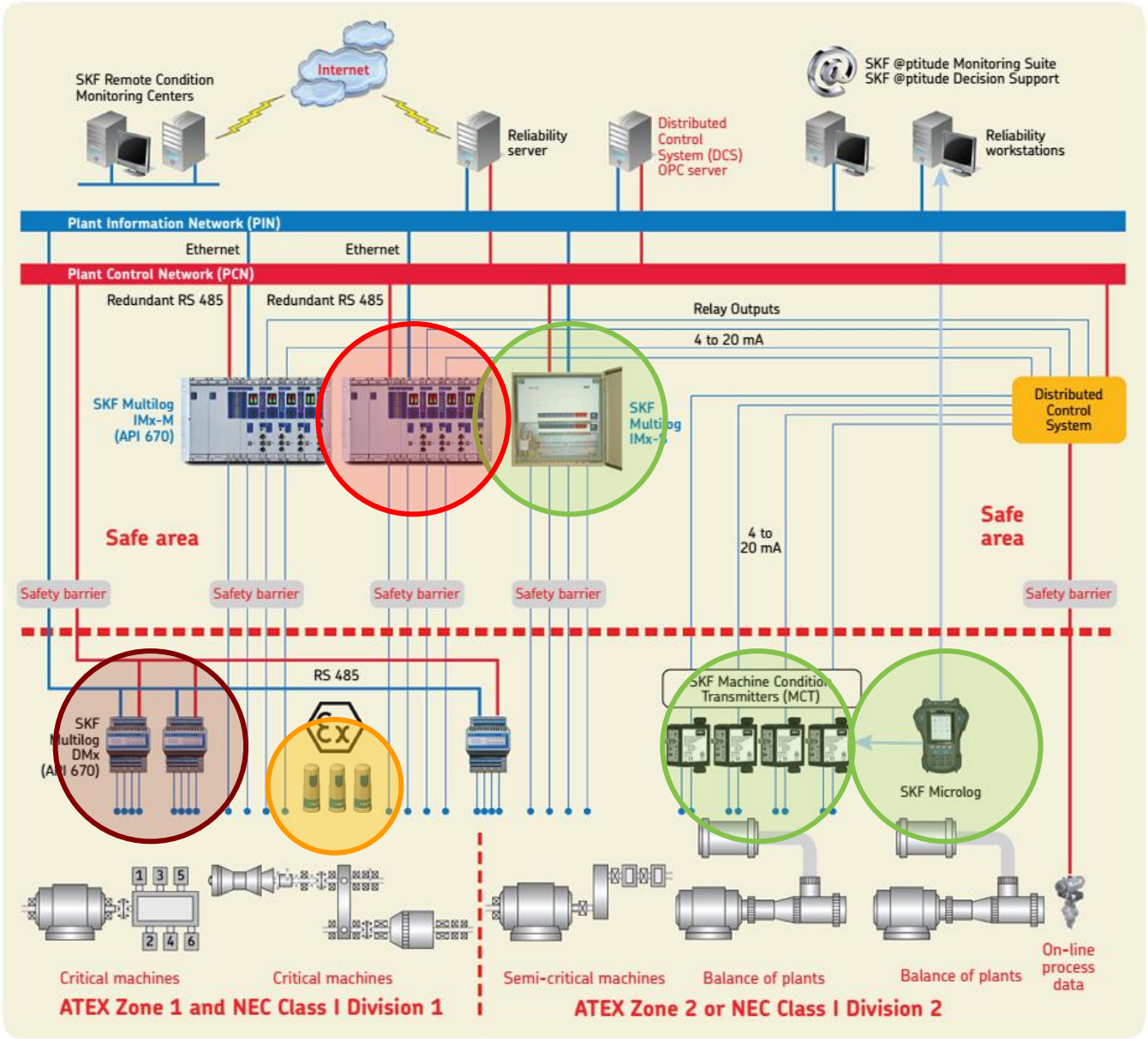
Services

Lubrication systems



Mechatronics

SKF in the Petrochemical: services and solutions



On-line CoMo multi-ch, single-ch, portables

On-line monitoring wireless ATEX

On-line CoMo multi-ch and protection API 670

Protection multi-ch in ATEX zone

mcT 2013

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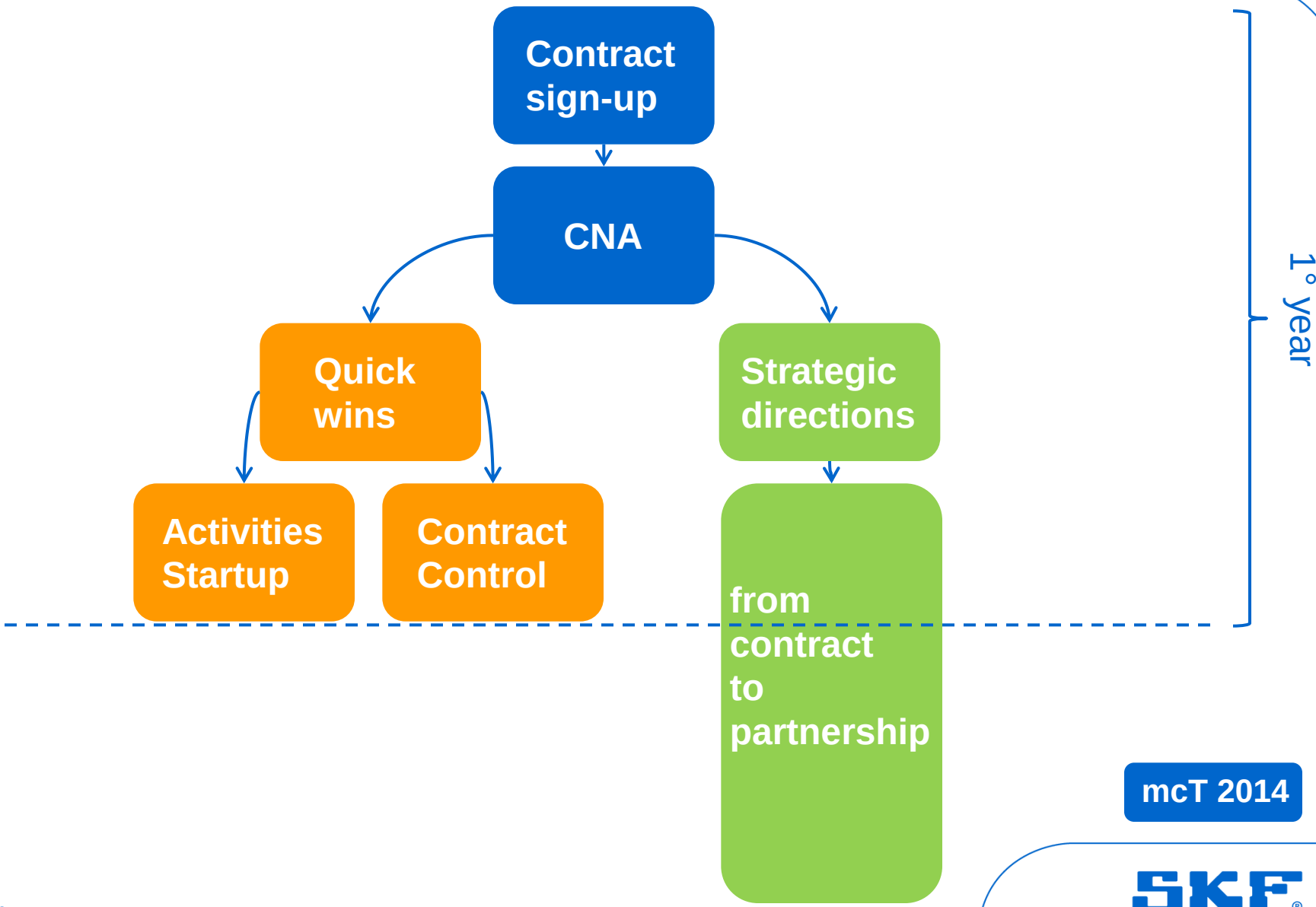
SKF in the Petrochemical: complex contracts



mcT 2014

SKF in the Petrochemical: Autonomous Maintenance

Autonomous
Maintenance
Smart Industry

- the Cloud becomes the infrastructure
- Big Data mgmt becomes the intelligence
- Connected sensors/systems become the data feed

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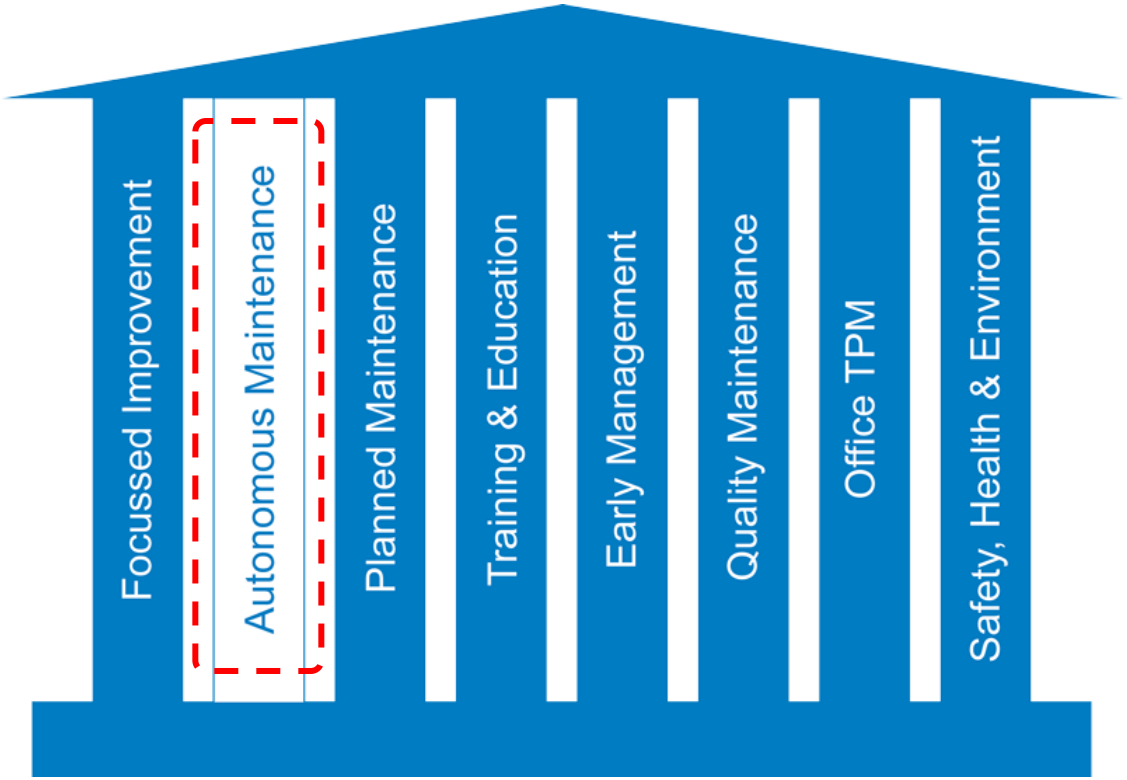
2

Autonomous Maintenance:

the process

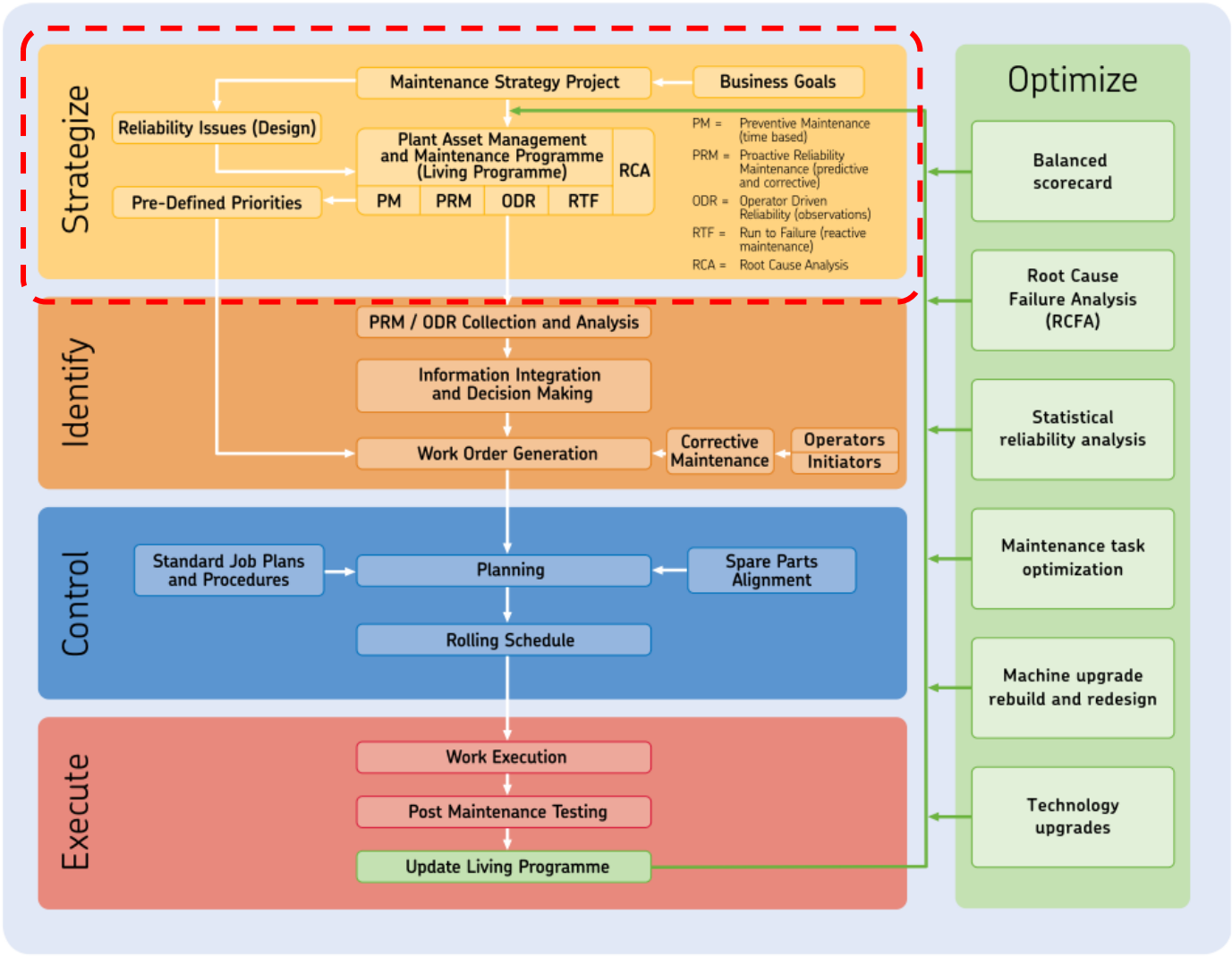
Autonomous Maintenance within **TPM** framework



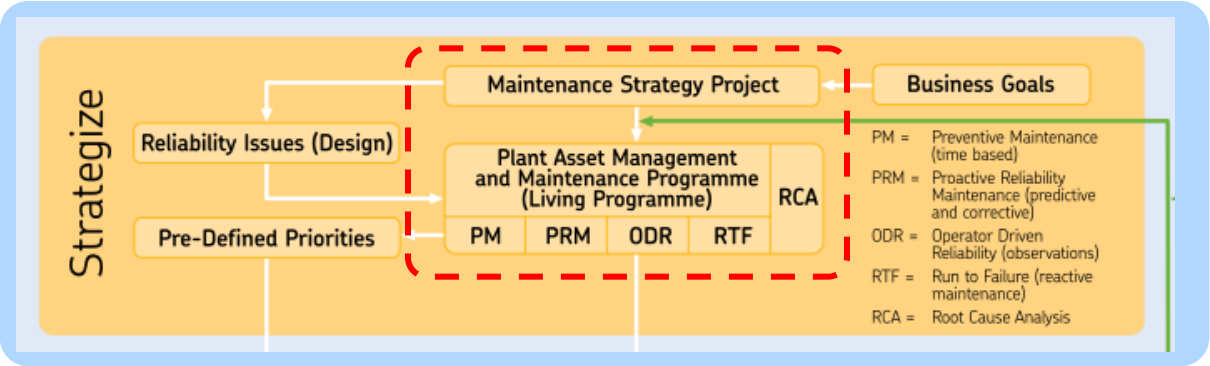
SKF: **ODR** Operator Driven Reliability

operator care, «manutenzione partecipata»

Autonomous Maintenance within **SKF AEO** framework



How to get to a modern maintenance strategy: **HOW**



MAINTENANCE PROGRAMME	driver / trigger	supporting tools
Run to failure	failure / breakdown	/
Preventive	time	maintenance program
Predictive	condition	monitoring program
Autonomous Maintenance (ODR)	observation	inspection program

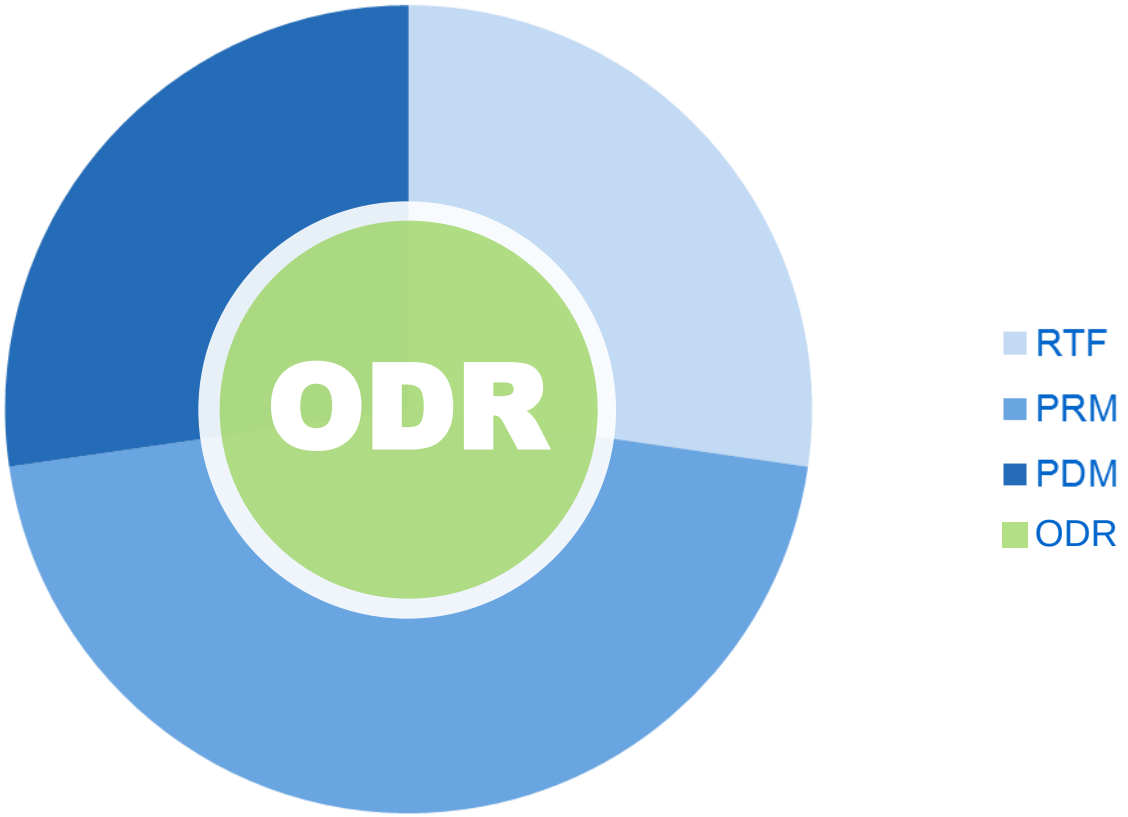
How to get to a modern maintenance strategy: **WHY**

Residual risk
Management
- OEE
- availability

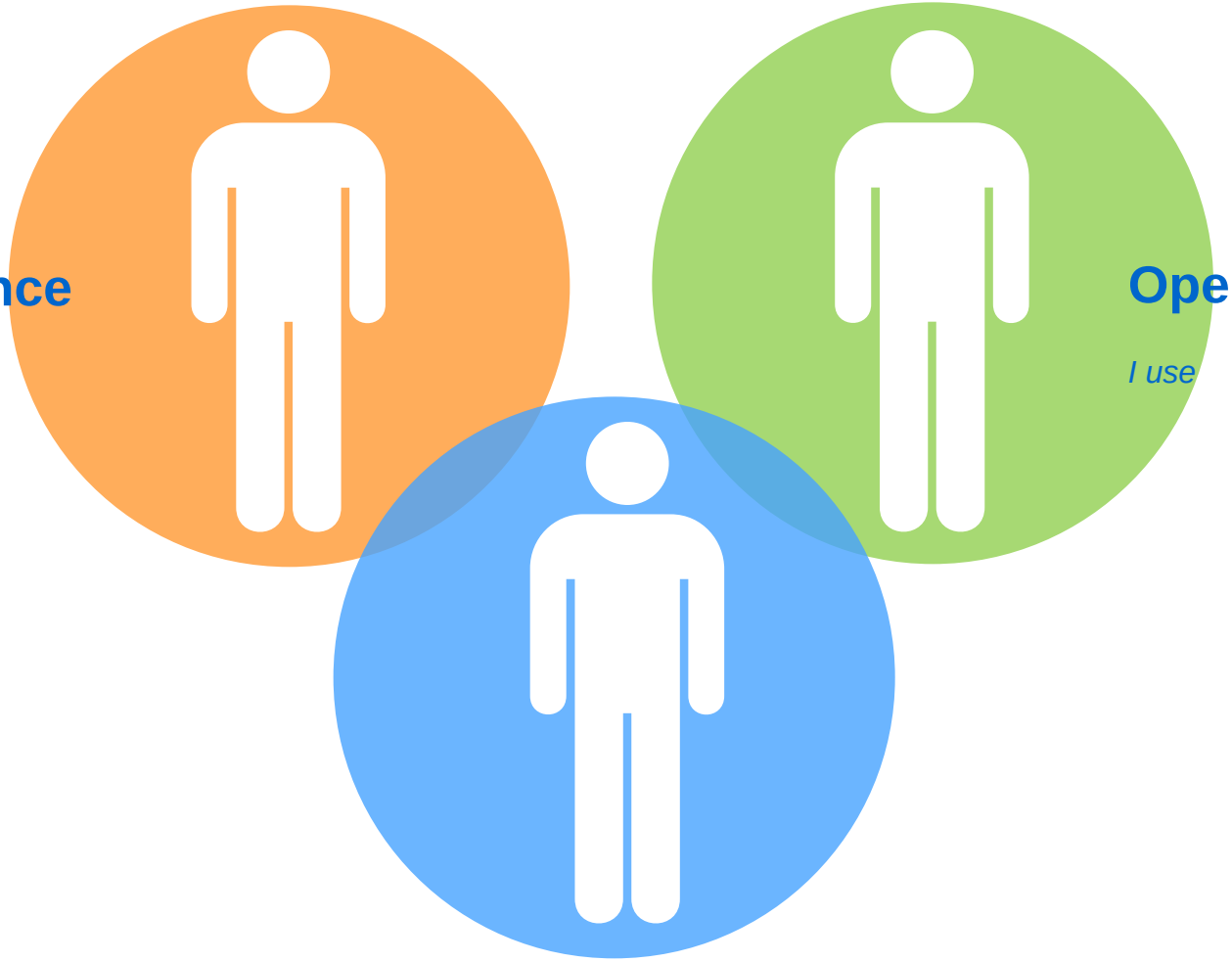
involvement,
capabilities
development,

Free up precious
resources

…in Petrochemical
Security checks
Huge plants



How to get to a modern maintenance strategy: **WHO**



Maintenance

I mantain
I fix

Operators

I use

Management

I coordinate

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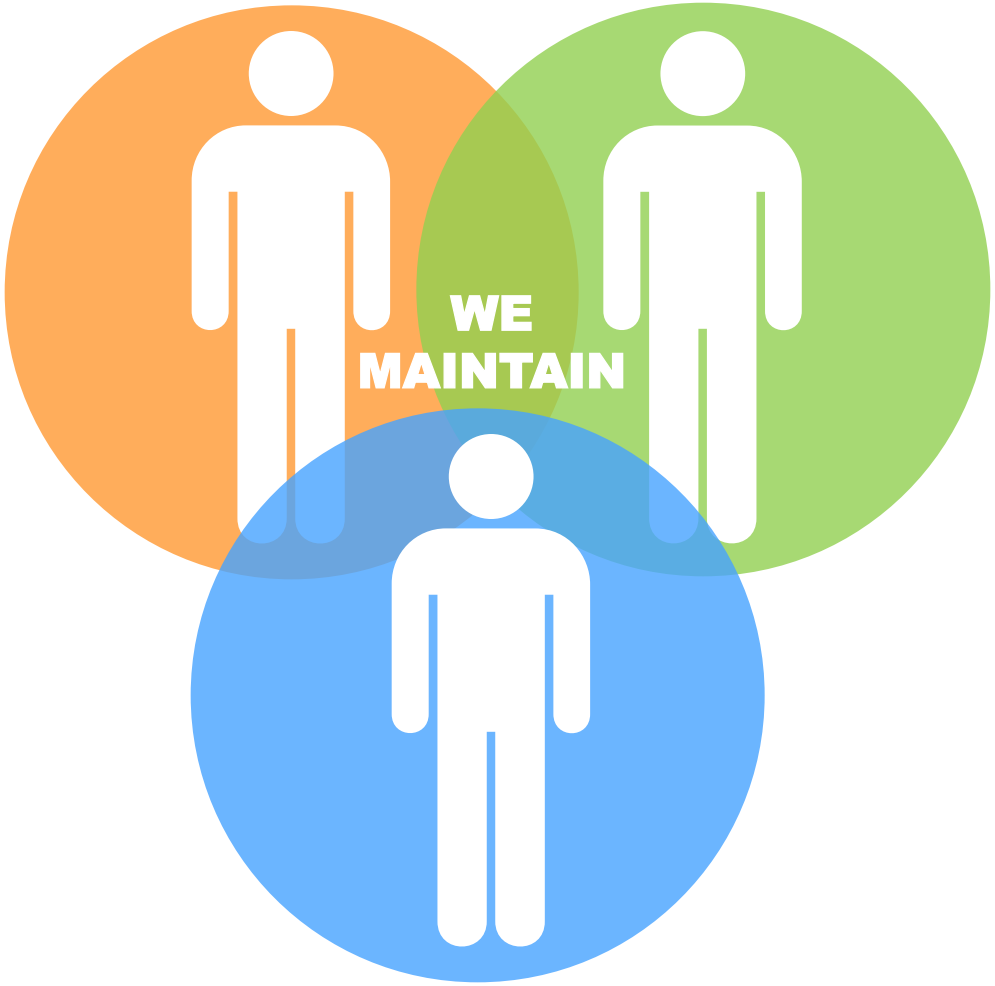
How to get to a modern maintenance strategy: **WHO**

Maintenance
Check list execution
Work orders generation
Main repairs



Operators
Check list execution
Feedback for the program
Small / basic repairs

Management
Communication & reward
Coordination
Evolution

How to get to a modern maintenance strategy: **HOW**

PHASE ONE

SCOPE:
rotating machines

AIM:
Gain **basic control** on machine health
Measure the program

+ small anomalies
+ contamination
+ out of range param.

PHASE TWO

SCOPE:
+ static parts

AIM:
+ increase the operators **capabilities**
+ measure impact **OEE**

+ deterioration causes
+ sources of contaminat.
+ small restorations

PHASE THREE

SCOPE:
+ mechanical seals

AIM:
+ take complete **ownership**
+ measure impact **COSTS**

+ interact with mech seals manuf./contractors
+ continuous improvement
+ review: maint. strategy, wharehouse

Visual check | Process parameters | Basic measurement

Tightening | Lubrication | Cleaning

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How to get to a modern maintenance strategy: **HOW**

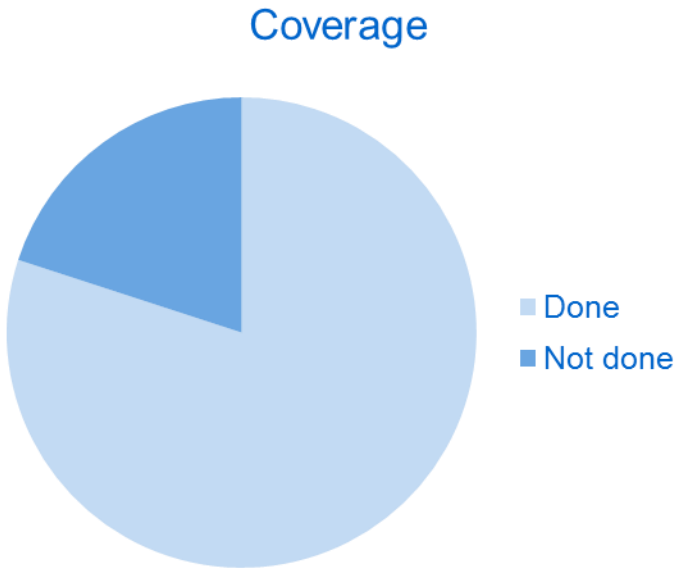
Critical success factors

- Don’t forgeto to re-think maintenance strategy as a whole, and wharehouse
- Incremental / phased implementation
- Training on the job
- Operators level of interest, Management commitment
- Communicate, communicate, communicate
- Results driven program (measure, use KPIs)

How to get to a modern maintenance strategy: **HOW**

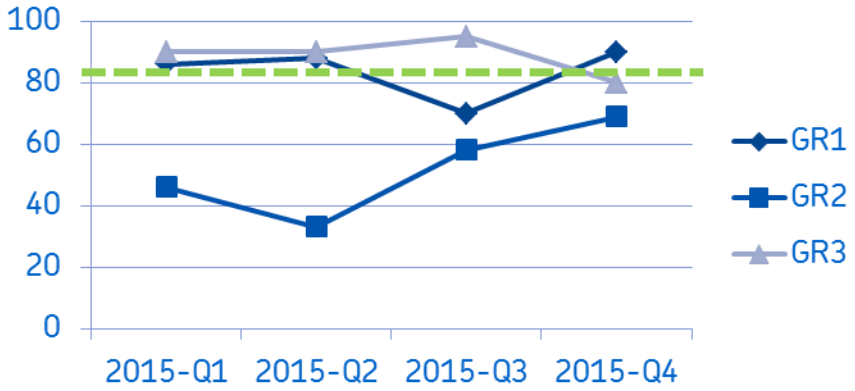
KPIs

Coverage: executed vs expected
per group, per plant
Effectiveness: confirmed vs total
false positives/negatives
Saved Costs: what if not advised?



KPOs

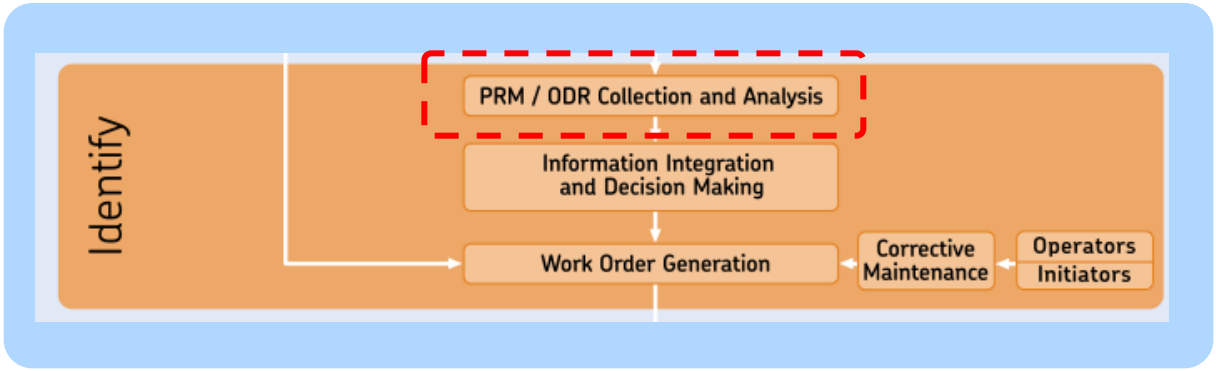
Targets vs measured



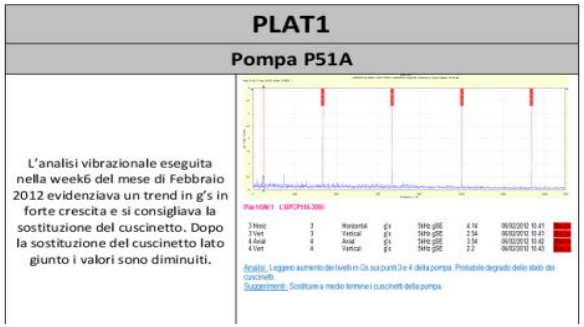
Other key aspects

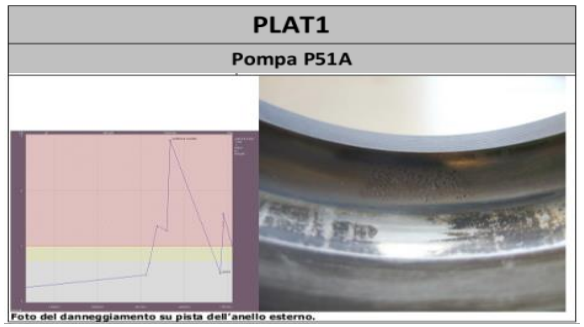
How to aggregate?
Weekly, Monthly?
Distribution list?

How AM fits the overall maintenance process



First input: ODR inspection (AM)
History & Analysis: PdM program → WO
Fix: PMT
Root cause: RCFA activity
Proactive maintenance: SKF AE team





How AM fits the overall maintenance process

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2. Dati dal campo

La rottura si è manifestata a meno di un anno dall'ultima revisione meccanica del motore stesso.
Il motore ha manifestato elevate temperature sin dal suo primo avvio dopo la manutenzione, a tal scopo è stata posizionata una manichetta di aria compressa al fine di mantenere la temperatura al di sotto dei 90°C.
I valori vibrazionali disponibili presso il sito SKF di Milazzo sono stati presi in considerazioni e non evidenziano ulteriori anomalie.
La rottura è avvenuta poco dopo un avvio della macchina senza manichetta di aria compressa per il raffreddamento.
Si mostrano le foto fornite dal cliente dove si nota la rottura e una quasi assenza della gabbia massiccia sul cuscinetto DE.

Fig. 1-2 rotore e cuscinetto DE

Fig. 3-4 cuscinetto DE e targhetta motore

SKF

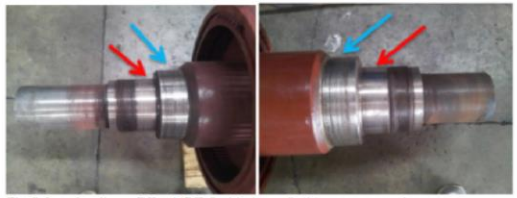


Fig.2-3 sede albero DE e NDE (in blu le sedi di tenuta grasso)


Fig.4-5 Anello interno cuscinetto DE – surriscaldamento, rifollamento(indicato da freccia) e rotazione sull'albero


Fig.6-7 flangia bloccaggio DE con zona di passaggio grasso e dettaglio mancanza feltrini

- Regime di lubrificazione e scelta del lubrificante
- Giuochi interni: lato bloccato, lato libero
- Tolleranze per rilavorazione scudi
- Precauzioni per il riassemblag.
- Proposta di un giunto alternativo

3

Autonomous Maintenance:

smart technologies

Autonomous Maintenance: check lists **ON PAPER**

PROS

Easy to implement
Light to carry with you

CONS

- Execution not guaranteed
- Correctness not guaranteed
- No history, no Database
- No correlation to other:
  - events
  - reliability parameters
- Digitalization is
  - time consuming
  - subject to errors

Autonomous Maintenance: check lists **ON PALM**

PROS

Execution guaranteed
Correctness guaranteed
History, Database
Correlation to other:

- events
- reliability parameters

Digitalization is easy (synch)
Rugged and atex

CONS

Checklist need to be traslated
Quite long learning curve
Relavively heavy to carry with you

Autonomous Maintenance: check lists **ON TABLET**

Tablet + SKF Data Collect app

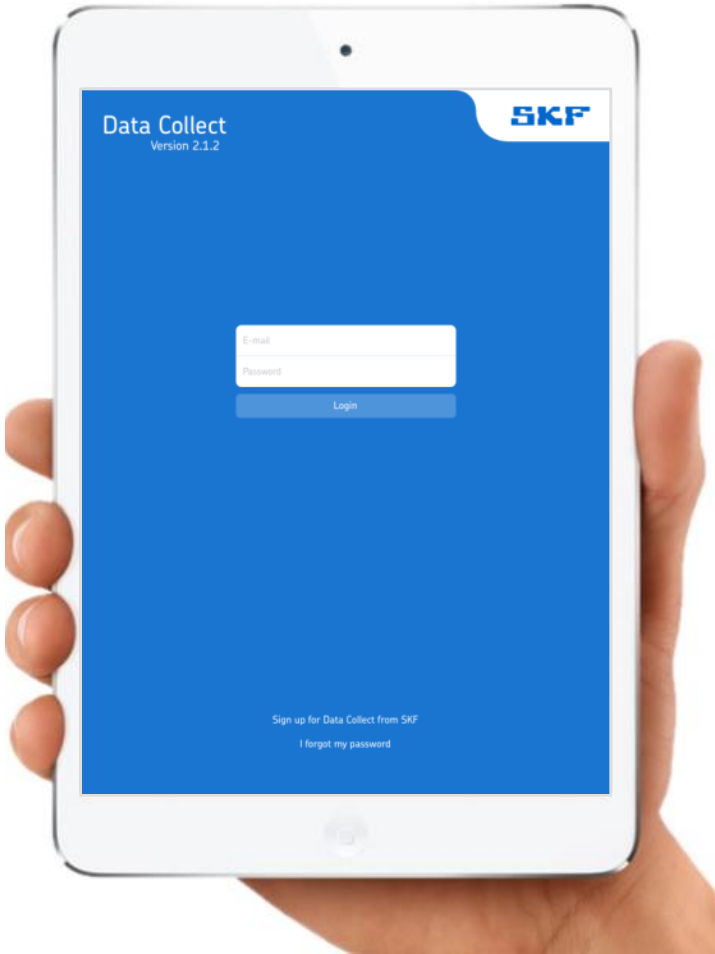
PROS

Quite steep **learning curve**
Empowering
Communicates with sensors
Light to carry with you
Execution guaranteed
Correctness guaranteed
History based inspections
Correlation to other:
events, reliability parameters
Data is already digital (**Cloud**)
Rugged and **atex** executions

CONS

Checklist need to be **traslated**
The **process** needs to be governated

Autonomous Maintenance: check lists **ON TABLET**



ANNOTATE:
text, quote, highlight, vocal memos, sounds

BARCODE ID:
identify machine, proof of execution

TAKE PICTURES:
proof, add details, provide evidence

CROSS-ANALIZE:
vibrations, WO, PMT, SAP

INVESTIGATE:
if clauses, add details, avoid useless checks

URGENCY mngt:
instant reporting, full details

CLOUD BASED:
instant upload,

ACCOUNTA BILITY:
responsibility, reward

Autonomous Maintenance: check lists **ON TABLET**

- Rugged design
- Rechargeable battery
- Class I, Division 2, Groups A, B, C, D and T6

- Overall machine vibration (vel)
- Bearing vibration (gENV, acc)
- Temperature
- FFT spectral data (800lines gENV)

Autonomous Maintenance: check lists **ON TABLET**

Autonomous Maintenance: check lists **ON TABLET**

Ipad Air 2 with Rugged Life proof case
Ipad Mini 32 with Rugged Life proof case
} IP 68 and Mil 810

SKF Ruggedized Tablet
SKF Ruggedized Smartphone
} IP 67 and Mil 810

SKF Ruggedized Tablet
SKF Ruggedized Smartphone
} ATEX / IECEX / NEC Zone 1

Autonomous Maintenance: check lists **ON TABLET**

Autonomous Maintenance: just around the corner

SKF Remote
Diagnostic Center

SKF Specialistic
Reliability Report

interface

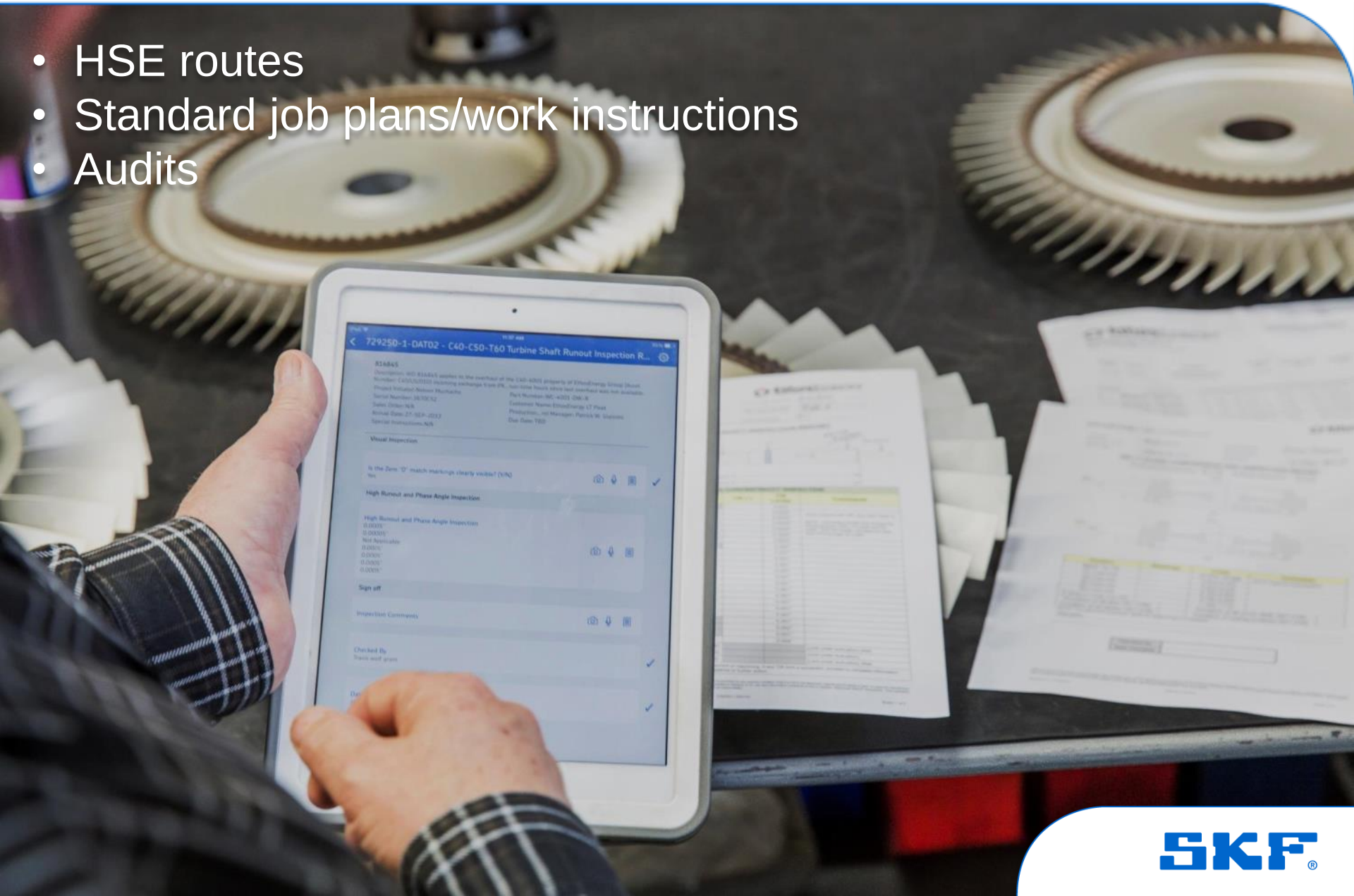
CMMS

PCS

ERP

Others

Autonomous Maintenance: just around the corner



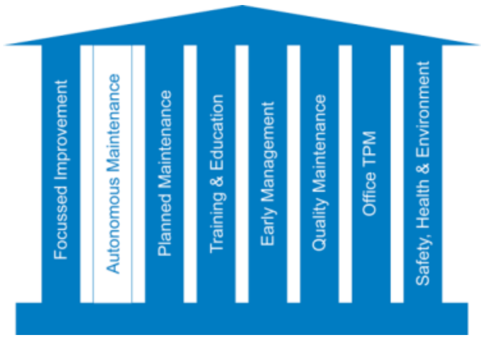
- HSE routes
- Standard job plans/work instructions
- Audits

4

Autonomous maintenance

ottimizzazione del processo manutentivo nel petrolchimico e ruolo delle nuove tecnologie

Autonomous Maintenance – the SKF point of view



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+ continuous improvement
+ review maintenance strategy

Visual check	Process parameters	Basic measurement
Tightening	Lubrication	Cleaning

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Autonomous Maintenance – the SKF point of view

*The **Autonomous Maintenance** improves housekeeping, and allows early detection of failure, may improve safety and the environmental performance. It also frees up valuable and precious maintenance craft time to focus on specialistic maintenance and failure causes eliminations.*

Thank you for your attention