A VIEW OF CHOSEN EUROPEAN MAINTENANCE (CEN) AND GLOBAL (ISO) STANDARDS – HOW THEY CAN GIVE SUPPORT TO MAINTENANCE AND PHYSICAL ASSET MANAGEMENT

(1) SHOULD WE BE LOOKING FOR OPPORTUNITIES TO CHANGE THE PERCEPTION OF 'MAINTENANCE? (2) DOES AN APPLICATION OF THE FOLLOWING DO THAT?

From a 'Costs Down' approach to *'Value Added'*

- Should we challenge any opinion at the Leadership and Management levels – that:

  'Maintenance is a necessary evil. Its future potential is only to drive down its costs'.

  Could we give a more enlightened, positive and proactive view that …..

- 'Maintenance' is a core and essential part of an ***organisation's 'value adding' activities***.
- Which can, first, achieve and then continue to develop ***asset optimisation'***.
- And that the improvement of results arises from better ***skill competencies and involvement,***
- Supported by a 'mind-set' of delivering a ***quality service,***
- With ***front line staff receiving proactive support from their Leaders and Managers.***

These trends and others may already define your 'maintenance approach' to-day or in the future years to come

BEGINNING – FROM 1980 TO 2000+
TEROTECHNOLOGY SUGGESTED AN IMPROVEMENT

Consisting of Policies and Practices which have Application To-day, for example:

- Future Asset Designers ***'designing-out' the failures & safety risks*** of to-day.
- Sustainability is required of the ***asset qualities and functional specifications*.**
- ***An optimum asset configuration is*** needed for ***reliability and maintainability.***
- ***'Communication Bridges'*** should connect the ***Manufacturer and the Owner***.
- An overall aim is still to implement a so-called ***Total Quality Management approach***; as is an aim of the **Asset Management Standard ISO 55001 To-day**!

TEROTECHNOLOGY

The scope of ‘Terotechnology’, even then, consisted of aims which:

- (1) **recommended Whole Life Asset Costing** to obtain an optimum balance of asset purchase/and installation/operating/maintenance costs;
- (2) applied **RCM and *predictive maintenance*** – and increasing the use of suitable inbuilt condition monitoring techniques;
- (3) focused on the ***identification of potential failures*; *and health & safety risks;*** that can be corrected in the time before a potential failure occurs;
- (4) introduced ***’benchmarking’***; i.e. comparing KPI changes in different systems;
- (5) began an application known as ‘Expert Systems’; now known as ‘AI’.

RECENTLY, STANDARDS PRODUCED INCLUDE THOSE APPLICABLE TO INFRASTRUCTURE / FACILITIES / BUILDINGS ETC. AND RELATED TO CONSTRUCTION AND MAINTENANCE

- E 917-17: 2020 A PRACTICE FOR MEASURING ***THE LIFE CYCLE COSTS OF BUILDINGS***
- E 1699-14 2020 A PRACTICE FOR PERFORMING ***VALUE SYSTEMS ENGINE*****ERING**

- ASTM E 3035-15: 2020 CLASSIFICATION OF ***A FACILITIES ASSETS COMPONENT TRACKING SYSTEM***
- 201320-20 PRACTICES FOR DEVELOPING FUNCTIONS *IN* ***CONSTRUCTION FIELDS***

- E 2506 STANDARD GUIDE FOR DEVELOPING ***A COST EFFECTIVE RISK MITIGATION PLAN FOR NEW AND EXISTING CONSTRUCTED FACILITIES***
- ASTM E 3035-15: 2020 A STANDARD ***CLASSIFICATION OF FACILITY COMPONENTS***

HOW EUROPEAN MAINTENANCE (CEN) AND GLOBAL (ISO) STANDARDS CAN GIVE SUPPORT TO MAINTENANCE MANAGEMENT AND PHYSICAL ASSET MANAGEMENT

ILLUSTRATED FIRST, BY A CASE STUDY APPROACH
TO APPLYING SOME MAINTENANCE STANDARDS:

– THE EXPERIENCE OF A FOOD PRODUCING ORGANISATION IN THE UK

– OPERATING ON TEN SITES OF JUST 20 TO 50 PEOPLE ON EACH SITE

– HOW MAINTENANCE DATA SYSTEMS, FAILURE ANALYSES, PROCESSES ETC. WERE SUPPORTED WITHIN A THREE PHASE SET OF TACTICS

– RESULTING IN THE IMPROVEMENT OF PERFORMANCE ON THE SITES

AN OVERALL MAINTENANCE MANAGEMENT IMPROVEMENT STRATEGY WAS DEVELOPED BASED ON THREE PHASES OF TACTICS (1) – (3):

(1) ***THE IMPLEMENTATION OF A CMMS*** (COMPUTER SYSTEM) TO ASSIST IN PROVIDING BETTER INFORMATION ON ***EQUIPMENT FAILURE PROBLEMS.***

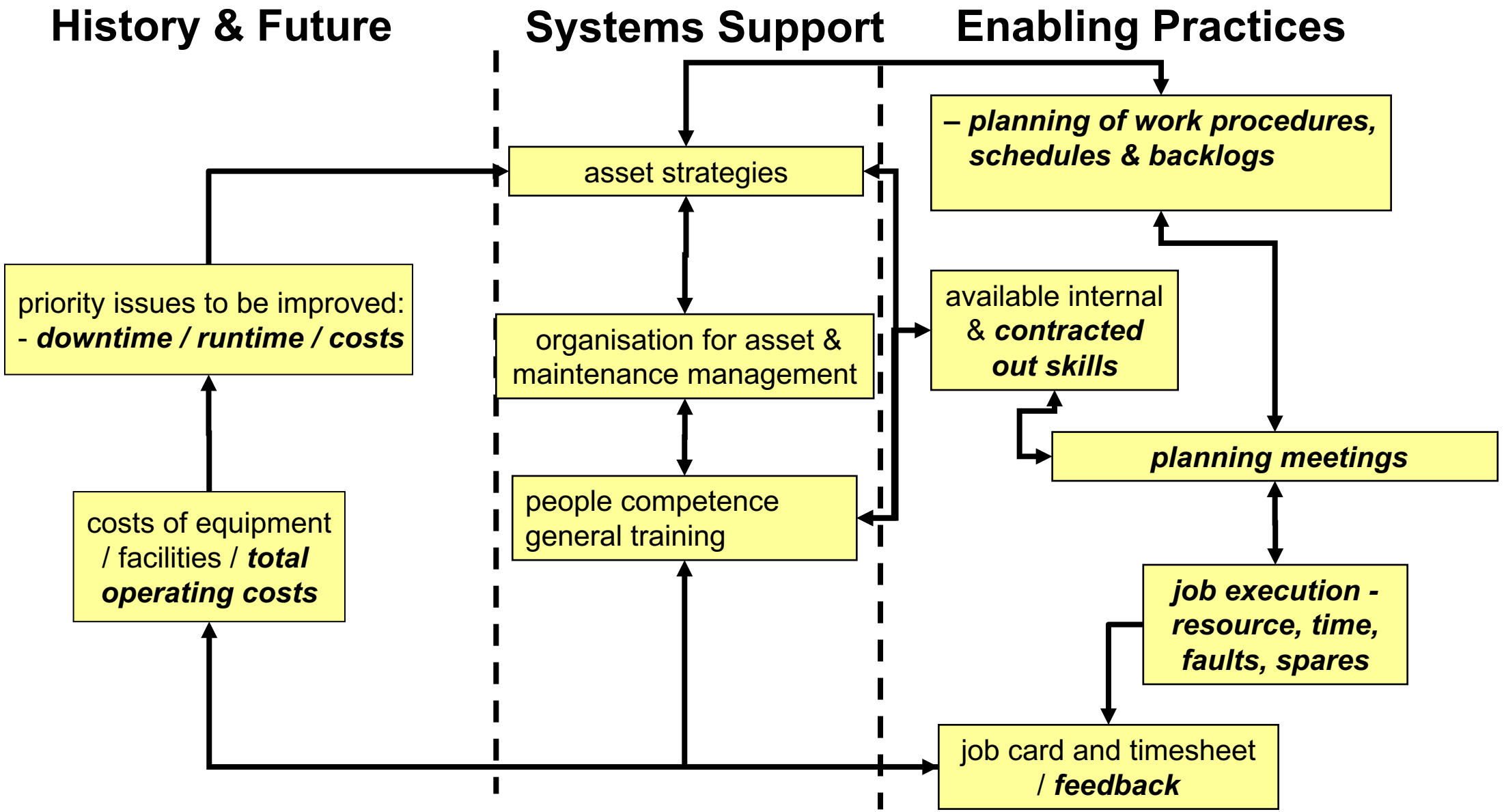
ROOT CAUSE ANALYSIS (RCA) – AND THE ACCURACY OF SAFE ASSET STRATEGIES BY A METHOD OF RELIABILITY CENTRED MAINTENANCE (RCM)

(2) THE DEVELOPMENT OF ***A TRAINING CULTURE*** STARTING WITH IMPROVEMENTS IN CRAFTSMAN COMPETENCE.

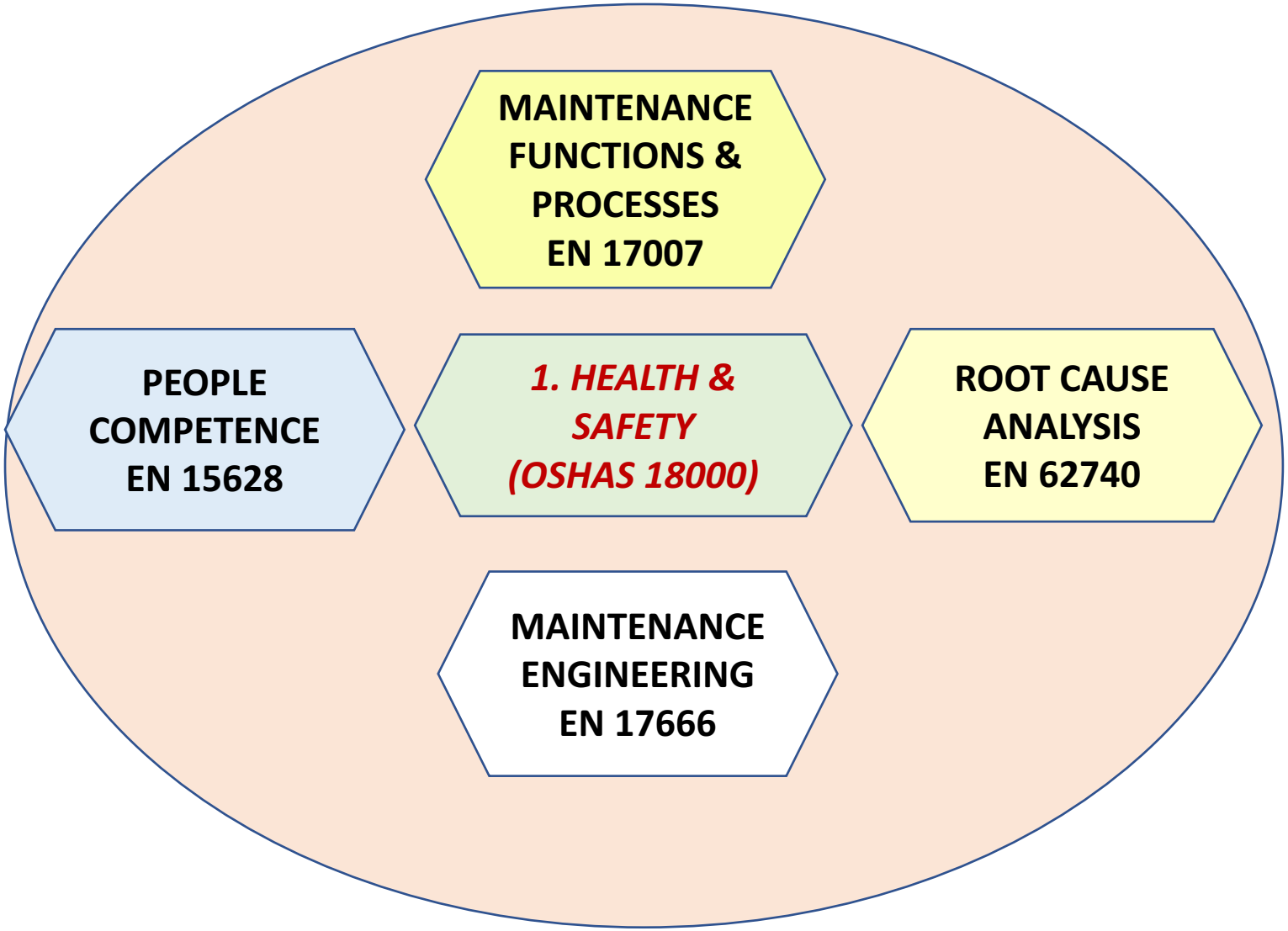
– PROGRESSED TO ***MULTI-SKILLING FOLLOWED BY FLEXIBILE WORKING***
– WITH STRONG ENCOURAGEMENT GIVEN BY THE 'TOP MANAGEMENT'

(3) THE IMPLEMENTATION OF ***NEW ENABLING PRACTICES AND PROCESSES WITHIN A STRUCTURE OF TOTAL PRODUCTIVE MAINTENANCE (TPM)***

BEFORE THE MAINTENANCE MANAGEMENT IMPROVEMENT STRATEGY THE BASIC COMPUTER SYSTEM FLOW LOOKED LIKE THIS



THE UK FOOD COMPANY DEVELOPMENT – WHICH OF THESE CEN STANDARDS DO YOU THINK MAY GIVE USEFUL SUPPORT?



SETTING POLICIES FOR H&S / SAFE SYSTEMS OF WORKING

HEALTH & SAFETY (OSHAS 18000)

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The Corporate Policy – e.g. the 'Safe Systems of Work' process – will comply with requirements of the National Health and Safety Legislation*;*

A Functional Policy – the preparation of maintenance activities will include ***Risk Assessments and Work Permits***,

– *are to be approved by the relevant Operation's Authorities,*

– *unless the activities are routine and in a non-hazardous environment;*

A Workface Policy – the Process for 'Safe Systems of Work'

– ***will include a flowchart*** showing who is responsible / who is involved / who monitors its performance.

A STANDARD 'PILLAR' CHOSEN EXISTS FOR – HEALTH AND SAFETY (OSHAS 18000) – CONSISTING OF:

HEALTH & SAFETY (OSHAS 18000)

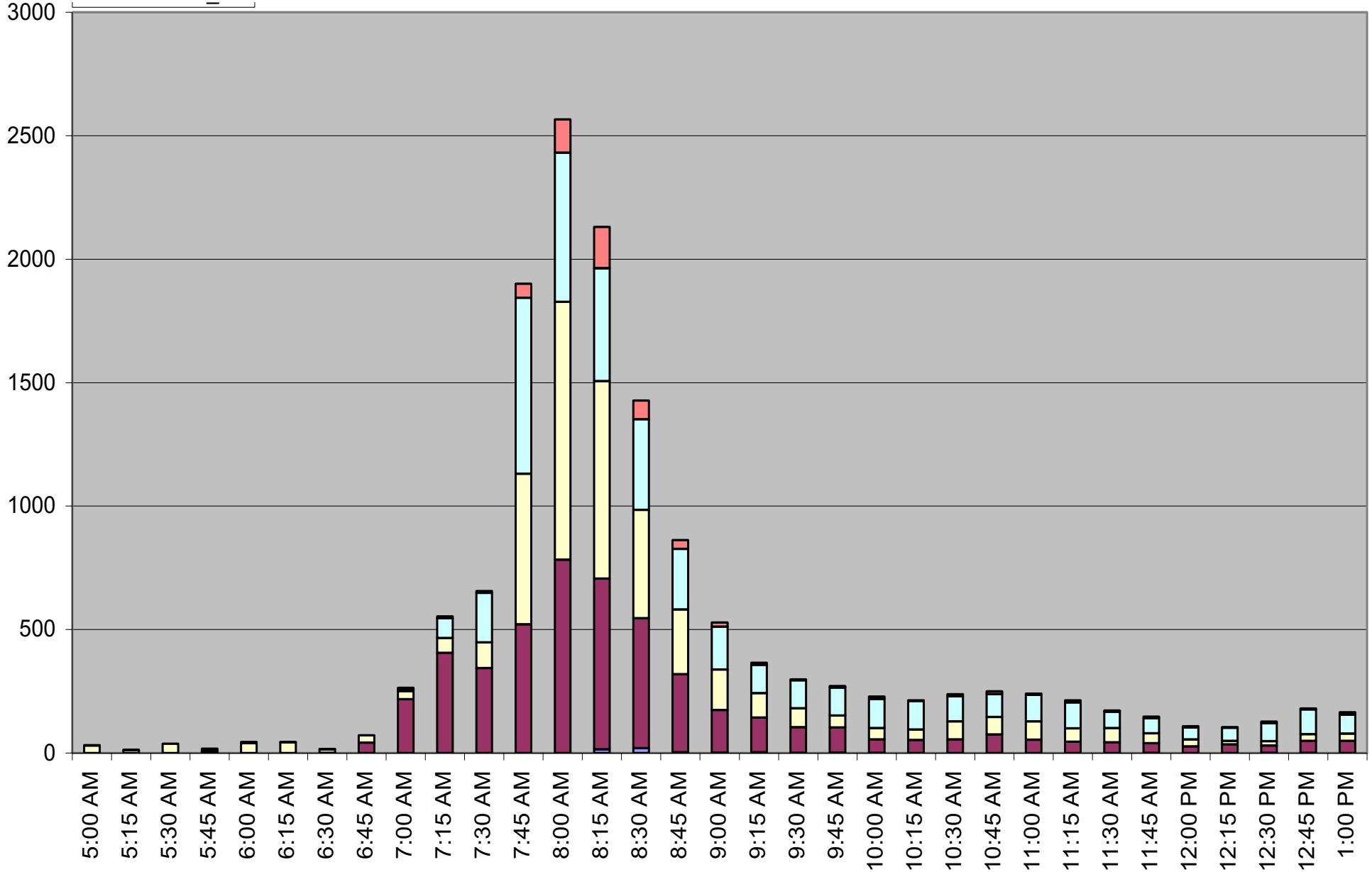
A. The Maintenance ***"Handbook"***
B. Procedures and ***Devices*** to prevent accidents
C. Protective Equipment (Collective and Personal)
D. Safety Education and ***Training*** for all site personnel (as related to their functions)

E. Review of Maintenance ***Practices*** / Health-Safety Staff ***Competence***, Training
F. The recording of ***H&S events*** and related Performance Indicators
G. Analysis of the ***Priority of Failure Effects (RCM)*** with 'Health and Safety' at top

H. Ongoing potential ***Risk Analysis and the Assessment of Hazards***
I. Checking the performance of the ***Safety Devices*** (reliability & configuration)
J. The potential and danger for the ***Emittance*** of site fluids, flooding, explosions
K. Reviewing the ***Quality of Work Permits***, and the time to develop and issue them

A TYPICAL DIAGRAM OF THE ISSUE OF WORK PERMITS FROM SUPERVISORS TO TECHNICIANS / CRAFTSMEN

HEALTH & SAFETY (OSHAS 18000)



A PILLAR OF HSE ON MAINTENANCE INCLUDES TRENDS – PROSPECTIVES – CONTENTS

HEALTH & SAFETY (OSHAS 18000)

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- **A NEW TREND**
  - TO ACHIEVE ZERO DISEASE - ZERO INJURIES - ZERO LOSSES - ZERO POLLUTION.

- **NEW PROSPECTIVES**
  - TO SUPPORT THE APPLICATION OF NEW TECHNOLOGIES – TO IMPROVE THE ERGONOMIC PRODUCTIVITY OF OPERATORS IN A SAFE WAY.
  - TO CONTRIBUTE TO THE DESIGN, IMPLEMENTATION AND TESTING OF ASSET SYSTEMS AND FACILITIES, WITH A FOCUS ON H&S.

- **NEW CONTENTS**
  - TO REDUCE ANY ASSOCIATED KINDS OF RISK.
  - TO BE INVOLVED IN ALL PHASES OF THE PHYSICAL ASSET LIFE CYCLE STAGES OF DESIGN – CONSTRUCTION – OPERATIONS AND MAINTENANCE.

A SETTING FOR SAFETY – A PLAN

HEALTH & SAFETY
(OSHAS 18000)

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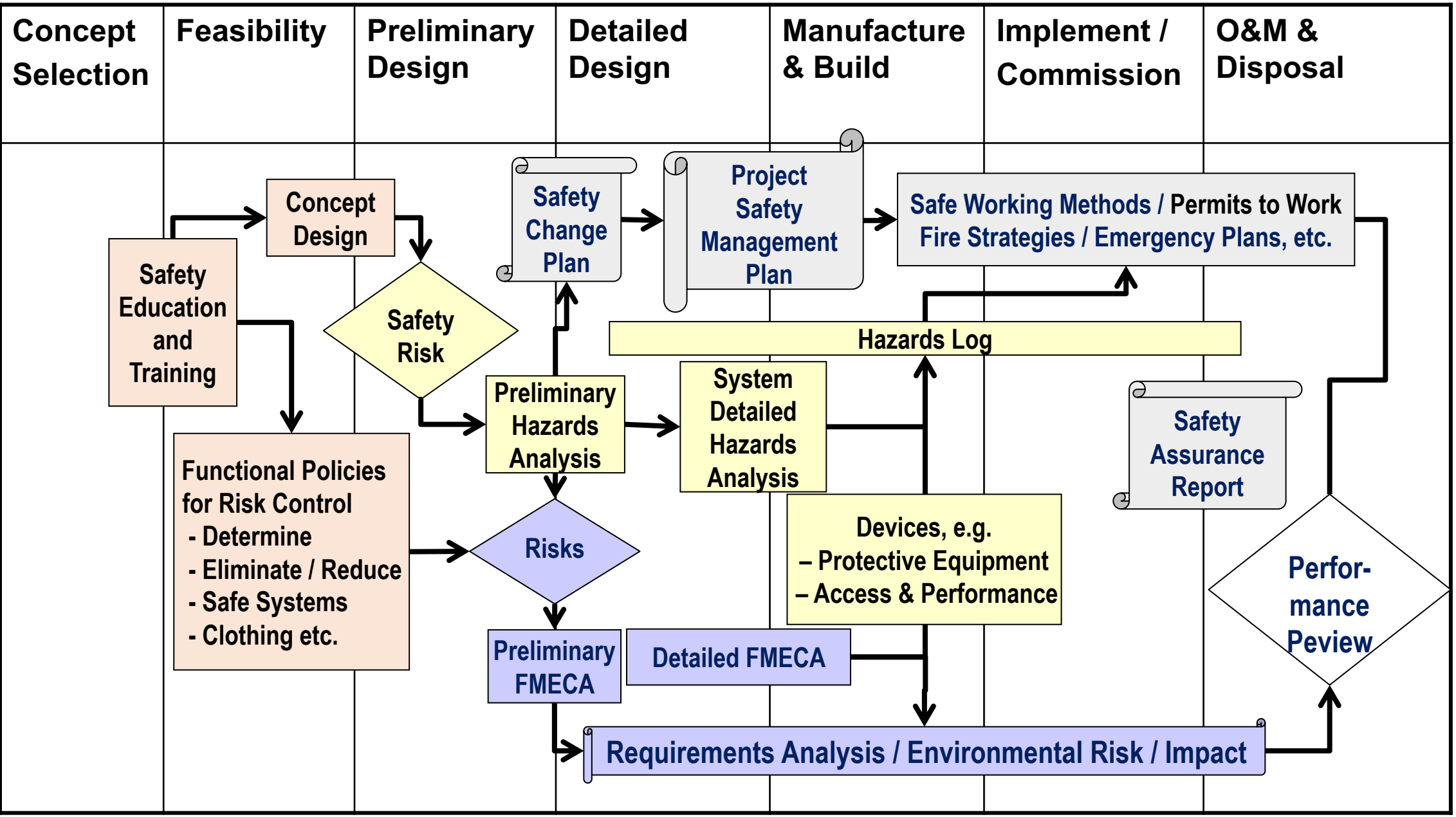

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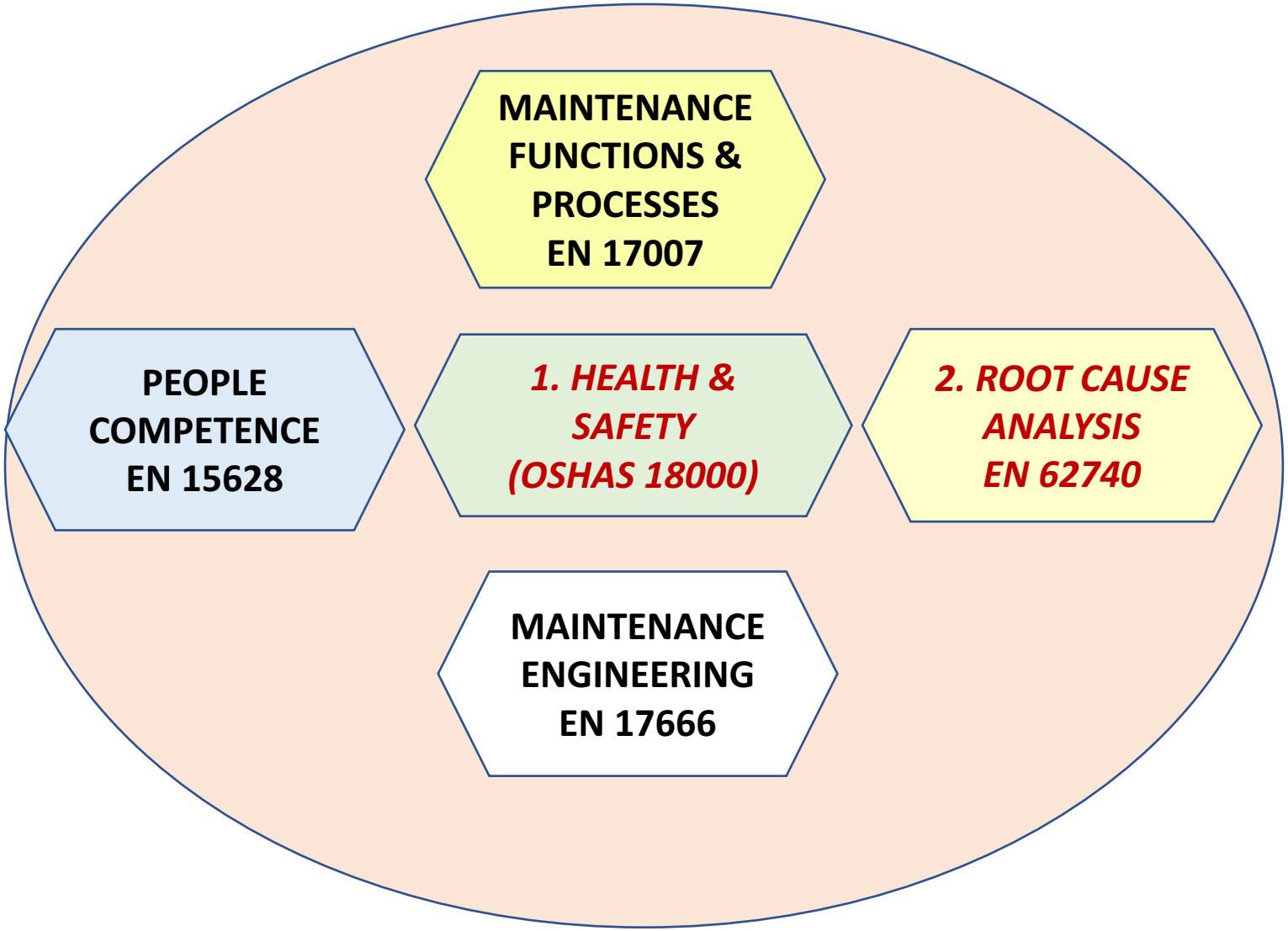


Standard: Root Cause Analysis (RCA):
– Risk and Control of Equipment Faults

ROOT CAUSE ANALYSIS
EN 62740

THE STANDARD EN 62740, DESCRIBES ROOT CAUSE ANALYSIS AS:

ANY SYMPTOMATIC RCA PROCESS WHICH FOCUSES ON ISSUES:

- ***THAT HAVE CONTRIBUTED TO ASSET FAILURES;***
- ***OR ALTERNATIVELY, HAVE CONTRIBUTED TO AN IMPROVEMENT SUCCESS.***

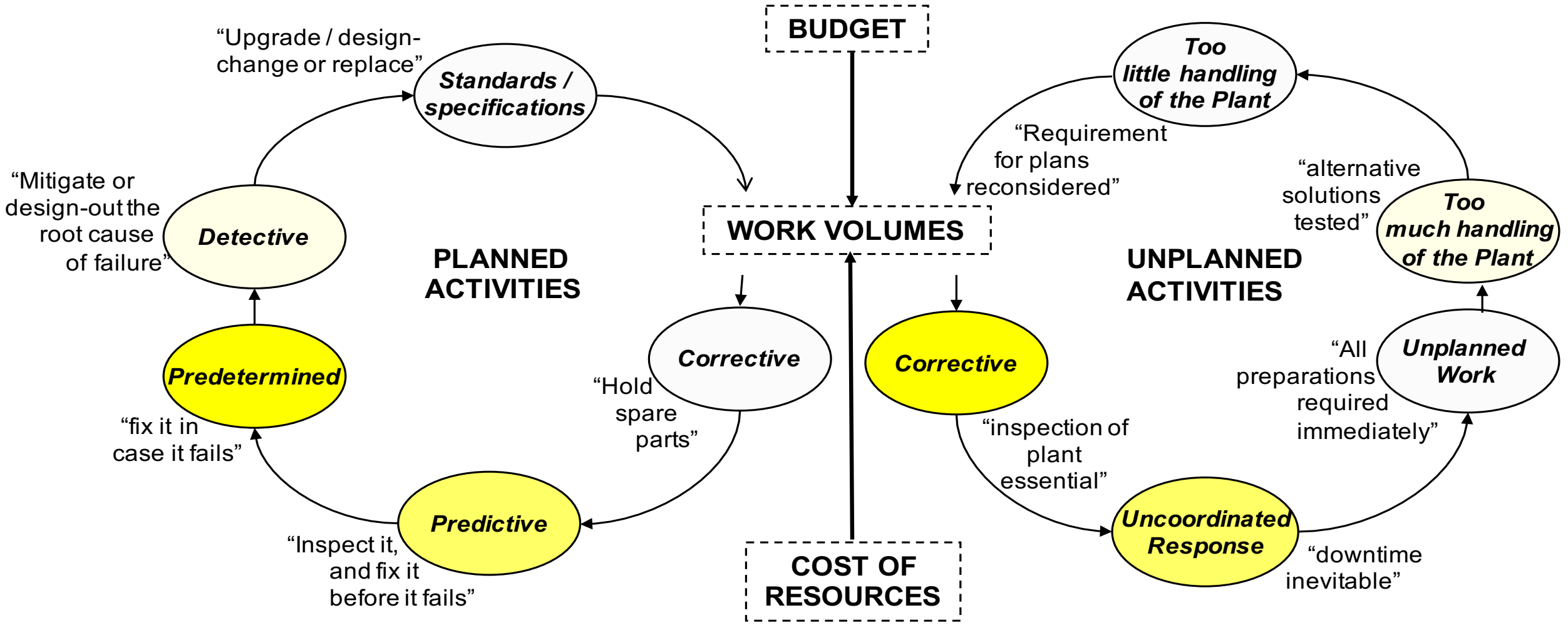
– IN THIS PHASE, EMPHASISED IS THE NEED TO ***UNDERSTAND THE ROOT CAUSES OF ASSET FAILURES – AND NOT TO APPLY ANY OBVIOUS FAILURE SYMPTOMS***.

– THE STANDARD DESCRIBES THE APPLICATION OF ***EIGHT ANALYSIS TECHNIQUES*** AND COMMENTS ON ***THE STRENGTHS AND WEAKNESSES OF THOSE TECHNIQUES*****.**

– THE SUGGESTION IS THAT ***EACH TECHNIQUE SHOULD BE CONSIDERED FOR ITS USE.***

TWO APPROACHES – DETERMINING (1) PLANNED OR (2) UNPLANNED ACTIVITIES

ROOT CAUSE ANALYSIS
EN 62740



PROACTIVE / PLANNED MAINTENANCE ACTIVITIES

REACTIVE / UNPLANNED MAINTENANCE ACTIVITIES

STANDARD : Root Cause Analysis (RCA)

Root Cause Analysis standard (BS_EN_62740:2015) describes RCA as any process that focusses on factors that have contributed to a particular event, good or bad.

– Standard emphasises the need to understand root causes rather than symptoms.

– Gives a description of various analysis techniques strengths and weaknesses, e.g.

– FIVE TIMES 'WHY?'

Questions are asked of ‘why?’ an event happened; and raises other ‘whys’.

– A FISHBONE DIAGRAM (CAUSE / EFFECT DIAGRAM)

A Fishbone diagram identifies and classifies problems, recording a brainstorming.

– FAULT TREE ANALYSIS

STANDARD : Root Cause Analysis (RCA)

ROOT CAUSE ANALYSIS
EN 62740

FAULT TREE ANALYSIS

The ‘Fault Tree Analysis’ (FTA) approach is common in Maintenance Management. Its attributes include:

– being applied through both a modelling and a hierarchical structure;

– providing an in-depth approach to addressing root causes in both prospective (design) and retrospective (after failure) situations;

– supporting the continual development of safe working systems and safety;

– recommends the analysis of potential Failure Modes in Maintenance, and before the application of Reliability Centred Maintenance (RCM).

STANDARD : Root Cause Analysis (RCA) and an FMECA: – Equipment Faults

ROOT CAUSE ANALYSIS
EN 62740

– FMECAs, FAILURE MODE AND EFFECTS CRITICALITY ANALYSES [IEC 60300-3-11] SHOULD BE ***DEVELOPED WITHIN THE MANUFACTURER'S DESIGN STAGE OF AN INVESTMENT PROJECT***

– AND SHOULD PROVIDE ***A TRADE-OFF ANALYSIS OF RISK, AGAINST COST, BENEFITS, AND TIME***

– **FOR AN EXISTING DESIGN TO BE REVIEWED:**

- AN FMECA WILL ***LINK THE MAINTENANCE TASK WITH THE FAILURE MODE***

- AN FMECA / RISK BASED APPROACH ***SHOULD ALREADY BE AVAILABLE***, ***AND APPLIED***

– AN ASSOCIATED CRITICALITY MEASURE / RISK PRIORITY NUMBER (PRN) WILL NORMALLY:

– DETERMINE THE ***SCOPE OF THE FAILURE ASSET MANAGEMENT STRATEGIES***

– AND HIGHLIGHT ANY TASKS AND ***ASSOCIATED RISKS THAT ARE NOT IN THE BUDGET!***

– FOR PREVENTIVE/PREDICTIVE ACTION, ***RCM MAY BE APPLIED, AS SUGGESTED IN ISO 55001!***

PROGRESS THROUGH THE DEVELOPMENT OF AN FMECA FOR A BUSBAR

Plant	415 / 240 V Switchboard				Machine Group				Area		Unit / Equipment No.		
Function	To supply, contain & distribute 415V / 240 V in a safe, controlled, environmentally contained manner.						Manufacturer				Model No.		
											Type		
Unit / Assembly	Ref. No.	Functional Failure	MODE How it fails	EFFECT of failure	CAUSE of failure	Failure Characteristic Early Life, Random, Age	Pre-failure warning	MTBF Years	Type Hidden or Evident	Occur - ence Rating 'O'	Severity Rating 'S'	RPN O x S	Maint-enance Approach
Busbar	4.0	Busbar failure											
	4.1		Busbar failure due to moisture ingress leading to trip	Loss of production, cost of repair, possible safety implications	Seepage	Random	Visible	40 Yrs.	E	1	9	9	CBM
	4.2		Dust ingress	Loss of production, cost of repair, possible safety implications	Dusty environment leading	Age	Visible	50 yrs.	E	1	9	9	FTM
	4.3		Loose joints	Loss of production, cost of repair, possible safety implications	Loose joints	Age	Non-visible	20 Yrs.	E	2	9	18	CBM
	4.4		Mechanical damage to Busbar and circuit spouts	Loss of production, cost of repair, possible safety implications	Misalignment	Age - no. of isolations	Non-visible	40 Yrs.	E	1	9	9	CBM
Remove-able Covers	5.0	Failure of the mechanical enclosure											
	5.1		Security of remove-able covers fault / guards	Loss of production, cost of repair, possible safety implications	Damage from use	Age	Visible	40 Yrs.	E	1	9	9	CBM

Where, CBM = Predictive On-condition Based Maintenance

FTM = Predetermined, Scheduled Fixed Time Maintenance

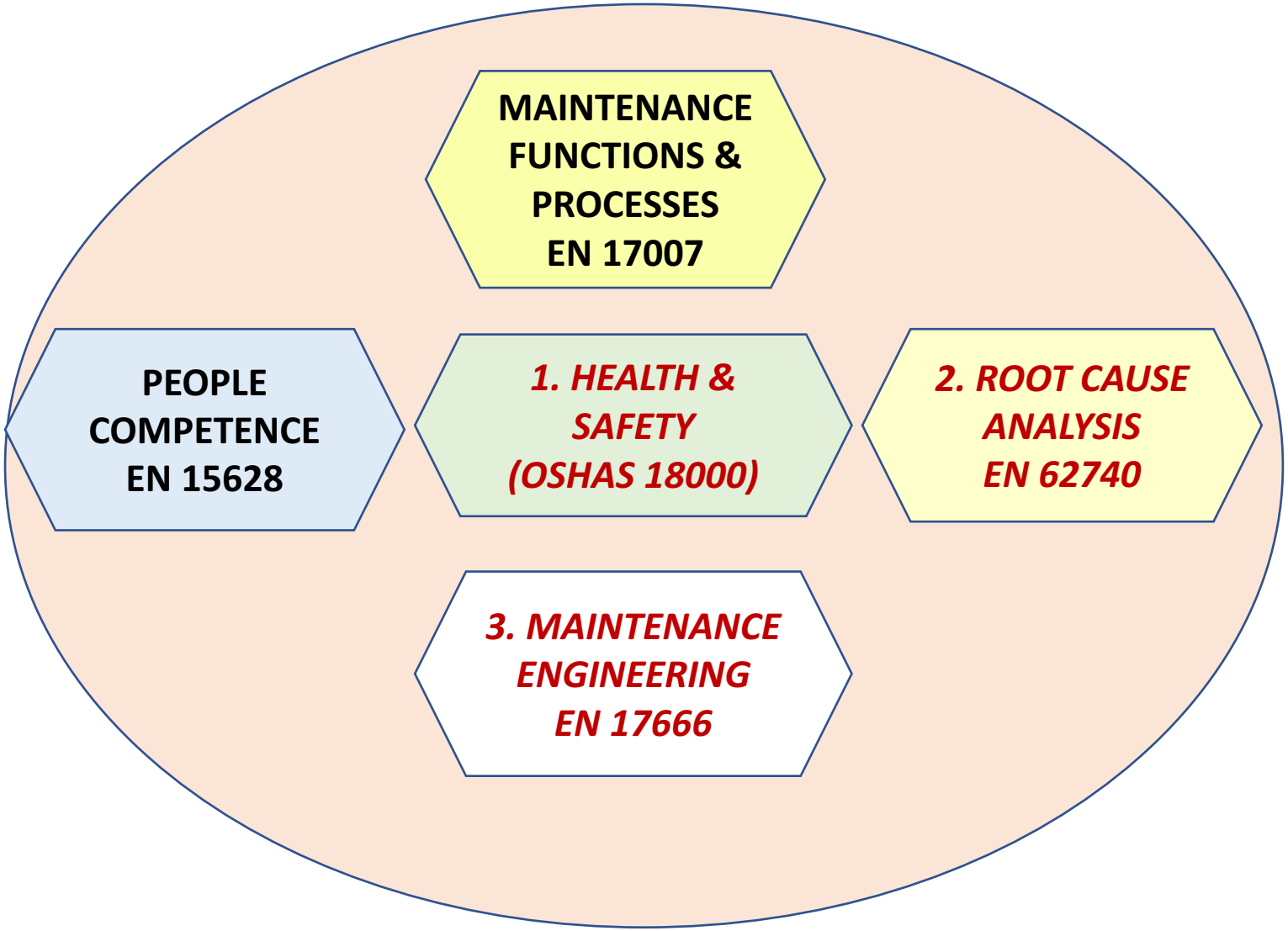
RPN = Risk Priority Number = Occurrence x Severity

E = Electrician

AND FMECA 1 & 2 (BELOW) ARE IN THE STANDARD MAINTENANCE ENGINEERING

Plant	415 / 240 V Switchboard				Machine Group			Area		Unit / Equipment No.			
Function	To supply, contain & distribute 415V / 240 V in a safe, controlled, environmentally contained manner						Manufacturer			Model No.			
										Type			
Unit / Assembly	Ref. No.	Maintenance Approach	Inspection Task Description	Frequency	Duration	Resource	Run or Stop	Repair Task Description		Frequency	Duration	Resource	Run or Stop
	4.0												
Busbar	4.1	CBM	Inspect for moisture in switch rooms	1 Month	1 Hour	Safety Tour	R	Increase ventilation & divert leaks			2 Hours	OP	
	4.2	FTM	Clean busbar	4 Years	4 Days	EF	S	Repair / replace as necessary			2 Days	F	
	4.3	CBM	Complete insulation resistance and Ducter test	4 Years	2 Days	EF	S	Dependent on findings					
	4.4	CBM	Visual check	4 Years	1 Day	EF	S	Correct the alignment			1 Day	EF	S
	5.0												
Remove -able Covers	5.1	CBM	Visual check	As required - 4 Years	1 Day	EF	S	Fix as necessary			1 Day	EF	

THE UK FOOD COMPANY DEVELOPMENT – WHICH OF THESE CEN STANDARDS DO YOU THINK MAY GIVE USEFUL SUPPORT?



CONTENTS OF THE STANDARD
'PILLAR' OF: MAINTENANCE ENGINEERING

MAINTENANCE ENGINEERING
EN 17666

MAINTENANCE ENGINEERING IS ABOUT THE APPLICATION OF METHODS AND TECHNIQUES, WITH THE CORRECT TOOLS AND ENGINEERING COMPETENCE TO:

– ensure that a physical asset performs as the specification requires,
– and the maintenance team has an influence on the engineering design:

- ***THE SUSTAINABILITY & INTEGRITY OF THE ASSETS***

  – regarding the reliability, maintainability, life duration

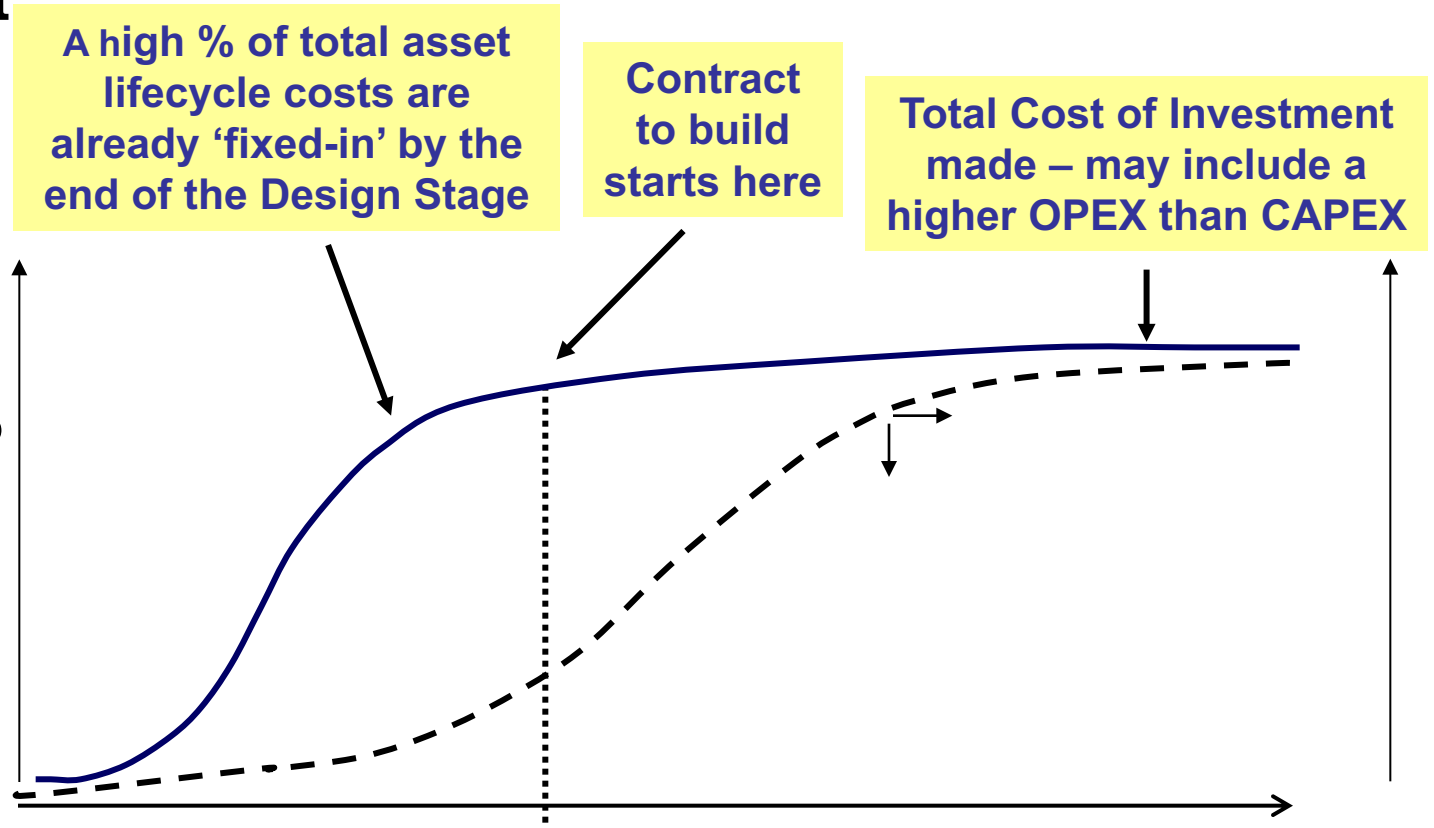
- ***AND DETERMINING AND APPLYING AN OPTIMAL BALANCE OF:***

  – the maintenance activity mix of preventive / condition based / predictive
  – and a measured and controlled stock–holding of spare parts

- ***AN INFLUENCE ON THE KEY 'DRIVERS' and KEY INDICATORS (KPIs)*** **APPLIED**

INVOLVEMENT OF THE O&M PERSONEL CANNOT BE TOO SOON:

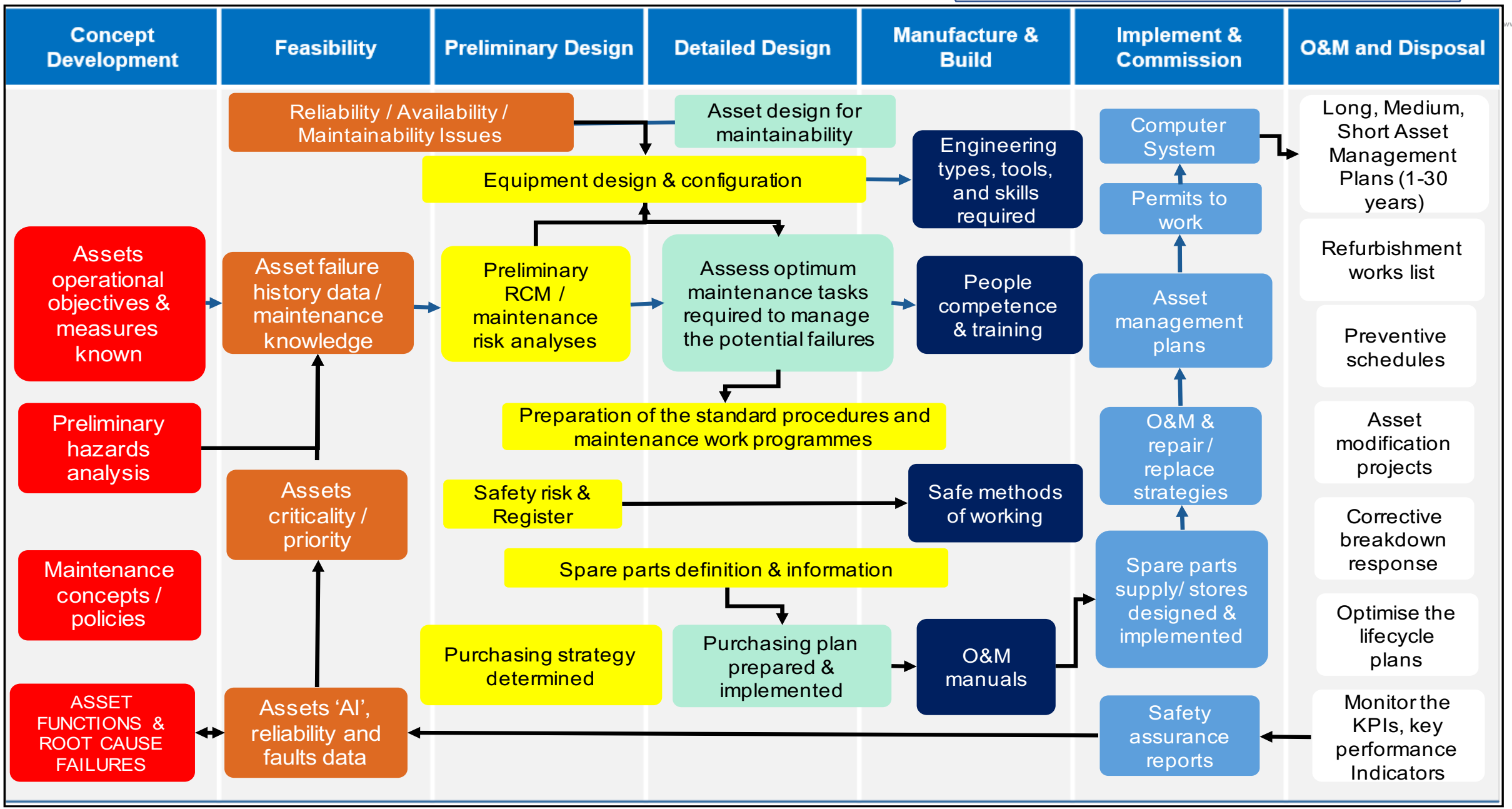
– To bring their influence on the asset expenditure / its quality / costs of O&M



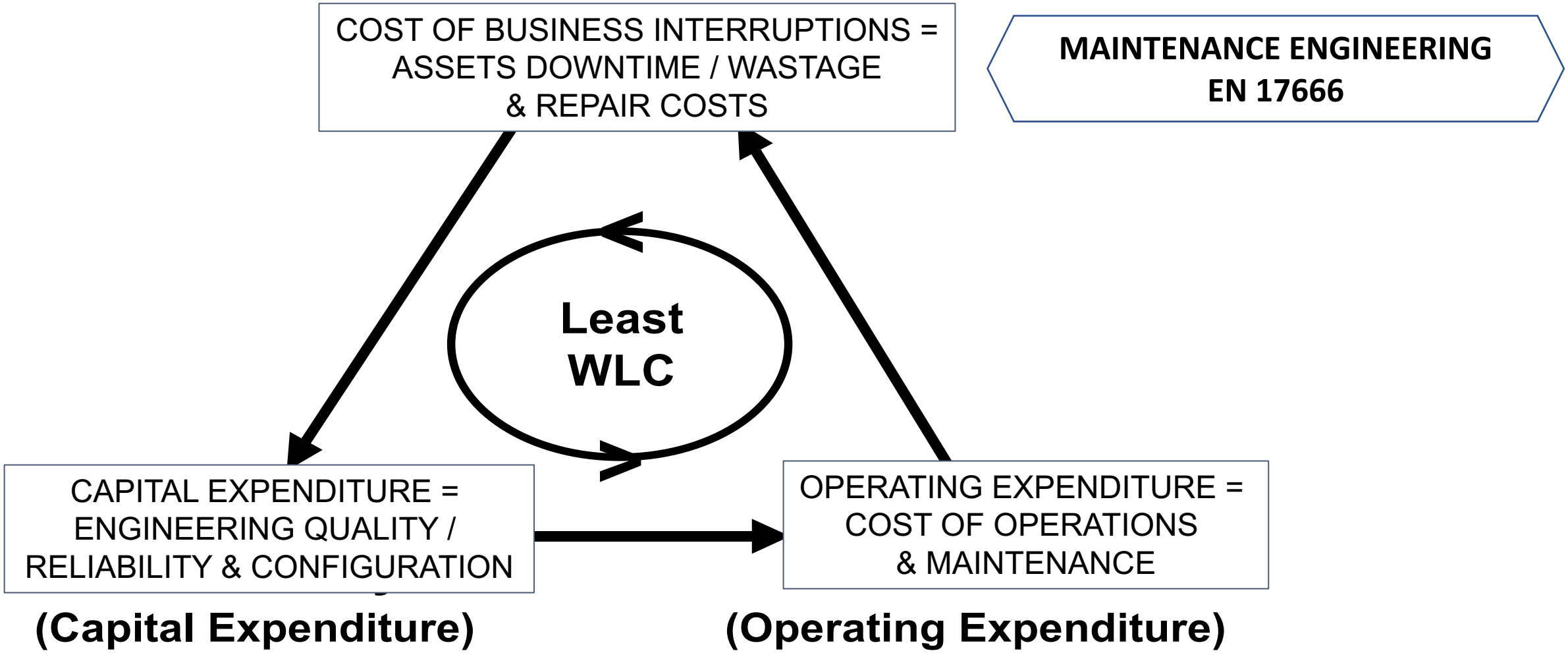
Development Through the Life Cycle Stages

MAINTENANCE ENGINEERING INFLUENCE DURING FEASIBILITY AND DESIGN IS ESSENTIAL

MAINTENANCE ENGINEERING EN 17666

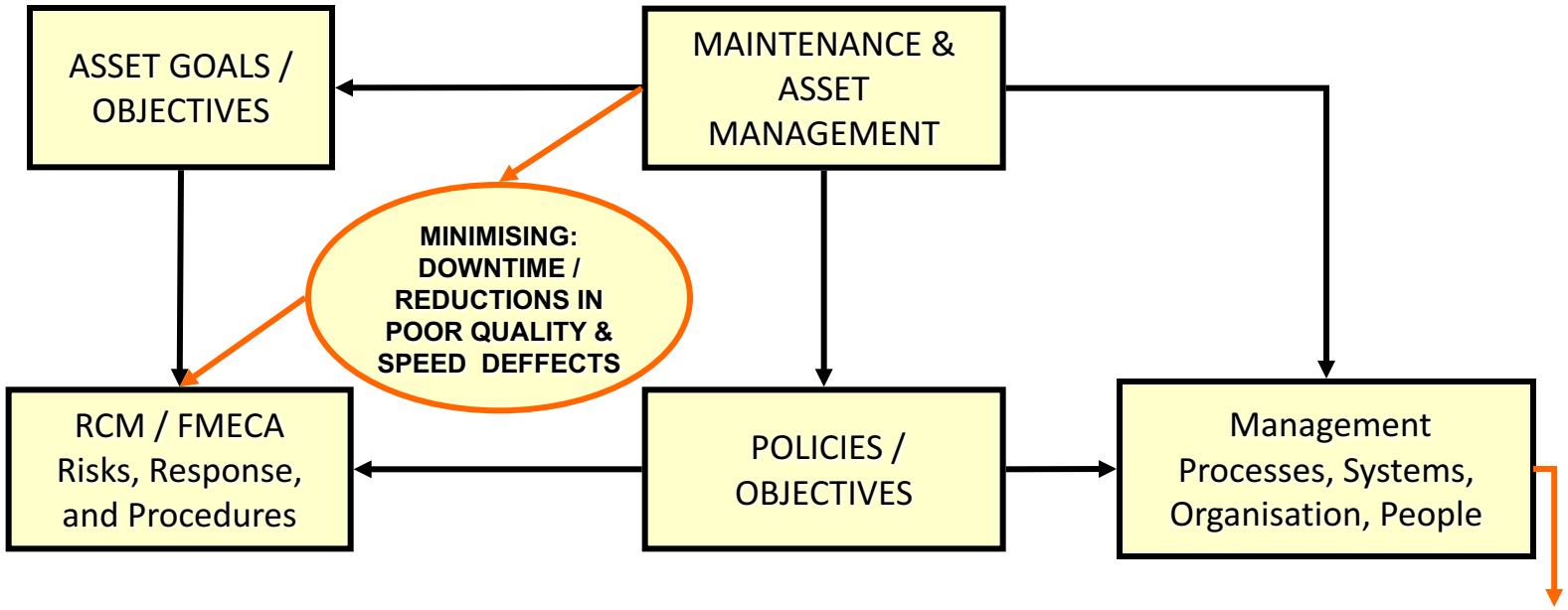


TRADE–OFF TO ESTABLISH POTENTIAL & ACTUAL WHOLE LIFE COST (WLC)



VALUE ADDED DEVELOPMENT OF 'DRIVERS' DURING THE EARLY LIFE-CYCLE STAGES OF ASSET MANAGEMENT

- In the design stages, the design team should check the detail of the specified asset reliability & configuration with the support of maintenance personnel.
- The maintainability should allow good staff access, with the correct procedures, tools and spare parts prepared for, and within the budgeted lifecycle costs.
- The types and volumes and description of the tasks, with recommended work procedures and programme, should be included in a manufacturer's handbook.
- Throughout each of the asset design stages, the total estimated life costs for each asset system should be checked against the quality and budget expected.
- That 'predictive' condition monitoring should be designed-in and built-in.


ASSET GOALS / OBJECTIVES
MAINTENANCE & ASSET MANAGEMENT
MINIMISING: DOWNTIME / REDUCTIONS IN POOR QUALITY & SPEED DEFFECTS
RCM / FMECA Risks, Response, and Procedures
POLICIES / OBJECTIVES
Management Processes, Systems, Organisation, People

PILLAR MAINTENANCE ENGINEERING TREND – PROSPECTIVES – NEW CONTENTS

MAINTENANCE ENGINEERING
EN 17666

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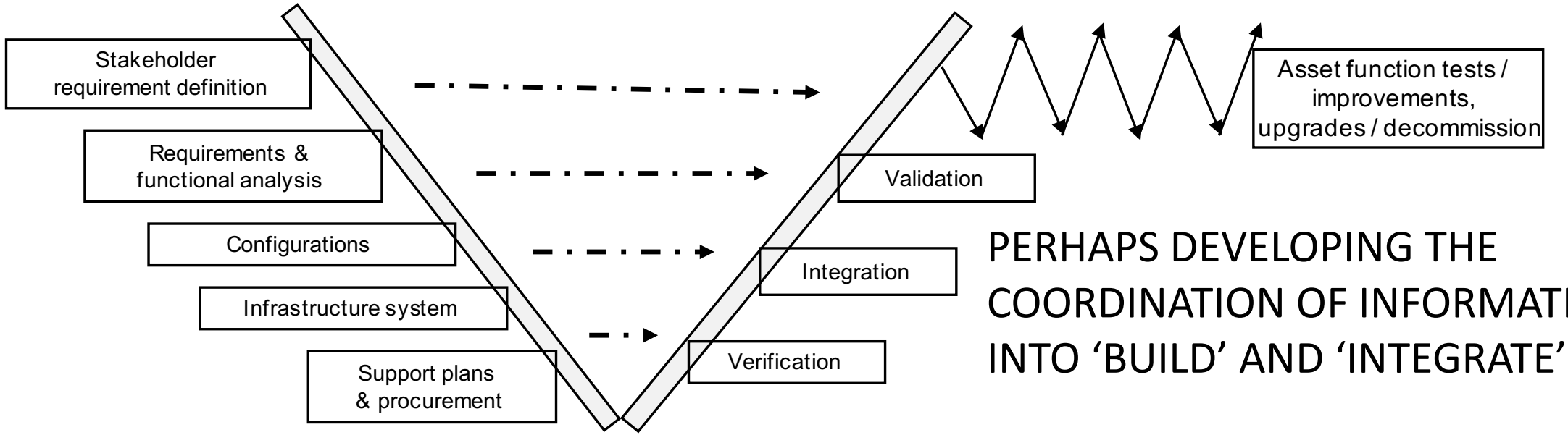
❑ DEVELOPED TRENDS

- TO ***INVOLVE 'MAINTENANCE' IN THE DESIGN AND CONSTRUCTION STAGES*** OF CAPITAL PROJECTS.
- TO ADOPT ***THE 'DIGITAL TWIN' SOFTWARE APPROACH*** FOR ALL ENGINEERING & TECHNICAL ACTIVITIES.
- TO ***DEVELOP A RELIABILITY CULTURE.***
- ***SUPPORT A COMPETENCE GROUP*** FOR TECHNOLOGIES AND ARTIFICIAL INTELLIGENCE, AND IMPLEMENT INNOVATION
- TO ***USE MACHINE LEARNING SYTEMS TO OPTIMISE PREDICTIVE AND ON-CONDITION TASKS***, I.E. PROGNOSTIC WORK.
- TO HANDLE MAINTENANCE ASSURANCE ***PLANS FOR THE INTEGRITY / SAFETY / SUSTAINABILITY OF CRITICAL UNITS.***
- TRAIN EXPERTS – ***SUCH AS: DATA SCIENTISTS, SYSTEM AND MAINTENANCE ENGINEERS 4.0.***

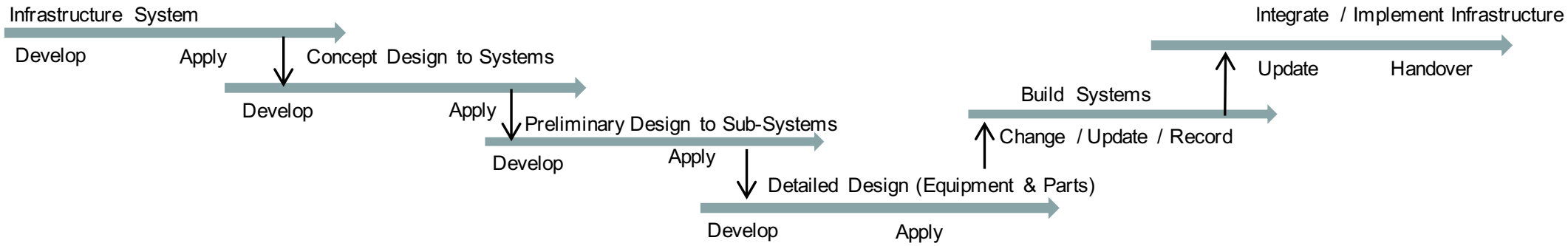
❑ NEW CONTENTS

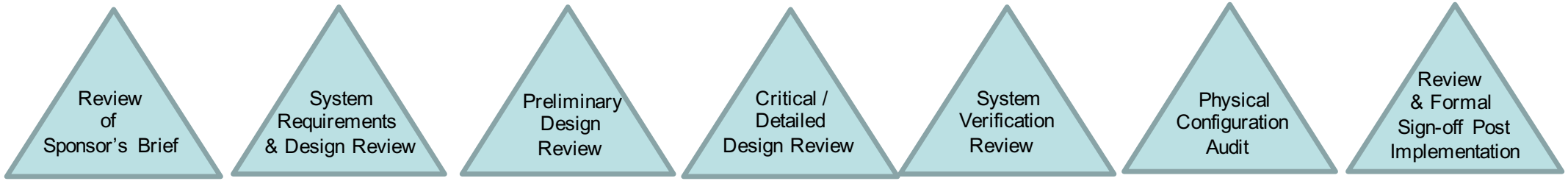
- ***ADOPT A MODEL OF 'SERVITISATION OF MAINTENANCE SERVICES***' TO IMPROVE ASSETS' PERFORMANCE.
- TO **GENERATE THE 'ADDED VALUES'** EXPECTED.
- ***TRAIN EXPERT PEOPLE – DATA SCIENTISTS, AND ENGINEERS, IN THE NEW TECHNOLOGIES***

Concept	Feasibility	Preliminary Design	Detailed Design	Manufacture / Build	Implement / Commission	Operations & Maintenance / Disposal



PERHAPS DEVELOPING THE COORDINATION OF INFORMATION INTO 'BUILD' AND 'INTEGRATE'





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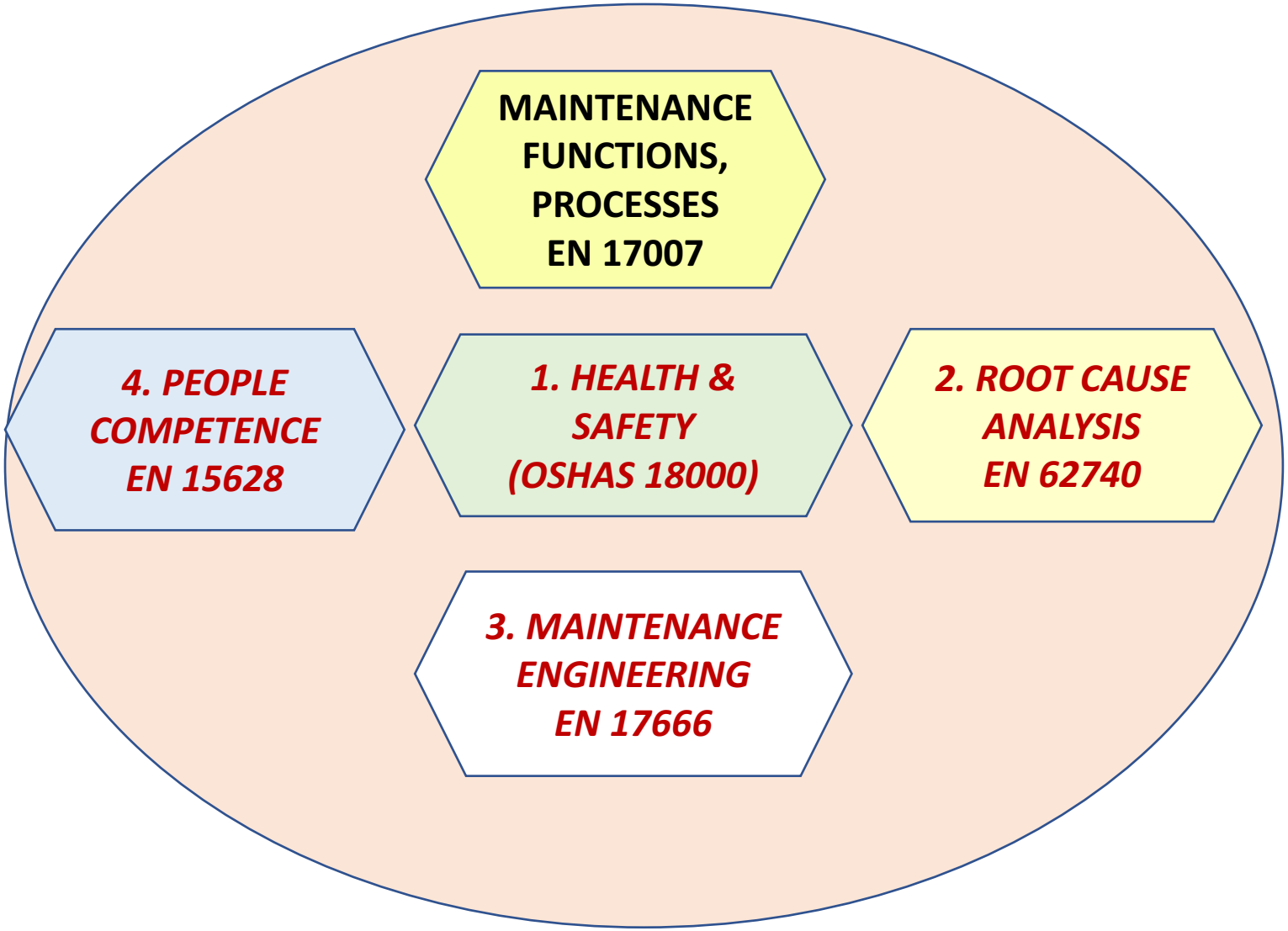

People Competence:

• BY ENG. PETER WILLMOTT

PEOPLE COMPETENCE
EN 15628

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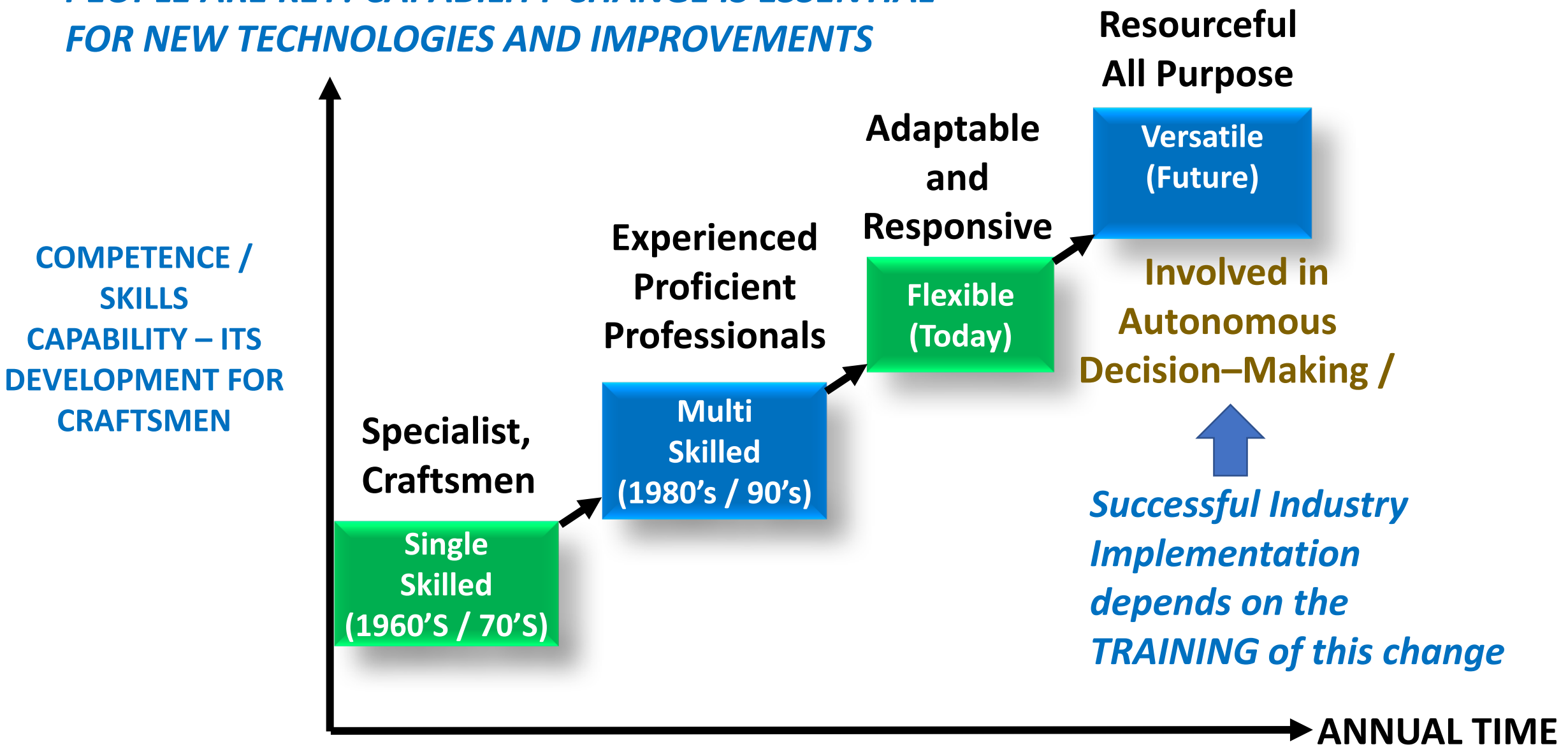
PEOPLE ARE KEY! CAPABILITY CHANGE IS ESSENTIAL FOR NEW TECHNOLOGIES AND IMPROVEMENTS



HIGHLIGHTED FOR THE SMALL UK COMPANY ARE:
– Multi-skills & Flexibility Training;
– Supervisor Training;
– Internal Condition Monitoring Training

PEOPLE COMPETENCE
EN 15628

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HIGH COMPETENCE OF THE MAINTENANCE PEOPLE IS CONSIDERED A PRIORITY

– THE QUALIFICATION SYSTEM OF EN 15628 GIVES THE SUPPORT ROLES AS FOLLOWS:

- *EQF LEVEL 3-4* MAINTENANCE TECHNICIAN CRAFTSMEN SPECIALIST
- *EQF LEVEL 4-5* MAINTENANCE SUPERVISOR
- *EQF LEVEL 5-6* MAINTENANCE ENGINEER
- *EQF LEVEL 7-8* MAINTENACE MANAGER

THE STANDARD DESCRIBES A ***SCOPE OF LEARNING AND COMPETENCE, AND WHICH ACTIVITIES ARE SUGGESTED*** FOR EACH OF THE LEVELS SHOWN ABOVE

EN 15628 STANDARD – SOME REQUIREMENTS OF THE QUALIFICATIONS

PEOPLE COMPETENCE
EN 15628

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1) THE EDUCATION:

Completing an education related to the appropriate technical, management, economics, investment and engineering issues – gained through learning in Schools and in Universities.

2) THE WORK EXPERIENCE:

Supports the ability to apply good Maintenance Practices / and, for example, to interact with Personnel regarding Social and Methodolical Behaviours / and similarly with Robots etc.

3) THE TRAINING:

Training is from the teaching, or from its self-development and knowledge, with a wide focus; including Maintenance / Asset Management Strategies, Performance, Quality, Planning, etc.

4) THE SKILLS

An ability to apply 'Value Systems Engineering' (EN 1699-14 2020) and 'Asset Management with BIM', for example, i.e. for the knowledge to improve the management of all asset types.

QUESTIONS WERE ASKED OF, AND WERE ANSWERED BY,

136 ORGANISATIONS GLOBALLY, REGARDING THE NEEDS

OF TRAINING WITH THE SUPPORT OF EN15628, INCLUDING:

PEOPLE COMPETENCE
EN 15628

– ARE THE ROLES WITHIN THE SCOPE OF THE CEN STANDARD 15628?

– IN A GLOBAL SURVEY, WE ASKED RESPONENTS TO POINT OUT:

WHICH OF THE ACTIVITIES SUGGESTED FOR EACH OF THE FOUR ROLES IN THE CEN STANDARD ARE CONSIDERED TO BE OF 'VITAL PRIORITY'?

– THE PRIORITY ACTIVITIES OF THE ENGINEERS, SUPERVISORS, CRAFTSMEN / TECHNICIANS: ARE THEY VITAL & OF PRIORITY BECAUSE THEY ARE DELIVERING THE MOST VALUE GLOBALLY?

Manager – Challenges & Future Trends
Items of 'Vital' Priority

PEOPLE COMPETENCE
EN 15628

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(1) ***To define and develop maintenance policies according to the business context and appropriate physical asset management model,*** and update the established organisational objectives.

(2) To define, manage and develop a relevant organisation structure for maintenance ***to assure delivery of the business objectives.***

(3) ***To deliver the levels of operability, availability, reliability, maintainability, supportability, safety and quality required*** for the entire useful life of the assets.

(4) ***To prepare and assure compliance with the maintenance revenue budgets*** with respect to the total maintenance activity including materials requirements.

(5) To ensure the correct maintenance management strategy and continuous ***improvement of maintenance is linked with the top organisational objectives.***

Engineer – Challenges & Future Trends
Items of 'Vital' Priority

PEOPLE COMPETENCE
EN 15628

IMA
www.ima-world.org

(1) ***To analyse and eliminate causes of equipment failure through data analysis*** including appropriate techniques such ***asset criticality, root cause analysis, and failure mode effects analysis (FMEA).***

(2) To develop and implement a justified balance of preventive and corrective maintenance tasks in order ***to achieve the business objectives regarding safety/environment, performance, cost, and the associated compliance.***

(3) To specify and implement the requirements for maintenance ***support such as reliability engineering, materials and spare parts management, planning and scheduling, maintenance execution, budgetary control, data feedback.***

(4) To define the total user requirements specifications when tendering for new equipment, and to understand / ***make use of developments in digital designs.***

Supervisor – Challenges & Future Trends
Items of 'Vital' Priority

PEOPLE COMPETENCE
EN 15628

IMA
www.ima-world.org

(1) ***To assure compliance with regulations*** and procedures related to safety, health and environment, including permit to work.

(2) ***To assure technical standards and maintenance tasks are delivered on time*** with both efficiency and effectiveness.

(3) ***To schedule / organise the maintenance tasks within the area of responsibility*.**

(4) ***To assure effective / efficient implementation*** of maintenance policies / strategies.

(EQUAL 5) To manage and develop the maintenance resources: personnel, materials, information, technical issues, tools, workshops, procurement transportation, and stores.

(EQUAL 5) To communicate and supervise effectively with all necessary partners including in-house staff, contractors, customers and suppliers

Craftsman / Technician – Challenges, Future Trends

PEOPLE COMPETENCE
EN 15628

IMA
www.ima-world.org

(1) ***To perform and assure the safe execution*** of agreed maintenance plans / actions.

(2) To perform the proper execution of the maintenance plans and procedures including ***safety, health, and environmental conformance***.

(3) To use the correct materials, tools and equipment necessary for execution of tasks.

(4) ***To understand and deliver the required quality of the maintenance tasks.***

(5) To pre-empt potential causes of equipment malfunction and in the case of malfunction, to implement counter–measures to prevent re-occurrence.

(6) ***To assure the effective application, scope and discipline of inputting data and applying the full capability of CMMS / EAMS systems.***

(7) ***To understand the importance of performance metrics such as Mean Time Between Failure (MTBF) and Mean Time to Repair (MTTR).***

ARE THOSE PRIORITY ACTIVITIES VITAL BECAUSE THEY DELIVER THE MOST VALUE GLOBALLY?

PEOPLE COMPETENCE
EN 15628

International Maintenance Association
IMA
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ACTIVITIES OF THE ENGINEER

(1) ***To analyse and eliminate causes of equipment failure through data analysis*** including appropriate ***techniques such asset criticality, root cause analysis, and FMEA.***

(2) To develop and ***implement a justified balance of preventive and corrective maintenance tasks to achieve business objectives regarding safety/environment, performance, cost.***

ACTIVITIES OF THE SUPERVISOR:

(1) ***Assure compliance*** with regulations & procedures related to safety, health, environment. including permits to work.

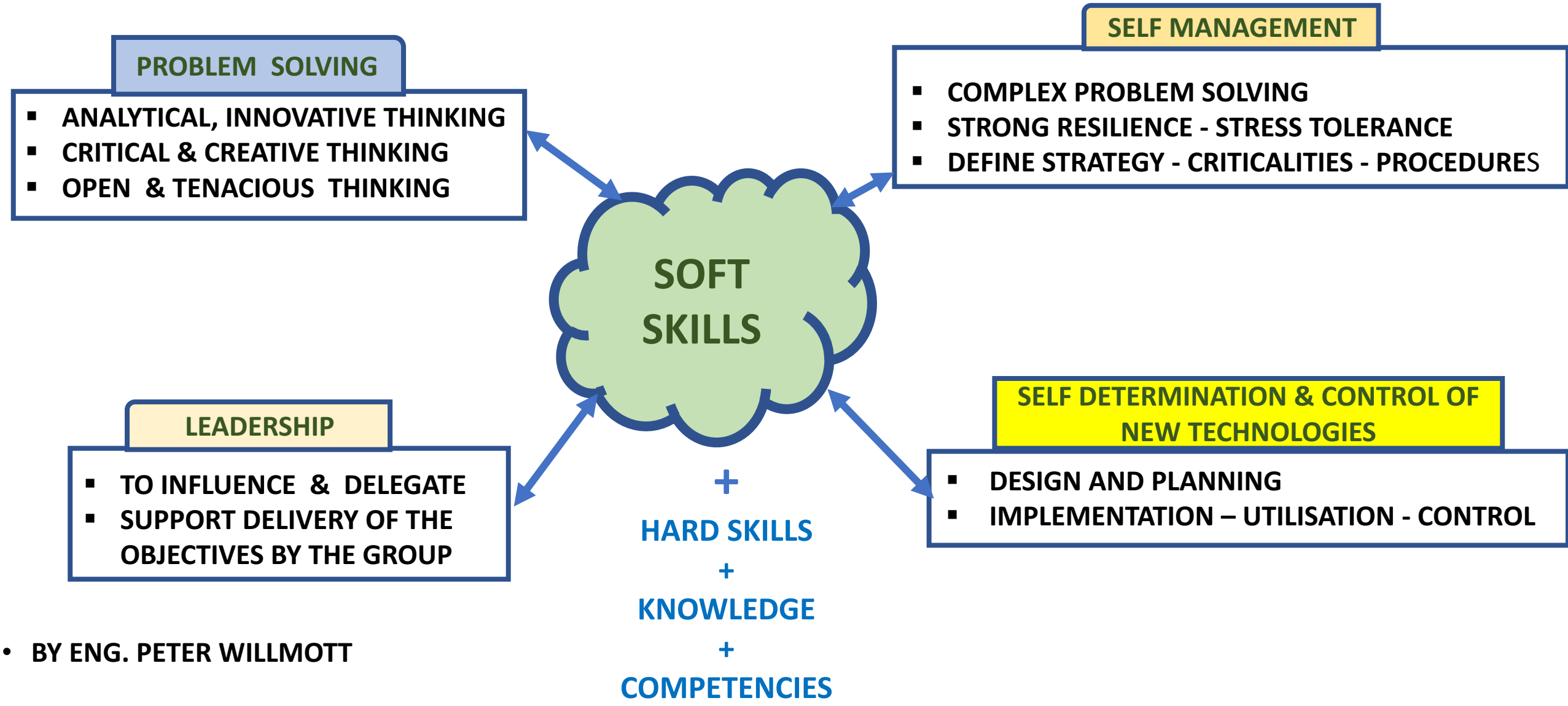
(2) ***To assure technical standards & maintenance tasks are delivered on time*** with effectiveness.

ACTIVITIES OF THE TECHNICIAN / CRAFTSMEN:

(1) ***Perform and assure the safe execution*** of agreed maintenance plans / actions.

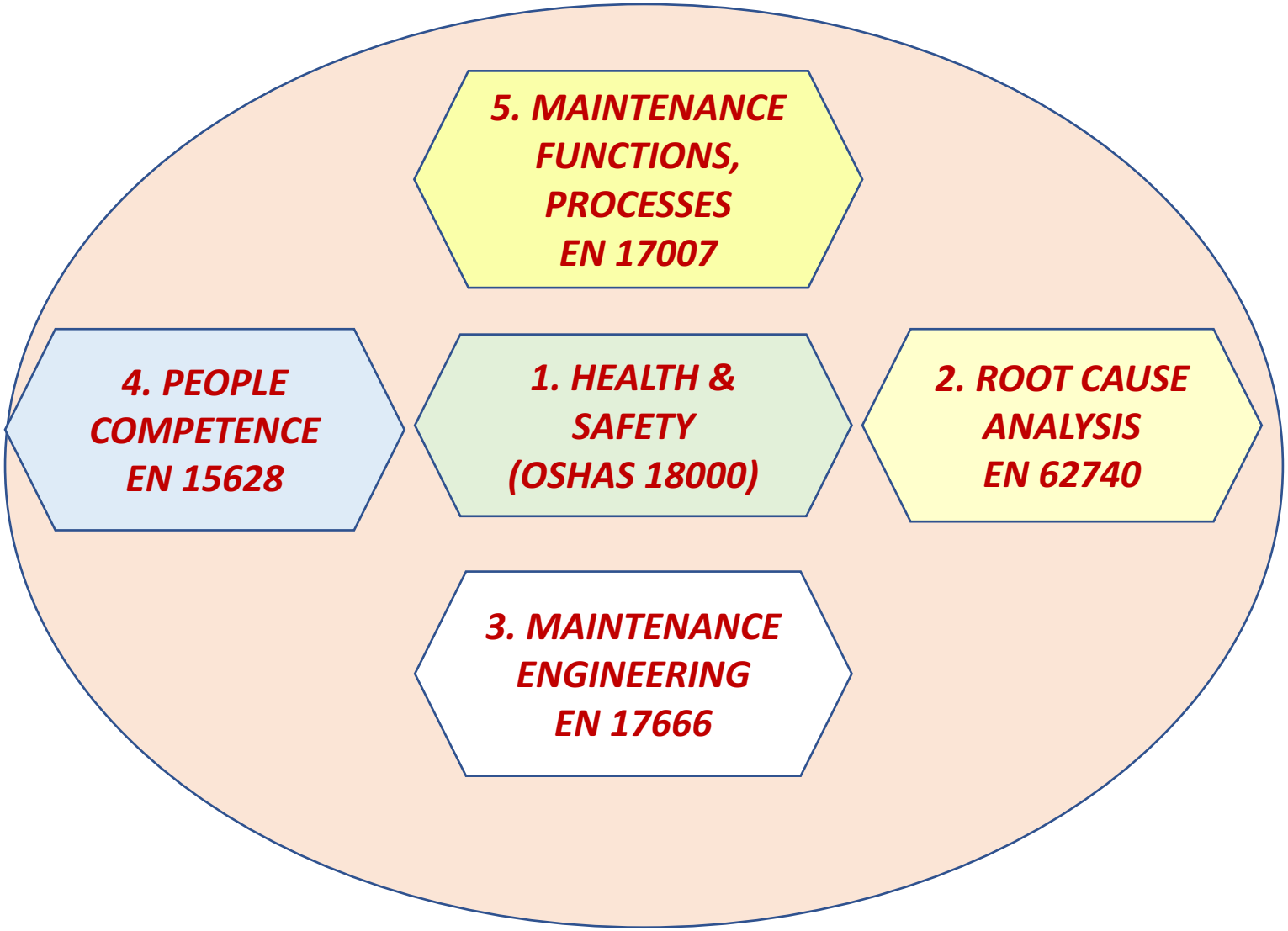
(2) Perform the proper execution of the maintenance plan / procedures including ***safety, health, and environmental conformance***.

‘SOFT SKILLS’ ARE CONSIDERED ESSENTIAL FOR THE FUTURE JOBS TOWARDS THE YEAR 2025 (ARISING FROM THE WORLD FORUM JAN. 2016)



- BY ENG. PETER WILLMOTT

THE ENGLISH FOOD COMPANY DEVELOPMENT – PROGRESS OF THE EUROPEAN STANDARDS?



RESULT OF THE DEVELOPMENT THROUGH PHASES 1 & 2 OF THE ENGLISH FOOD PRODUCING COMPANY

FIVE KEY CHANGES FROM THE ***COMBINED FIRST & SECOND PHASES OF THE TACTICS***:

1) RECEIVED DIRECTION FROM ***THE STANDARDS 1–4***

2) ***RECIEVED COMMITMENT OF 'THE TOP MANAGEMENT' AND FRONT-LINE STAFF***

3) *MADE THE COMPANY* ***POLICIES CLEAR & UNDERSTOOD*** *BY ALL THE STAFF*

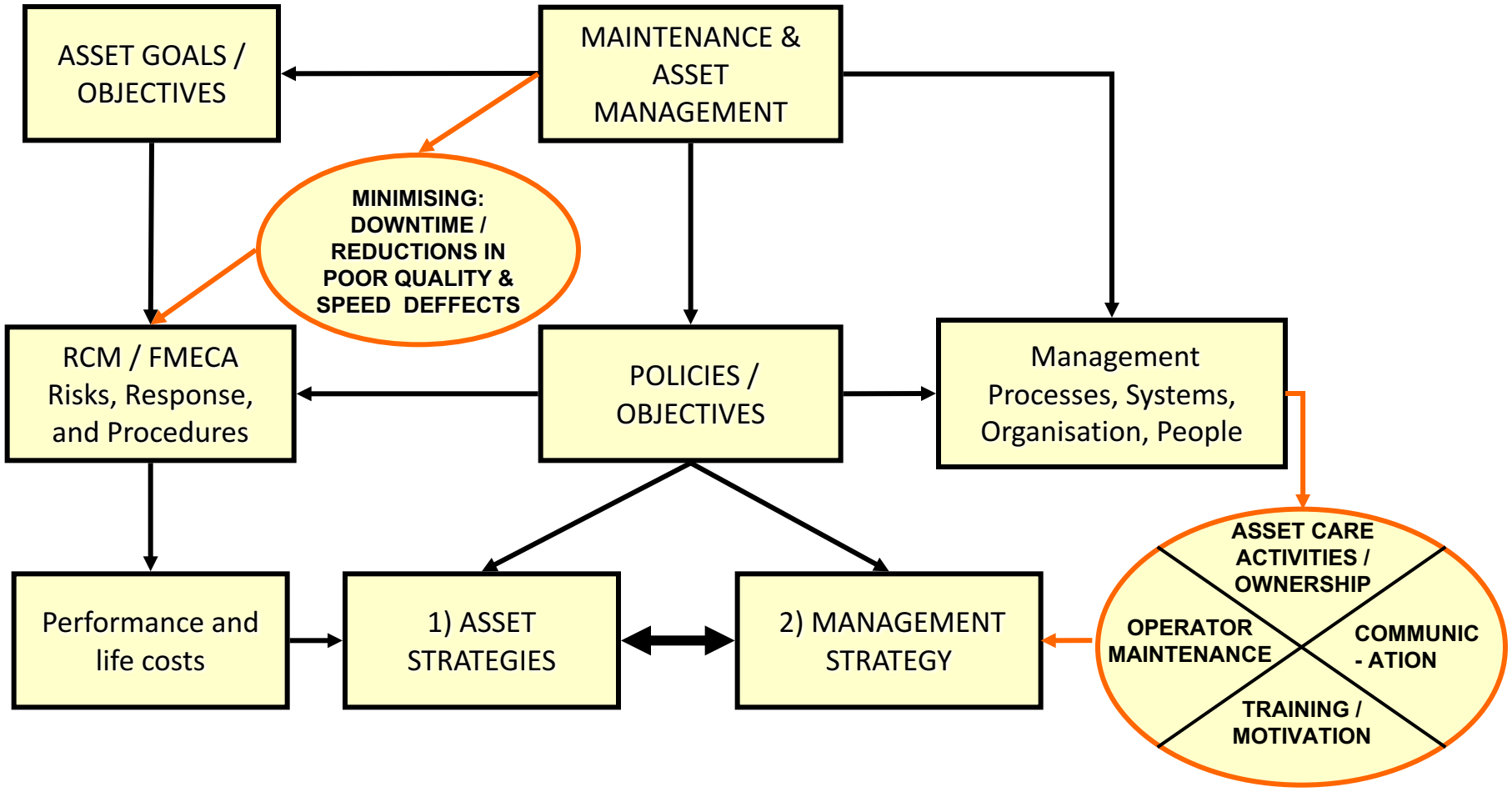
4) ***STARTED EQUIPMENT 'CONTINUAL–INFORMATION' AWARENESS SESSIONS***

5) ***PROVIDED COMPETENCE TRAINING TO DELIVER IMPROVEMENTS:***

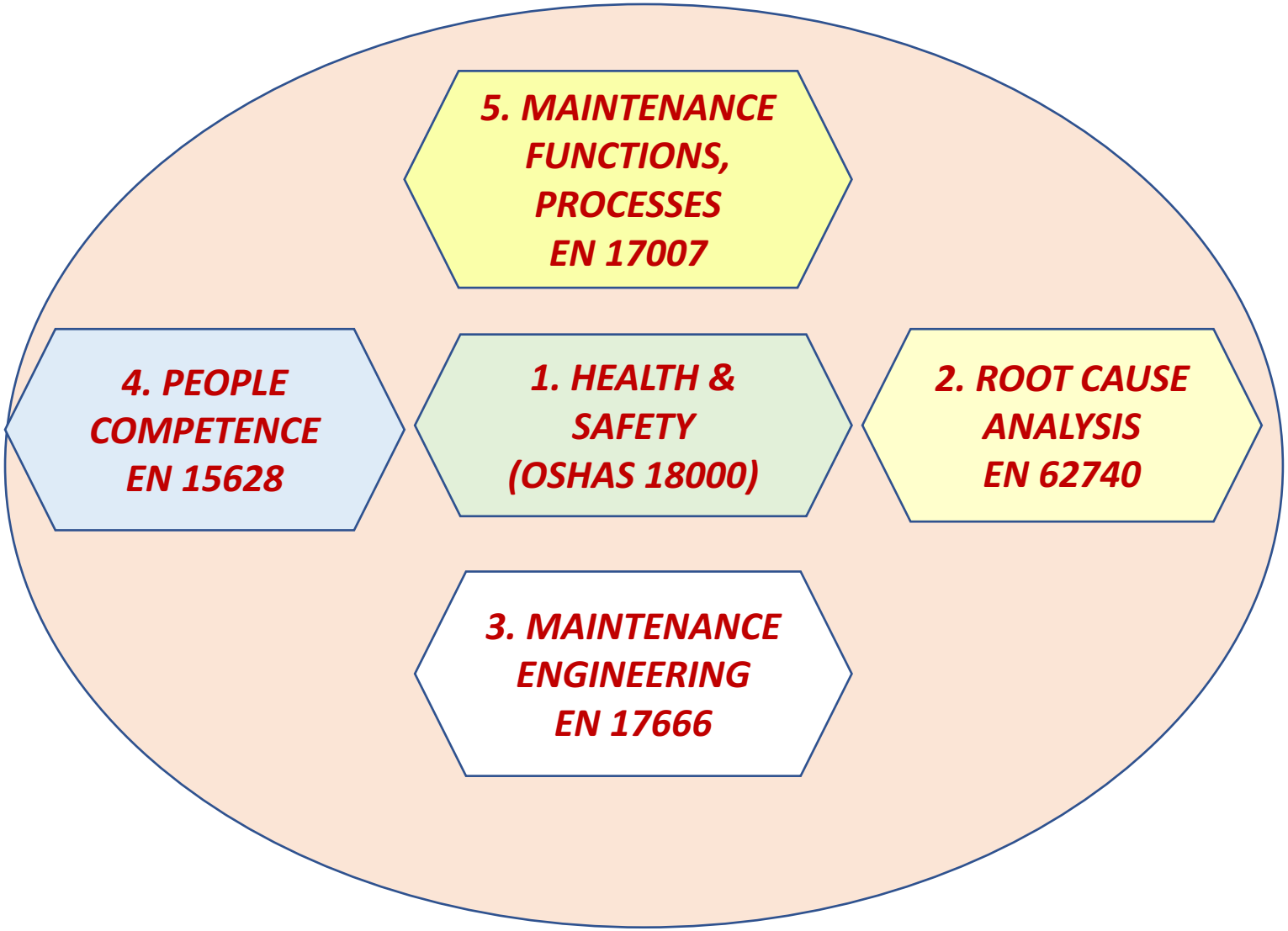
– OVER THE FIRST 5 YEARS, THE RESULT:

UPTIME WAS INCREASED FROM 86% TO 96%

I.E. DOWNTIME DOWN FROM 14% TO 4%


ASSET GOALS / OBJECTIVES
MAINTENANCE & ASSET MANAGEMENT
MINIMISING: DOWNTIME / REDUCTIONS IN POOR QUALITY & SPEED DEFFECTS
RCM / FMECA Risks, Response, and Procedures
POLICIES / OBJECTIVES
Management Processes, Systems, Organisation, People
Performance and life costs
1) ASSET STRATEGIES
2) MANAGEMENT STRATEGY
ASSET CARE ACTIVITIES / OWNERSHIP
OPERATOR MAINTENANCE
COMMUNIC - ATION
TRAINING / MOTIVATION

THE UK FOOD COMPANY DEVELOPMENT – PROGRESS OF THE EUROPEAN STANDARDS?



IN PHASE 3 AN OVERALL MAINTENANCE MANAGEMENT IMPROVEMENT STRATEGY WAS DEVELOPED

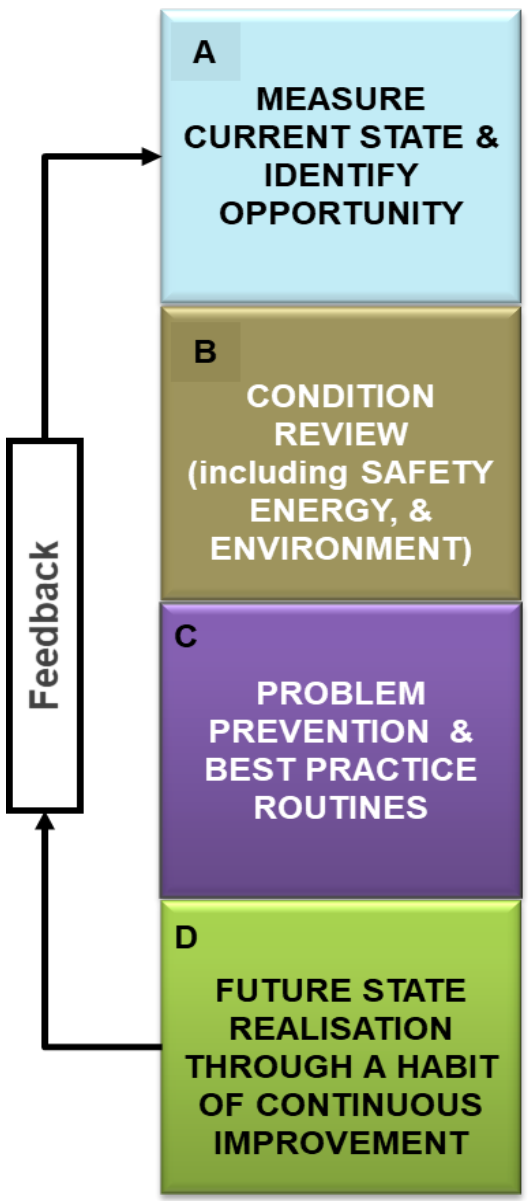
BASED ON THE DEVELOPMENTS IN THE PREVIOUS TWO PHASES:

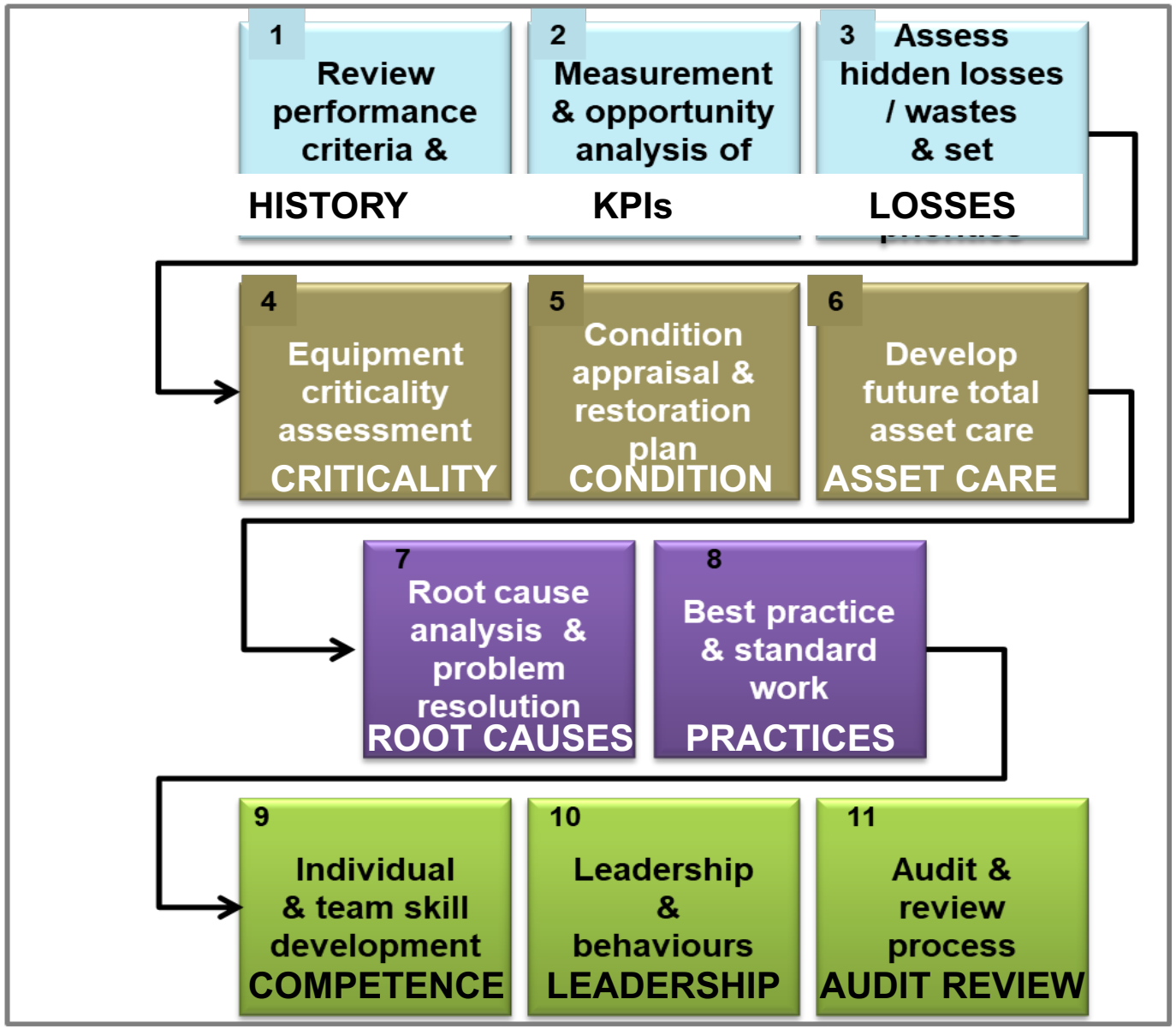
– *SAFETY ISSUES / ROOT CAUSE ANALYSIS & PROBLEM SOLVING / AND COMPETENCE TRAINING – FOLLOWING ASSET STRATEGY REVIEWS ETC. WERE ALREADY IN PROGRESS*

– A FOCUS ON 'ENABLING PRACTICES AND PROCESSES' OF THE TIME WAS NOW REQUIRED IN PHASE 3 TO TAKE ADDITIONAL STEPS FORWARD

– *AND* DEVELOPMENT OF THE MANAGEMENT PROCESSES IN A STRUCTURE BASED ON TOTAL PRODUCTIVE MAINTENANCE (TPM) WAS IMPLEMENTED

DEVELOPMENT INCLUDED IMPLEMENTATION OF THE ‘SHINGO‘ SYSTEM OF TOTAL PRODUCTIVE MAINTENANCE





PETER WILLMOTT

THE CONTENTS OF THE NEXT 'PILLAR': OF *MAINTENANCE PROCESSES, INCLUDES:*

- ***Flowcharts*** drawn of ***'driver' activities delivering value.***
- *Assigning* ***staff responsibilities for achieving targets*** in their roles.
- ***Applying KPIs / 'key performance indicators'*** (> 80 are illustrated in the Standard) ***to communicate progress of the 'drivers'.***
- ***Mapping out*** how staff activities link / and ***processes deliver results.***
- Ensuring that ***the coding and numbering systems*** are consistent for the site.

WHAT ARE THESE 'KEY PERFORMANCE DRIVERS' –

The Drivers' shown cover the responsibilities of one person for 'Shutdown' events.

The 'Engineering Driver' Activities for a 'Shutdown' Project Manager

1	***Optimisation of an Events Plan to meet the Business Objectives***
2	Life Cycle Management determines assets costs and timescales
3	Compliance with engineering legislative, company & site requirements
4	Preparation of special events Budgets and Cost Controls
5	Securing of funds for Work Order Approval
6	Preparation of Resource Integrated Team to deliver the Events Plan
7	***Assistance given to 'Projects' regarding Technical Advice and Installation***
8	HSE Plans defined and executed
9	Resources identified for delivering Shutdown and Plans
10	Services and Materials purchased to Deliver Special Events Plans
11	Detailed Execution of Work-packs including Risk Assessment
12	Management and definition of Quality Assurance and Quality Control
13	Man Management of labour workforce (Supervision, direction, productivity, HSE).
14	Execute events to KPIs on Safety, Duration, Cost, Quality, and report back

MANAGEMENT PROCESS FLOWS – ACTIVITIES NEEDED FOR Planning & Short Term Scheduling

MAINTENANCE FUNCTIONS & PROCESSES EN 17007

- *Site Engineers*
- *Technical Authorities*
- *Standards / Specifications*

- *Planners also Estimate*

- *Planners*
- *Use CMMS & Project Systems*

- *Supervision of all Work*

- *Supervisors sign off the completed job*
- *CMMS Recording*

Determine Asset Needs / Tasks / Priorities	Determine Job Requirements / Tools etc. / Risks & Skills	Estimate Time for Completion of the Job	Authorise Job Cost – Plan the Work & People Skills Required	Schedule, Issue Permit & Supervise the Work	Check Quality / Sign-off "On the Floor" & Record Data	Complete Commercially and Analyse Data

- *Engineers – Method Statement / Routine?*
- *Risk Assessments!*

- *Safe Systems of Working! – & Permits to Work!*
- *from Supervisors*

- *Technicians carry out Quality Assurance*

EVALUATE THE IMPROVEMENT VALUE OF IDEAS FROM MEETING WITH THE FRONT-LINE STAFF

Ideas Generation Notes - Maintenance / Contractor interface benefits – costs in euros

			H>1m	H>1m	H 3-5y	H-external issues / IR
			M>100k	M>100k	M<3y	M-internal
			L>10k	L>10k	L<1y	L-none
Nr.	**Theme**	**Idea**	**Benefit**	**Cost**	**Time**	**Risk**
38	Cost Control	Use contracts containing incentives	H	M	L	L
29	Cost Control	Scope of work needs more depth and has to be done by INHOUSE people not the contractor	H	M	L	L
59	Cost Control	All contractor work needs a time estimation	H	M	L	L
60	Cost Control	Contractor estimates need to be challenged	H	M	L	L
70	Cost Control	Improve skills for carrying checks and approval of contractor invoices	H	M	L	L
71	Cost Control	Improve scheduling of contractor work	H	M	L	L
51	Cost Control	Control contractor permit requests and time for issue	H	M	L	L

FLOW OF PLANNING / SCHEDULING A PROCESS – WHO IS INVOLVED & IN WHICH ACTIVITIES?

MAINTENANCE FUNCTIONS & PROCESSES EN 17007

Carry out Planning and Scheduling of Work

R Responsible for activity
C Cooperation, consulted
I To be informed

No.	Activity	Workflow	Ops. / Asset Manager	Maintenance Manager	Engineer / Supervisor	Technician	Planner / Estimator	Cost control	Documents / IT
100	Determine asset function & criticality	1	C	R	C				Manuals online
101	Determine risks, skills & capacity need	Projects & TAR	C	C	R	C	C		
102	Estimate time for access / job activities				I	C	R	I	Standard times
103	Authorise work				R				
104	Plan controls & sequence of people	Projects & TAR				C	R		Integrated site system
105	Carry out safe systems of work / review risks	2	C		R				Permit to work system

PILLAR OF MAINTENANCE MANAGEMENT PROCESSES
NEW TRENDS – PROSPECTIVES – CONTENTS

MAINTENANCE
FUNCTIONS & PROCESSES
EN 17007

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❑ NEW TRENDS

- TO DEVELOP AN EFFICIENT AND EFFECTIVE ***PROCESS–BASED MAINTENANCE CULTURE.***
- TO CONSIDER THE USE OF ***MORE AGILE AND RESILIENT SITE ORGANISATIONAL STRUCTURES.***

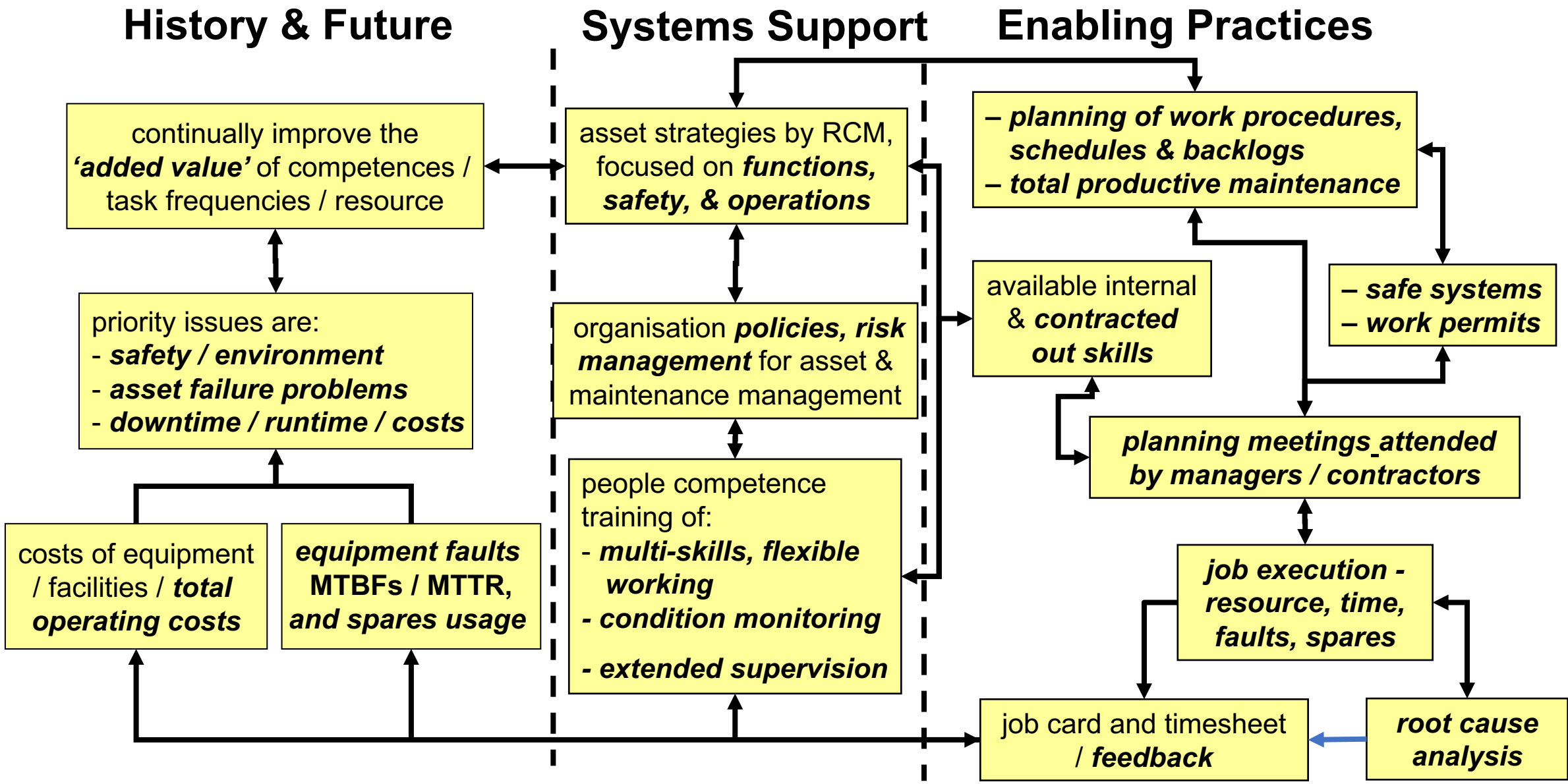
❑ NEW PROSPECTIVES

❑ TO ADOPT, IN A WORKING GROUP ***PROGRESSING CONTINUAL IMPROVEMENT***, REVIEWING DEVELOPING TECHNOLOGIES

❑ NEW CONTENTS

- ***TO DEFINE A 'ROAD MAP' FOR SELECTED TECHNOLOGIES*** WITH THE POTENTIAL FOR ARTIFICIAL INTELLIGENCE.
- TO DESIGN AND CARRY OUT INITIAL PLANS, FOR EXAMPLE – ***TEST THE TOTAL PRODUCTIVE MAINTENANCE TEN GUIDING PRINCIPLES FOR OPERATIONAL EXCELLENCE.***

IMPROVEMENT ACTIONS SUPPORTED BY THE EXTENDED COMPUTER SYSTEM – ADDING CLARITY TO THE PROCESSES / AND TO THEIR HANDLING OF DATA



WITHIN PHASE 3 – THE MAINTENANCE MANAGEMENT STRATEGIES WERE DEVELOPED

– **'ASSET CARE' INCLUDED IMPROVEMENT OF THE LIAISON OF OPERATIONS & MAINTENANCE,**

PRODUCING A MORE 'OPEN' STRUCTURE

– WITH THE SUPERVISOR ROLES BEING STRENGTHENED BY ***THE TRAINING***!

– THE TPM IMPLEMENTATION HAVING A BIG INFLUENCE ON ***STAFF AWARENESS.***

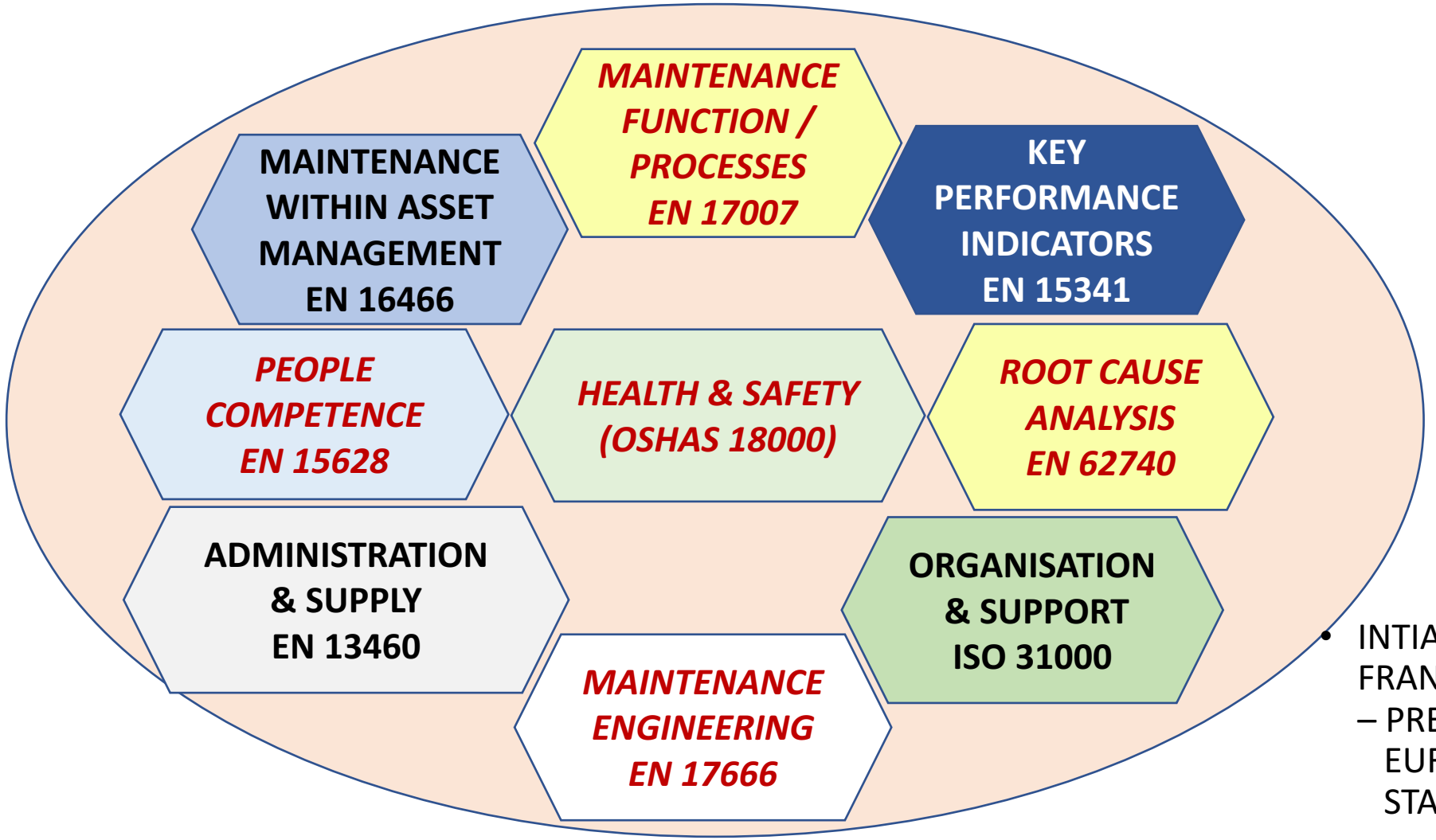
THE RESULT FROM PHASE 3 WAS:

– **'ASSET CARE' WAS APPLIED BY 'OPERATIONS' PEOPLE AT ALL LEVELS**

– **A REDUCTION DOWNTIME WAS ACHIEVED – NOW FROM 4% TO 1.75%**

ADDITIONAL CEN STANDARDS

A SCOPE OF CEN STANDARDS AIMED AT SUPPORTING & ENABLING MAINTENANCE & ASSET MANAGEMENT



- INTIAL DEVELOPMENT BY DR. FRANCO SANTINI – PRESIDENT OF THE EUROPEAN MAINTENANCE STANDARDS 'CEN GROUP'

GIVES A SCOPE OF ACTIONS REQUIRED TO PREPARE:

(1) THE ORGANISATIONAL OBJECTIVES SET BY THE TOP MANAGEMENT,
(2) THE STRATEGIC ASSET MANAGEMENT PLANS BY THE GENERAL MANAGEMENT / CONTRACTORS.

MAINTENANCE WITHIN ASSET MANAGEMENT EN 16466

"Top-down" Feed –the Organisational Objectives to be Delivered by the SAMP

"Bottom-up" Feed of a SAMP Designed to 'Add Value' to the Organisational Objectives & Strategic Programme

"Bottom-up" – Feed of the Asset Management Objectives / and of the Plans to Achieve them – Are they Sufficient to Support a SAMP?

‘AM’ OFFERS AN OPPORTUNITY TO CHANGE THE PERCEPTION OF ‘MAINTENANCE’ FROM “REDUCE THE MAINTENANCE COSTS – TO ‘MAINTENANCE ADDS VALUE”

MAINTENANCE WITHIN ASSET MANAGEMENT EN 16466

- TO A ***PROACTIVE VIEW*** THAT …..
- MAINTENANCE IS AN ESSENTIAL PART OF – ***DEVELOPING ‘VALUE–ADDED’ INPUT***
- THAT DURING ASSETS INVESTMENT AND DESIGN – ***HELPING TO SUSTAIN ASSET OPTIMISATION AND EXTENSION OF AN ASSET’S LIFE***
- BY DEVELOPING AN APPROACH OF – ***DELIVERING A QUALITY SERVICE***
- BY ***FRONT-LINE STAFF BEING EMPOWERED BY THEIR LEADERS, ETC.***

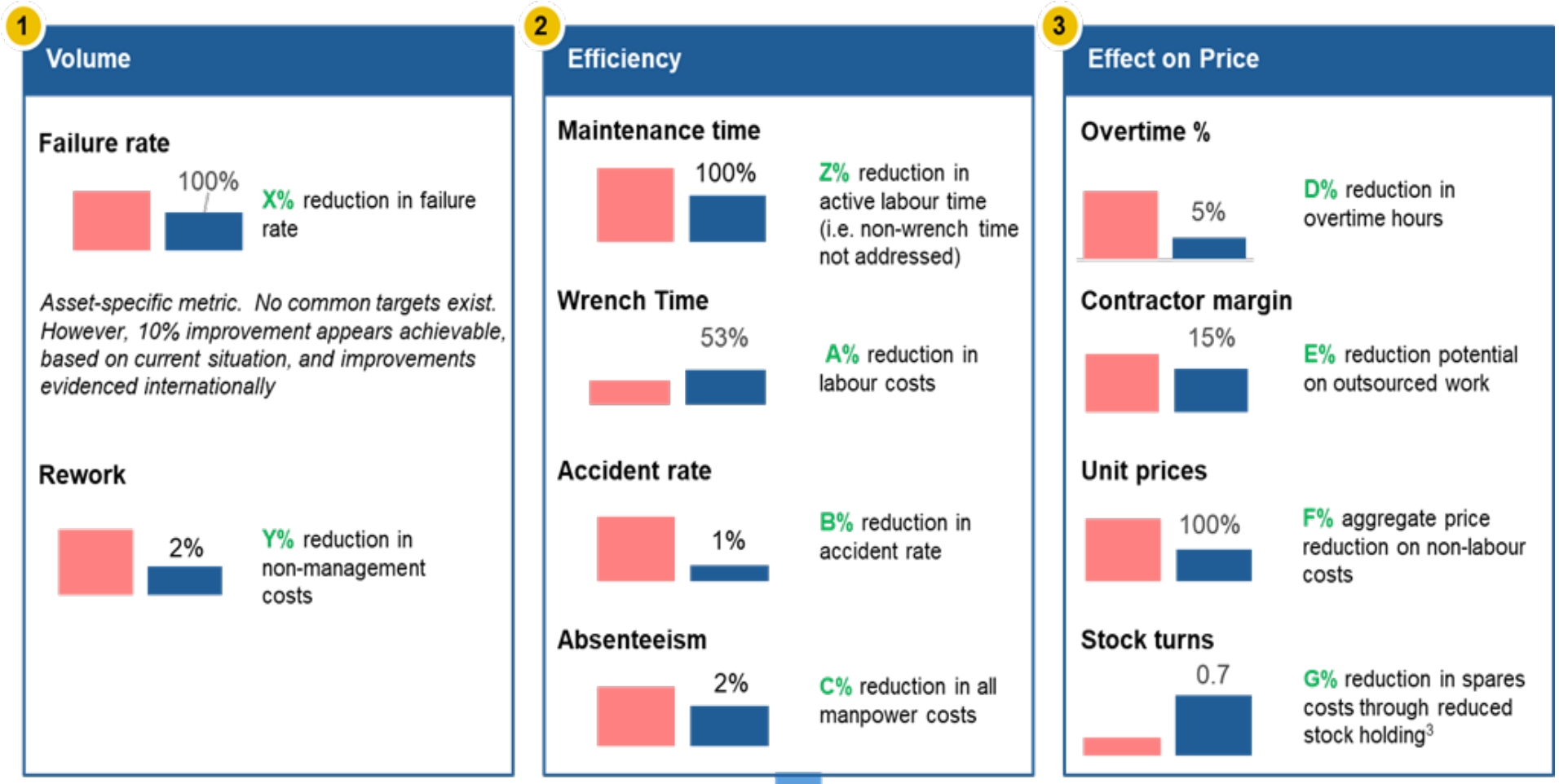
‘LEADERSHIP’ (5.1) SHOULD BE AWARE OF THE ACTIVITIES NEEDED AND THEIR COORDINATION AT ALL LEVELS – TO ‘DRIVE-IN’ THEIR OBJECTIVES

Efficiency & Effectiveness		Operations & Maintenance processes & tactics		Asset Management objectives		Stakeholder / Organisational objectives	
Execution:	*Wrench time in mean hours*	**Work identification:**	*% Preventive maintenance*	**Reliability/ availability:**	*% Reliability & Availability*	**Budgets:**	*Total Maintenance cost per ARV*
	Reduced mean time to repair		*% Failure events diagnosed by Root Cause Analysis*		*Increased time between failures*		*Costs / floor space*
	% Rework		*Work request and response rate*		*% Customer satisfaction*		*Costs / number of staff*
Inventory:	*% Stock-out rate*	**Stores / purchasing application system:**	*% Stock items within computer system control*		*Number of suppliers and ordering costs reduced*	**Materials:**	*Reduced % inventory value / asset value*
Workforce development:	*Training hours per annum*	**Safe practice systems**	*% Permits applied by type of task*	**Safety:**	*Injuries per 200k labour hours*		*Objective of Zero losses due to non-compliance*
	Training cost as % of salary	**Work planning:**	*% Maintenance which is planned*				

The Level of Actions Reviewed Within an Audit in a Transformation Project

KEY PERFORMANCE INDICATORS
EN 15341

– Never exclude a Review of the Front-Line Maintenance Activities,
– In a project carried out, the Craftsmen Front Line actions were assessed,
– They represented the highest potential improvement area for high productivity/low costs.



1. GOVERNMENT FACILITIES REVIEW OF O&M – MILITARY SITES, HOSPITALS, UNIVERSITIES / SCHOOLS, ROADS, OFFICES, MOSQUES, WATER / POWER, ETC.

KEY PERFORMANCE INDICATORS EN 15341

Ref.	Functional area	Activity		Dimension	Activity Measure	Performance Metric
1	Strategy and Governance	1.1	Strategy development	Alignment	1.1.1 Alignment of strategy with Ministry objectives	
				Content	1.1.2 Scope and content of O&M strategy	
				Development process	1.1.3 Robustness of strategy development process	
		1.2	Strategic direction	Priorities	1.2.1 Goals and objectives of O&M strategy	
				Outsourcing	1.2.2 Factors considered when deciding outsourcing strategy	1.2.2 O&M outsourcing rate (%)
		1.3	Organisation	Organisation structure	1.3.1 Organisational structure of O&M department	
				Roles and responsibilities	1.3.2 Definition of roles and responsibilities within department	1.3.2 O&M roles with job descriptions (%)
				Supervision	1.3.3 Measures in place to ensure effective supervision	1.3.3 Craftsman: supervisor ratio
				Integration of O&M	1.3.4 Interaction between operations and maintenance	
		1.4	Governance/ performance management	Structure	1.4.1 Governance structure of O&M department	
				Process	1.4.2 Governance processes in place	
				Customer satisfaction	1.4.3 Means in place to track customer satisfaction	1.4.3 Customer satisfaction score (%)
2	Delivery plans	2.1	Maintenance planning	Maintenance programme		2.1.1 Proactive maintenance (%)
				Maintenance programme selection	2.1.2 Preventive maintenance approach	2.1.2 RCM/ analytical framework asset coverage (%)
				Asset prioritisation	2.1.3 Approach to asset prioritisation	2.1.3 % assets with priority category
				Asset condition survey	2.1.4 Approach to recording asset condition	2.1.4 % assets with condition monitoring?
		2.2	Risk management	Emergency plans	2.2.1 Major disruption emergency plans	2.2.1 Emergency drills per year
				Risk assessment	2.2.2 Risk assessment procedures in place	2.2.2 Risk assessments per year
3	Procurement	3.1	Contractor procurement process	Prequalification	3.1.1 Steps taken to pre-qualify contractors	3.1.1 % of contracts with PQQ
				RFP (request for proposal) scope	3.1.2 Scope of service requirements included in tenders	
				Subcontractors	3.1.3 Extent of qualification of subcontractors	
		3.2	Inventory and spares	Strategy	3.2.1 Robustness of spare parts strategy	
				Stock outs		3.2.2 Stock out rate %
				Inactive stock		3.2.3 Inactive stock
				Categorisation		3.2.4 % spare parts categorised
				Reordering		3.2.5 % items with automatic reordering
4	Operations management	4.1	Agreement structures	Service Level Agreements (SLAs)	4.1.1 Robustness of service level agreements	4.1.1 % contracts with SLAs
				Key Performance Indicators (KPIs)	4.1.2 Scope of KPIs used in O&M contracts	4.1.2 % contracts with KPIs
				Payment mechanisms	4.1.3 Performance factors affecting contractor payment	4.1.3 % contracts performance-based
		4.2	Monitoring and management	Performance management	4.2.1 Approach to delivery team performance monitoring	
				Delivery team supervision	4.2.2 Delivery team supervision structures	4.2.2 Work order approval process compliance (%)
				Management reporting	4.2.3 Scope of periodic management reporting in place	4.2.3 # regular O&M reports per year
				Continuous improvement	4.2.4 Approach to continuous improvement	
		4.3	Planning and scheduling	Work planning	4.3.1 Considerations included in the planning process	
				Work scheduling	4.3.2 Considerations included in the work scheduling process	4.3.2.a Schedule compliance (%)
						4.3.2.b Schedule coverage (months)
				Work orders	4.2.3 Robustness of work order management	4.3.3.a % work hours recorded in work order system
						4.3.3.b Work order form completion %
						4.3.3.c Maintenance request response time compliance

2. GOVERNMENT FACILITIES REVIEW OF O&M – MILITARY SITES, HOSPITALS, UNIVERSITIES / SCHOOLS, ROADS, OFFICES, MOSQUES, WATER / POWER, ETC.

KEY PERFORMANCE INDICATORS EN 15341

Ref.	Functional area	Activity		Dimension	Activity Measure	Performance Metric
5	**Service delivery**	5.1	Delivery team performance	Performance	**5.1.1** Delivery team performance against SLA conditions	**5.1.1** SLA compliance (%)
				Quality of work		**5.1.2** Rework (%)
		5.2	Contractor workforce	Organisation structure	**5.2.1** Robustness of contractor's organisation	
				Qualifications	**5.2.2** Qualification levels of contractor workforce	**5.2.2** Workforce qualification (%)
				Saudisation	**5.2.3** Steps taken by contractors to provide Saudi jobs	**5.2.3** Contractor Saudisation (%)
		5.3	Maintenance procedures	Standing Operating Procedures (SOPs)	**5.3.1** Use of standard operating procedures	**5.3.1** % processes with SOPs
				Quality Control plans	**5.3.2** Robustness of quality control plans	**5.3.2** Process compliance with Quality Control standards (%)
6	**Information and systems**	6.1	O&M information systems	O&M manuals	**6.1.1** Scope of information held in O&M manuals	**6.1.1** % asset coverage of O&M manuals
				Asset registry	**6.1.2** Scope of information held in asset registry	**6.1.2** % assets on asset registry
				CMMS/ CAFM	**6.1.3** Features of CMMS / CAFM systems	
				Remote monitoring	**6.1.4** Features of on-line / digital monitoring systems	**6.1.4** % assets connected to central control system
		6.2	Management systems	Finance systems	**6.2.1** Features of finance system	
				HR systems	**6.2.2** Features of HR system	
				O&M system integration	**6.2.3** Degree of integration of key on-site systems	
7	**Finance and budgeting**	7.1	Performance	Maintenance cost		**7.1.1** Maintenance cost/ Replacement Asset Value (RAV) %
				Reinvestment rate		**7.1.2** Reinvestment rate % (Renewal capital spend/RAV)
		7.2	Budgeting and reporting	Budget approach	**7.2.1** Scope and robustness of O&M budget	
				Methodology	**7.2.2** Elements of budget creation process	**7.2.2** % assets with condition assessment-driven budgets
				Budget reporting	**7.2.3** Structure of regular performance reporting against budget	**7.2.3** O&M budget compliance (%)
		7.3	Lifecycle costing and reliability	Cost effectiveness vs reliability	**7.3.1** Balance of cost effectiveness and asset reliability	
				Lifecycle costing		**7.3.2.a** % assets with Lifecycle Cost budgets
						7.3.2.b % assets procured with Lifecycle Cost principles
		7.4	Controls and policies	Cost codes	**7.4.1** Cost coding structure	**7.4.1.a** % assets with standard cost codes
8	**Human resources**	8.1	Recruitment and Saudisation	[illegible]	[illegible]	[illegible]
				Recruitment approach	**8.1.2** Steps taken in recruitment to ensure capable workforce	**8.1.2** % candidates screened
				Employee motivation	**8.1.3** Degree of employee engagement and motivation	
		8.2	Training and development	In-house team	**8.2.1** Scope of in-house training program	**8.2.1.a** Annual training hours per employee
						8.2.1.b % staff with up to date training records
				Contractors	**8.2.2** Scope of contractor's training program	**8.2.2** Annual training hours per contractor employee
		8.3	Employee performance management	Performance management	**8.3.1** Approach to managing employee performance	**8.3.1** % employees with performance targets
				Absenteeism approach	**8.3.2** Approach to absenteeism	**8.3.2** % absenteeism
9	**QHSE compliance**	9.1	HSE compliance	Environmental	**9.1.1** Scope of energy and environmental management plan	
				Health and Safety	**9.1.2** Scope of QHSE approach	**9.1.2** # injuries per 200,000 hours
				Fire safety	**9.1.3** Fire safety actions	**9.1.3** % staff with up to date fire training

A CHEMICALS / REFINERY SITE IN EUROPE

WHAT THE BOARD WANTED TO HEAR:

– WILL THEIR AIMS & OBJECTIVES BE ACHIEVEABLE

FROM A PHYSICAL ASSET MANAGEMENT VIEWPOINT

– THAT IS FOR 'ROAD MAPS' OVER TIMESCALES OF 1 – 3 – 5 – 15 YEARS?

- ***Output focus*** – achieve a mean delivery of Y tonnes per annum
- **Compliance** – fulfil COMAH compliance / statutory health & safety requirements
- ***Reliability*** – target of 95%; ***Utilisation*** – over 98% in a non-turnaround year
- at **Cost – X%** = ***total cost of all activities on the Assets x 100%***

  estimated assets replacement value (ERV)

ADMINISTRATION AND SUPPLY TRENDS – PROSPECTIVES – CONTENTS

❑ NEW TRENDS

1. ***TO CALCULATE AND COMPARE ASSETS TOTAL MAINTENANCE COSTS,*** ACCORDING TO THE EN 15341: KPIs.

2. ***TO PROVIDE AN OPTIMUM APPLICATION*** OF THE ACTIVITIES AND RESOURCES USED.

❑ PROSPECTIVES

1. TO CARRY OUT MAINTENANCE ***BENCHMARKING COMPARISONS OF SIMILAR PROCESSES & ASSETS EQUIPMENT***.

❑ NEW CONTENTS

1. ***TO DEFINE AND EVALUATE AN INDICATOR OF 'RETURN ON MAINTENANCE' AS A PARAMETER OF COMPETITIVENESS***

   i.e. WHAT IS THE AIMED-AT EXPENSE OF MAINTAINING TO THE REQUIRED TARGETS & LEVEL OF SUSTAINABILITY?

Item 6.2.1 The Inclusion of Asset Management (AM) Targets and Objectives

Included in ***the planned activities and the organisational objectives are.***

- Which function should be accountable for what/how in the processes?

  Asset Management; Projects; Operations; Maintenance; Procurement?

- At what Role Levels in the organisation should objectives/KPIs be allocated?:

  For Technicians / Supervisors; or Engineer / Maintenance Manager; Asset Manager; or Board Member; etc.

Item 6.2.1 The Inclusion of Asset Management (AM) Targets and Objectives

Answers to these questions depend on such issues as:

- *the priority of each "action" and the level of responsibility,*

- *the "action" risks for the organisation; and whether they create issues,*

- *the information and knowledge needs, how difficult is that,*

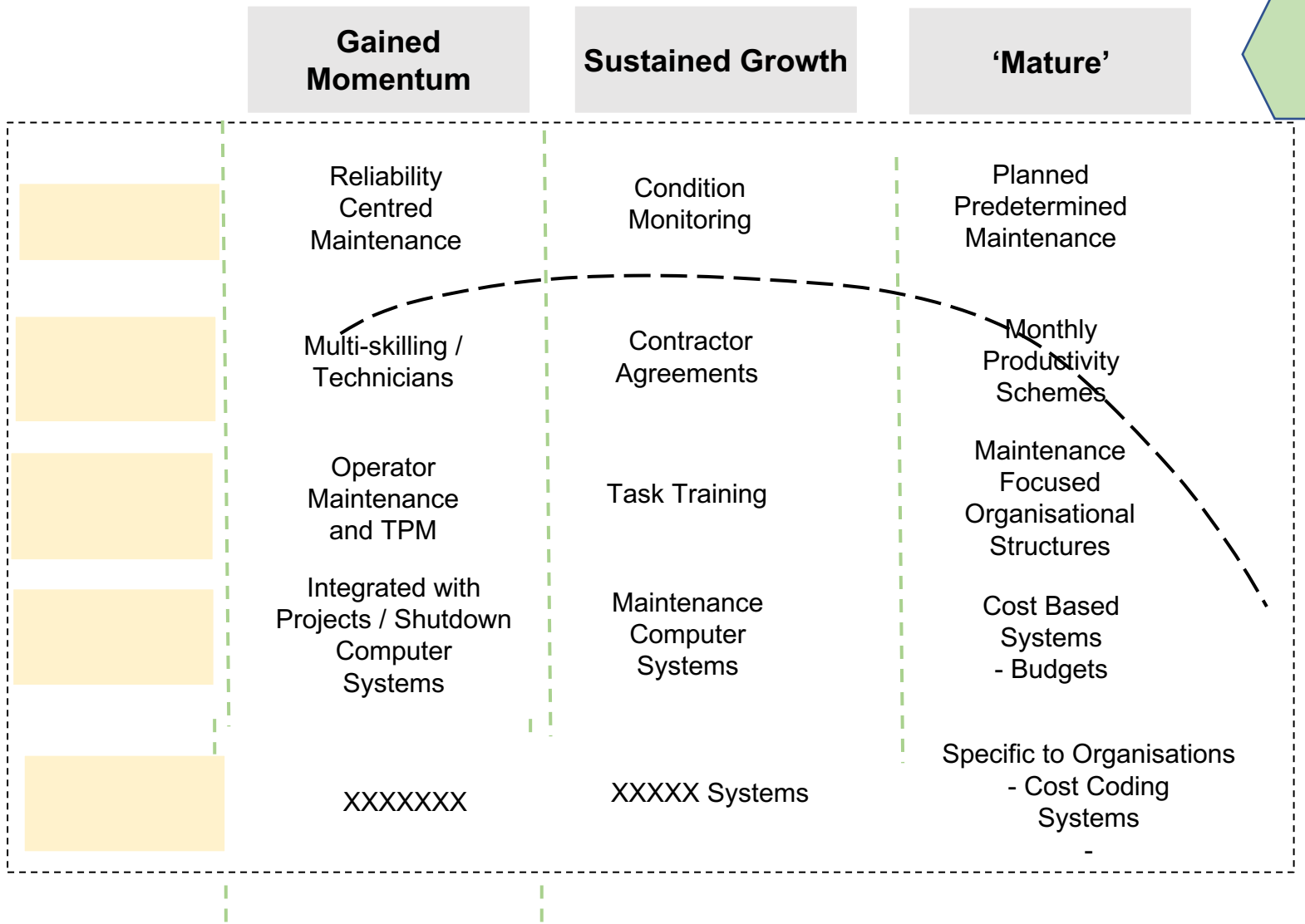
- *the resourcing requirements and whether these are internal or external.*

THE MAIN CONTENTS OF THE NEXT 'PILLAR' OF MAINTENANCE ORGANISATION INCLUDES:

ORGANISATION & SUPPORT
ISO 31000

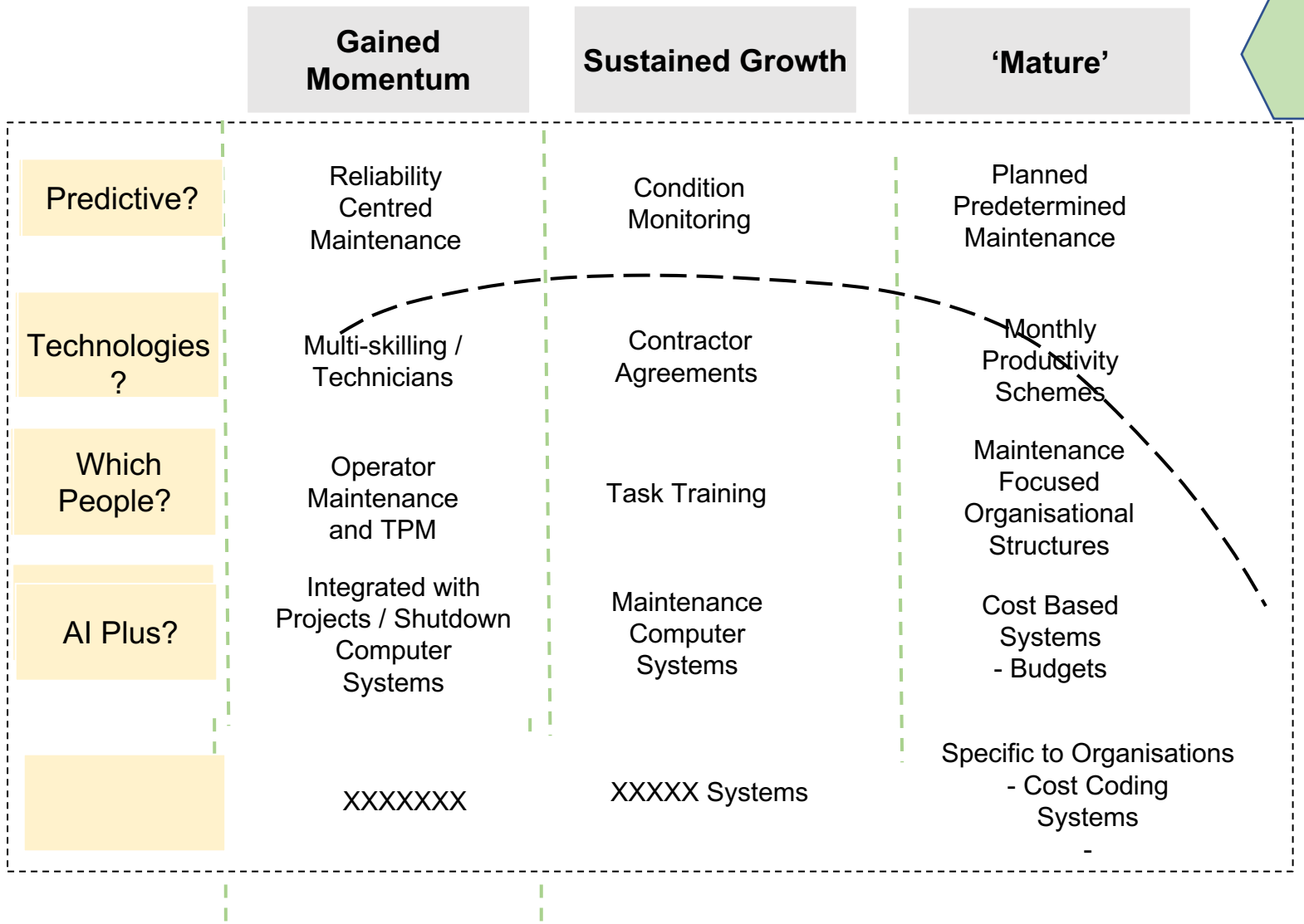
- DEFINING THE RULES OF ASSESSING ***CRITICALITY AND PRIORITY*** OF THE ASSETS
- PROCEDURES FOR WORK ORDERS – ***SPECIFYING TASKS, THEIR TIMES, KPIS, ETC.***
- DEVELOPING ***PROCESSES FOR PLANNING-SCHEDULING-REPORTING*** JOBS ETC.
- ESTABLISHING WORK PLANS, ***PROGRAMMES (ANNUALY, QUARTERLY, WEEKLY)***
- APPLYING COMPUTERISED PROCEDURES TO ACHIEVE ***INTEGRATED PLANNING***
- IMPLEMENTING METHODS ***FOR INCREASING PRODUCTIVITY SUCH AS BASIC CARE AND TOTAL PRODUCTIVE MAINTENANCE, ETC.***

Practices & Processes - Stages of Development from 'Mature' (old news) to 'Gaining Momentum' (new news)



Happening in Organisations – when?

Practices & Processes - Stages of Development from 'Mature' (old news) to 'Gaining Momentum' (new news)



Happening in Organisations – when?

ORGANISATION & SUPPORT:

– Planning & Scheduling; – Job Execution Process;
– Computerised Procedures; – Resources Activities/Time

ORGANISATION & SUPPORT
ISO 31000

IMA
www.ima-world.org

- **NEW TRENDS**
  1. DEVELOP THE BEST VISION FOR THE ***MAINTENANCE PRACTICES.***
  2. IMPROVE ***SAFETY, QUALITY, EFFECTIVENESS***, AND EFFICIENCY OF THE FIELD MAINTENANCE ACTIVITIES.

- **NEW PROSPECTIVES**

  1. ***USE DIGITAL TWIN / MACHINE LEARNING TECHNOLOGY***, WITH THE **MANUFACTURER'S INPUT TO ANALYZE, PREDICT AND SIMULATE FAILURE CAUSES & DESIGN IMPROVEMENTS**

- **NEW CONTENTS**
  1. WITH THE NEW INTELLIGENT INFORMATION – ***OPTIMISE THE PREDICTIVE, ON–CONDITION MAINTENANCE WORK.***

NEW TECHNOLOGIES – MAJOR CONSIDERATIONS FOR DELIVERING FUNCTIONAL BENEFITS IN MAINTENANCE (1)

NEW TECHNOLOGY–MAINTENANCE APPLIED BY 'ENABLING TECHNOLOGY' INTEGRATED WITH SMART SYSTEMS / INTERNET OF THINGS etc. on :

1. **Co-Robotics**, to reduce the ergonomic problems of people, increasing H&S

2. **Digital Twin**, as a virtual identical electronic representation of the structure of each Asset, to plan predict failures, plan the work, design improvements.

3. **Big Data,** a collection of informal data, extensive in terms of Volume, Speed and Variety – requires specific analytical methods for the extraction of value.

4. **Machine Learning**: collect big data through sensors, and transform the data into information – to optimise predictive and prognostic maintenance.

NEW TECHNOLOGIES – MAJOR CONSIDERATIONS FOR DELIVERING FUNCTIONAL BENEFITS IN MAINTENANCE (2)

5. Artificial Intelligence: significant data being embedded on and transferred between Machines able to action Machine Operation.

6. Cloud Computing: to receive and computing by remote big data in more effective and secure ways.

7. Printing 3D: to produce spare parts from Computer Aided Design, throughout special printing machines in 3 Dimensions

8. Cyber Security Systems: to protect the knowledge and 'know-how'.

THE SUPPORT OF THE ASSOCIATED ISO GLOBAL STANDARDS

SOME GLOBAL MANAGEMENT STANDARDS ASSOCIATED WITH TO-DAY'S ASSET MANAGEMENT 5500+

- *ISO 9001* – *World's HIGHEST purchased standard, is of high influence, Quality Management Systems*
- *ISO 14001* – *International standard for Environmental Management*
- *OHSAS 18001* – *(now ISO 45001) for Occupational Health & Safety*
- *ISO AS SHOWN* – *Risk Management*
- **ISO 27001** – **Standard for Information Security**
- *ISO 19011* – *Guideline for Auditing Management Systems*

1/23/24 - Geoff Vorley

ISO 55001
ASSET
MANAGEMENT

GIVING SUPPORT ARE SOME RELEVANT GLOBAL ISO STANDARDS

- ISO 31000 RISK MANAGEMENT
- ISO 15288 SYSTEMS ENGINEERING
- ISO 9001 QUALITY MANAGEMENT
- ISO 19011 AUDITING
- HEALTH & SAFETY (OSHAS 18000)

ADDED TO THE SUPPORT OF THE RELEVANT EUROPEAN STANDARDS

- ROOT CAUSE ANALYSIS (EN 62740)
- ADMINISTRATION & SUPPLY (EN 13460)
- PEOPLE COMPETENCE (EN 15628)
- ORGANISATION & SUPPORT (ISO 31000:2018)
- MAINTENANCE FUNCTION / PROCESSES (EN 17007)
- MAINTENANCE ENGINEERING (EN 17666)
- MAINTENANCE WITHIN PHYSICAL ASSET MANAGEMENT EN 16466

What is Asset Management?

ISO 55001
ASSET
MANAGEMENT

IMA
www.ima-world.org

- Asset Management Council (Australia)

  "The lifecycle management of physical assets to achieve the stated outputs of the Enterprise"

- ISO 5500+ Asset Management (UK)

  "The coordinated activities of an organization to realise value from assets"

- PAS 55-1:2008

  "*Systematic and coordinated activities and practices through which an organization optimally and sustainably manages it's assets and asset systems, their associated performance, risks and expenditures over their life cycles for the purpose of achieving the Organisational Strategic Plan*".

A STANDARD FOR:

PHYSICAL ASSET MANAGEMENT (ISO 55001)

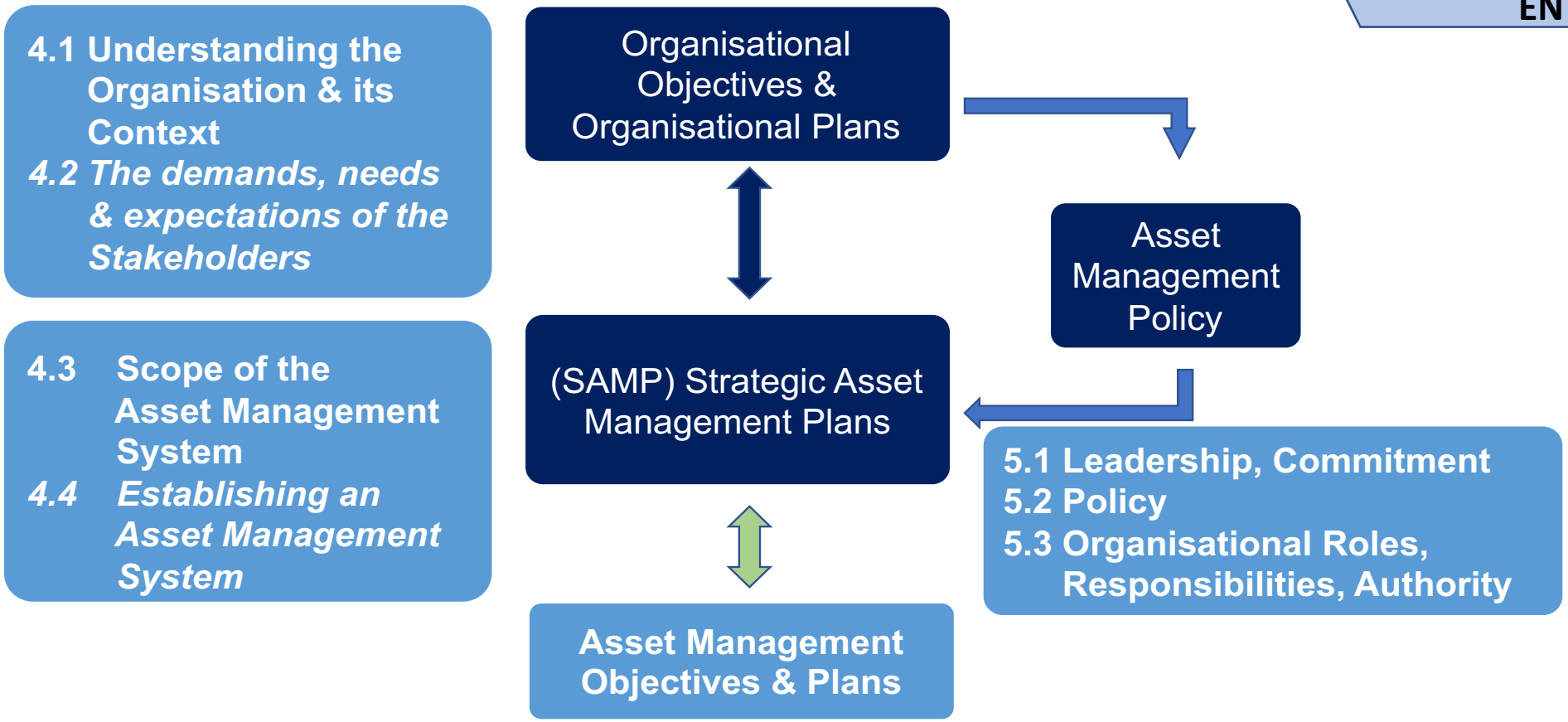
– SUPPORTING THE ACHIEVEMENT OF MAINTENANCE PLANS

– 'KEY PERFORMANCE DRIVERS'N FOR ADDING VALUE TO THE ASSET MANAGEMENT PLANS

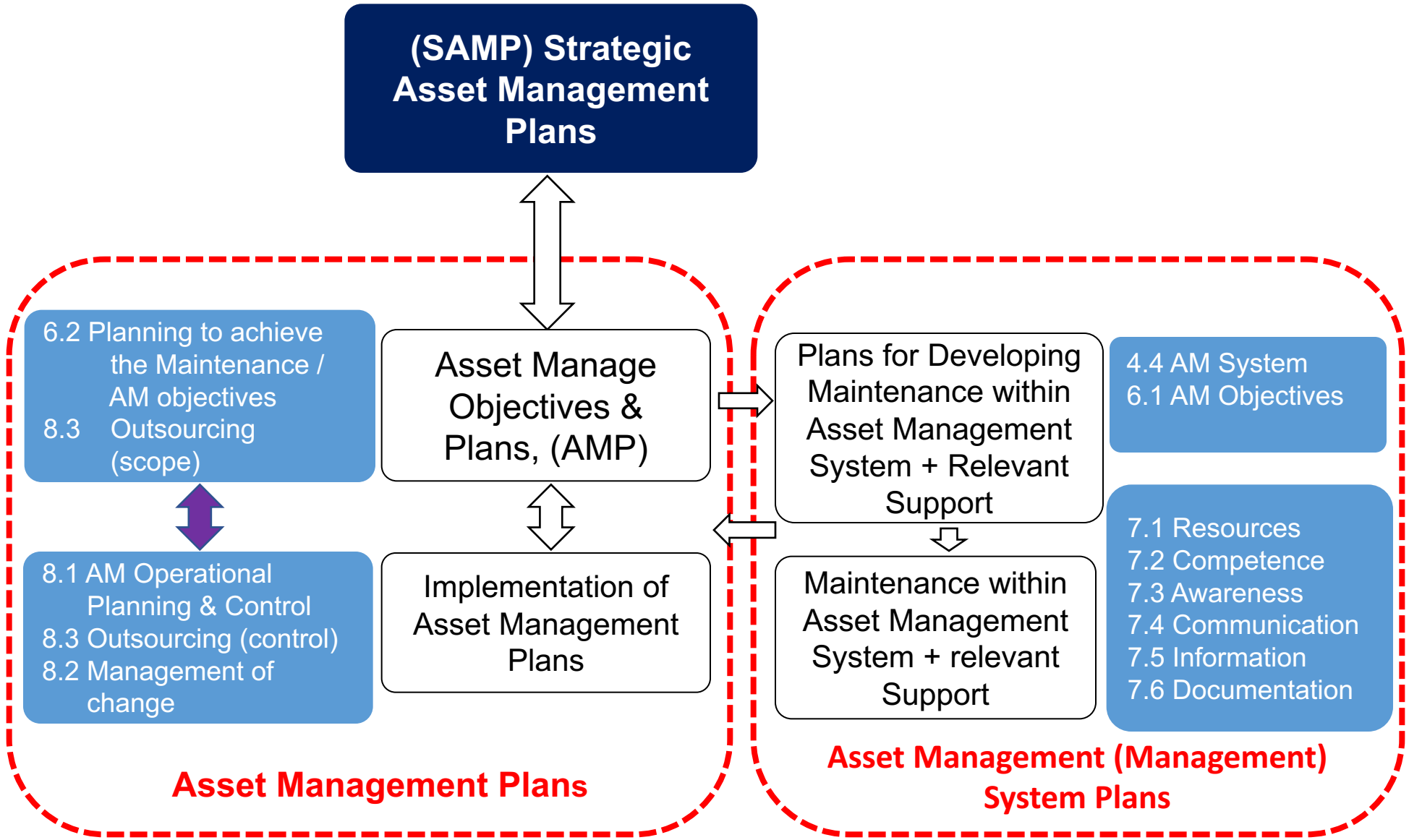
ISO 55001 ASSET MANAGEMENT

MAINTENANCE WITHIN ASSET MANAGEMENT EN 16466

4.1) – 5.3) Context; Policy; Leadership; System & SAMP



ISO 55001 – Developing the Asset Management Objectives & Plans



IF THE ASSET MANAGEMENT SYSTEM ISO 55001 IS CONSIDERED

ISO 55001 ASSET MANAGEMENT

SUGGESTED IS A READ THROUGH THE ISO 55001 REFERENCES TO THE ACTIONS FOR IMPLEMENTATION. THERE IS AN EMPHASIS ON:

> ***20 REFERENCES TO RISK MANAGEMENT,***

> ***10 REFERENCES TO THE DEVELOPMENT OF THE PROCESSES,***

> ***5 REFERENCES TO THE STAKEHOLDERS REQUIREMENTS***

IN ISO 55001 THERE ARE > 20 REFERENCES TO RISK MANAGEMENT – WHY SUCH A FOCUS ON RISK MANAGEMENT?

BECAUSE THE NEED FOR RISK MANAGEMENT AND CONTROL ARISES THROUGHOUT MAINTENANCE AND ASSET MANAGEMENT WITHIN:

– 1. WITHIN THE DEVELOPMENT OF RELIABILITY CENTRED MAINTENANCE / FAILURE MODE AND EFFECTS ANALYSIS / ROOT CAUSE ANALYSIS

– 2. WITHIN ASSET CRITICALITY ANALYSIS AND MEASURING ASSET PRIORITY / AND WHICH TASKS ARE INCLUDED-IN OR EXCLUDED-OUT THE BUDGET

– 3. WHEN MAKING CHANGES TO A TASK OR TO A PROCESS – A RISK EVALUATION MAY INCLUDE:

WHAT ARE THE BENEFITS? / WHAT IS THE COST? / IN WHAT TIME IS COMPLETION ANTICIPATED? / AND WHAT MAY BE THE RISKS AND ISSUES?

TWO RISK MANAGEMENTS – (1) RISK MANAGEMENT

ISO 31000 RISK MANAGEMENT

- The Document (ISO 31000), Risk Management, is for Use By People who Create and Protect Value in Organisations. HOW? By Managing Risks. – *For Setting and Achieving Objectives and Improving Performance.*

- ISO 31000 is Considered to be Part of Governance and Leadership – *Is Fundamental to How an Organisation is Managed at all Levels*.

- Its use is Based on applying an Iterative Process – *This Assists when it is Essential to Make Informed Decisions, i.e. There are Good Reasons why you should do it / or not do*

TWO RISK MANAGEMENTS – (2) MACHINERY RISK MANAGEMENT

– ISO 14121-1:2007, Establishes General Principles intended for Use to Meet: *Risk Reduction Objectives Established in ISO 12100-1:2003.*

– The Principles of Risk Assessment bring together Knowledge and Experience of: *The Design, Use, and Incidents Related to Machinery.*

– The Standard Gives Guidance on Risk Assessment to be carried out, with: *Procedures for Identifying Hazards & Estimating the Risks*

– and Guidance on: *Verification that a Risk Assessment was Completed.*

THERE ARE > 10 REFERENCES TO QUALITY & MANAGEMENT PROCESSES

CLAUSES 4.4 of ISO 9001 and of ISO 55001 ARE SIMILAR – WHY?

QUALITY MANAGEMENT ISO 9001

For Example:

The Clause (4.4) of the Quality Management System:

The system should be seen to use a Range of Sustained / Continually Approved Processes to achieve Management and Control.

ISO 55001 ASSET MANAGEMENT

The Clause (4.4) of the Asset Management System:

Every Process used in Asset Management will need to be defined and specified; for how to apply each Step of the Process.

ISO 9001 VERSUS ISO 55001

QUALITY MANAGEMENT ISO 9001

- WITH SOME ORGANISATIONS ISO 9001 (QMS) HAS BEEN IN PLACE FOR YEARS PREVIOUS TO THE ASSET MANAGEMENT STANDARDS 55000

- ISO 9001 (QMS) SPECIFIES THE REQUIREMENTS FOR A QUALITY MANAGEMENT SYSTEM

  - QMS demonstrates its ability ***to provide services to the customer***, to statutory & regulatory requirements

  - It aims to enhance ***customer satisfaction*** through the effective application of the system

  - Having the QMS means that ***those standards are already met!***

(4.2) THE STANDARD HAS > 5 REFERENCES TO THE STAKEHOLDERS

ISO 55001 ASSET MANAGEMENT

A QUESTION HERE IS: *HOW DO WE PREPARE FOR AND MANAGE THE SHAREHOLDERS EXPECTATIONS – BY KNOWING?*

- **Who** are the key Stakeholders / what are their Expectations
- **What** Potential Issues / Policies do the ‘High Stakeholders‘ Support?
- **What** Preferences Exist for Delivery of those Expectations?
- **What** if Differences in the Expectations need to be Resolved?

What if Differences in the Expectations need to be Resolved?

The Risks may be Positive or Negative,
Depending on how they are Managed!

– High power, interested people need to be fully briefed, consulted regularly and engaged

– High power, less interested people brief initially & gain visible support

– Low power, interested people, brief initially & gain active involvement with projects/developments

– Low power, less interested people, brief initially & provide reports on progress at critical points

THIS IS ABOUT MANAGING THE STAKEHOLDERS' EXPECTATIONS

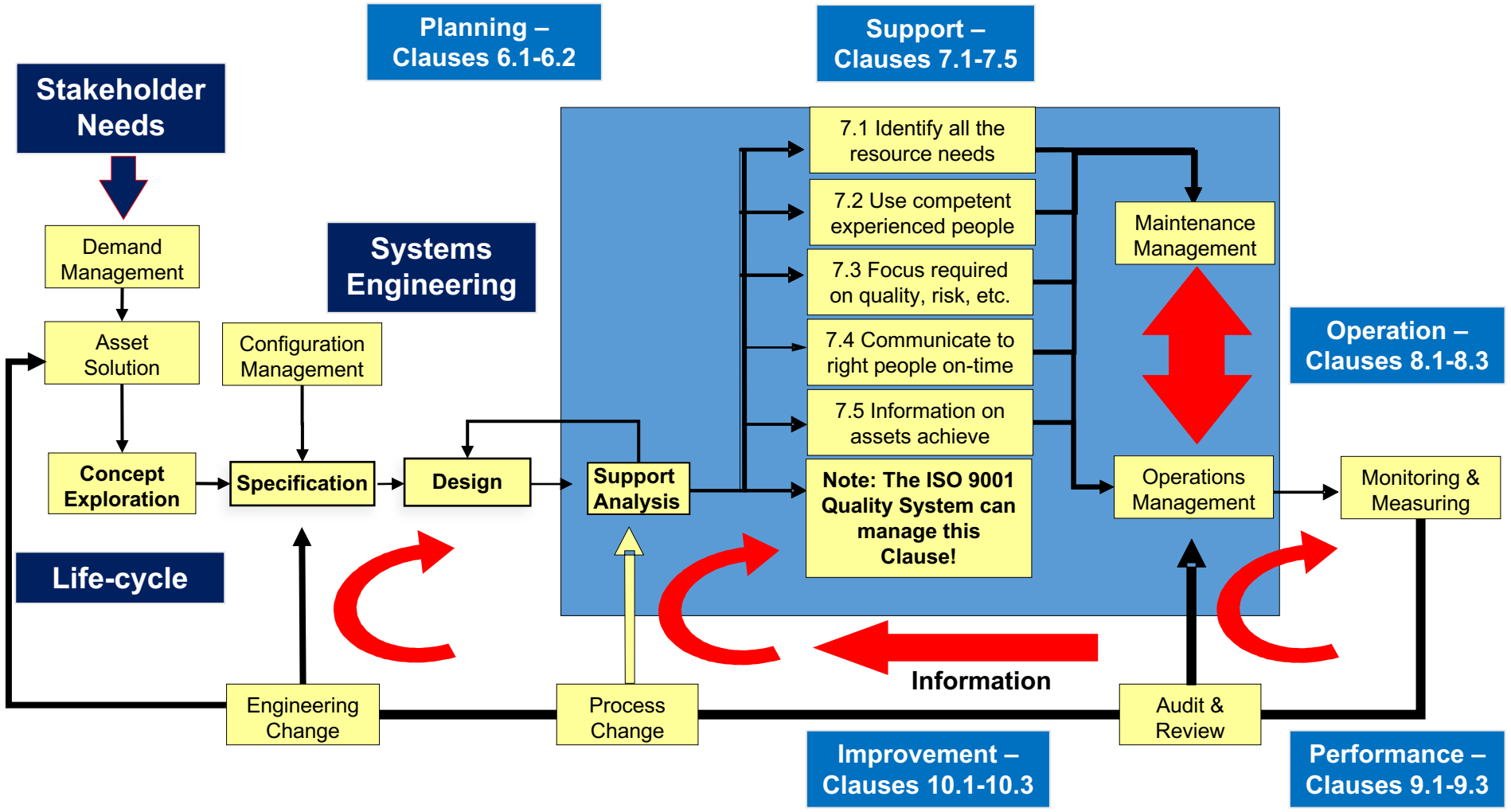
ISO 55001 ASSET MANAGEMENT

- Listing who the ***'Top' Stakeholders are.***
- Including ***their Expectation Preferences.***
- Setting-out the ***Priority Expectations.***
- ***Resolving Differences of Opinion.***
- ***Finding ethods to Solve Solutions when Opinions Influence the Key Issues***
- Understanding by how much ***the receipt by the Stakeholders of a Good Financial Return / or of Meeting the Customer's Satisfaction influences them***

At what Asset-Life Stages are the ISO55001 Clauses focused on the System & Operations & Maintenance (devised from ISO15288)?

ISO 15288 SYSTEMS ENGINEERING

By permission of James Kennedy



A RESPONSE TO THE GLOBAL CHANGES OCCURING IN RECENT YEARS

1. ***NEW TECHNOLOGIES, ARTIFICIAL INTELLIGENCE AND NEW ASSET STRATEGIES*** ARE NOW KEY CONSIDERATIONS FOR DELIVERING BENEFITS FROM THE APPLICATION OF MAINTENANCE AND ASSET MANAGEMENT

2. ADDITIONAL COMPETENCE ***TRAINING*** MAY BE AN ESSENTIAL REQUIREMENT

3. DUE TO SUPPLY CHAIN INCREASES IN THE COSTS AND DELIVERY TIMES FOR OBTAINING REPLACEMENT ASSETS OR SPARE PARTS; A RESULT HAS BEEN AN INCREASE IN FOCUS ON THE ***NEW MAINTENANCE MANAGEMENT, ENGINEERING AND ASSET MANAGEMENT STANDARDS.***

(c) Administration & Supply:

ADMINISTRATION & SUPPLY

– Applying Economic Principles to the Costs; – Stock Control, ETC.

- NEW TRENDS:

  1. TO CALCULATE THE TOTAL MAINTENANCE COST, ACCORDING TO THE EN 15341: MAINTENANCE KPIs,

  – TO COMPLETE BUDGETS & CONTROL SYSTEMS FOR THE TASKS, SUPPLY CHAINS, ETC.

  – TO PROVIDE INFORMATION OF THE MAINTENANCE SOURCE UTILISED, AND THE ACTIVITIES COMPLETED

  2. TO INCLUDE DATA ON:

  – PROJECTS, CLASSIFIED AS CAPITAL COSTS, AND

  – THE UPDATES OF THE TOTAL LIFECYCLE COSTS, FROM ONE PHASE TO ANOTHER, AND

  3. EVALUATE THE INDICATOR *'FINANCIAL RETURN ON MAINTENANCE'*

- A NEW PROSPECTIVE:

  1. IS TO CARRY OUT MAINTENANCE *BENCHMARKING COMPARISONS OF SIMILAR EVALUATIONS COMPLETED* ON SIMILAR ASSETS EQUIPMENT.