ROI of Futuristic & Evolving Solutions of Digitization Technology towards operating Intelligent Plants of Industry 5.0

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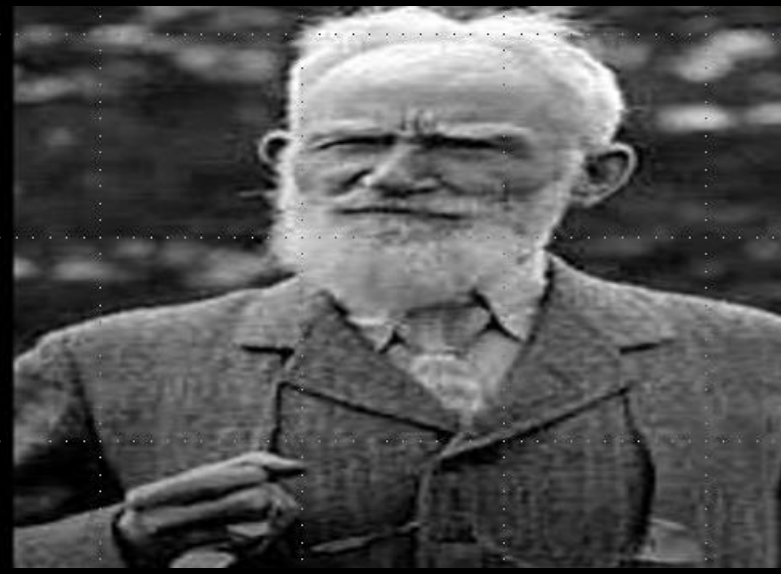
Drivers to Learn about Digitization

A reasonable person adapts to the worlde. A fool tries to adapt the world to himslf. Therefore, progress always depends on unreasonable people

~ George Bernard Shaw ~



Dare to know! Have the courage to use your own intelligence!

~ Immanuel Kant

اقْرَأْ وَرَبُّكَ الْأَكْرَمُ الَّذِي عَلَّمَ بِالْقَلَمِ عَلَّمَ الْإِنسَانَ مَا لَمْ يَعْلَمْ.

Read and your Lord is Most Honorable, Who taught (to write) with the pen, Taught man what he knew not

Strategy of Presenting Digitization

Let's go to for a Trip to the Future and Buckle Your Seat Belt during this Shuttle Ride.

Strategy of Presenting Digitization

- Provide Background to Increase Awareness about Digitization
- Provide Definitions to Explain Terms of Digitation
- Provide Examples as Application for Digitation
- Provide Reverse Sequinning from the Title of the Work Shop Title
  - Manufacturing Business Processes
  - Technology Analysis
  - Mapping the Technology to Solution
  - Competencies {Chemical Engineering In Particular and All Engineering in General
  - Economic Analysis for the Estimation of the Return on Investment
- Provide Details that Differentiate focus on:
  - Granularization & Deep Diving
  - Architecting & Modeling
- Provide Formatting to illustrate the
  - Text & Video
  - Symbols & Pictures
  - Architecture Diagrams & Tables
  - Animations

“Digitization Table of Contents”

1. Block Chain

Digitization Backgrounds &

Define Industry → Define Digitization → Define Models → Define Terms

The term Industry 4.0 revived in 2011 at the Hanover Fair in 2011, which was originated from a project in the high-tech strategy of the German Government to promote the Computerization of Manufacturing

- The Simple approach to explain or to Define Digitization Technology is to relate this technology to the Term Digital (0 & 1) which is extracted from running software on Computers. Digitization Technology is about having Data in the Digital Formats.

- Digitization is based on Selecting Technologies in its one Third (1/3) of Life Cycle that balances between Bleeding Edge Technologies and Technology Obsolescence
- Digitization require Multi Discipline Competencies, Rigorous Analysis & Knowledge Elicitation

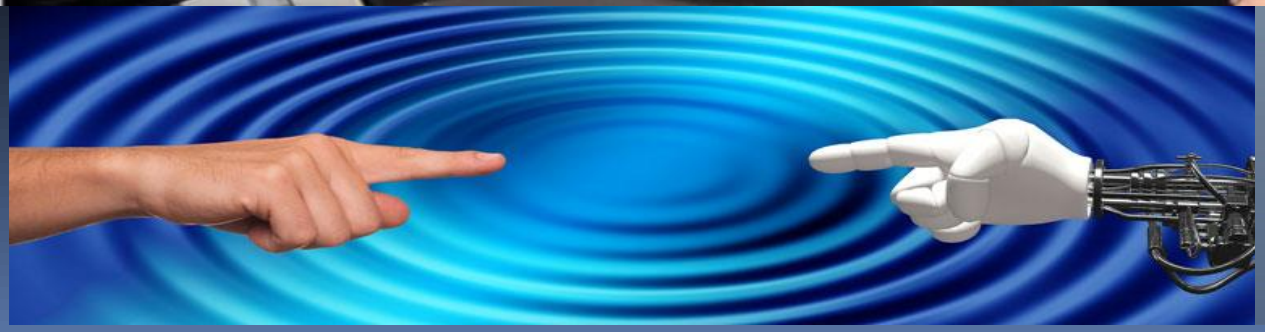
Definitions of Industry 3.0, 4.0 & 5.0

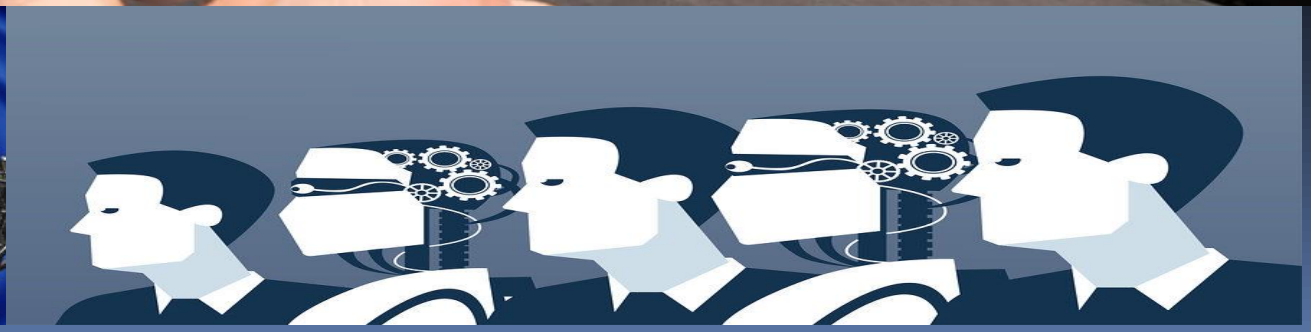
Automation is the Evolution of Industry 3.0

Digitization is the Backbone of Industry 4.0, which is Today

Digitization is the Driver for Industry 5.0, which is Tomorrow

The Futuristic “Industry 5.0”





The “Industry 5.0” of Tomorrow

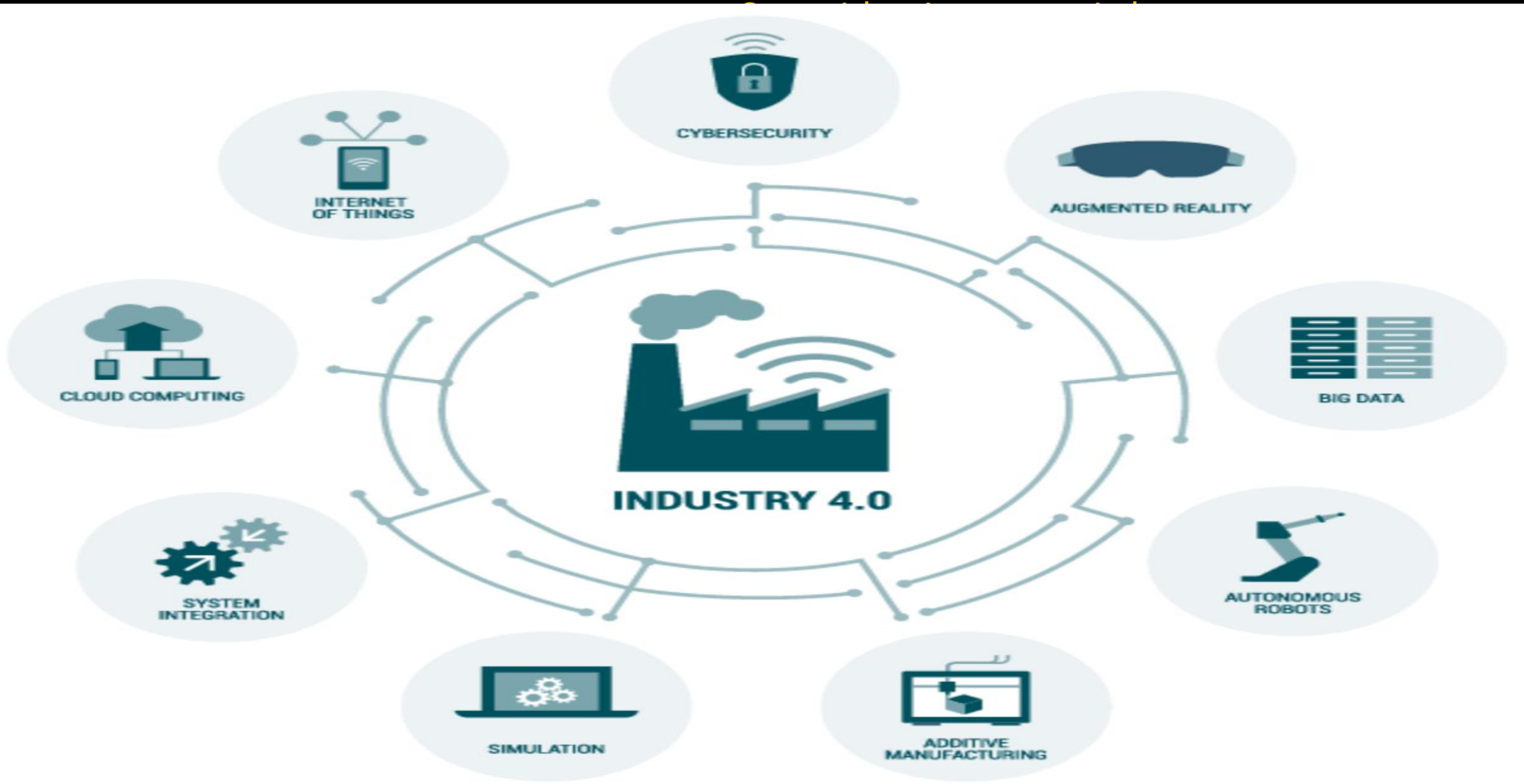
ns and Smart Systems

To capture the Future Industry 5.0, we need to build on the Progress Made in Industry 3.0 & Industry 4.0.

In other words, Both of Industry 3.0 & 4.0 are perquisites for Industry 5.0 and needs to be assessed and implemented first.

ystems to elevate the q

The “Industry 4.0” of Today



The “Industry 4.0” of Today

Industry 4.0 represents the Today trend of **Digitization** in the Industry that referred to as the **Fourth Industrial Revolution**

Industry 4.0 includes **Cyber-Physical Systems, Internet the Internet of Things (IIoT), Cloud Computing**, and **Cognitive Computing**.

Industry 4.0 creates “**Intelligent Plants**” and provides structured modules smart factories with the cyber-physical systems to **monitor physical processes**, **create a virtual copy of the physical world** and **make decentralized decisions**.

Industry 4.0 offers

1- **Communication** among Internet of Things, cyber-physical systems, data analytics,,,,

2- **Cooperation** with each other and with humans in real time, and via Cloud Computing to offer both internal and cross-organizational services that will used by participants of the **Value Chain**.

Industry 4.0 Digitization Technologies Addressed in the Workshop

Industry 4.0 Digitization Technologies is to provide Intelligent Manufacturing through:

The Rigorous Integration of the Industry 4.0 Digitization Technologies {{i.e. IIoT, Cyber-physical Systems, and Cloud and Bid Data and Data Analytics Computing and services, Augmented Reality to generate Robotic Automation, Artificial Intelligence and Cognitive Analysis and Additive Manufacturing

The basic principle behind the fourth industrial revolution is that by chaining machines, intelligent devices, and systems, manufacturers are creating smart networks throughout the value chain (from materials to production) that can control each other

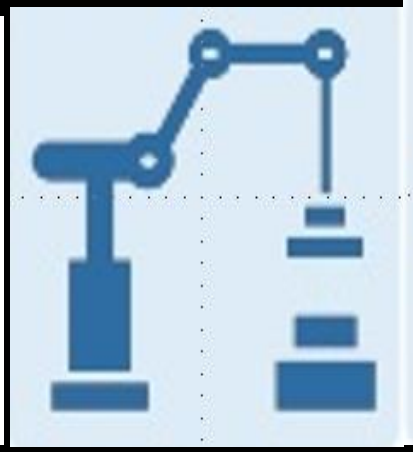
Simulation, Modeling and Optimization {Digital Twins)

2. Big Data & Data Analytics {Machine Leaning, Conative Analysis, Deep Neural Leering, Block Chain, }
3. Cyber Security (CIA) {i.e. Continentality, Integrity & Availability}
4. Cloud Computing {SaaS, PaaS & IaaS, etc.)
5. Industry Internet of Things (IIoT) {Sensors, Local WiFi, Applications on Smart Phones,
6. Integrated & Horizontal Integration {Services based Messaging Bus without
7. Augmented Reality {Google Glass, Smart Helmets for viewing Trends, Video, 3 D , Sound Recognitional and Messaging, Camera,
8. Autonomous Robotics & Unmanned Aerial Vehicles (UAV) / Drone Plans
9. Additive Manufacturing 3 D Printing {On Site Manufacturing &Spare parts for equipment and Control Systems Mobility

Industry 4.0 Digitization Solutions Addressed in the Workshop

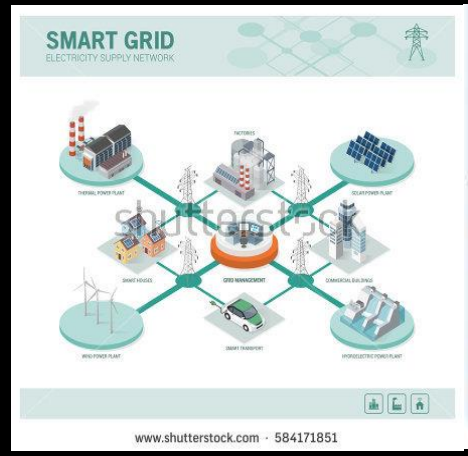
Home Automation

IoT Platform



Industrial Automation

Energy Management

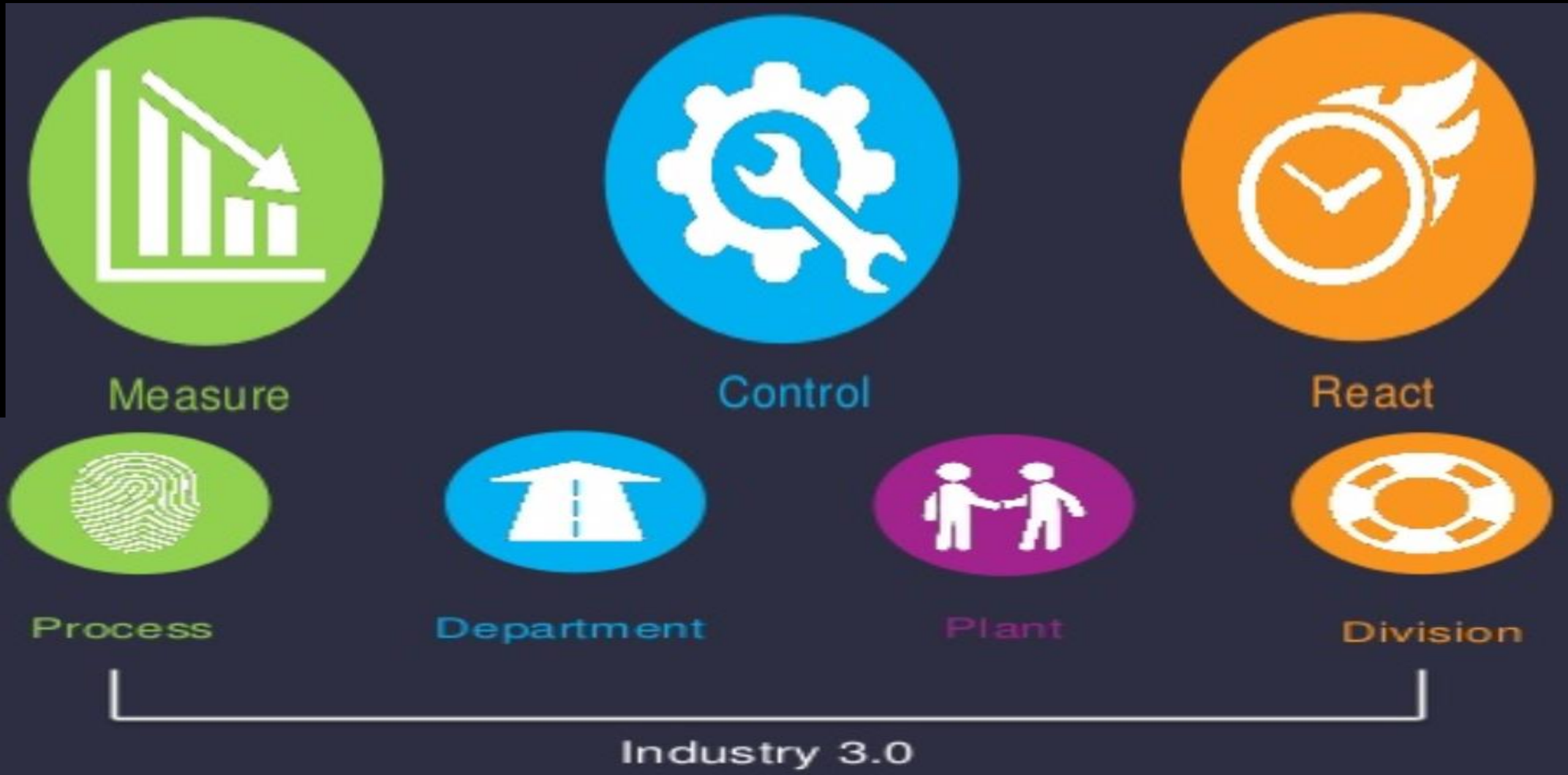


Smart Skid

Connected Cites

Manufacturing and Oil & Gas

The “Industry 3.0” of Yesterday



The “Industry 3.0” of Yesterday

Industry 3.0 represents the Yesterday trend of **Automation** and **Data exchange** in the I… **Third Industrial Revolution**

…**anced Control, Manufacturing** …**rce Planning (ERP)**

The Scope of **Industry 4.0.**

Is Dependant on What has been achieved in Industry 3.0

The Existing Industry 3.0 Automation {Software & Hardware}

Regulatory & Advanced Control | Flat, Relational & object Data Bases | MOM Technologies | ERP & SCM Technologies | User Interface & Document Management | 64 Processors & Virtual Servers

Industry 4.0 Digitization Technologies is to provide Intelligent Manufacturing through:

The Rigorous Integration of the Industry 4.0 Digitization Technologies with the Industry 3.0 Automation and in particular all the Advanced Control, Manufacturing Operation Management (MOM) and the Enterprise Resource Planning (ERP) technologies and Solution

Definition of Digitization-Based Control Terms

Advanced Regulatory Control (ARC) is the Control Strategies that are built on the top of the Loop-based PID Control using Complex Cascade, Override and Constraint Control with Time Delay, Dead Time and Feedforward Modeling

Procedural Control is the Control Strategies that are built to control the Step transition of the process in a procedural steps during start up, controlled shutdown, fill-in, warm up, total recycle, abnormality and turndown on unit based-control and not on Loop- based PID Control

Predictive Multi Variable Constraint Control (PMVCC) is the Control Strategies that are designed based on a matrix of MVs and CVs used to predict the future move of MVs simultaneously to control CVs against set points to overcome the disturbances considering the relative weight and priorities of both of the MVs & CVs and decoupling among these variables

Iterative Learning Control (ILC) is the method of tracking control for systems that work in a repetitive mode. Such as Robot arm manipulators, chemical batch processes and reliability testing rigs.

Cooperative control deals with the problem of controlling a multi-agent robotic system to fulfill a common goal. The tasks associated with these robotic systems include search, exploration, surveillance, rescue operations and mapping unknown or partially known environments.

Definition of Digitization-Based Data Terms

Bid Data captures extremely large data sets of structured and non-structured data gathered by archived database, Hand Held Monitoring, information-sensing Internet of things devices such as mobile devices, aerial (remote sensing), software logs, cameras, microphones, radio-frequency identification (RFID) & Scan Readers, wireless sensor networks, and Text Data from e mail, specification, etc.

Data Analysis is the process of inspecting, cleansing, transforming, modeling data and computation to reveal patterns, trends, and associations, especially relating to human behavior and interactions with the goal of discovering useful information, suggesting conclusions, and supporting decision-making.

Data Processing includes capturing data, data storage, data analysis, search, sharing, transfer, visualization, querying, updating, information privacy and data source. Data Analysis and.

Definition of Digitization-Based Analysis Terms

MOM Technologies are the Manufacturing Operation Management (MOM) technologies that include Production, Quality, Inventory, Maintenance, Reliability and Integrity, and Process Safety, Operation Risk, Environmental Compliance and Occupational Health.

ERP Technologies are the Enterprise Resource Planning (ERP) technologies that include Business, Human Resources, Finance, Procurement, Material, Warehousing, Sales, Supply Chain Management, Product Lifecycle (PLM).

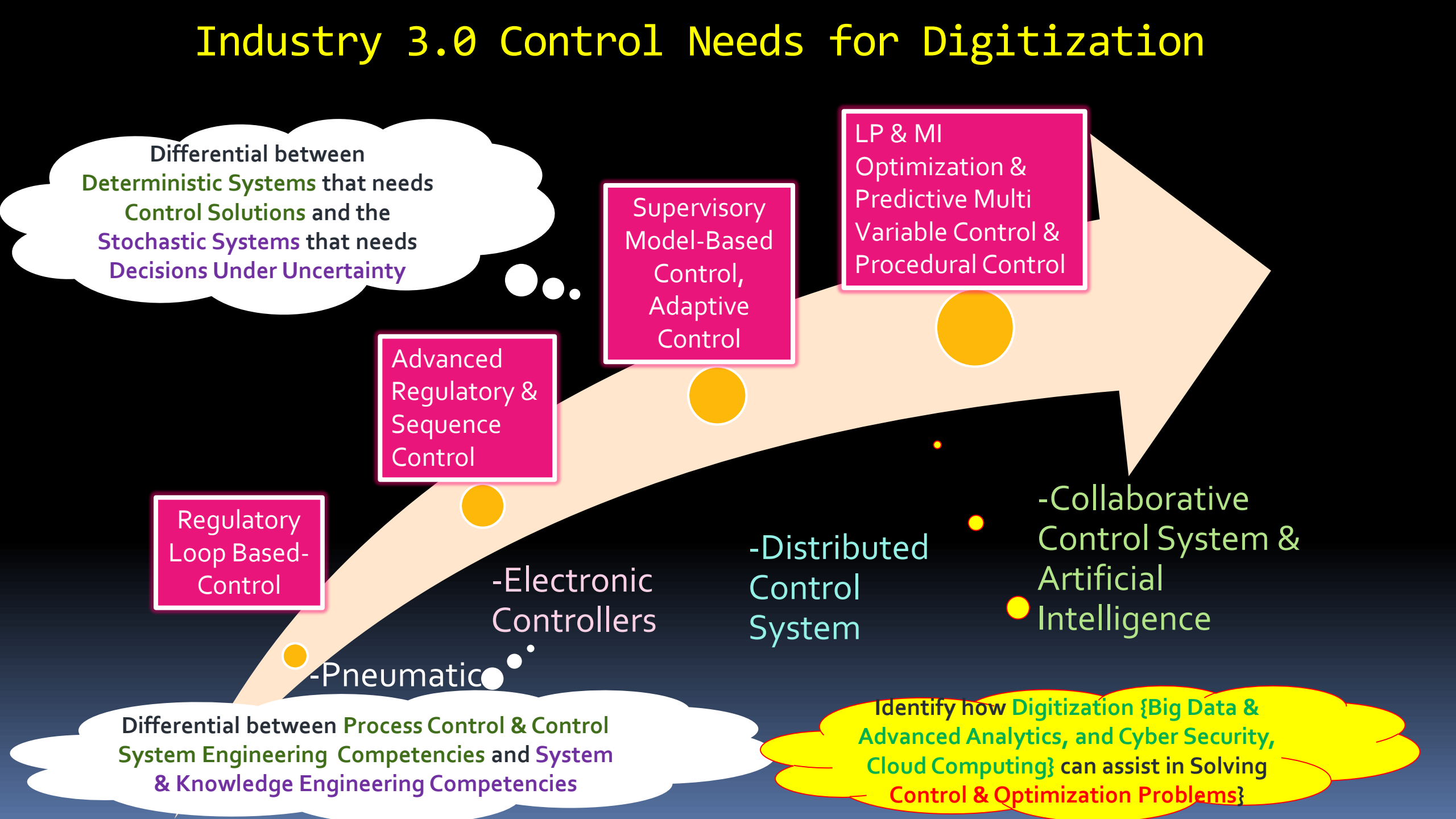
Artificial Intelligence (AI) is Intelligence demonstrated Machines via Advanced Algorithms to mimic cognitive functions that humans associate with other Human Minds , such as learning. and problem solving.

Cognitive Computing (CC) describes Technology Platforms associated with the scientific disciplines of Artificial Intelligence and Signal Processing that encompass Machine Leaning, Temporal Reasoning, Natural language Processing, Speech Recognition and Vision (Object) recognition), Human-Machine Interaction, Dialogue and Narrative Generation.

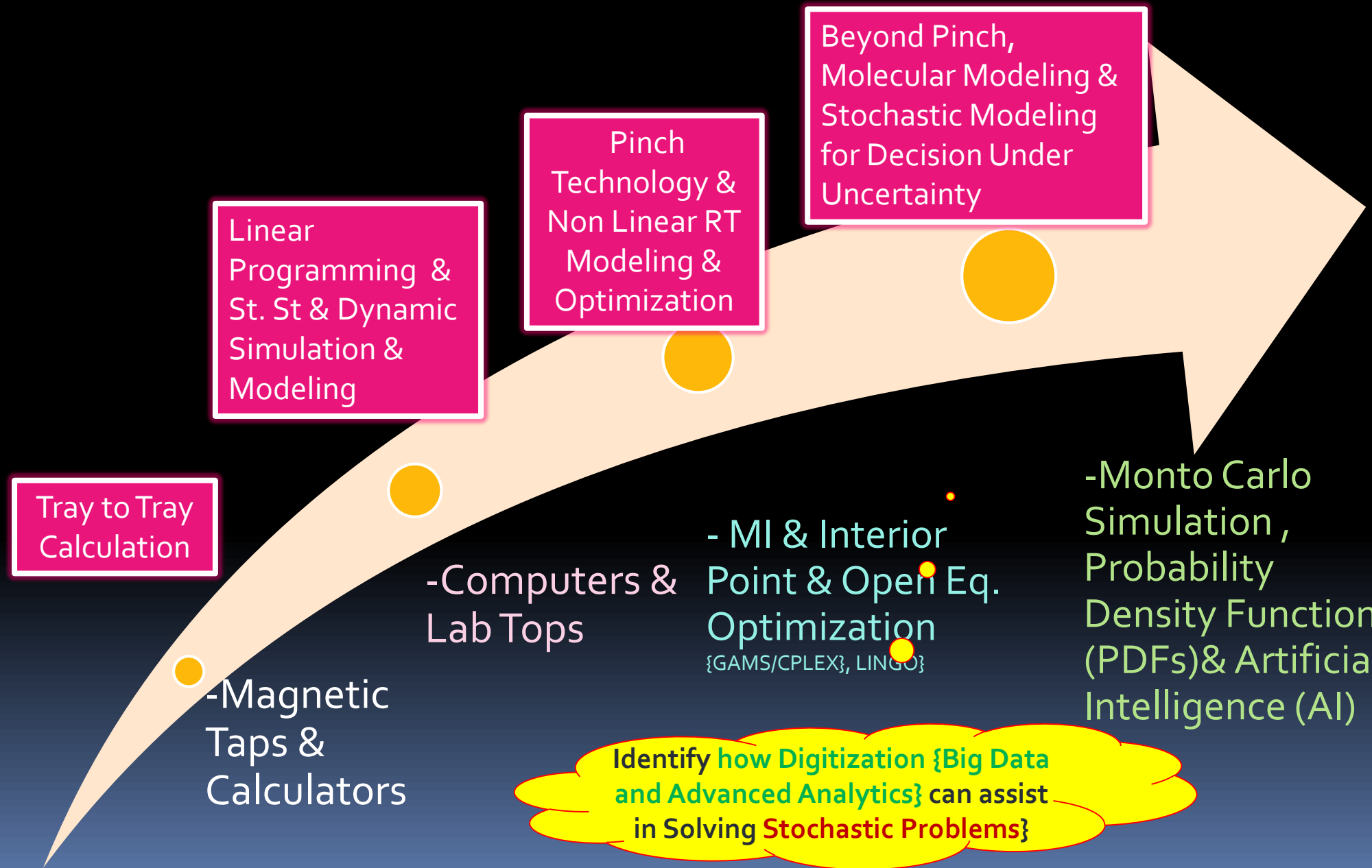
“Digitization Table of Contents”

1. Block Chain

Industry 3.0 Control Needs for Digitization

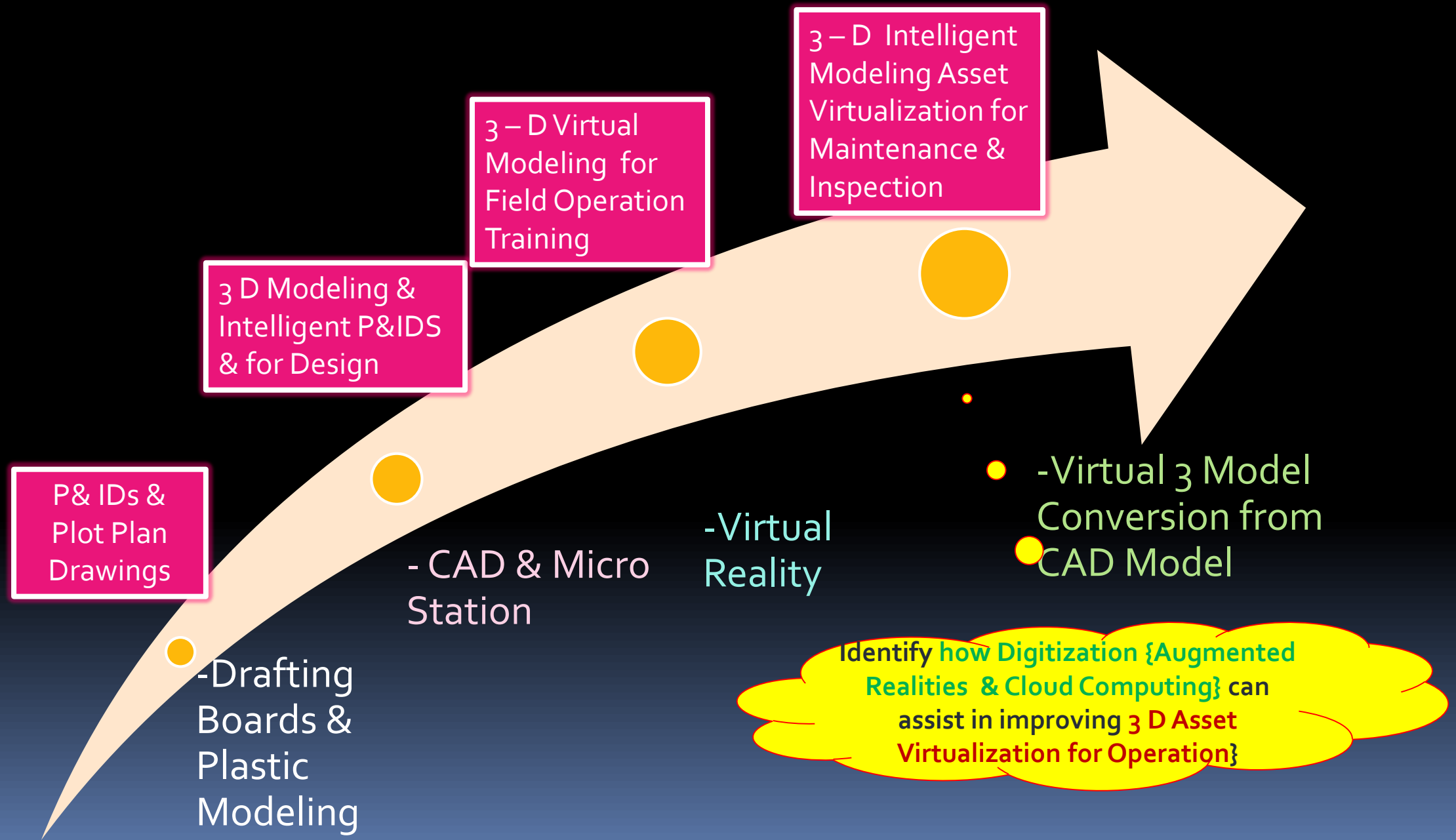


Simulation & Modeling Needs for Digitization

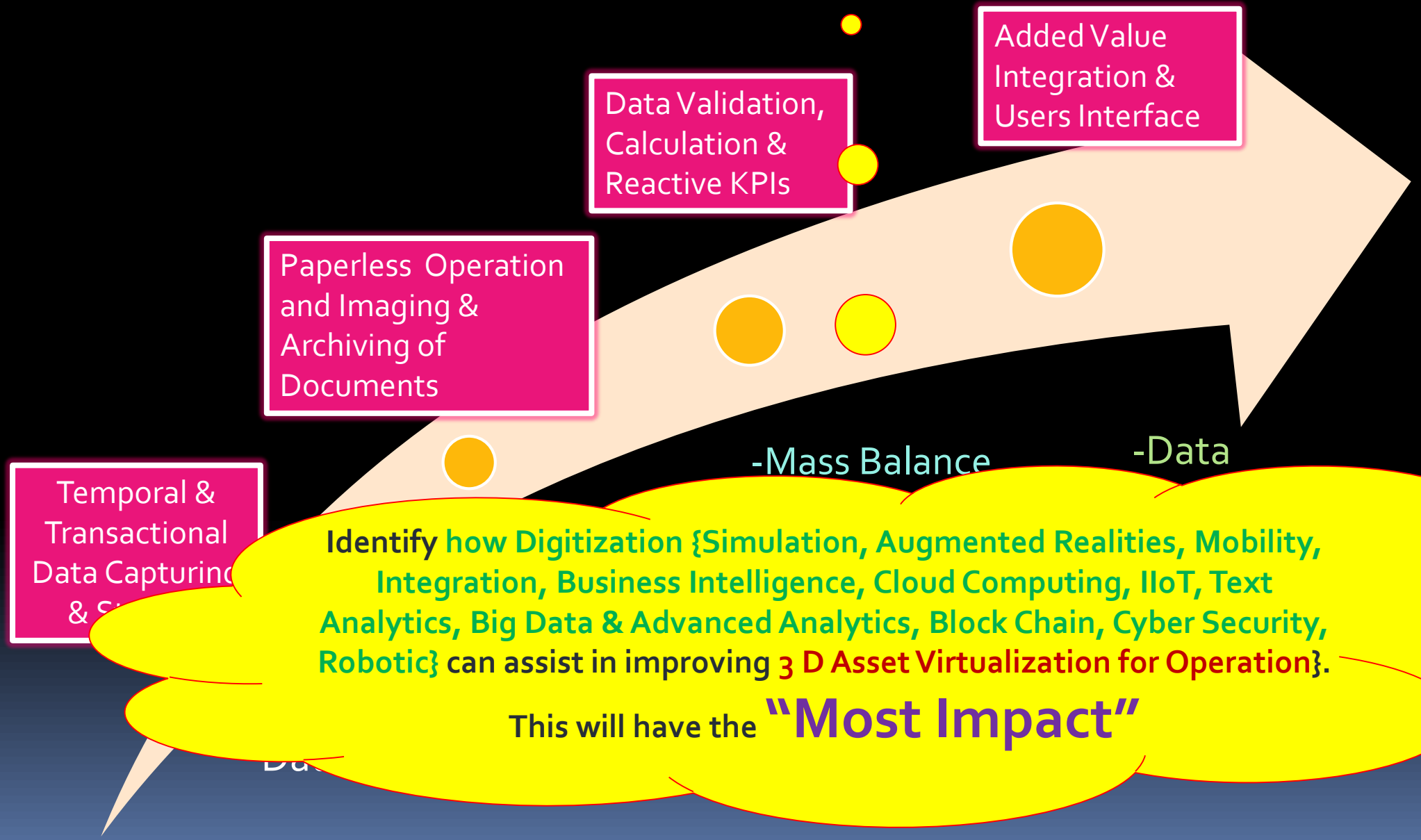


Identify how Digitization {Big Data and Advanced Analytics} can assist in Solving Stochastic Problems}

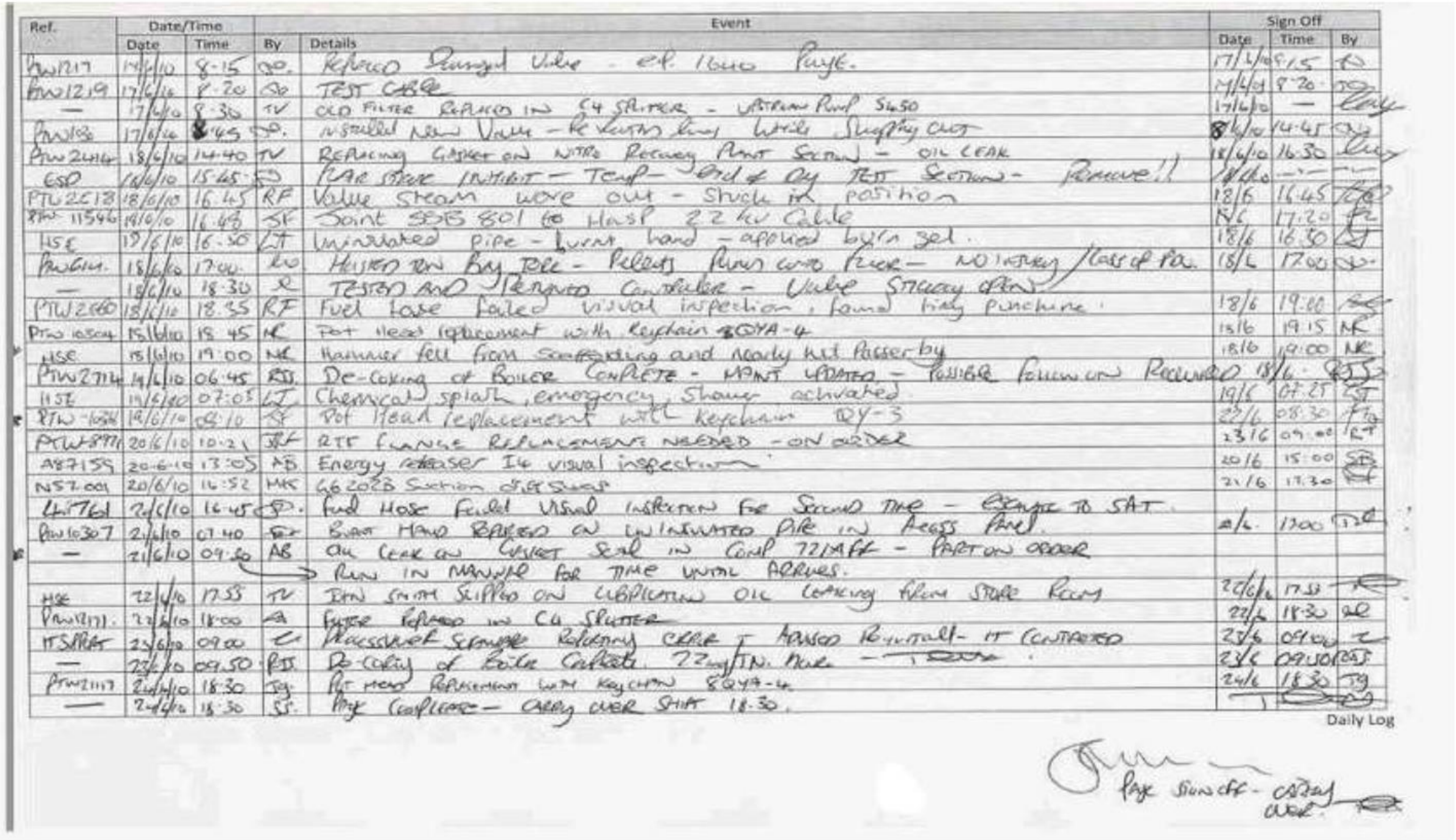
3-D Modeling Needs for Digitization



MOM & ERP Needs for Digitization "Most Impact"



Traditional Operations Logbook



Ref.	Date/Time		Event		Sign Off		
	Date	Time	By	Details	Date	Time	By
PW1217	14/6/10	8-15	[illegible]	Replaced [illegible] Valve - ef. 1600 Purge.	17/6/10	9.15	[illegible]
PW1219	17/6/10	8-20	[illegible]	TEST CABLE	17/6/10	8.20	[illegible]
—	17/6/10	8-30	TV	OLD FILTER REPLACED IN C4 SPLITTER - UPSTREAM PUMP S450	17/6/10	—	[illegible]
PW1[illegible]	17/6/10	8.45	[illegible]	INSTALLED NEW VALVE - RE[illegible] LINE WHILE SUPPLY OUT	8/6/10	14.45	[illegible]
PTW2[illegible]	18/6/10	14-40	TV	REPLACING GASKET ON NITRO RECOVERY PLANT SECTION - OIL LEAK	18/6/10	16.30	[illegible]
ESD	18/6/10	15-45	[illegible]	[illegible] INHIBIT - TEMP - END OF DAY TEST SECTION - Remove!!	18/6/10	—	—
PTW2[illegible]18	18/6/10	16.45	RF	Valve Steam wore out - Stuck in position	18/6	16.45	[illegible]
PTW 11546	18/6/10	16.48	SF	Joint SSB 801 to HASP 22 kV Cable	18/6	17.20	[illegible]
HSE	18/6/10	16.50	LT	Uninsulated pipe - burnt hand - applied burn gel.	18/6	16.50	LT
PW[illegible]	18/6/10	17.00	[illegible]	[illegible] BAY [illegible] - [illegible] - NO INJURY / LOSS OF [illegible]	18/6	17.00	[illegible]
—	18/6/10	18.30	[illegible]	TESTED AND [illegible] CONTROLLER - VALVE STICKING OPEN			
PTW2[illegible]	18/6/10	18.35	RF	Fuel hose failed visual inspection, found tiny puncture.	18/6	19.00	[illegible]
PTW 10[illegible]	18/6/10	18.45	NC	Pot Head replacement with Keychain [illegible]QYA-4	18/6	19.15	NC
HSE	18/6/10	19.00	NC	Hammer fell from scaffolding and nearly hit Passer by	18/6	19.00	NC
PTW2[illegible]	19/6/10	06.45	RJJ.	De-coking of Boiler COMPLETE - MAINT UPDATED - POSSIBLE FOLLOW ON REQUIRED	19/6	[illegible]	RJJ
HSE	19/6/10	07:05	LT	Chemical splash, emergency shower activated	19/6	07.25	LT
PTW-[illegible]	19/6/10	08.10	[illegible]	Pot Head replacement with Keychain QY-3	22/6	08.30	[illegible]
PTW[illegible]	20/6/10	10.21	[illegible]	RTF FLANGE REPLACEMENT NEEDED - ON ORDER	23/6	09.00	RT
A87159	20-6-10	13:05	AB	Energy releaser I4 visual inspection	20/6	15.00	[illegible]
NS7001	20/6/10	16:52	MK	G6 2028 Suction [illegible]	21/6	17.30	[illegible]
[illegible]	21/6/10	16.45	[illegible]	Fuel Hose Failed Visual Inspection For Second Time - [illegible] TO SAT.	21/6	17.00	[illegible]
PW10307	21/6/10	07.40	[illegible]	BURNT HAND BACKED ON UNINSULATED PIPE IN ACCESS PANEL.			
—	21/6/10	09.50	AB	OIL LEAK ON GASKET SEAL IN COMP 72/AFK - PART ON ORDER → RUN IN MANUAL FOR TIME UNTIL ARRIVES.			
HSE	22/6/10	17.55	TV	[illegible] SMITH SLIPPED ON LUBRICATION OIL LEAKING FROM STORE ROOM	22/6/10	17.55	[illegible]
PW[illegible]	22/6/10	18.00	[illegible]	FILTER REPLACED IN C4 SPLITTER	22/6	18.30	[illegible]
[illegible]	23/6/10	09.00	[illegible]	[illegible] RELEASING [illegible] - ADVISED [illegible] - IT CONTACTED	23/6	09.00	[illegible]
—	23/6/10	09.50	RJJ.	De-coking of Boiler Complete. 72[illegible] [illegible]	23/6	09.50	RJJ
PTW2[illegible]	24/6/10	18.30	[illegible]	POT HEAD REPLACEMENT WITH KEYCHAIN 8QYA-4.	24/6	18.30	[illegible]
—	24/6/10	18.30	SS.	Page Complete - CARRY OVER SHIFT 18.30.			

Daily Log

Page sign off - carry over.

inefficiencies, such as:

- Paper
- Spreadsheets
- Word Processor Documents
- Scattered Databases
- Email
- Whiteboards
- Inconsistent Verbal Meetings
- Phone Calls / Radio
- Text / Instant Messages
- Multiple MES Applications

Asset

Type here to search asset

- Malibu
  - Alumina
  - Chemicals
  - Mine
  - Refinery
    - 03-Tower
    - 05-Offsites
    - 10-CDU
      - 10-AGO
      - 10-Bottoms
      - 10-Diesel
      - 10-Feed
      - 10-Jet
      - 10-LE
      - 10-Naphtha
      - 10-Products
    - 12-Tower
    - 15-Gas Plant
    - 16-Merox
    - 18-Hydrotreater
    - 20-CCR Regenerator
    - 30-Hydrotreater
    - 35-FCCU
    - 40-Hydrocracker
    - 50-Coker
    - 60-H2 Plant
    - 65-Sulfur
  - Smelter

Overview | Shift Summary | Comments

Operator Shift Report

In progress

Asset : 10-CDU
Start Time : 10/14/2014 6:00 PM
Created By : Elizabeth Swann

Shift : Night
End Time : 10/15/2014 6:00 AM
Created Date : 10/14/2014 7:03 PM

Operations Highlights

Plant running normal at 143 KBPD.

Crude change over planned tomorrow.

Critical Asset Status

Equipment	Status	Comment
Furnace EX1003	Normal	
Desalter V1006	Normal	
Feed Pump P1002	Normal	Strainer needs to be cleaned
Reflux Pump P1007	Normal	

Operating Instructions

Crude API needs to be kept in watch. Lab sample needs to be taken every shift

Key Process Variables

Planning Targets

Target	Limit		Asset	StartTime	Actual	Reason	Comment
F001A %Oxygen	Efficiency		10-CDU	10/14/2014 4:14 AM	1.62		
F001B High Skin Temp	Efficiency		10-CDU	10/14/2014 10:06 AM	1170.73		

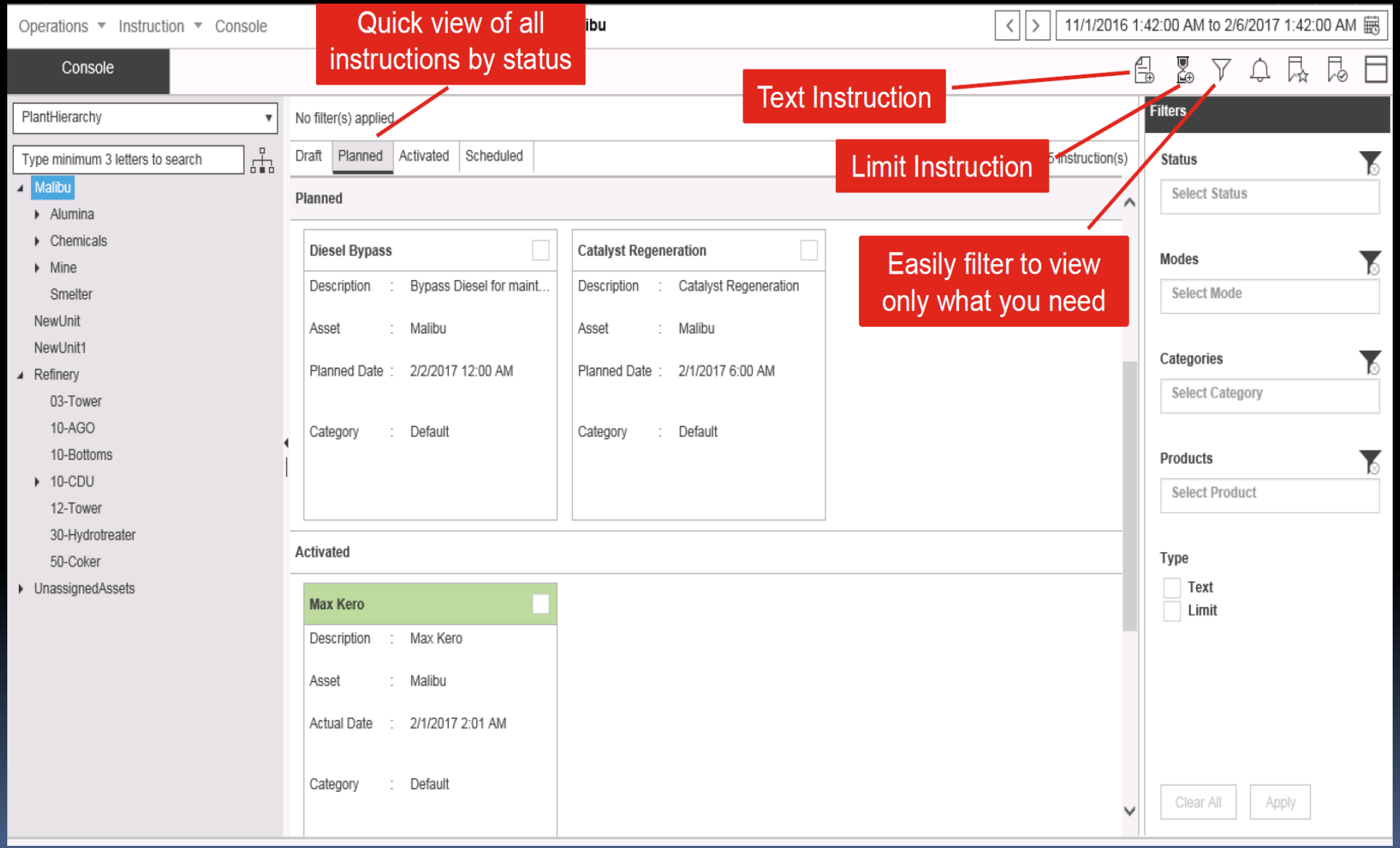
Operations Parameters

Tag Label	Value
Crude Feed - KBPD	142.023216247559
Crude API	21.9385
CDU Pressure - PSIG	20.26334
Furnance Skin Temp - DEGF	1081.413

Standing Alarms

TAG	TAGDESC	ALARM	PRIORITY
83A6023H	CCR FG H2S 3 HOUR AVG	BADPV	HIGH
83Y015H	F 1-4 DUTY FINAL HR AVG	BADPV	LOW
83Y016H	F-5 DUTY FINAL HR AVG	BADPV	LOW
83Y017H	F-101 DUTY FINAL HR AVG	BADPV	LOW
83Y111H	CO FINAL HR AVG	BADPV	EMERGNCY

Automated consolidation of critical shift information


Operations
Instruction
Console
Quick view of all instructions by status
ibu
11/1/2016 1:42:00 AM to 2/6/2017 1:42:00 AM
Console
Text Instruction
Limit Instruction
Easily filter to view only what you need
PlantHierarchy
Type minimum 3 letters to search
Malibu
Alumina
Chemicals
Mine
Smelter
NewUnit
NewUnit1
Refinery
03-Tower
10-AGO
10-Bottoms
10-CDU
12-Tower
30-Hydrotreater
50-Coker
UnassignedAssets
No filter(s) applied
Draft
Planned
Activated
Scheduled
Instruction(s)
Planned
Diesel Bypass
Description : Bypass Diesel for maint...
Asset : Malibu
Planned Date : 2/2/2017 12:00 AM
Category : Default
Catalyst Regeneration
Description : Catalyst Regeneration
Asset : Malibu
Planned Date : 2/1/2017 6:00 AM
Category : Default
Activated
Max Kero
Description : Max Kero
Asset : Malibu
Actual Date : 2/1/2017 2:01 AM
Category : Default
Filters
Status
Select Status
Modes
Select Mode
Categories
Select Category
Products
Select Product
Type
Text
Limit
Clear All
Apply

The Power of Digital on Sustainability Model as Per SDGs

Digitization Technologies {IIoT, Big Data and Cloud Computing} allow for the everyone to create, access, utilize and share information of their choice that will drive the need for cyber security and establishing legal frameworks need to be put in place to protect security and privacy in the digital age and to avoid potential large-scale intrusions and minimize abuses

The Power of Digitization on New Control Skills

	Traditional Manufacturing	Smart Manufacturing	Autonomous Vehicles	Rehabilitation Robotics
Novel Sensing Technologies	X	X		X
Modeling & Simulation		X		X
Advanced Process Control	X	X		
Cooperative Control		X	X	X
Iterative Learning Control	X		X	X

The Power of Digitization as An Agent for Game Changer

Digitization Technologies shall demand increased focus on the design, operation, control and optimization of chemical processes and manufacturing plants with mandatory requirements to improve collaboration among industry partners, vendors and academic institutions

Digitization Technologies shall drive workers of the future to spend more time on tasks requiring social & emotional skills and logical reasoning, and less time on tasks requiring repeated motor skills and structured information gathering and processing incidents and emergencies

Digitization Technologies shall result in increasing the productivity of humans via using robotics and on line advisories and mobility to execute tasks, However, Digitization will also create new jobs associated with Digitization Service and could create net new jobs, most of them outside the technology sector itself. New types of "middle jobs" could arise with strong human-machine interaction straddling between domains.

Digitization Technologies shall result in a new, leaner industry that promotes unmanned operations as the standard approach for many plants and production facilities. Unmanned Site With Zero Normal Operating Presence (ZNOP) will be operated from offsite Control room using specialty design control room & Robotics to drive vehicle, climb ladders and turn on and off valves.. [Reference is the Pohokura field is New Zealand's largest natural gas resource, owned by a joint venture between Shell, Todd Pohokura, and OMV New Zealand

Validation of Digitization Technology

- **Why is Digitization is needed?**

Digitization ***shall use Digital Technologies to change a Business Model and provide New Revenue and Value-producing Opportunities; it is the process of moving to a Digital Business***

- **Why Digitization is Needed????**

To **Increase** Human Productivity & Decision Making with Reliable, Timely and Accurate Decisions.
To **Maximize** **Availability, Utilization, Performance, Compliance, Effectiveness** and **Revenues.**
To Minimize Human Mishaps, Loss, Waste, Cost for Energy, Utility, Maintenance, Safety & Environmental Incidents

- **How Could Digitization be Executed ????**

- Create **Awareness** on Digitization Definitions, Methods, Technologies and Process
- Create the **Agents of Changes** and **Sponsors** to Promote the Digitization Quantum Leap
- Provide **Systemic Thinking** to Capture the **Systematic Business Process** that Could benefit from Digitization
- Perform **Digitization Technology Scouting**, **Analysis Evaluation** and **Risk Management**
- Focus on **Systemic** Approach that **Map Technologies** to **Digitization-based Solutions**
- Increase **Education, Training and Competencies** of **Engineers**
- Provide **Coaching** and **Adaptions** to increase **Utilization, Added Values and Benefits**
- Develop **Cost and Benefit Analysis** to calculate the **Rate of Return (IRR & NPV)**

Validation of Digitization Technology

- **Is Industry 4.0 Digitization Technology a Reality ????**

There are at least 10 System Integrators who are working on Industry 4.0 Digitization Technology, such as Accenture, IBM, Honeywell, Schneider, WIPRO, Rolta, TATA, Siemens, ABB, Info System

There are at least 13 Vendors who are working on Industry 4.0 Digitization T Data Analytics Technology such as IBM, Honeywell, Schneider, GE, ABB, Aspen, SAP, Oracle, Micro Soft, Integrated Objects, TIBCO, Rolls Royce, Oracle

there are at least 30 Vendors who are working on Industry 4.0 Digitization Technology such as IBM, Honeywell, Schneider, GE, ABB, Aspen, SAP, Oracle, OSI, Lab Ware, OM-PLus, Belsim, Petrotechnique, e Visoon, Enablon, Sephra, Mustung, Meridiem, Bentley, Micrsoft, J5, BNF, Integrated Objects, Hunt, North West, Flow Serve, KBS,

- **Are Clients Investing in Digitization ????**

Saudi Armco has been spending Jointly with its partners such as Dow, Total, Shell, SONPEC, Somotomo in the Last Ten Years alone more than $1.00 on Smart Field, MOM in the in Upstream, Middle Stream and Domestic and Joint Ventures Down Stream (Gas Plants, Refineries & Petrochemical.} SA has also about 100 Engineers in the Corporate Engineering (Not including IT Engineering or Field Engineering) and in the Plants working on Advanced Control, Simulation, Modeling, Optimization, Data Analytics, Decision Support, Energy Systems, UAV, Control Cyber Security, Mobility & Mission Critical Data Basses

ADNOC Takreer / UAE is currently executing a Project with Honeywell and has awarded a large job to Schneider. Other Clients such as Port Aruther Refinery/Taxes and KIPIC Refinery/Kuwait is the process of developing a Pre-FEED

Validation of Industry 4.0 Digitization Technology

- **Is Industry 4.0 Digitization Technology a Viable Business Model**

1- **GE & Rolls-Royce's Business Model** in the last ten years has flipped from selling engines to now having 50 per cent of its revenue from providing services to the engine.

2-**WIPRO** is **Indian Company** and one of the largest System Integrators (SI) who are generating revenues from Industry **4.0 Digitization Technology** from being recognized globally for its comprehensive portfolio of services that include, designing and deploying of Digitization-based Solutions and Technology using **Cognitive computing, hyper-automation, robotics, cloud, analytics, services-oriented architecture integration** and other emerging technologies to help their clients who are adapting to the digital world by their 160,000 employees across six continents

- **Is Industry 4.0 Digitization Technology will evolve to Industry 5.0**

A recent report by **Jürgen Maier** found the UK's manufacturing sector could **unlock £455 billion** over the next decade if it cracks Industry 4.0, with **probably 175,000 highly skilled jobs** to go along with it, but that requires leadership and intervention from the government. But the needle needs to move a little bit to take the **brilliant research out of the universities and into industry**

RMIS Drives Transformation of Practices

As –Is

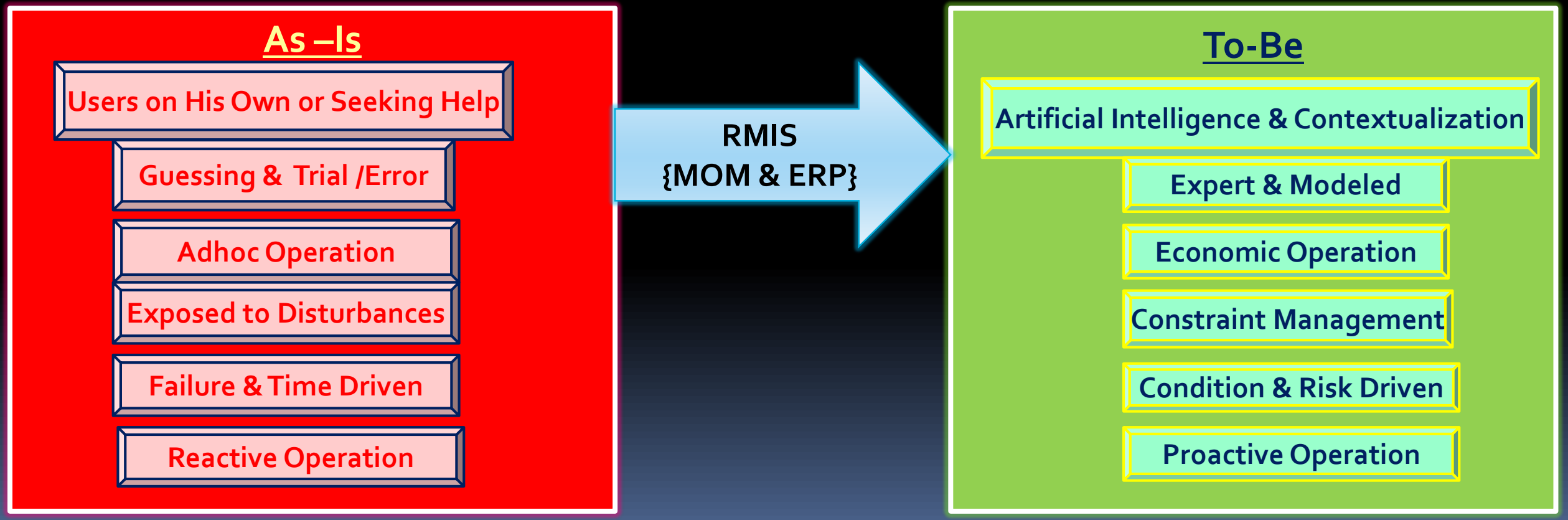
- No Technology Enablers
- Meeting, Phone Call, Paper
- Manual Data Entry & Misssing Data
- Nescience Data W/ Errors In Data
- Excessive Analysis Time & Mishaps
- Unplanned Shudown, Incidents
- Lost Opportunities

RMIS
{MOM & ERP}

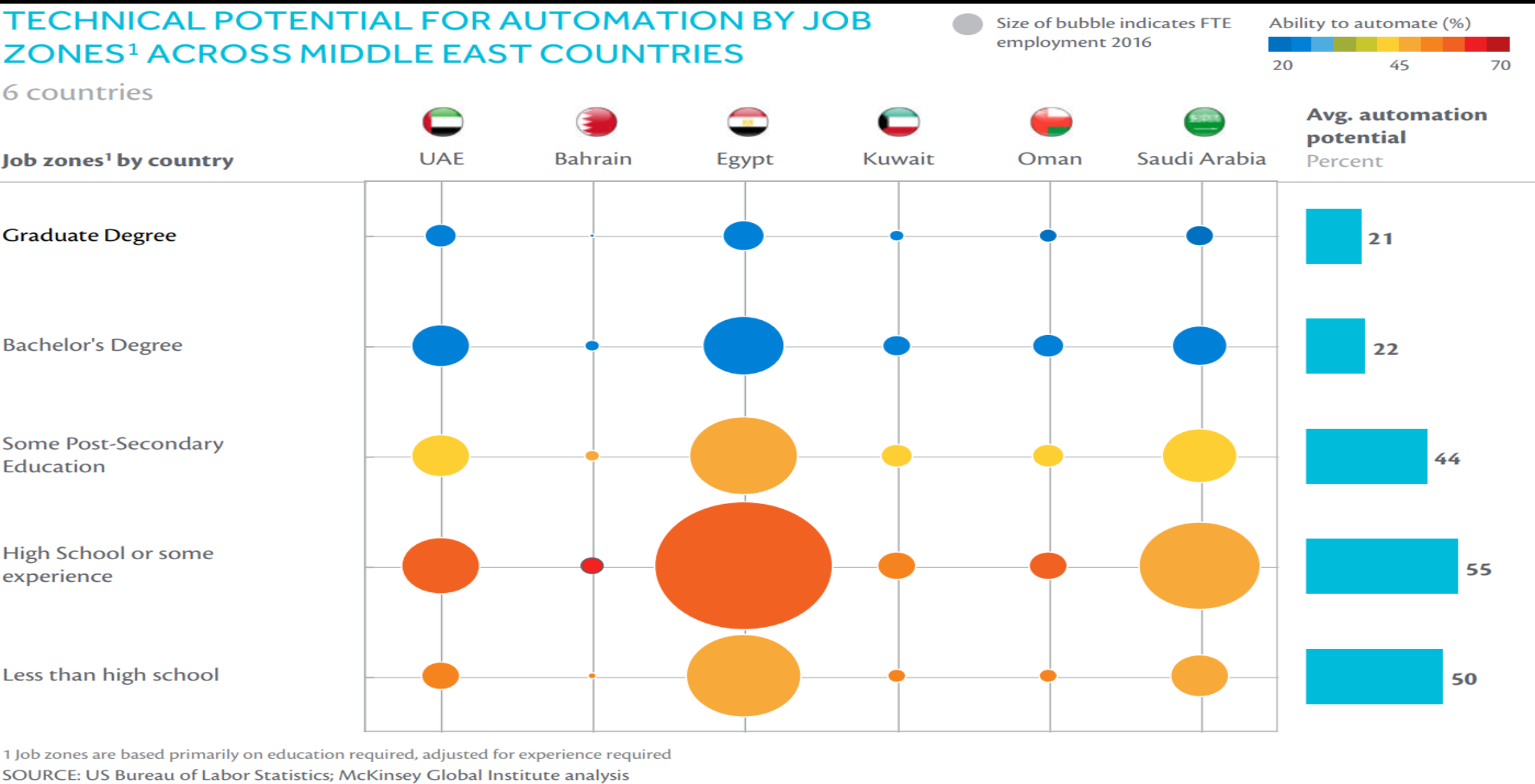
To-Be

- Advanced Technology Enablers
- Automated Workflow & Paperless
- New, Automated & Integrated Data
- Data Filtration & Reconciliation
- Timely & Accurate Decisions
- High Availability/Utilization
- Capturing Opportunities

RMIS Drive the Transformation of Practices



Job Needs for Digitization In Egypt



KEI Improvement Needs for Digitization In Egypt

Economic Incentive & Institutional Regime, Innovation, Education & Human Resources and and Information and Communication Technology (ICT)

Country	KEI	KI	Economic Incentive Regime	Innovation	Education	ICT	2008 Rank
Denmark	9.58	9.55	9.66	9.57	9.80	9.28	1
Sweden	9.52	9.63	9.18	9.79	9.40	9.69	2
Finland	9.37	9.33	9.47	9.66	9.78	8.56	3
Netherlands	9.32	9.36	9.18	9.48	9.26	9.36	4
Norway	9.27	9.27	9.25	9.06	9.60	9.16	5
Canada	9.21	9.14	9.42	9.43	9.26	8.74	6
Switzerland	9.15	9.03	9.50	9.89	7.69	9.52	7
United Kingdom	9.09	9.03	9.28	9.18	8.54	9.38	8
United States	9.08	9.05	9.16	9.45	8.77	8.93	9
Australia	9.05	9.17	8.66	8.72	9.64	9.16	10
Ireland	8.92	8.82	9.23	9.04	9.08	8.33	11
Austria	8.89	8.76	9.30	8.90	8.53	8.85	12
Iceland	8.88	8.87	8.92	7.98	9.44	9.18	13
Germany	8.87	8.83	8.99	9.00	8.46	9.04	14
New Zealand	8.87	9.00	8.48	8.65	9.79	8.56	15
Belgium	8.73	8.70	8.82	8.96	9.14	8.02	16
Taiwan	8.69	8.80	8.35	9.24	7.91	9.26	17
Luxembourg	8.65	8.40	9.42	8.91	6.66	9.62	18
Japan	8.56	8.84	7.71	9.15	8.71	8.66	19
France	8.47	8.69	7.82	8.61	9.08	8.38	20
Estonia	8.34	8.22	8.68	7.49	8.27	8.90	21
Slovenia	8.25	8.29	8.11	8.31	8.24	8.33	22
Spain	8.24	8.13	8.58	8.14	8.21	8.04	23
Singapore	8.24	7.75	9.71	9.56	5.19	8.50	24
Israel	8.22	8.24	8.16	9.34	6.72	8.64	25
Hong Kong, China	8.20	7.73	9.60	8.64	5.30	9.26	26

Economic Needs for Digitization In Egypt

Investing in the Design, Procurements and Deployment in the **Digitization Technologies and Solutions** shall have the following Business Advances:

1- Establish Business Model that is based on providing Digitalized Service by capitalizing on the Use the intellect, innovation and knowledge of Humans to **create employments and generate income by transferring the relatively low cost raw material needed to create processors, memoirs and software into high value, information-rich, automation, and integrated solutions. This shall result in contribute to a Quantum Leap in Economy Growth of Egypt and will accelerate the transformation of such economy to Knowledge and Digital Economy.**

2- Generate Tangible and Intangible Added Values through the improvement of quantity, quality, and accessibility of the data, information, knowledge and associated Decision Making to **increase the Human Productivity, maximizing Availability, Utilization and Revenues and reducing Maintenance, Energy, Utility and Operating Cost. This shall result in increasing the Return On Investment of Intelligent Manufacturing & Plants**

“Digitization Table of Contents”

1. Block Chain

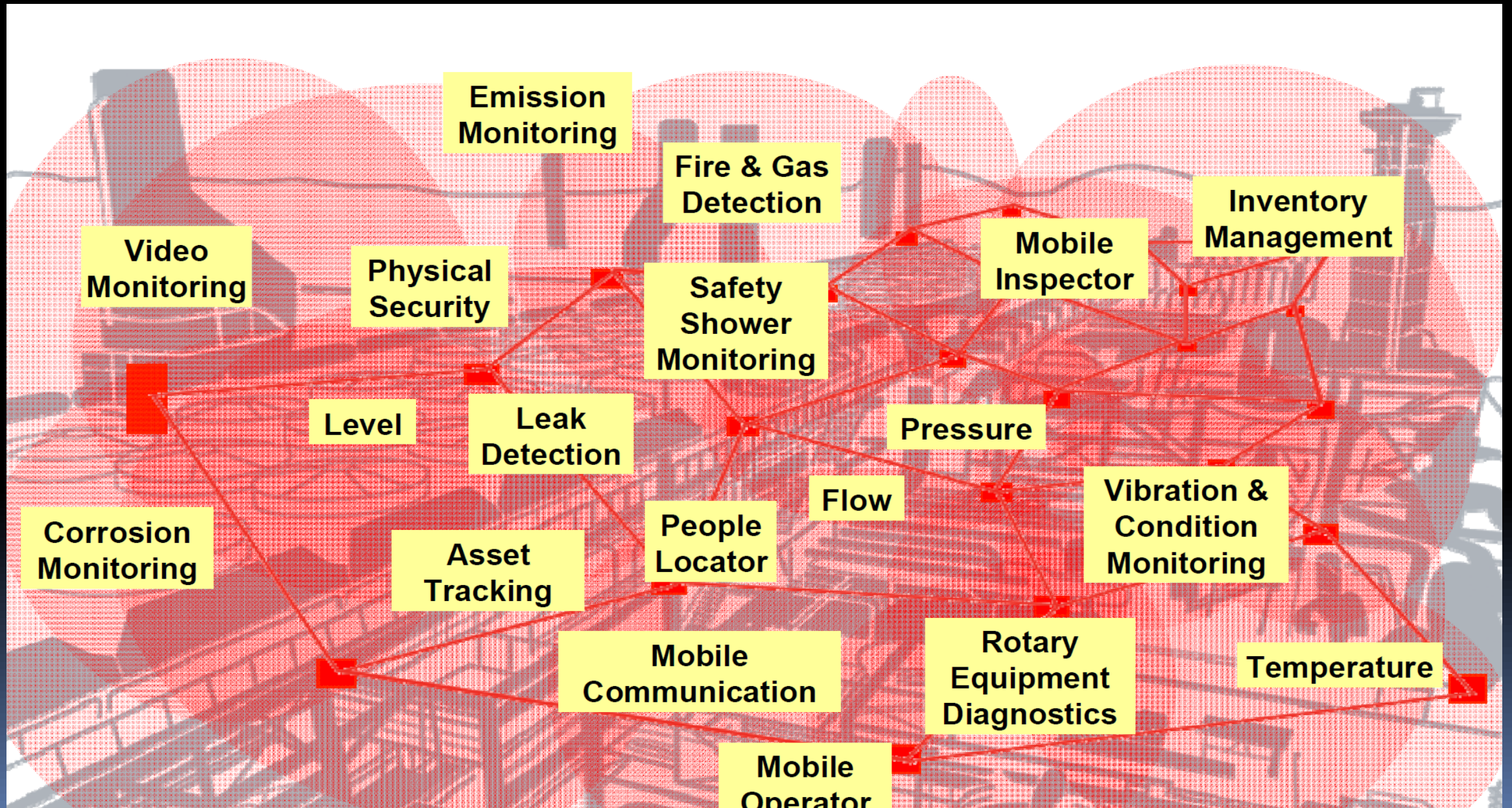
Mandatory Data Needs for Digitization

The Key Mandatory Requiems for **the Digitization Technologies and Solutions** to maximize the captured Tangible and Nontangible Benefits of the
are as follows:

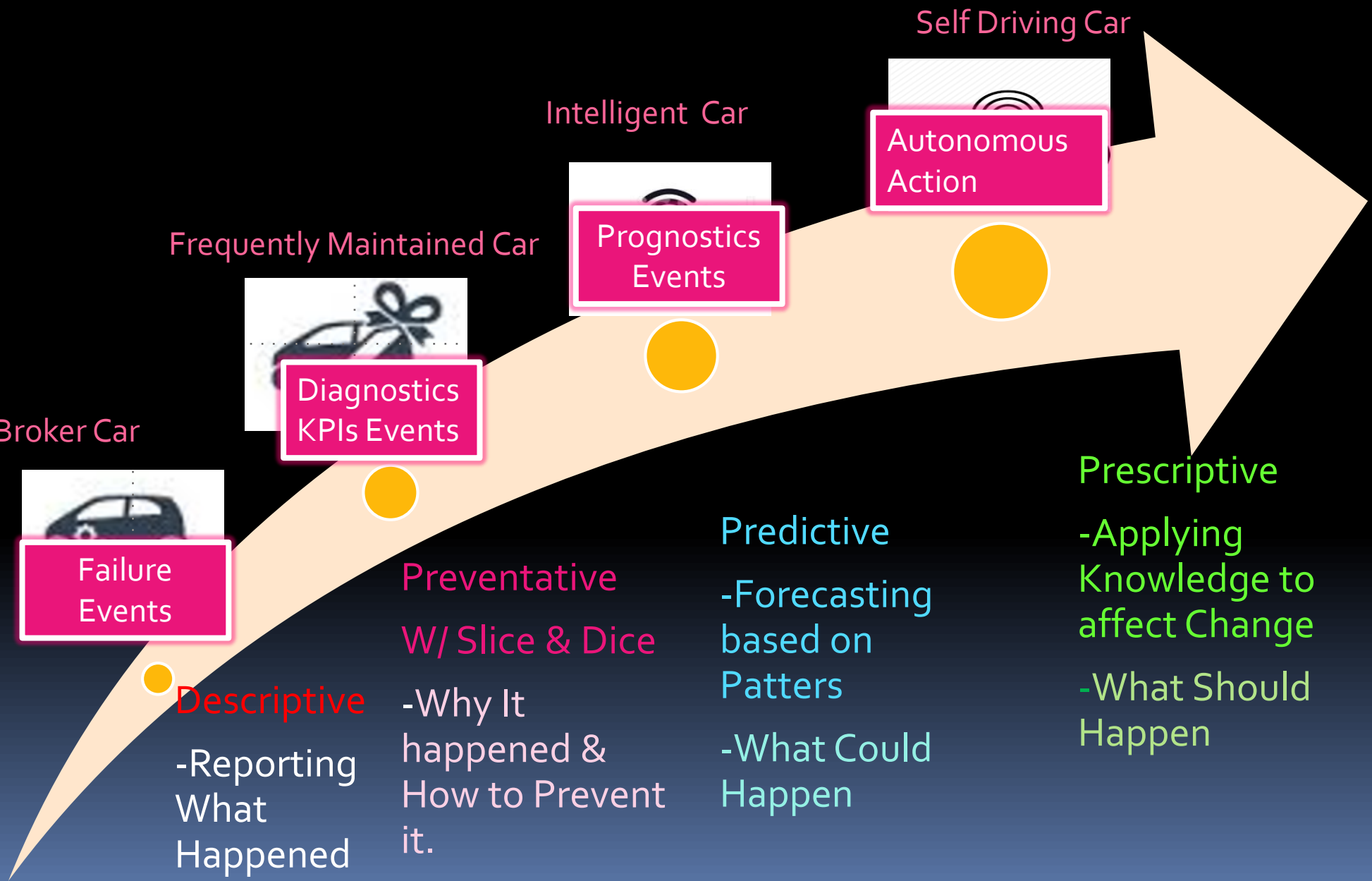
1. Provide **Abundance of Data** to avoid needing Missing Data and to ensure that there will be always enough Data to control, analyze and make decisions.
2. Provide **Consistency of Data** to avoid having Redundant Data and to ensure that there will be always one single version of the Truth.
3. Provide **Validation and Reconciliation of Data** to avoid making decisions based on data with gross error and/or with random error and to ensure that calculations decisions are made with good dAT
4. Provide **Integrity of Data** to avoid hacking, phishing, attacks
5. Provide **Confidentiality of Data** to avoid raveling sensitive information on the cloud
6. Provide **Availability of Data** to avoid denying power users from accessing cortical data needed to perform their jobs.
7. Provide **Integrability of Data** to avoid having data in isolated islands with low added value quality and ensure data exchange among applications to have a Total Virtual Added-Value that is More than the total sum of these individual , isolated and separated data in standalone isolated sates .
8. Provide **Sharing of Data** to avoid having data locked in the date based and/or only owned by one with User without sharing and Collaboration with other Users on the Utilization of such tasks for Effective and timely decision making by all Users.

Extern of Data Needs for Digitization

Extern of Wireless Sensor Needs for Digitization

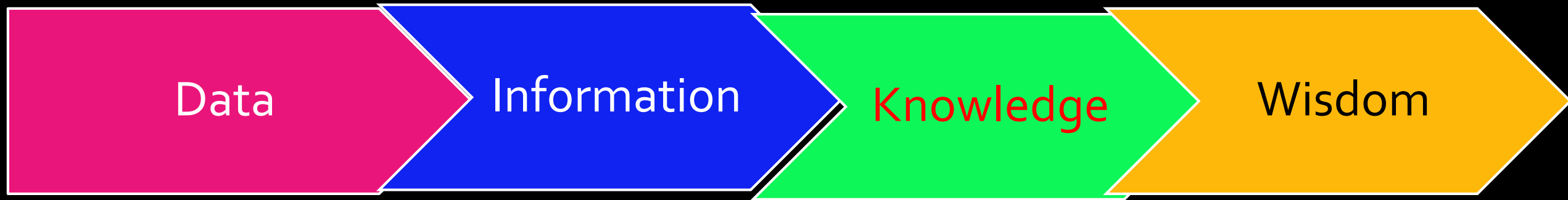


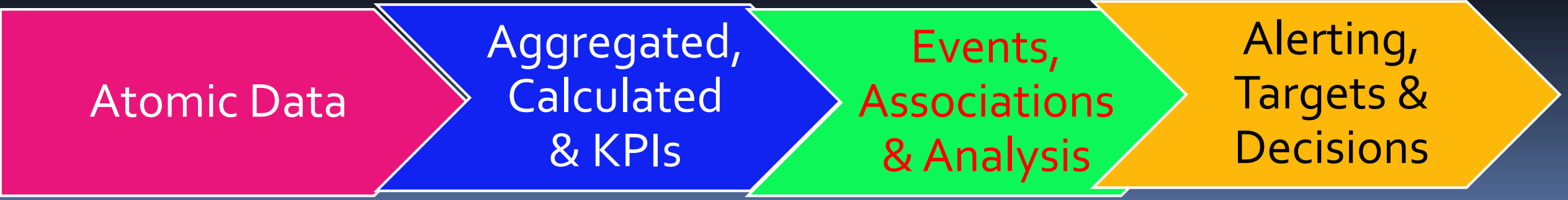
The Evolution of Data Analytics and Artificial Intelligence



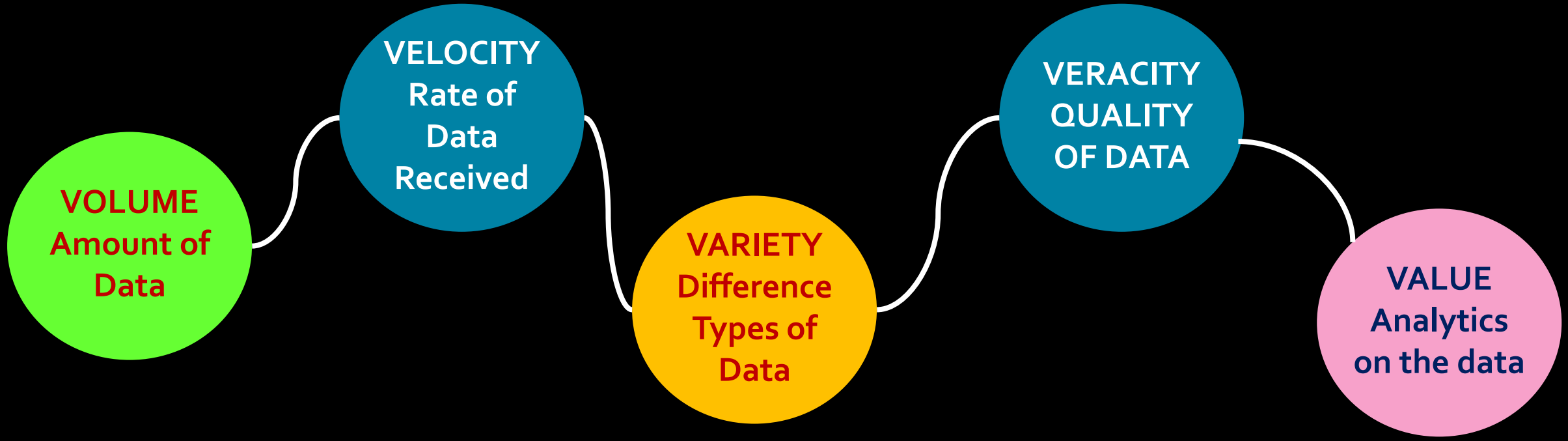
Liebowitz Model for DIKW Transformation

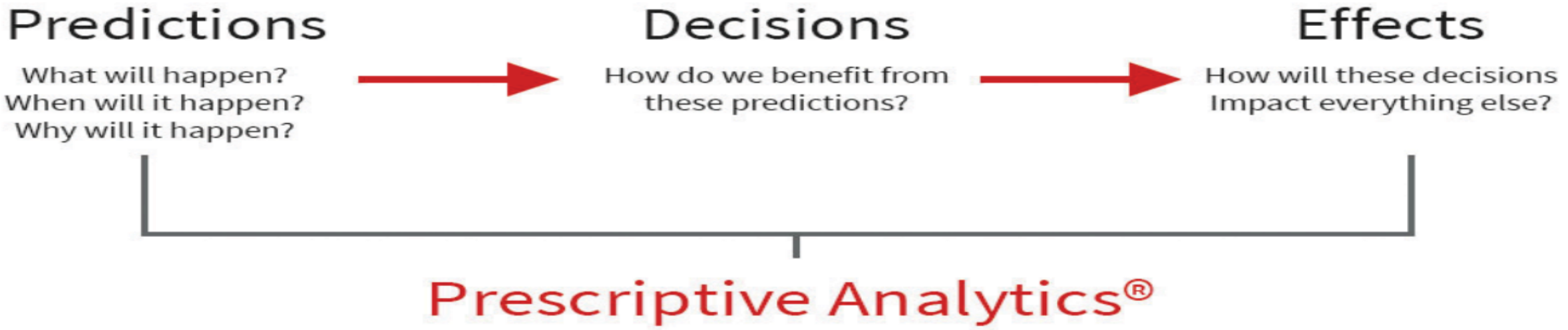
- The Data in the Automation technology & Digitization Technology require an Added-Value Transformation Process to Manual, Semi-Automated and/or Automated Open and/or Closed Loop Decision Making though Generation of Advisories, Targets, Sep Points, Robotic Automation that is Timely, Accurate and Reliable.



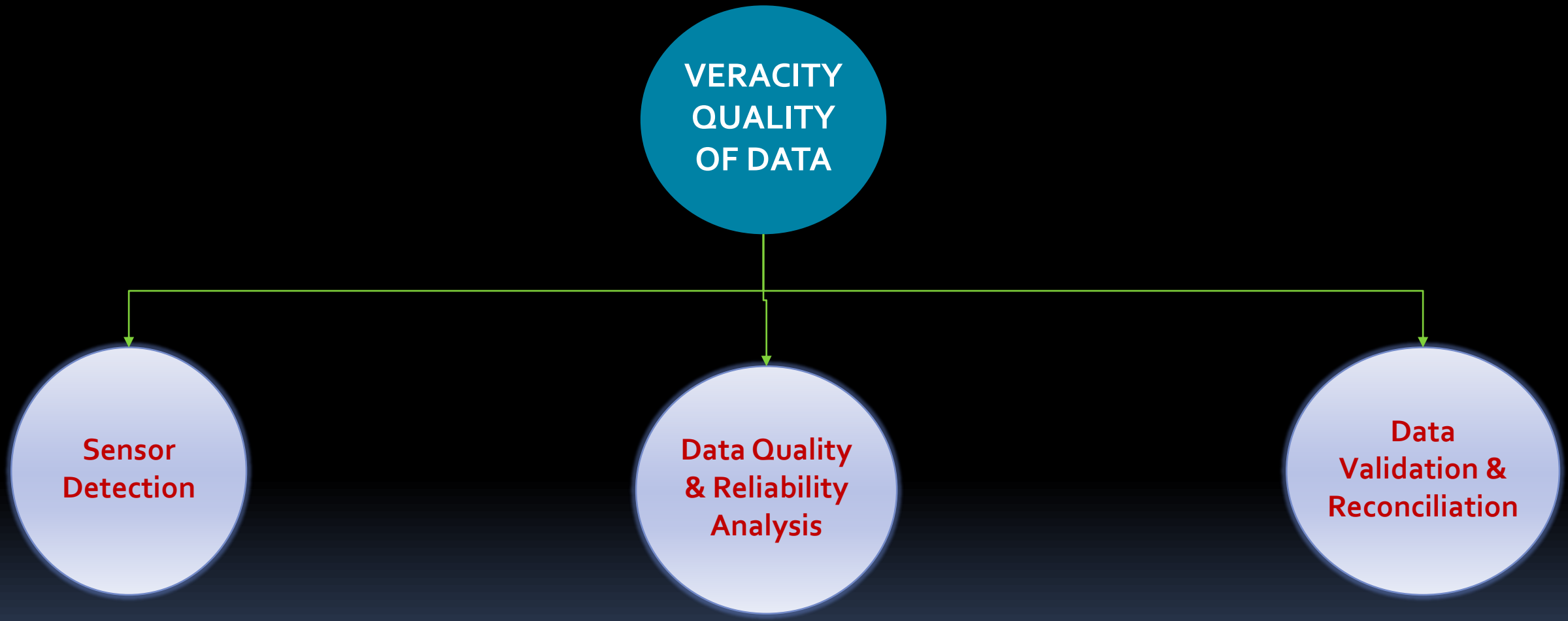


Extent of Data Analysis (5 Vs) Needs for Digitization





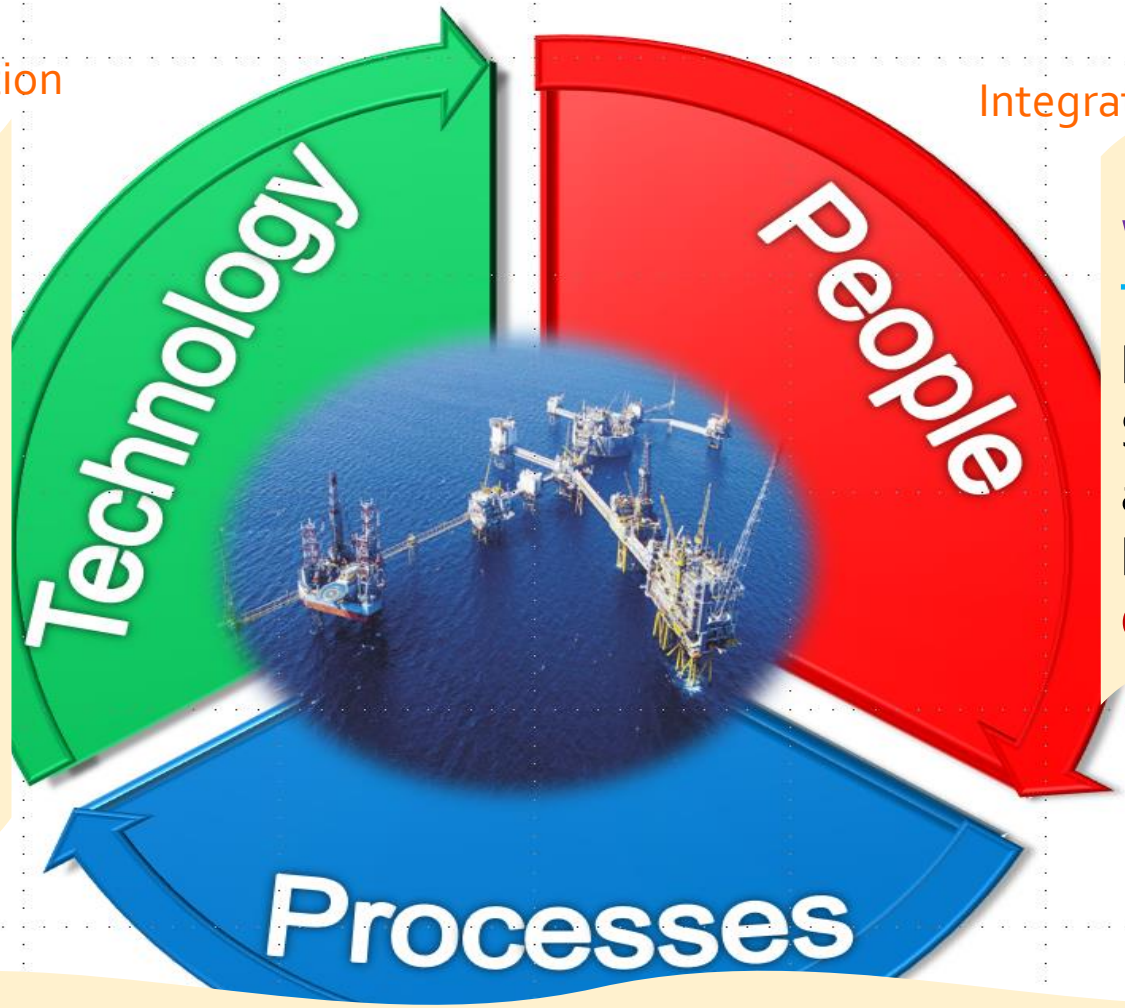
Extent of Data Quality Needs for Digitization



“Digitization Table of Contents”

Industry 4.0 Digitization PPT Transformation Model

"Digitization needs **Disruptive Technology** that Promotes the Adoption of **New Technologies** of doing things differently and Disrupt **Existing Technologies** to Overturn the Traditional Solutions and Replace it with **New** Solutions



"Digitization needs **System Thinking** that differentiable between **Simple** and **Simplistic** Solutions, between **Systematic** and **Ad-Hoc** Solutions and between **Systemic** and **Compartmental** Solutions

"Digitization needs **Well- Defined Processed** that Drives **Modeled Business Process** rather than **Random Business Process** and **Robust Integration** rather than **Loose Integration**.


Mechanical Completion Certification
Pre-commissioning
Commissioning
Safety Readiness Review
Start-Up
Decommissioning & Mothballing
MOC Design Alteration
MOC KPIs Targets & PIOW Limits
MOC Operation Procedures
MOC Maintenance Procedures
Safety Walk Through Review
Asset Integrity Review
Asset RBI Review
Asset Reliability Review
Asset Quality Control
Asset Quality Assurance
Executing Real-Time Based RIM &SOP
Executing Document Based RIM &SOP
Execute Reliability Driven Operation Tasks
Define Total Plant Reliability Strategy
Execute Total Reflux
Execute Recycle Operation
Execute Turn Down Operation
Execute Constraint Based Procedures
Execute Economic Based Set Point
Execute Performance Based Set Point
Execute Compliance Based Set Point
Execute Reliability Based Set Point
Execute Integrity Based Set Point
Execute Operation Round Tasks Tasks
Track Catalyst Inventory
Track Chemical Inventory
Track Spare Inventory
Track Catalyst Consumption
Track Chemical Consumption
Track Utility Consumption
Maintain Asset Reliability Records
Assess & Mitigate Risk
Asset RBI Review
Track Asset Criticality
Track Asset FEMCA
Asset Registry & Functional Location
Spare part Cataloging & Bill of Material
Asset Reliability Review
T &I
Major Maintenance
Minor Maintenance
On Stream Inspection
Equipment Inspection Schedule
Track RAM Modeling
Track Reliability Analytics
Track Failure Root Cause
Track Quality Giveaway
Track Quality Off Spec
Track Blending Touch-Ups
Product Quality Control
Product Quality Control
Track Operation Costing
Track Manpower Productivity
Track Energy Consumption
Track Safety Incidents
Track Environmental Incidents
Track Lost Opportunity
Operation Within Envelops
Operation Within Parameter Limits
Proactive Operation
Continuous Improvements
Oil & Product Movement
Blending
Track Asset Running Status
Track Asset Effectiveness
Track Asset Running Time
Track Asset Efficiency
Track Utilization
Cleaning
Purging
Flushing
Priming
Monitoring
Switching Over
Asset Remaining Life
Asset Time to Fail
Asset Mean Time Between Failure
Asset Mean Time To Repair
Track Asset Availability
Track Asset De-Bottlenecking
Track Planning Order Compliance
Track Order Execution Time
Track Cash to Order
Track Schedule Driven Availability
Track Scheduled Shutdown Duration
Track Unscheduled Shutdown Duration
Track Theater Thermal Constraints
Track Compressor Speed Constraints
Track Asset/Pipe Hydraulic Constrains
Track Product Quality Constrains
Alarm Response

Three Dimension Business Process Model (BPM)

Functional Decomposition With Parent Child Relationship (Yordon De Marco)

- Level 1: Global BPM @ Enterprise Level
- Level 2: Core BPM @ Site Level
- Level 3: Strategic BPM @ Area Level
- Level 4: Tactical Step BPM @ Plant Level
- Level 5: Elementary BPM @ Unit Level
- Level 6: Atomic BPM@ Asset Level

Sequential Execution With Start-End Relationship

Lean manufacturing

Plan | DO | Check | Adjust

Six Sigma

Define | Measure | Analyze | Control | Approve

Work Flow Tasking With initiate Complete Relationship

ANSI/ISA – SP 95 Logical Model

Cloud Computing & Service

Business Process Transactions

Production Management

Mission Critical

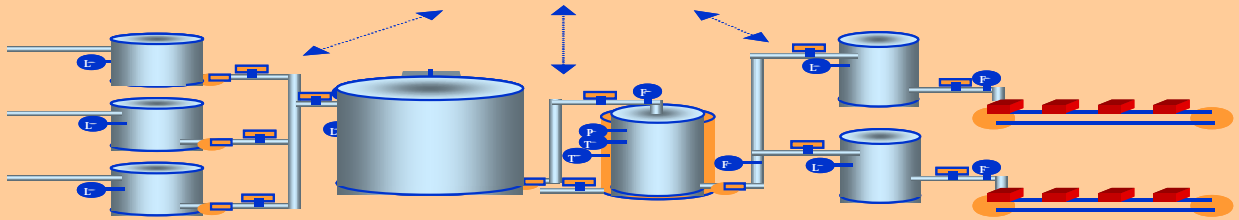
Business Planning & Supply Chain Mgmt.

Manufacturing Operations Management

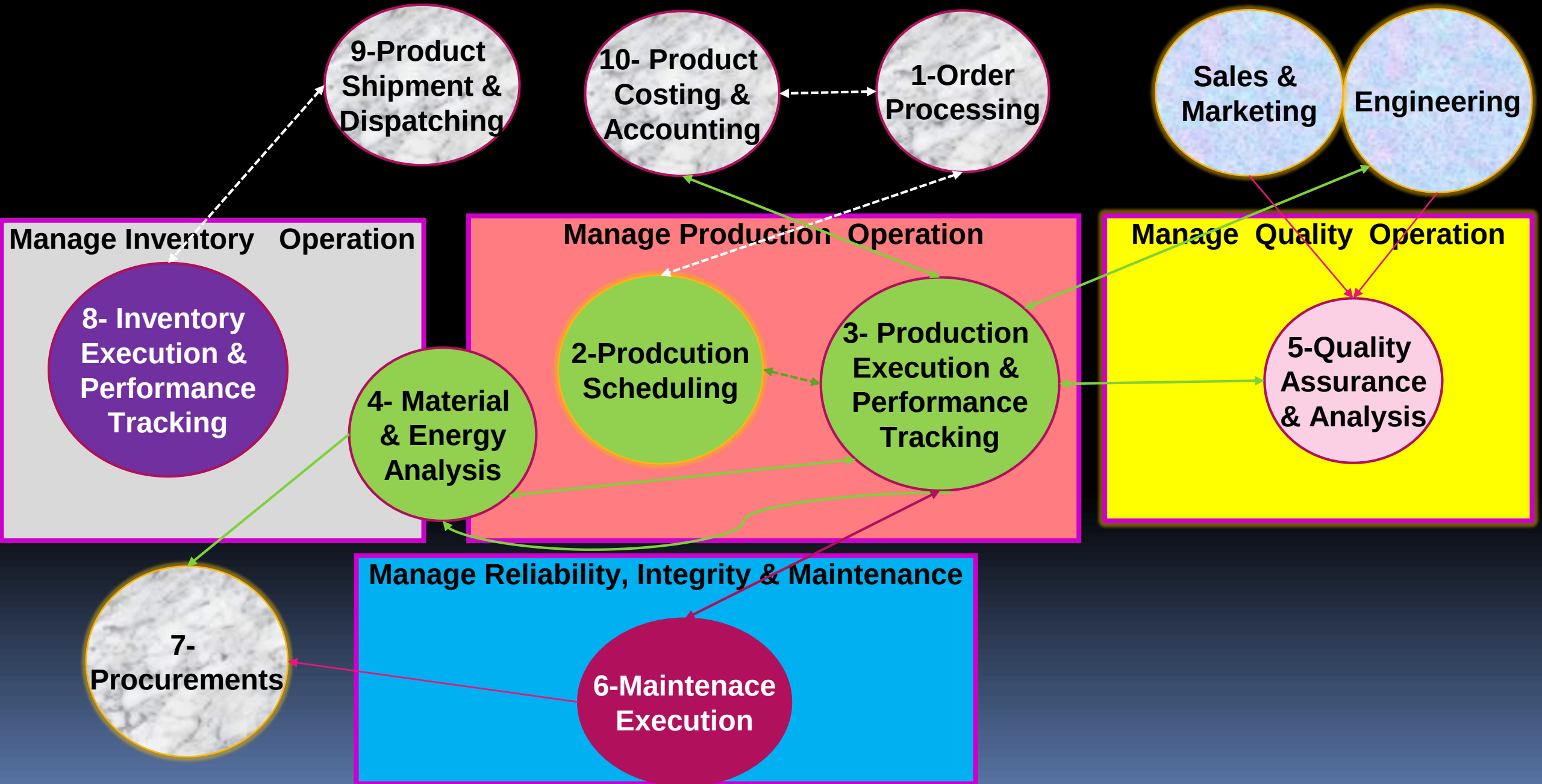
Real-Time Control & Events

Process Automation System

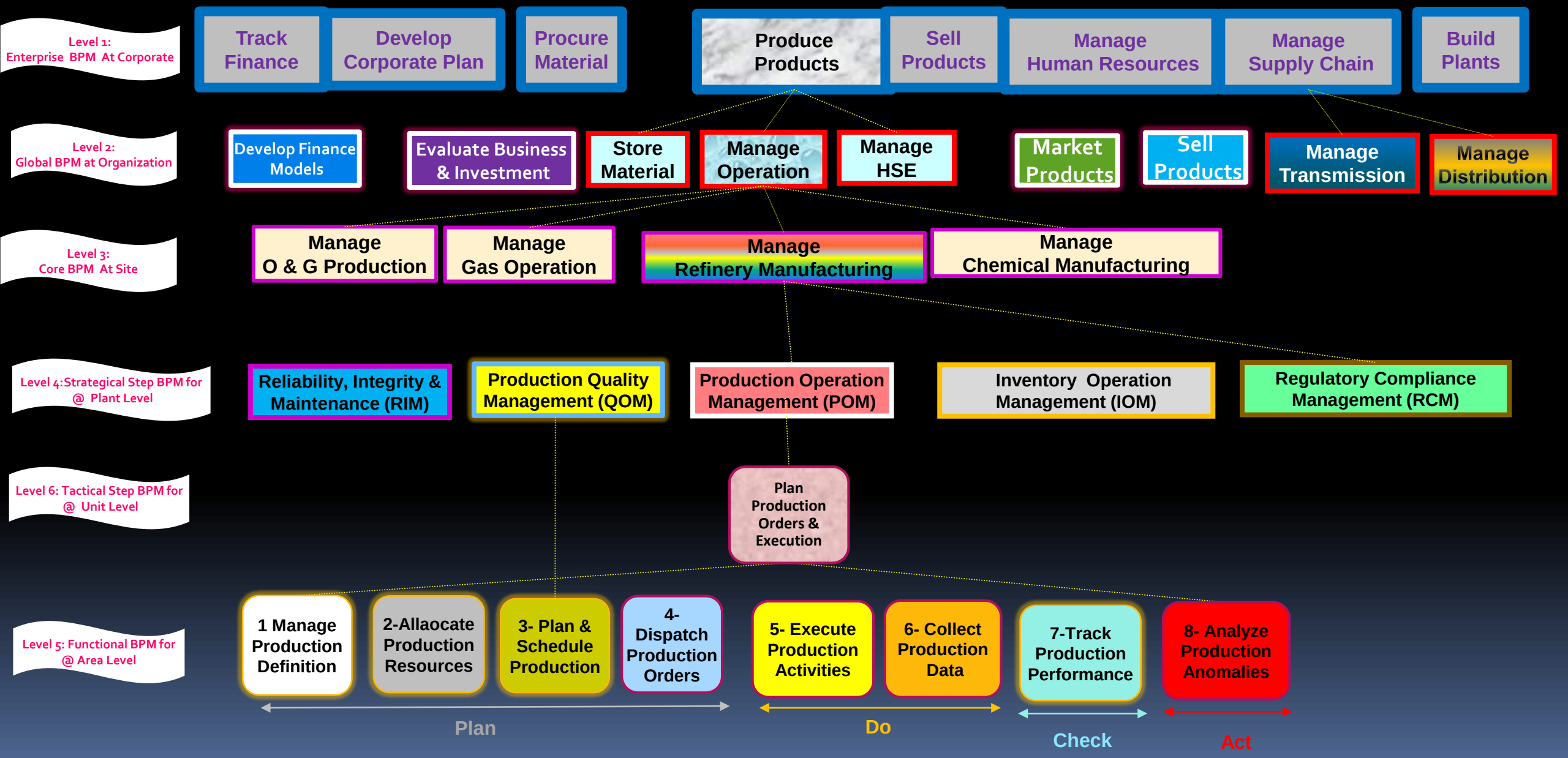
Sensors, Transmitters, Actuators and Mobility



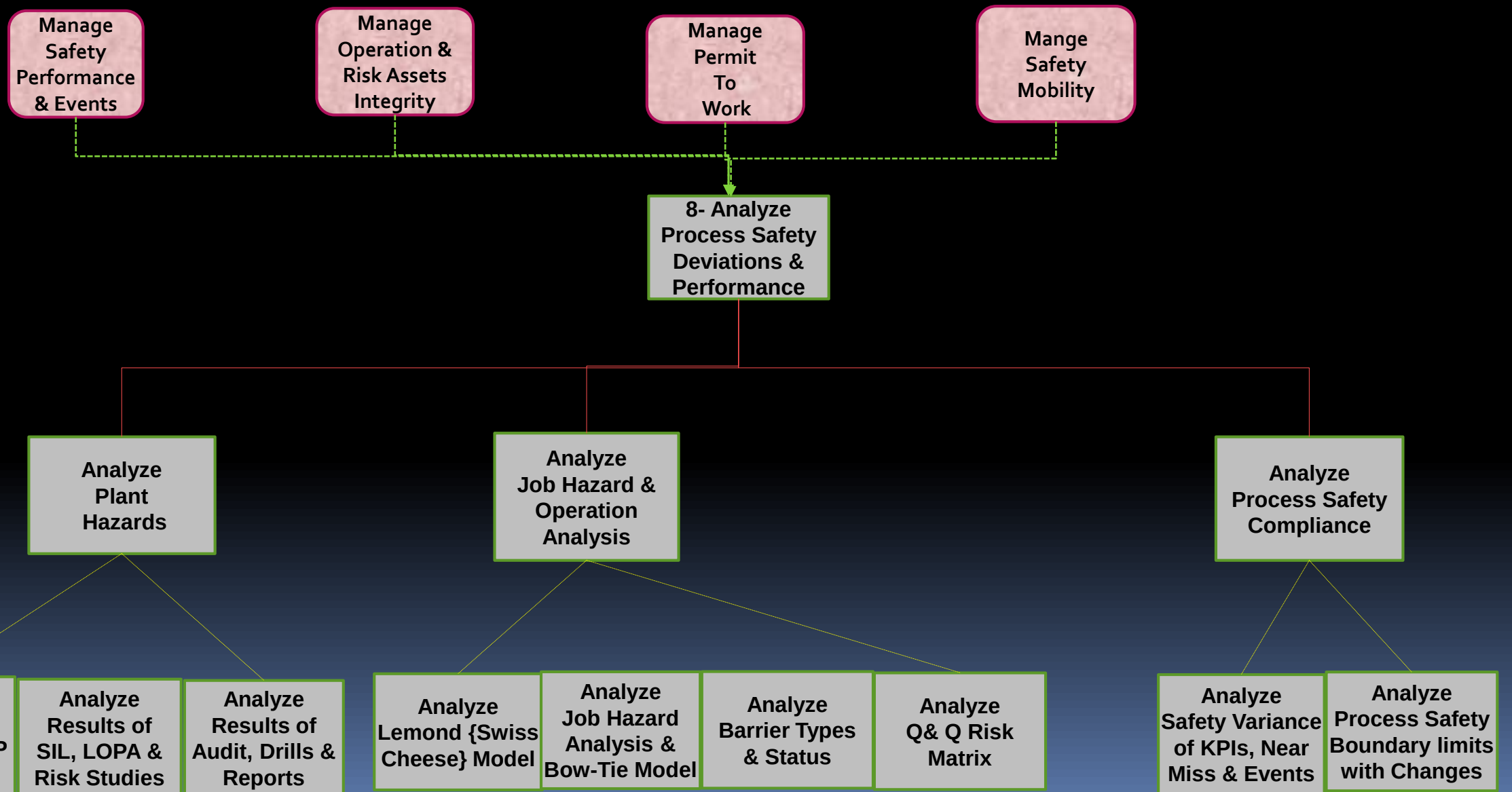
MOM ISA 95 Functional-Based Integrated Solutions



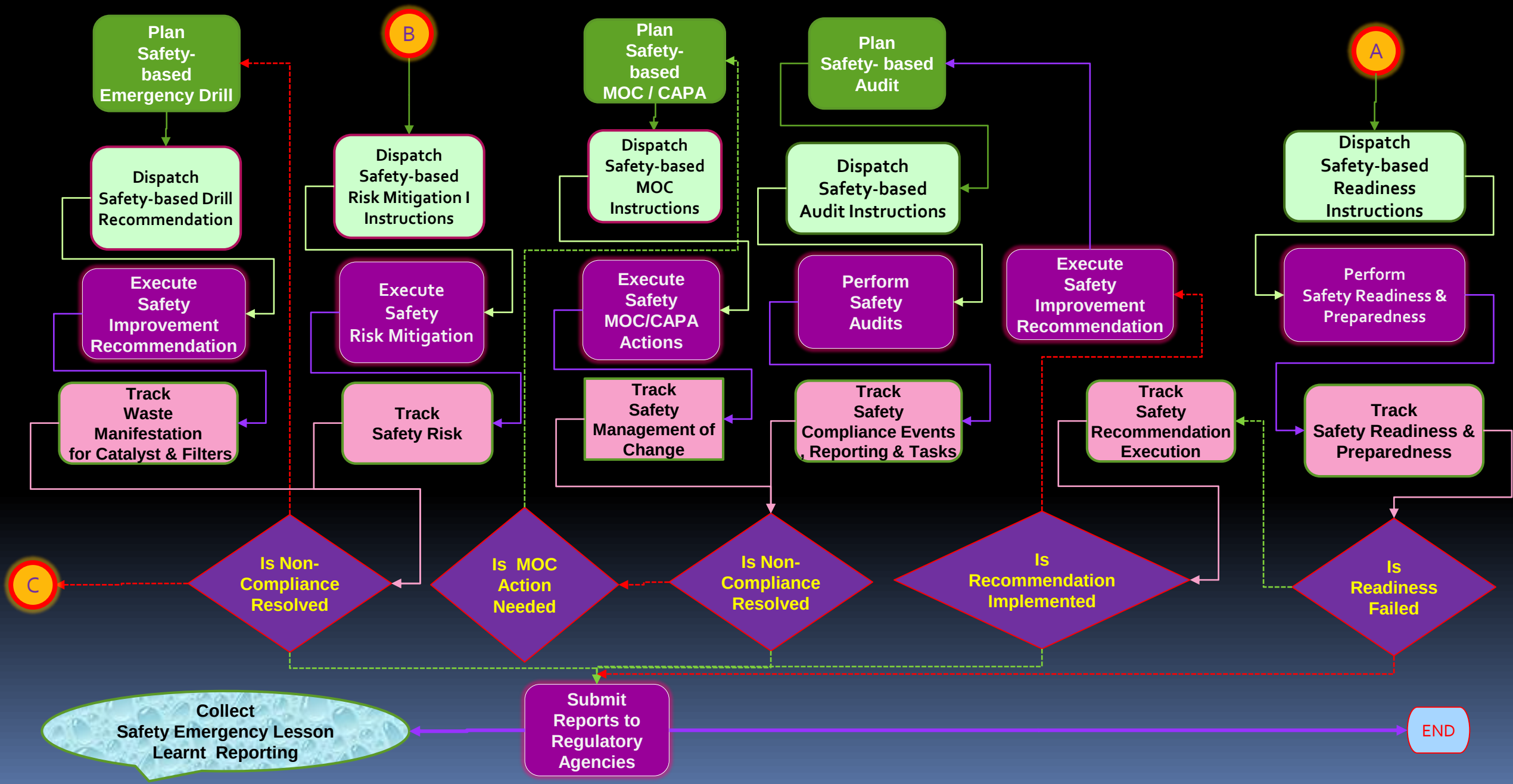
Corporate Business Process Functional Decomposition



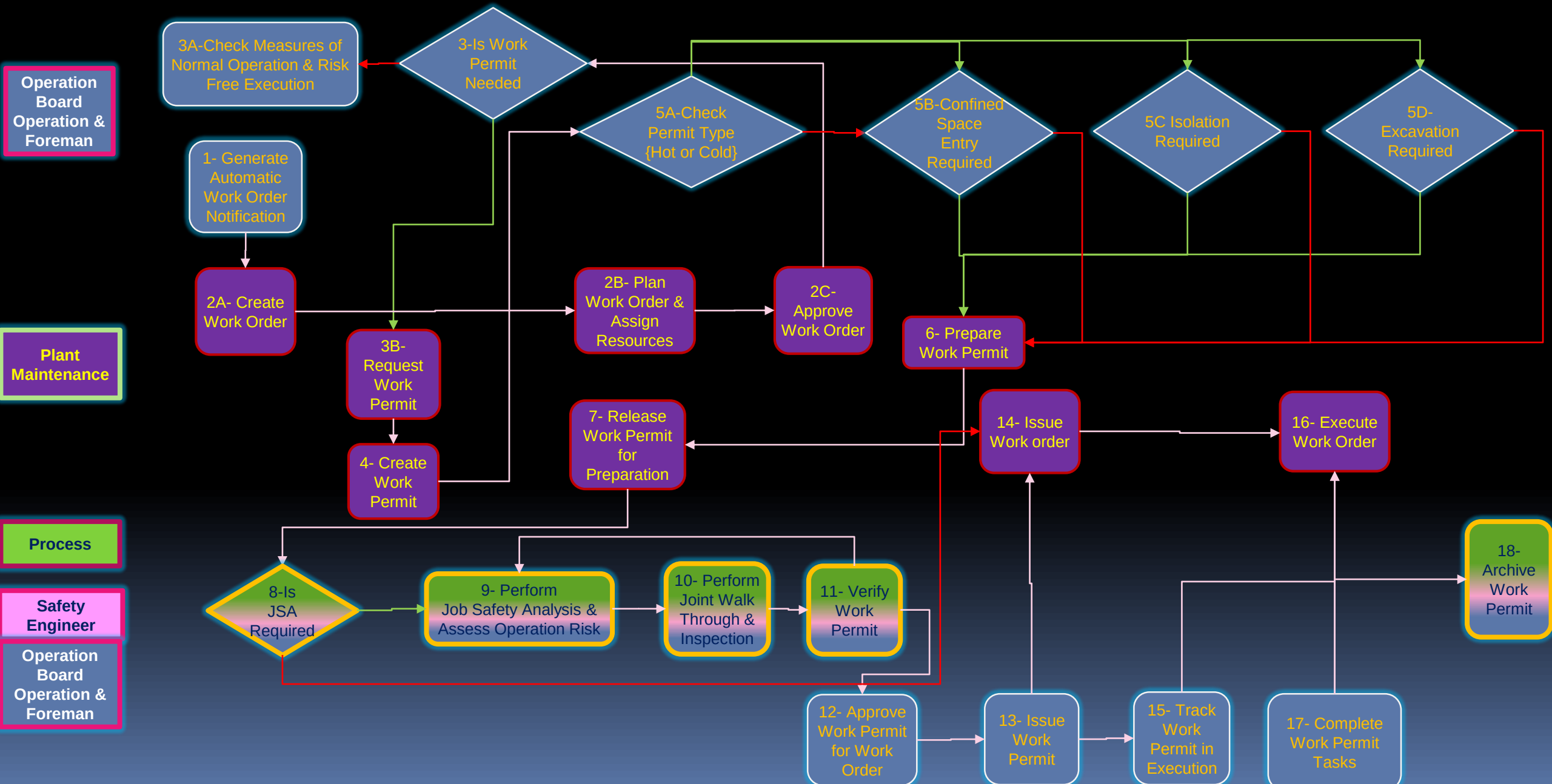
Safety Performance Analysis BP's Functional Decomposition



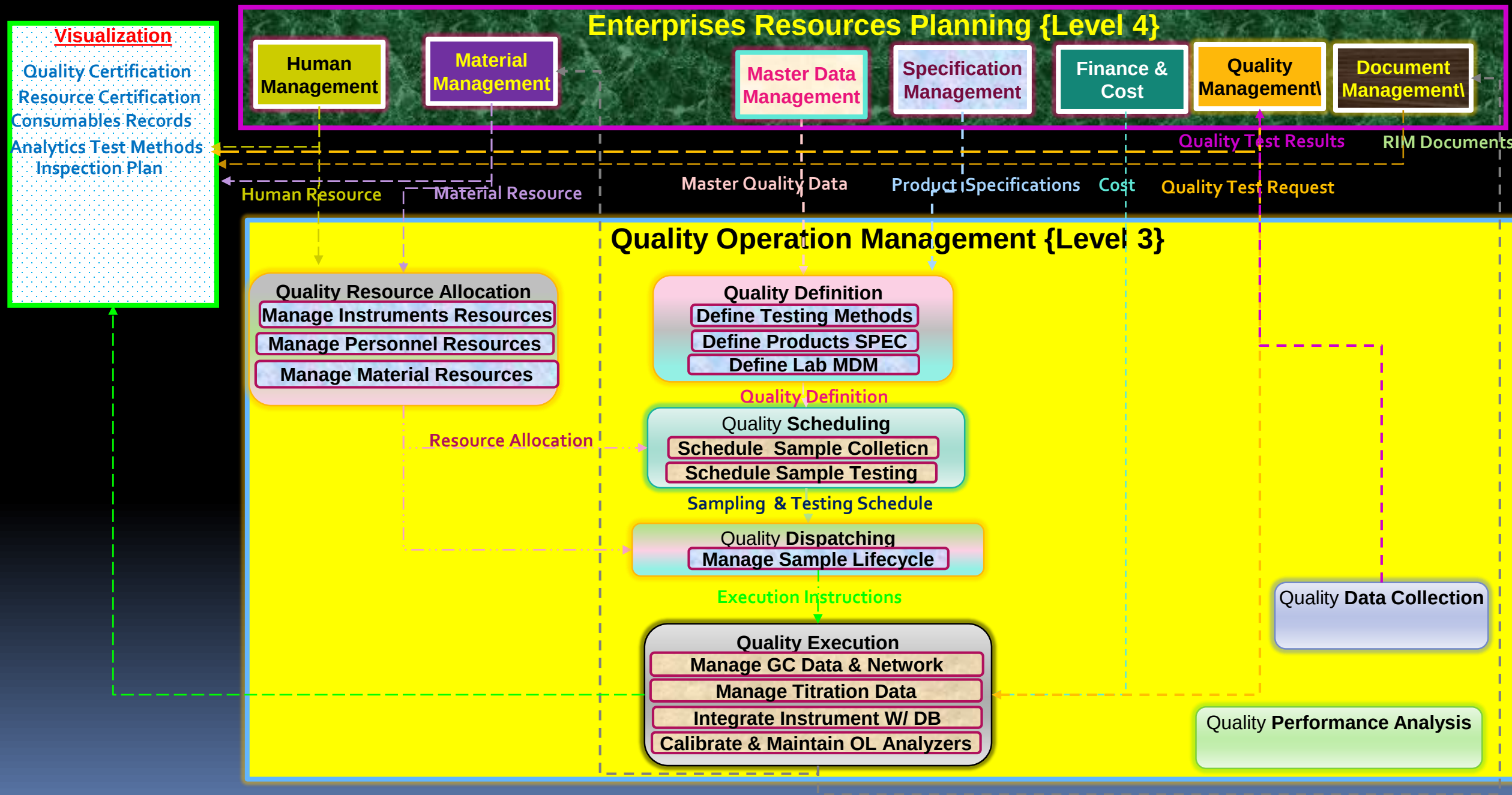
Safety Readiness, Audit, Risk Mitigation & MOC Swim lane



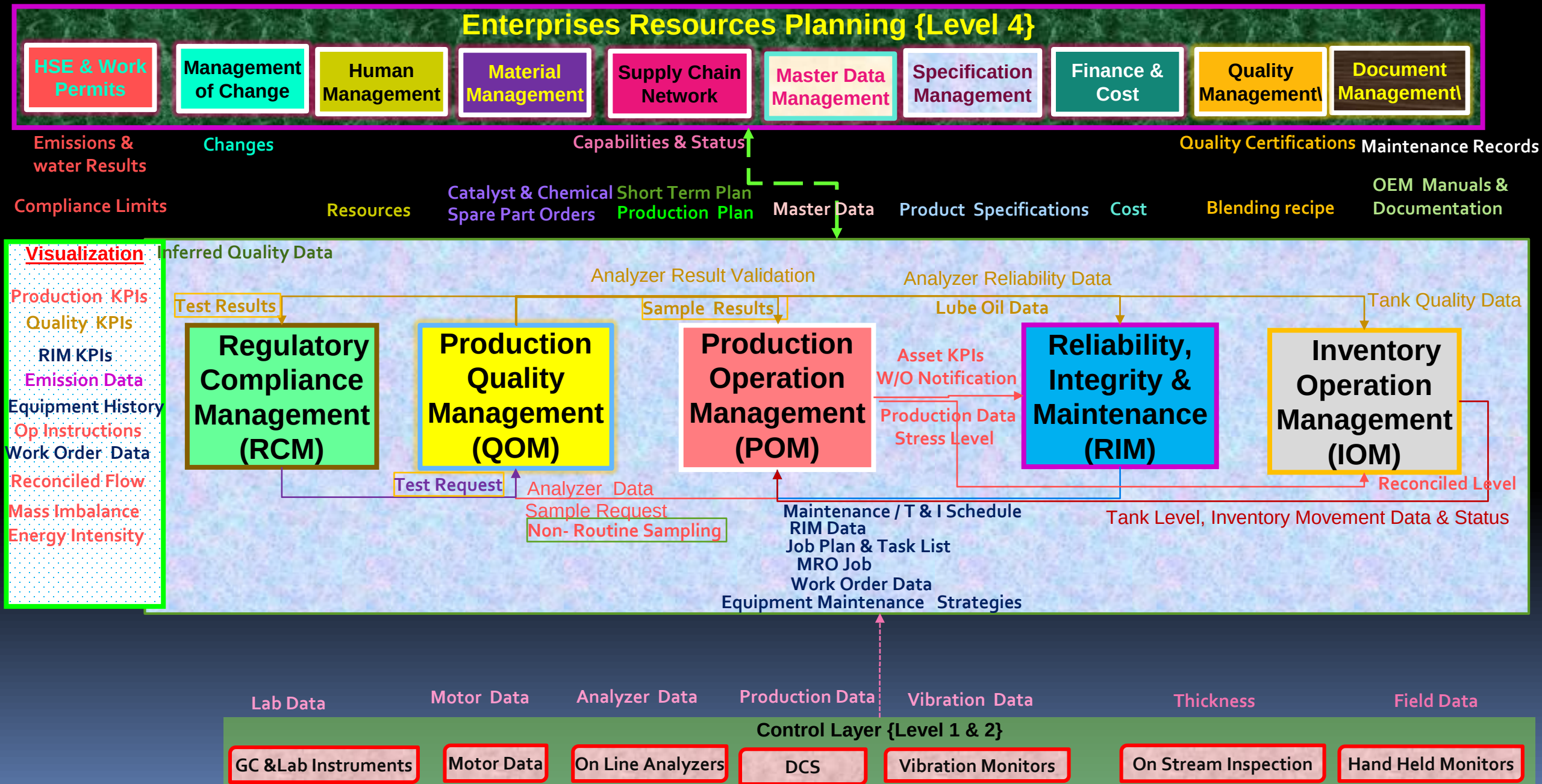
Safe Permit to Work Execution Flow Chart



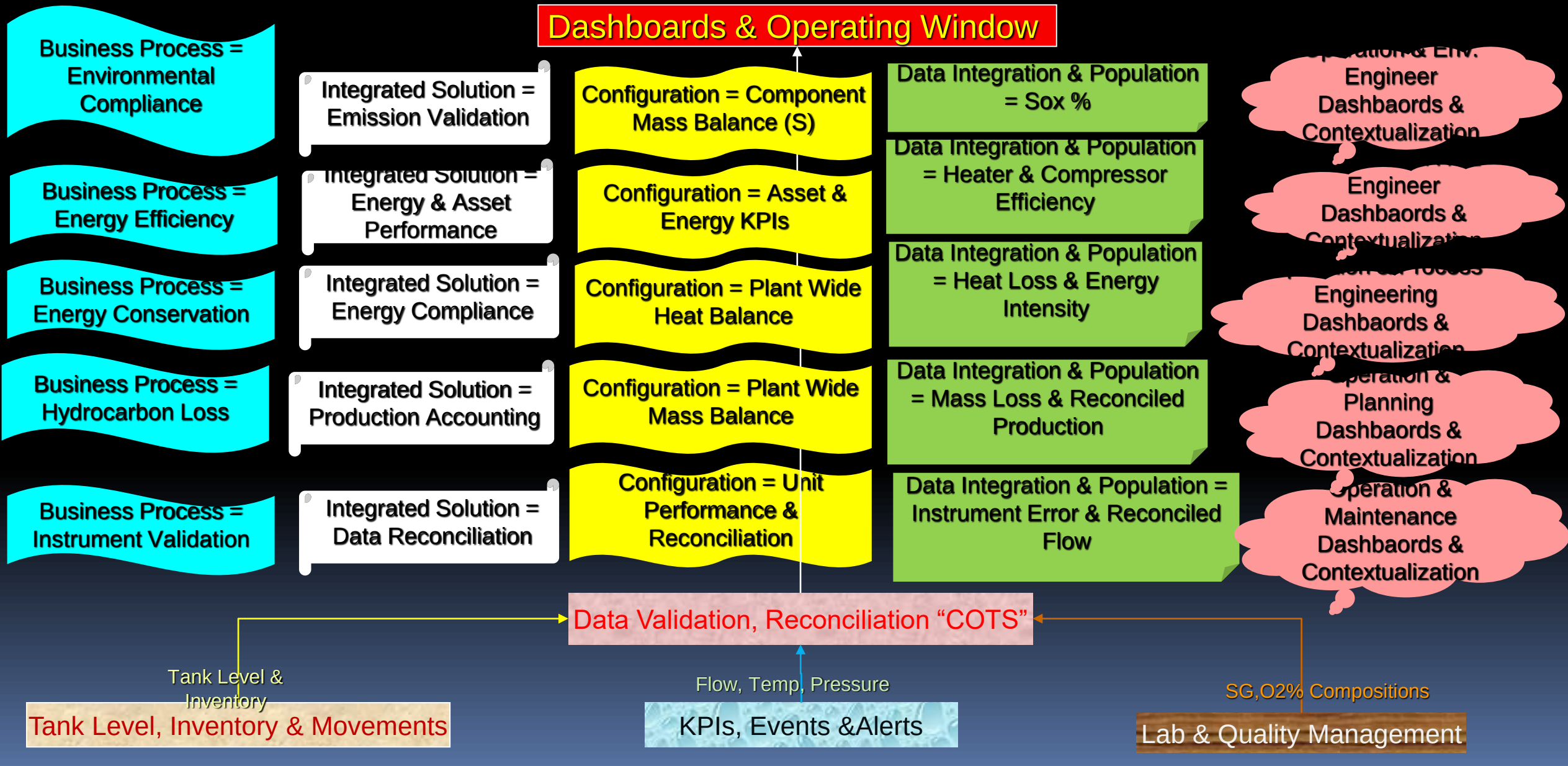
RMIS-Quality ISA 95 Business Processes & Data Flow



RMIS FEED Design Legend



e Business Processes, Integrated Solutions, Configuration Modes, Data Sets & User Class with One DVR COTS



“Digitization Table of Contents”

Digitization Platform Components

Miscellaneous Services
{Risk mgmt., cognitive IoT Cookbook, Natural Language Interface, Security Solutions}

Device Management

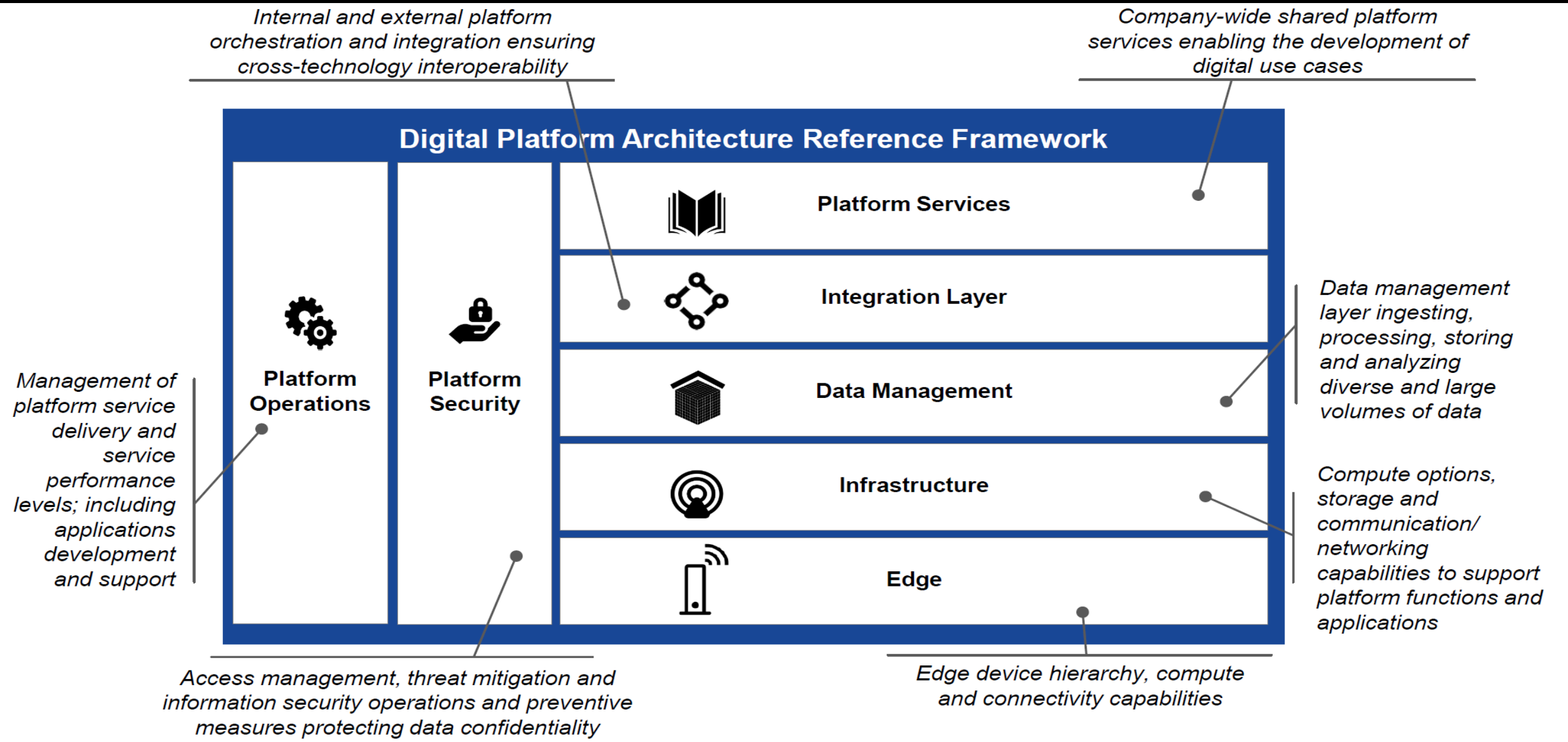
Connectivity Management

Vertical Solutions
{Oil & Gas, Energy & Utilities}

Bid Data & Data Analytics
{A Number of cognitive services ranging from object-in-motion recognition to text and linguistic analysis}

Application Enablement

Digitization Architecture Reference Model



Sensors Technologies {Digitization}

❑ Embedded Sensing Systems

- Embedded in Equipment around plants or facilities to make more data available to the decision makers
  - Using sensors such as
    - IIoT Sensors & Local Wi FI
    - Wireless Sensors and Warless Communication Protocols
    - Transmitting Measurements over Wi FI to Applications on
      - The cloud
      - Smart Phones
  - Performing Tasks such as Process Integrity Monitoring to reduce downtime and deferment and enhance equipment/process safety.
    - Conform to environmental standards
    - Self powered Sensors using Solar, Pressure, Heat, Motion

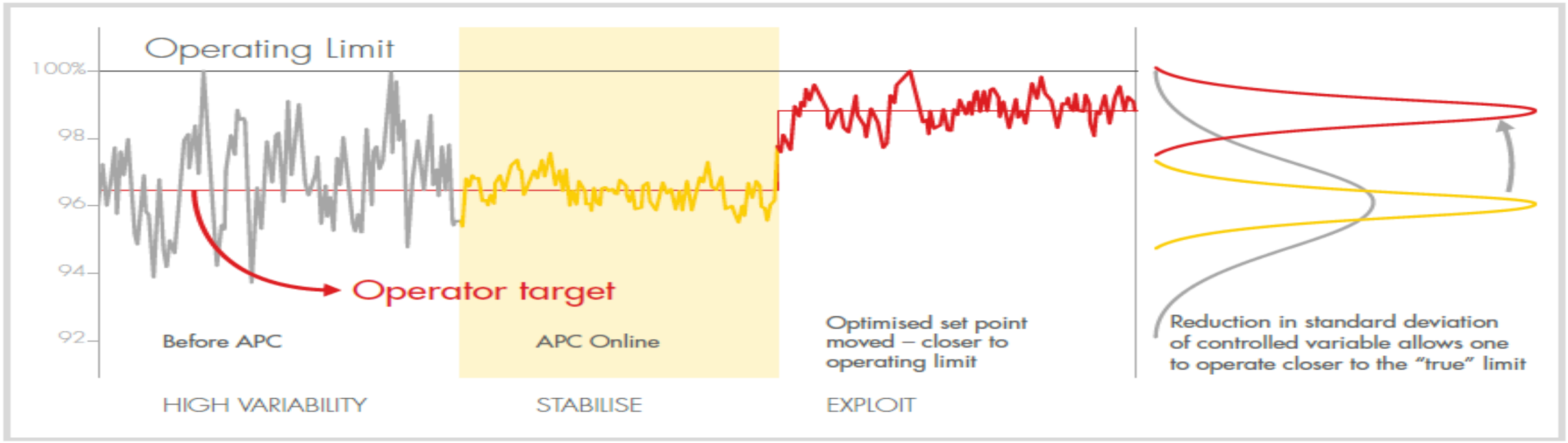
❑ Green Completion

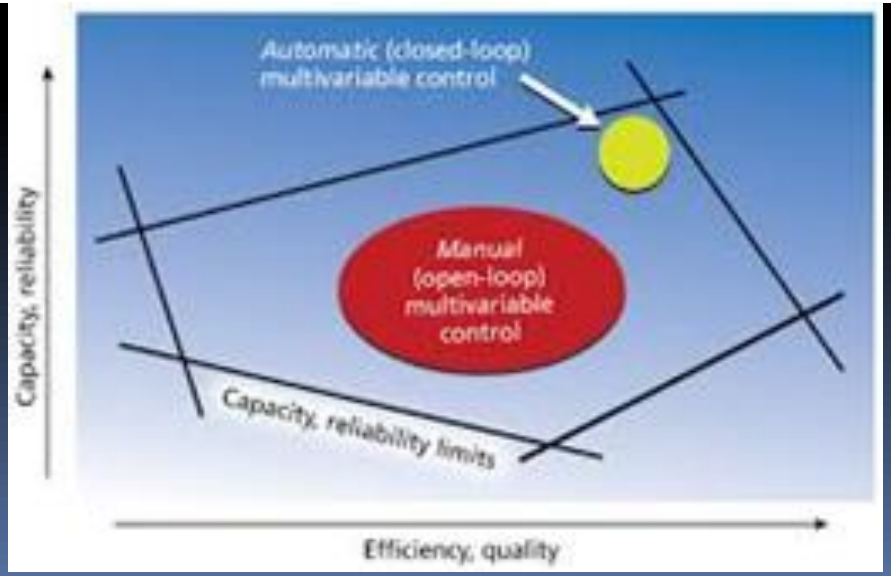
- Captures Emissions of methane & volatile organic compounds and other potential pollutants from wells Ensure that operations conform to environmental standards

Sensors Technologies {Automation & Digitization}

- Process Control
  - Multi Carriable Constraint Control & Optimization (MVCC& O)
  - Advanced Control and Estimation (PACE)
- Cyber Security In Process Control
  - Threat-Proof Process Control with Cyber Security (Two Ways Flow to Down Load Set Points to DCS)
  - following practices of the Process Control Domain (PCD) Risk Profile – Asset inventory; access control; operating system security patches; event log management, white listing, and anti-virus
  -

Sensors Technologies {Automation & Digitization}

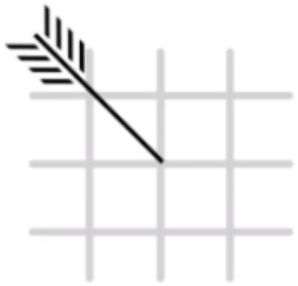




Top 10 Trends of Industry 4.0 Digitization

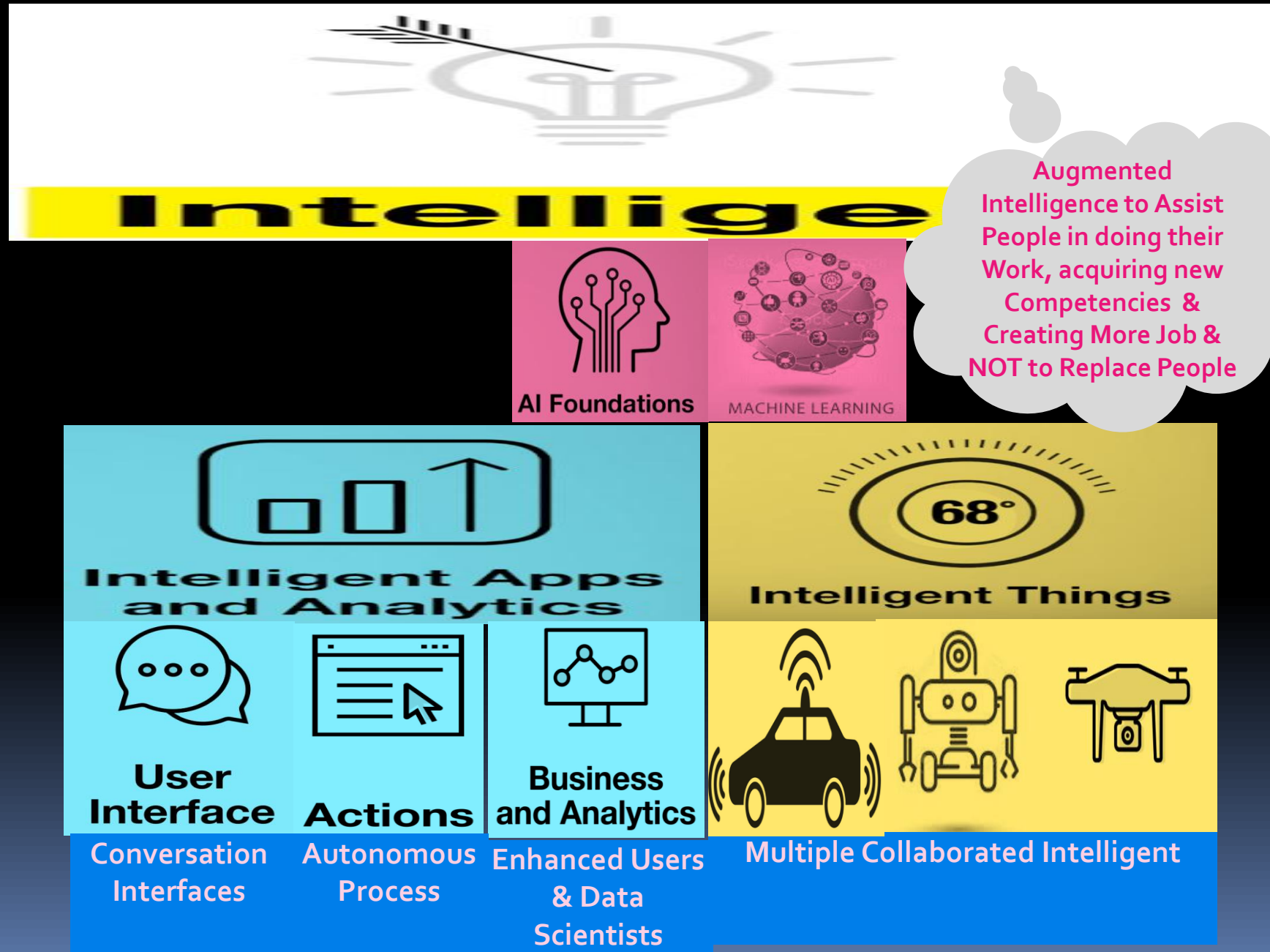
Intelligent

Digital



Mesh

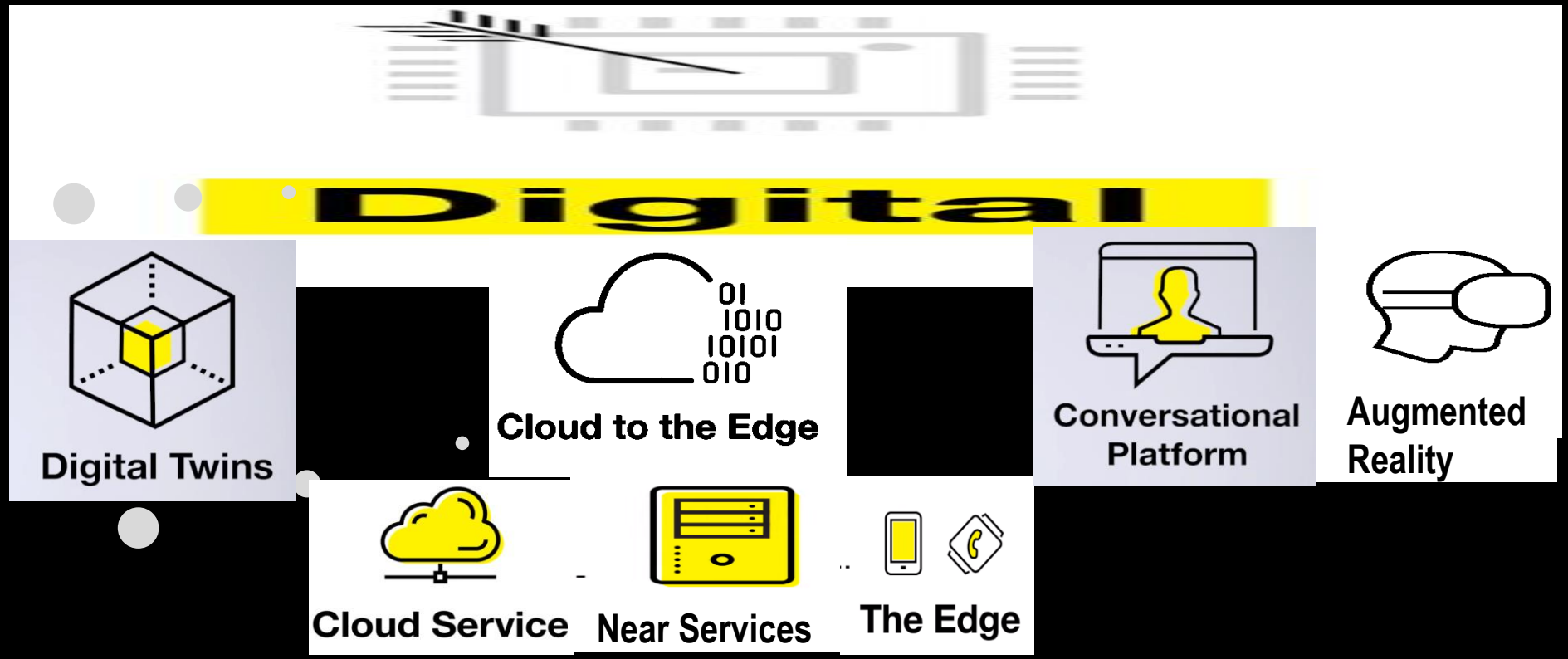
Top 10 Trends of Industry 4.0 Digitization



Top 10 Trends of Industry 4.0 Digitization

Merging Real World & Virtual World

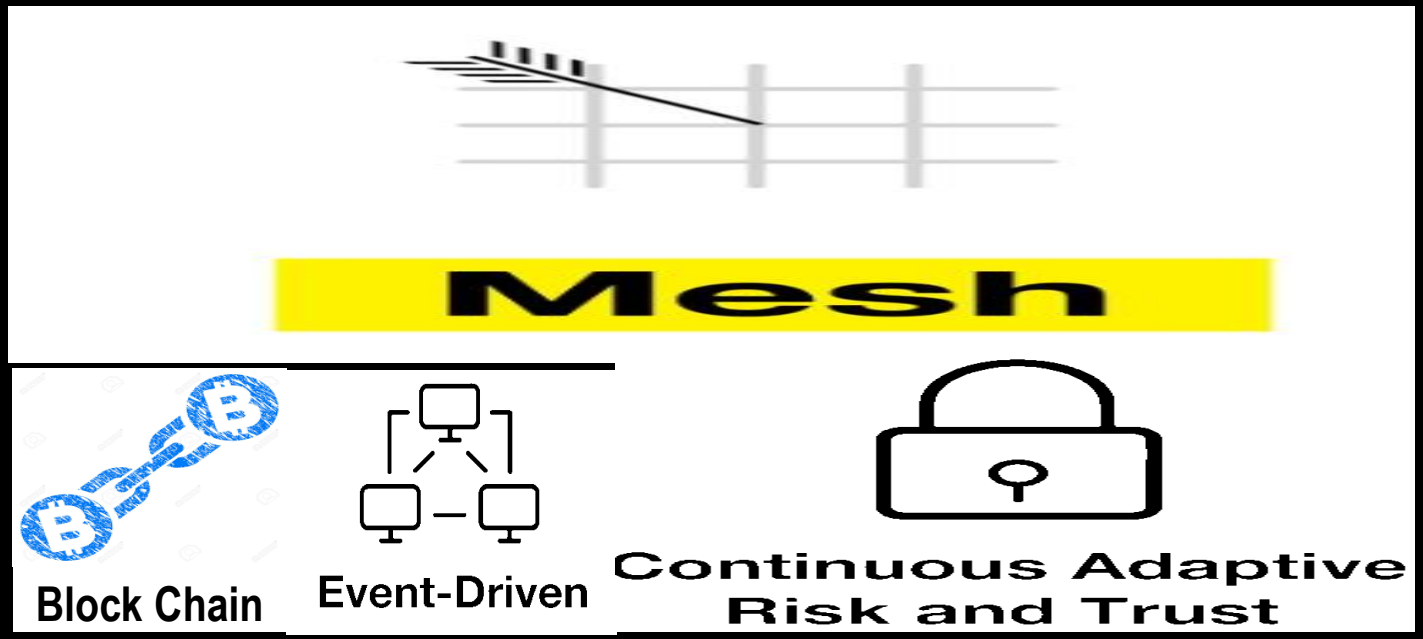
Distributed Computing



Digital Representation for Better Operation & Maintenance	Software ss a Service (Saas), Platform as a Service, (PaaS)	Gateway [Cloud Services & HHH/Mobile]	Mobility W/ HHM & Smart Phones	Users Interact W/ Systems

Top 10 Trends of Industry 4.0 Digitization

Dynamic Connection About people, Process Y

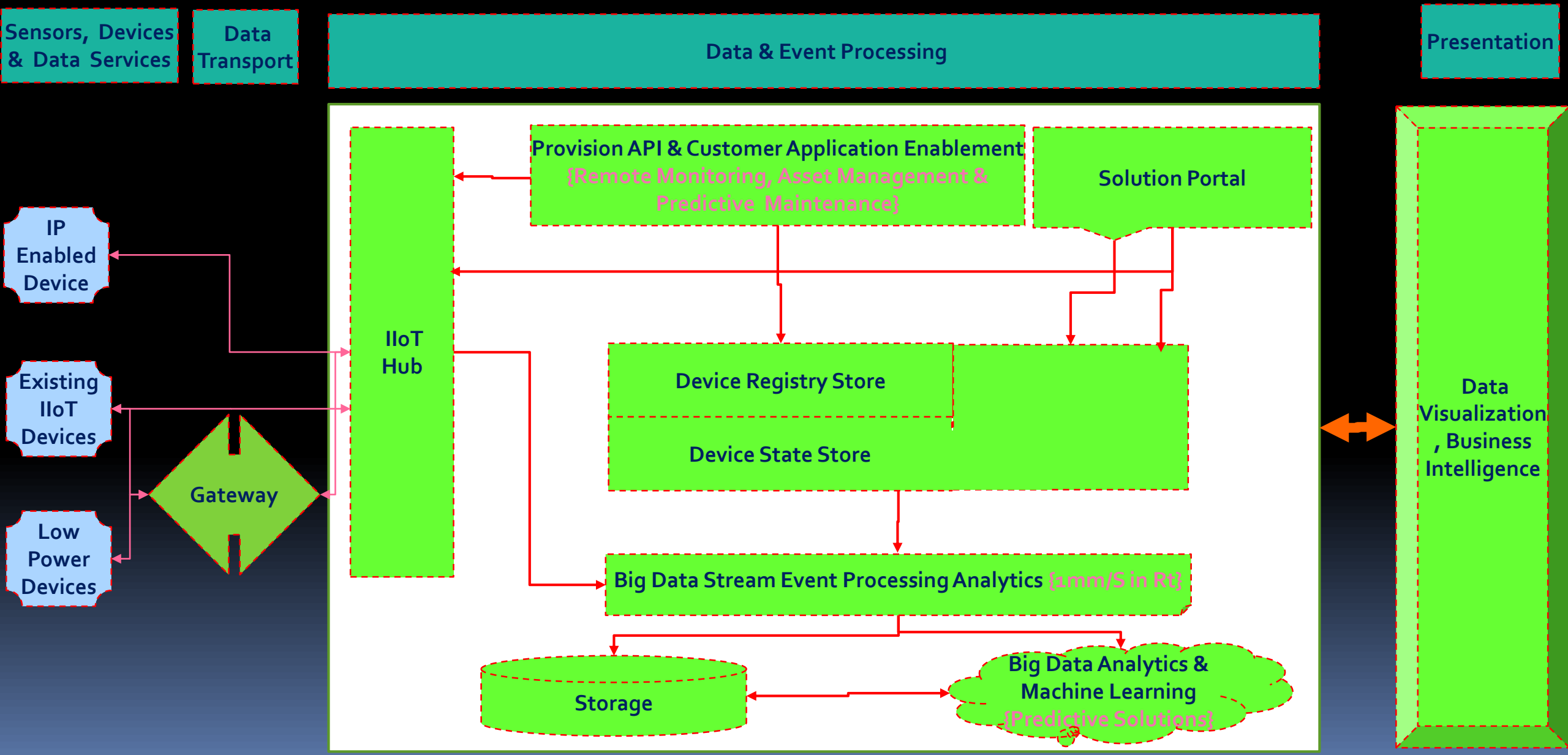


Shared distributed Ledger for cryptographic validation	Flexible Dynamic & Equal Event Driven & Request Driven Model	1) Build the Dev-Sec-Ops Model that includes Security between the Development and Operation 2) 2) Apply Deception Technology to detect, analyze, defend and proactively deceive attackers

Pilots can fly the camera-equipped UAVs to improve the following O & G maintenance, safety and industrial security applications:

1. Areas of the site to survey pipe rack and equipment for maintained and consecution where people have previously had to climb scaffolds or use cranes to survey the refinery .
2. Pipeline to inspect the integrity of pipeline and to capture any leakage
3. Refineries subject to fire or exposition to capture the extent of fire, damage, the direction of fire cloud and assist to mitigate the fire.

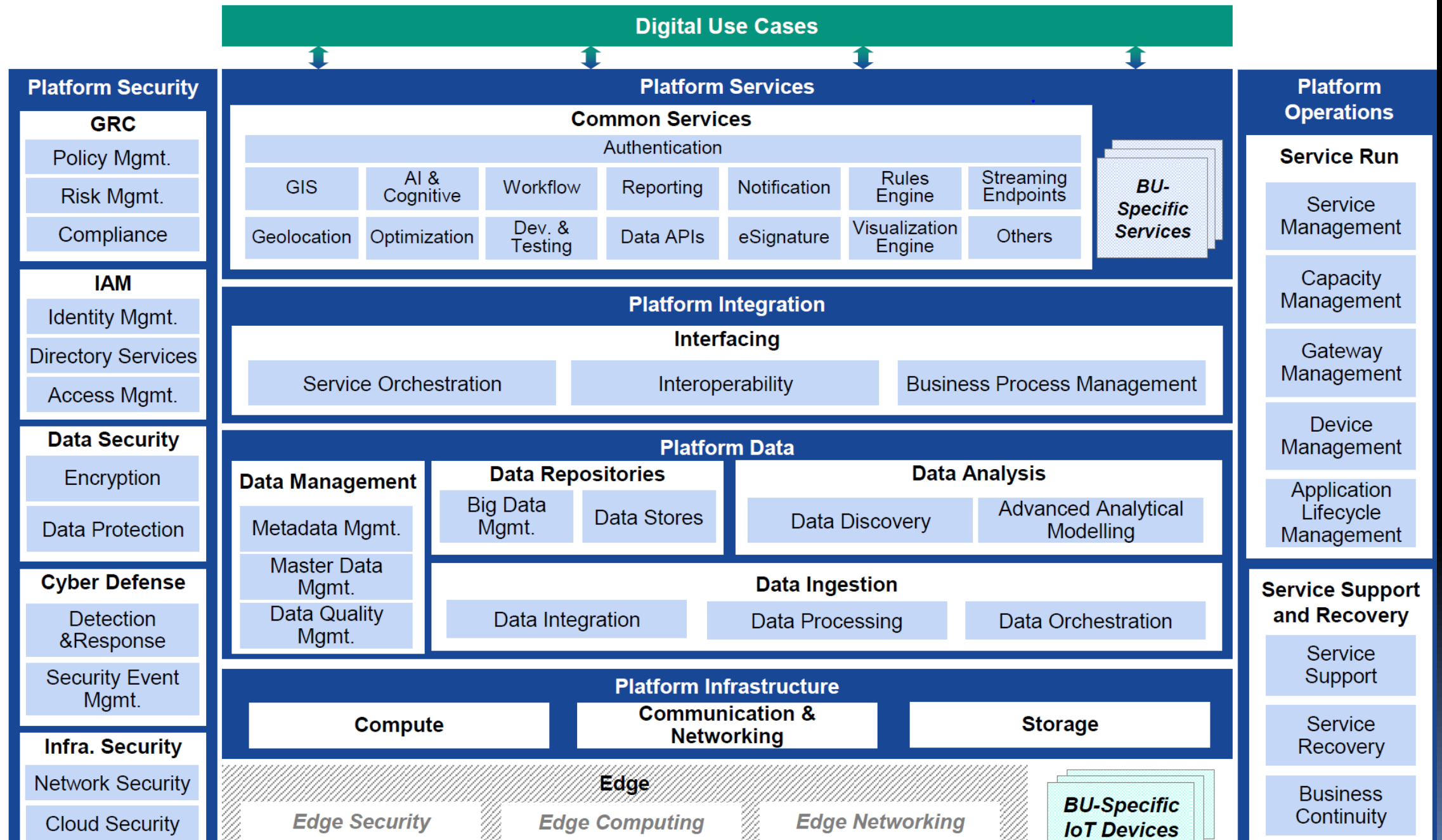
Architecture Platform for IIoT



Vendor Evaluation for the IIoT Platform

Company	Platform	IIoT Capabilities	Notable Acquisitions	Solutions &Use Cases
Microsoft	MS Azura, Iiot Suit	Offers Services across the Technology Stack for Building and managing Cloud Services that include Connected Devices, Storage, Analytics, take Actions and Business Intelligences	Mile IQ, Soliar, Mentain, Autix	Remote Monitoring, Predictive Maintenance, Business Process transformation
SAP	SAP Leonarde	Offers Services for to build, deploy and manage real - time and transaction data (e.g. streaming data} IIoT Applications on the Cloud	AlitScale, Plant one, Fedem	Asset Optimization, Connected Logistics & Connected Energy
SIEMENS	Siemense Mind Sphere	Offers Services for Industrial companies as open infrastructure based on SAP HANA and support digital services on the Cloud	Adapaco	
GE	GE Predix	Offers Services for GE Products and Services and updated the capabilities to offer open platform for 3rd party application developments (Apps)	Meridium, Smart Energy	Asset Performance, Automation & Brilliant Manufacturing
IBM	IBM Watson IIoT	Offers Services across the IIoT Value Chain with strong analytics capabilities	Weather CO, StrongLoop, Turven	Asset Performance, PLM & Contextualized Data

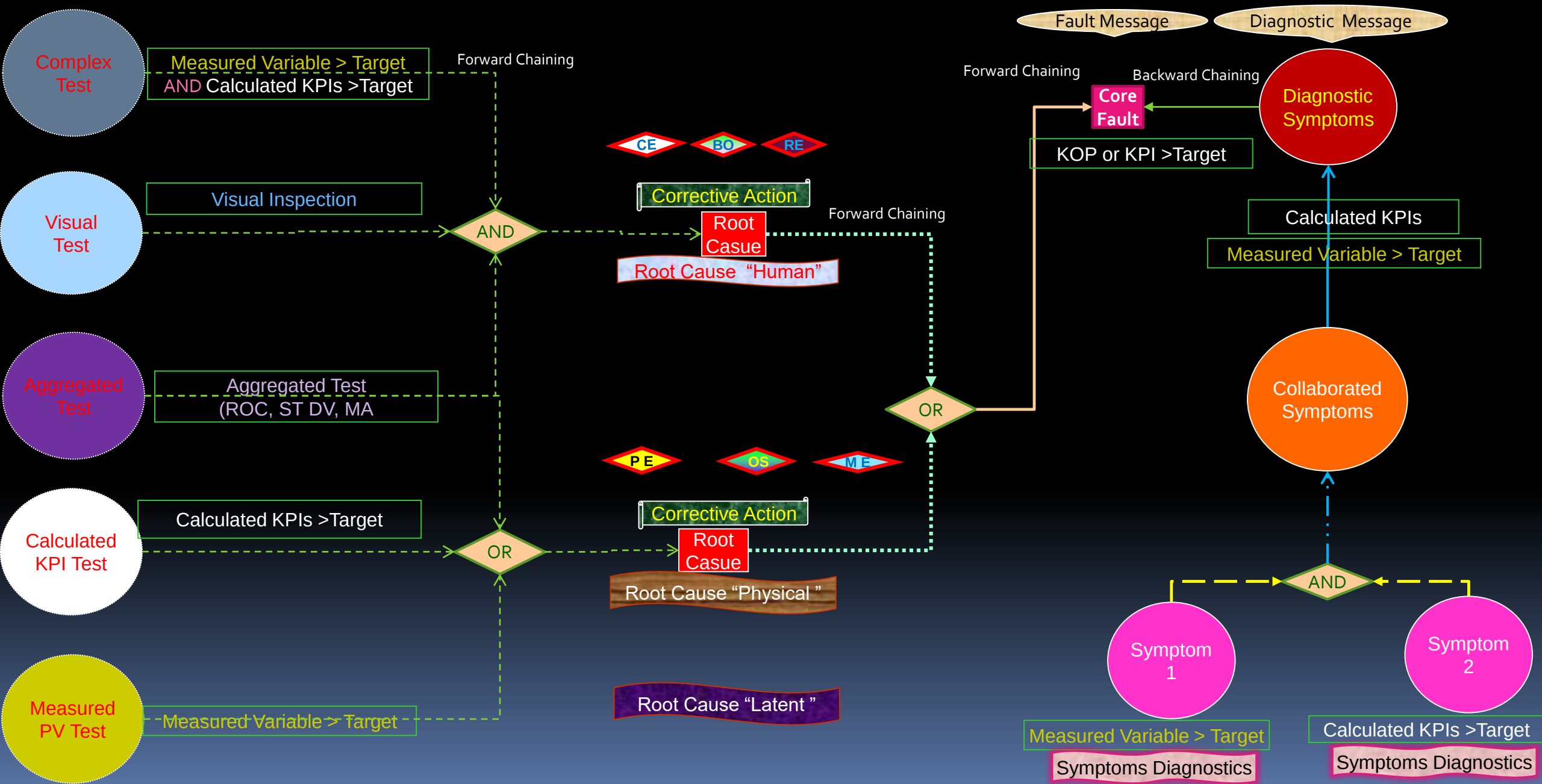
DIGITAL ARCHITECTURE FUNCTIONAL BLUEPRINT – LEVEL 2



Microsoft Azura Service Offering for IIoT

Connected Device	Storage	Autonomous Vehicles	Take Action
Event Hubs	SQL Data Base	Machine Learning	Azura Website
Service Bus	Table/Blob Storage	Stream Analytics	Power BI
External Bus	Documents Database	HDInsight	Notification Hubs
Cooperative Control	External Data Sources	Data Factory	Mobile Services
			BizTalk Services

Causal Fault Identification Modeling



Linear & Non Linear Regression for Data Analytics

- **Provide Modeling Techniques**

The Software Platform shall provide the following modeling techniques using detailed process or equipment engineering data:

1. Calculation Library & Arithmetic Algorithms
2. Thermodynamic Library
3. Mathematical Modelling
4. Logical & Conditional Algorithms

- **Provide Linear Regression Techniques**

The Software Platform shall provide the following Linear Regression techniques using historical operating data:

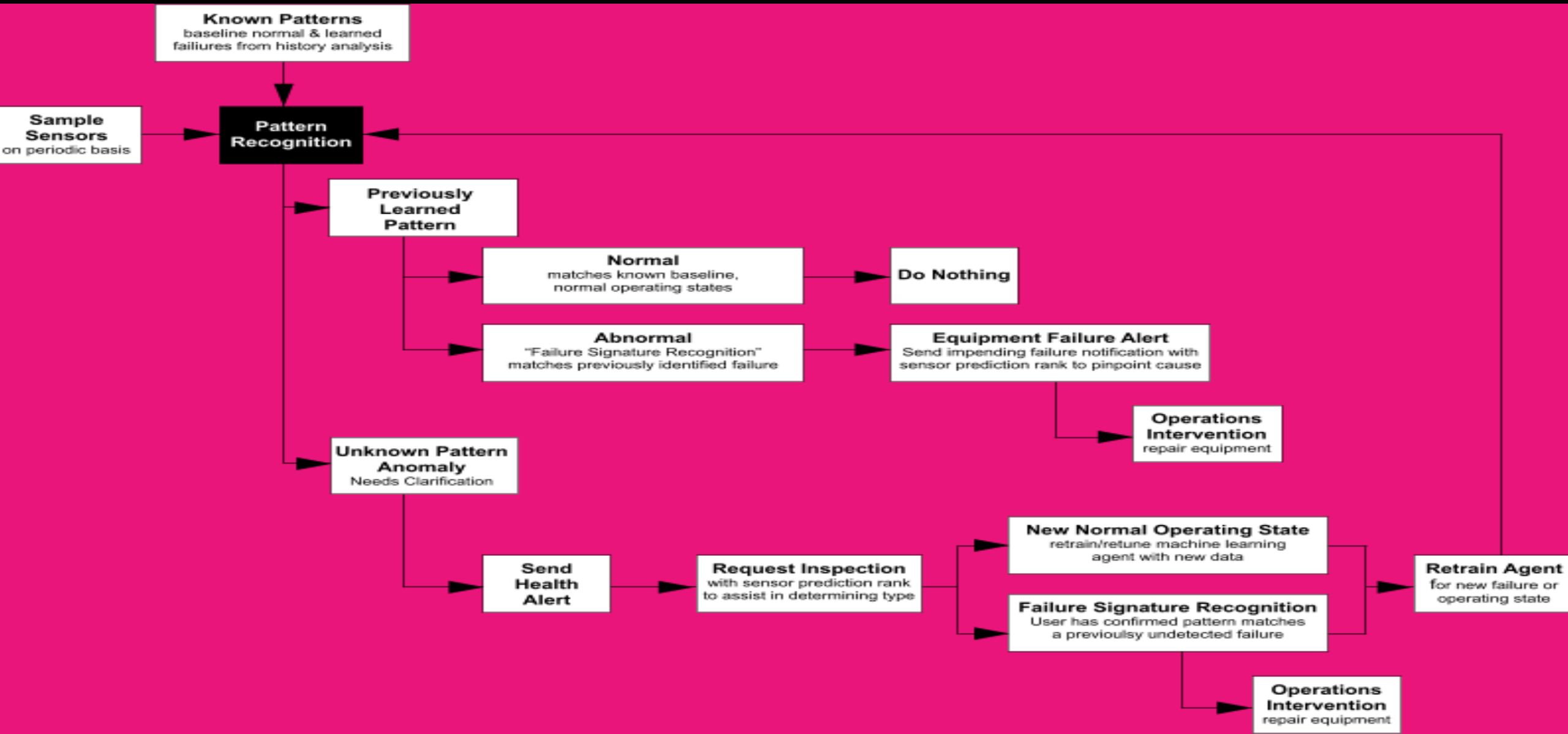
1. Statistical
   a. Observations Blocks
   b. Univariate & Multivariable Techniques
   c. Data Consistency
   d. Partial Least Square (PLS)
   e. Principal Component Analysis (PCA)
   f. Autoregressive Integrated Moving Average (ARIMA
2. Support Vector Network (SVN)
3. Gaussian Network Models (GNM)
4. Vector Space Model (VSM)

- **Provide Non-Linear Linear Regression Techniques**

The Software Platform shall provide the following Linear Regression techniques using historical operating data:

1. Expert Rule Engine
2. Temporal Reasoning
3. Artificial Neural Networks (ANN) and Deep Learning
4. Genetic Algorithms.

Machine Learning for Data Analytics

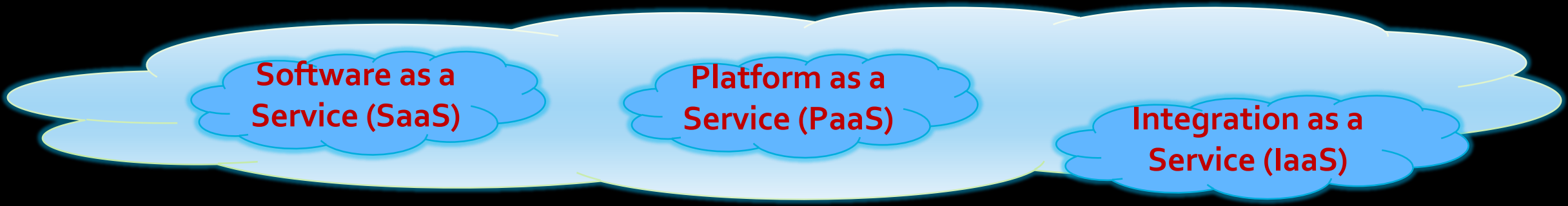


Cloud Computing, Services & Architecture

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. **[NIST]**

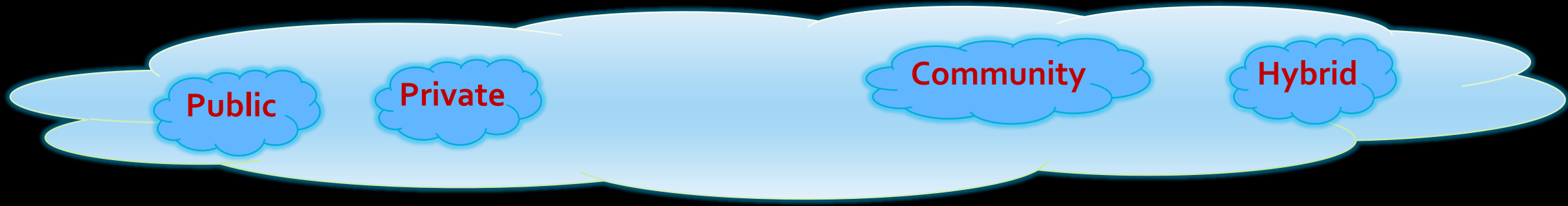
Cloud services are self-contained units of functionality or IT capability offered through cloud computing to its consumers. Cloud service offerings range from managed units of computing infrastructure (such as storage) through platforms (database, web containers, etc.) all the way to complete software solutions (e.g. finance, HR, Asset Management, Modeling & Optimization, etc.)

Cloud Computing, Services & Architecture



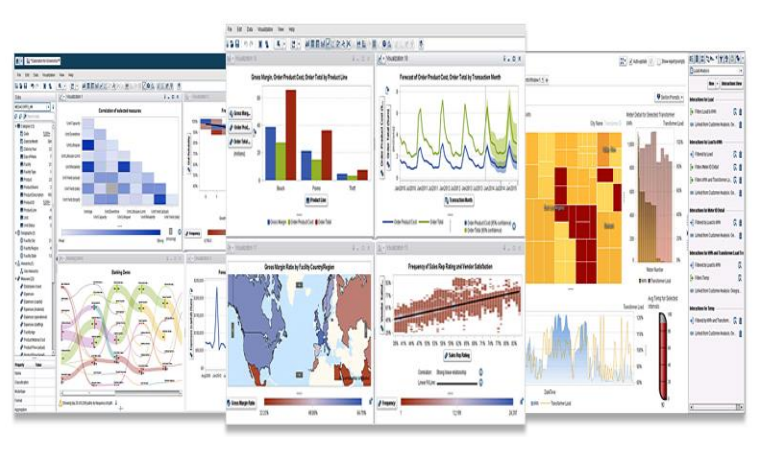
Cloud Services	Descriptions
Software as a Service (Saas)	The Software Applications shall be deployed and run on the Provider Cloud Infrastructure without the need of the User to install any software in their workstations in order to be able to access these functionalities. User Can access the software via the web browser. Example [Ex. Visualization, or HR & Finance Applications].
Platform as a Service (Paas)	The Software Applications shall be deployed as a consumer-created, or acquired applications created **using programming languages and tools supported** by the Provider and require running plant specific models. Example [Ex. Reconciliation, Planning, Scheduling]. **The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations.**
Integration as a Service (IaaS)	Provide **fundamental computing resources** where the consumer is able to deploy and run **arbitrary software** and perform horizontal and vertical Integration among ERP and MOM Applications as a service, in which the integration is done at the metadata level and not hardcoded, allowing for exchanging data sources without impacting the preconfigured and engineered solutions (e.g. exchanging data among two historian databases
Other Services	**Security as a Service (SaaS,), business Process as Services, Infrastructure as a Services, Governance as a Services**

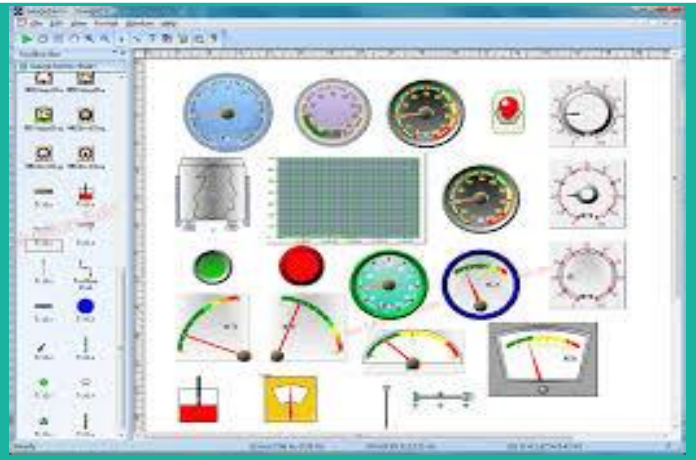
Cloud Computing, Services & Architecture

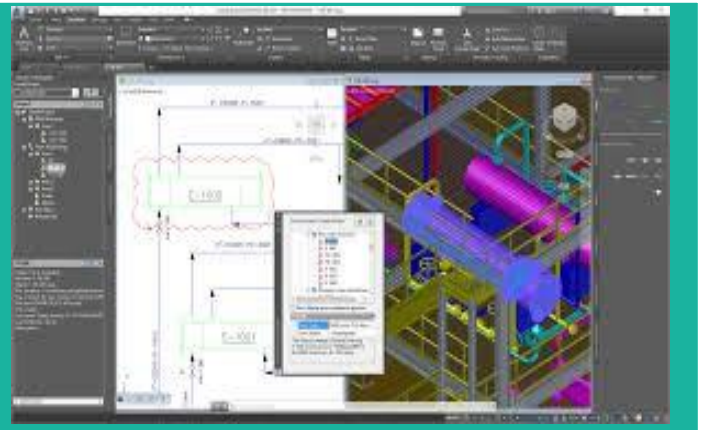


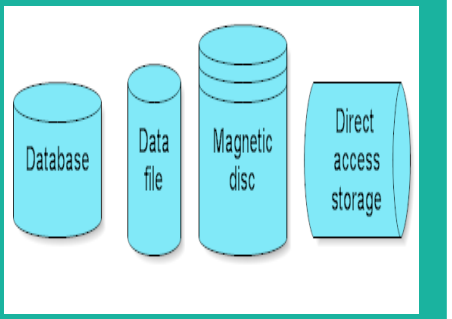
Cloud Types	Descriptions
Public	The Cloud Computing is owned by **Service Provider such as SAP,ORACLE, IBM, Amazon, MS, GE, Honeywell,** and the Organization is making it available to the general public as Cloud Service
Private	The Cloud Computing is owned and Operating by **Users such as Ministry of Petroleum, Cairo University, ENPPI, ERC** and the Organization.
Community	Supports a specific community that has shared concerns
Hybrid	Composition of two or more clouds

Visualization & OLAP Business Intelligence









Visualization

Cloud Computing, Services & Architecture

Communication & Collaboration

Queuing & Computing

Applications & Solution

Data Analytics

Security

Content & Visualization

Time Series Databases

Relation Databases

Object Storage

Block Storage

Cloud Gateway & Messaging Bus

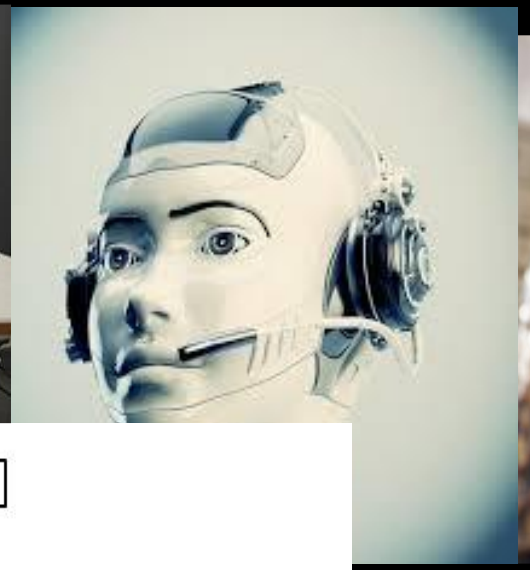
IIoT Sensors in the Field

Smart Phone

Manufacturing Operations Management

Embedded Sensors in Equipment


Dassault
Training
Academy
Dassault
Training
Academy



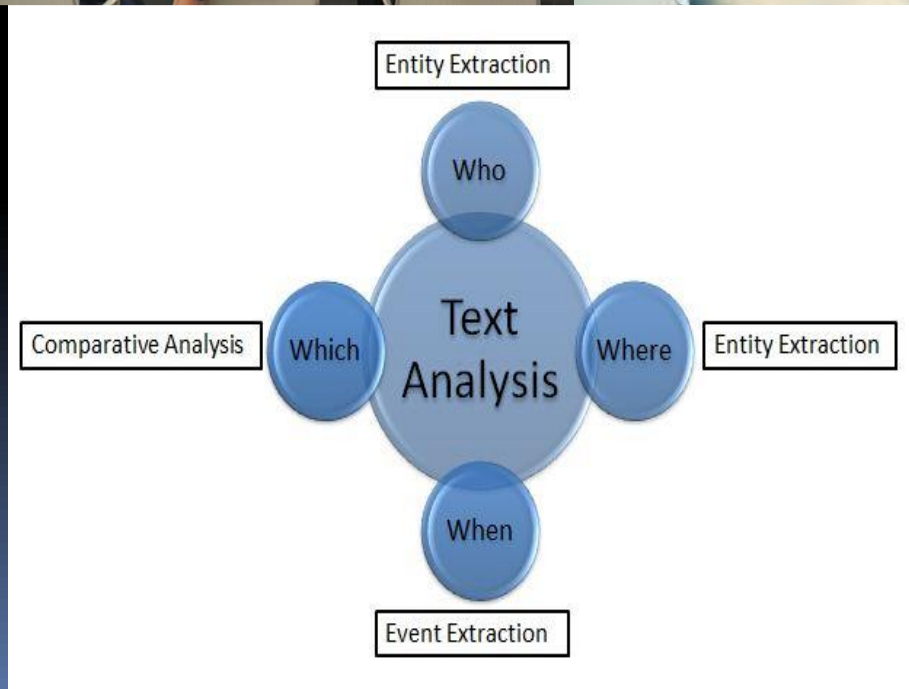
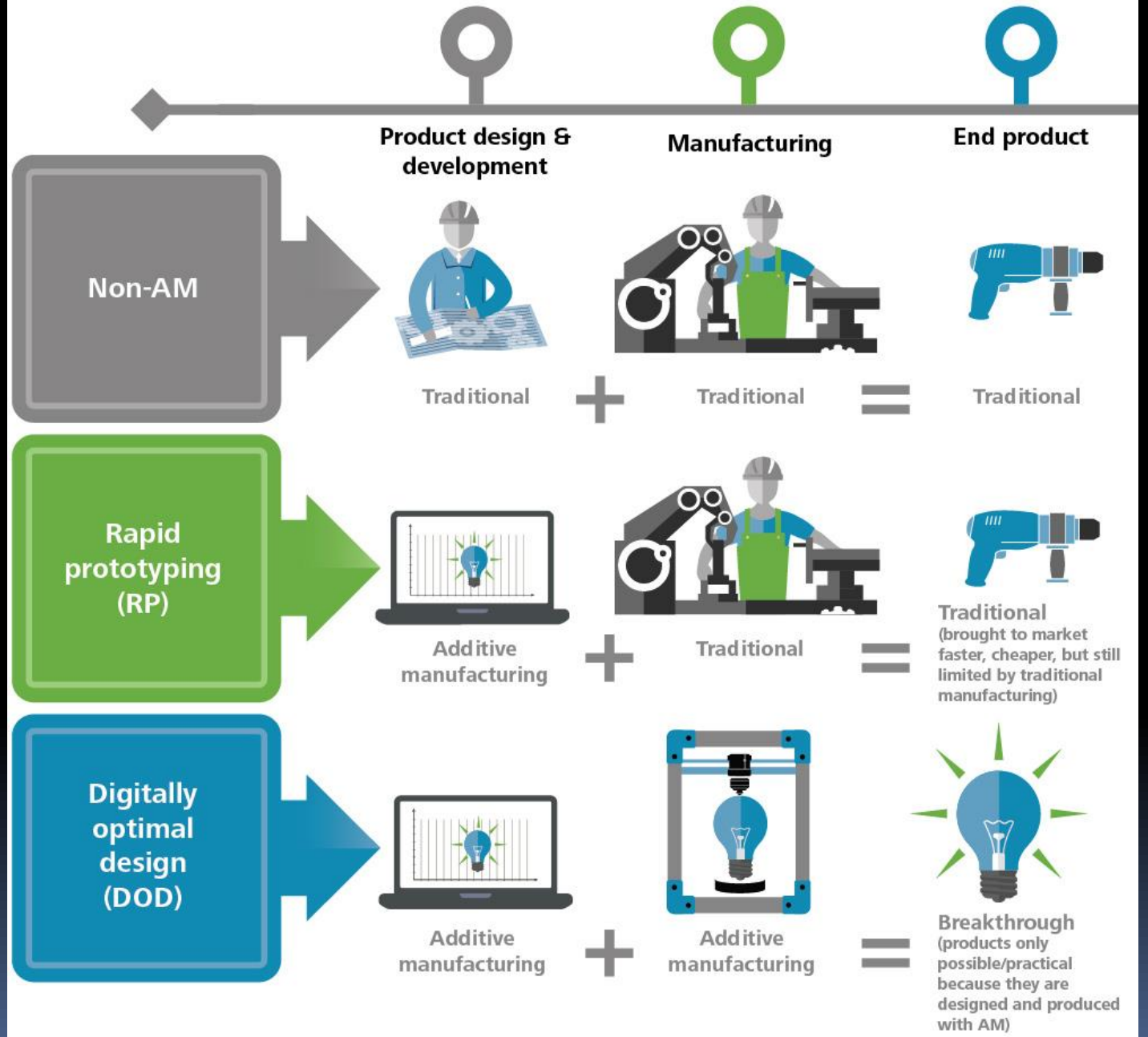

Entity Extraction
Who
Text Analysis
Comparative Analysis
Which
Where
Entity Extraction
When
Event Extraction

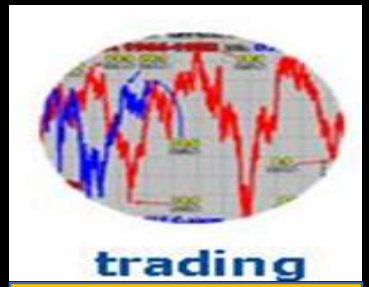
Figure 2. Comparison of non-AM, RP, and DOD product design and development processes



Graphic: Deloitte University Press | DUPress.com

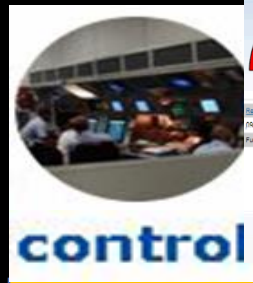
SOA Physical Architecture

Asset Perf. +Inspect.
RBI, AIM & Meridium

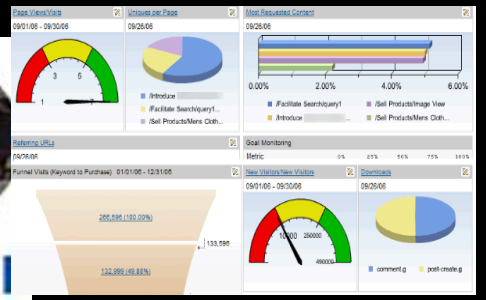


Root Causes & Exp. Sys
Gensym + Optegrity

Leading/Lagging & Safety KPIs
Hysis + PI ACE



APC & CPM
Matrikon CPM



Presentation
RtWebParts/XHQ

Enterprise Service Bus

Asset Virtualization
INOVx

Plant Maintenance
SAP-PM

LIMS
LabWare

Historian
PI/Documentum

Shared Services

- Security
- Registry
- Repository
- BPM
- Integration
- Data

“Digitization Table of Contents”

MOM/ERP Logical Model

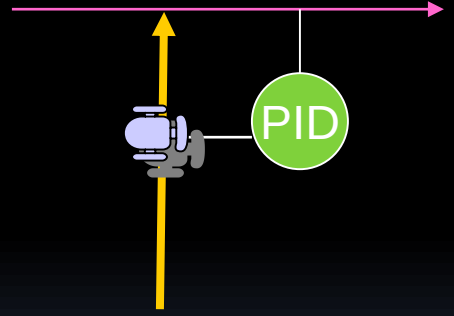
"Open Loop with Slow and Questionable Decisions

"Simulate Closing the Loop for Fast and Reliable Decisions

Saving
$

Decisions

Verification



MOM Algorithms, Models & Artificial Intelligence

MIS

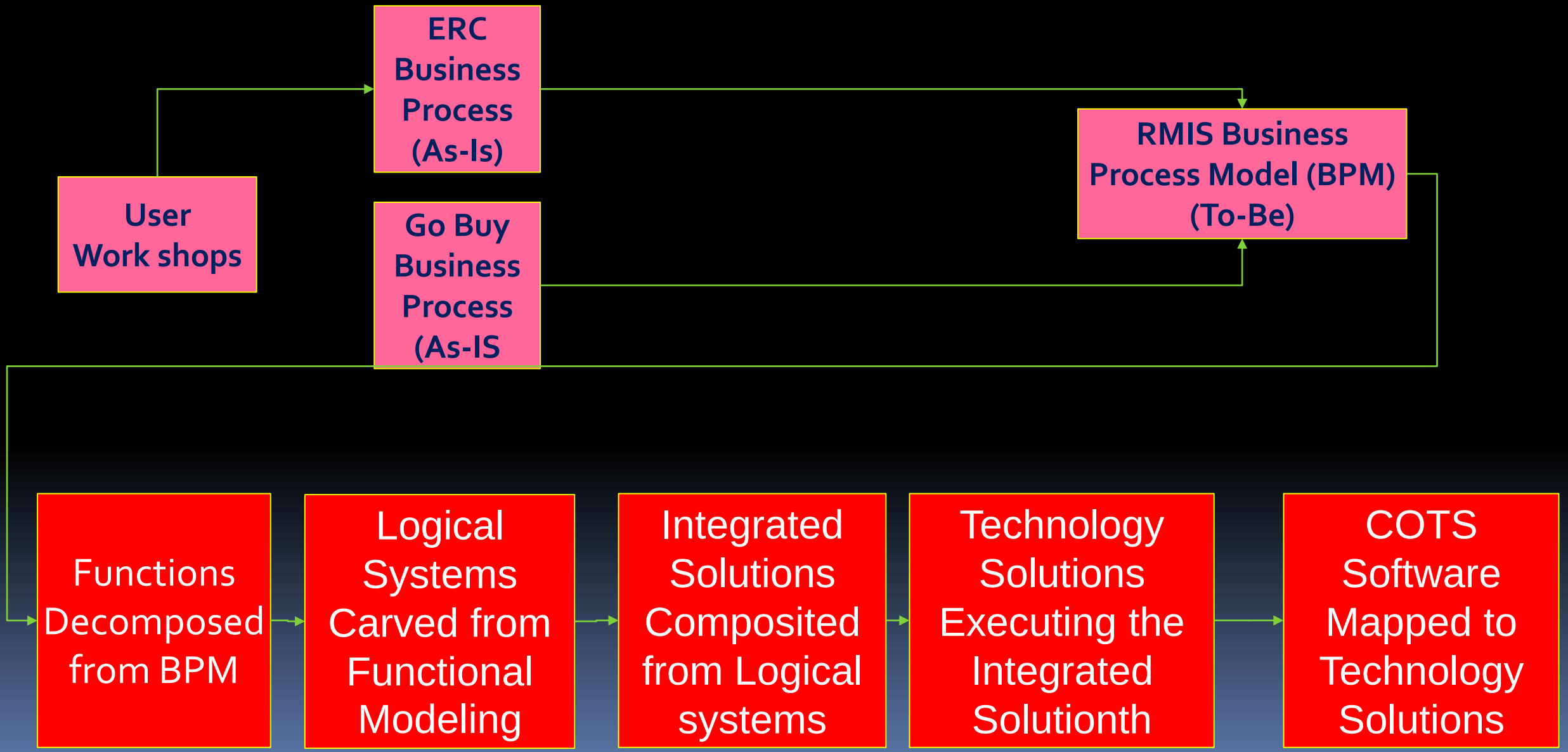
Information

User Interface

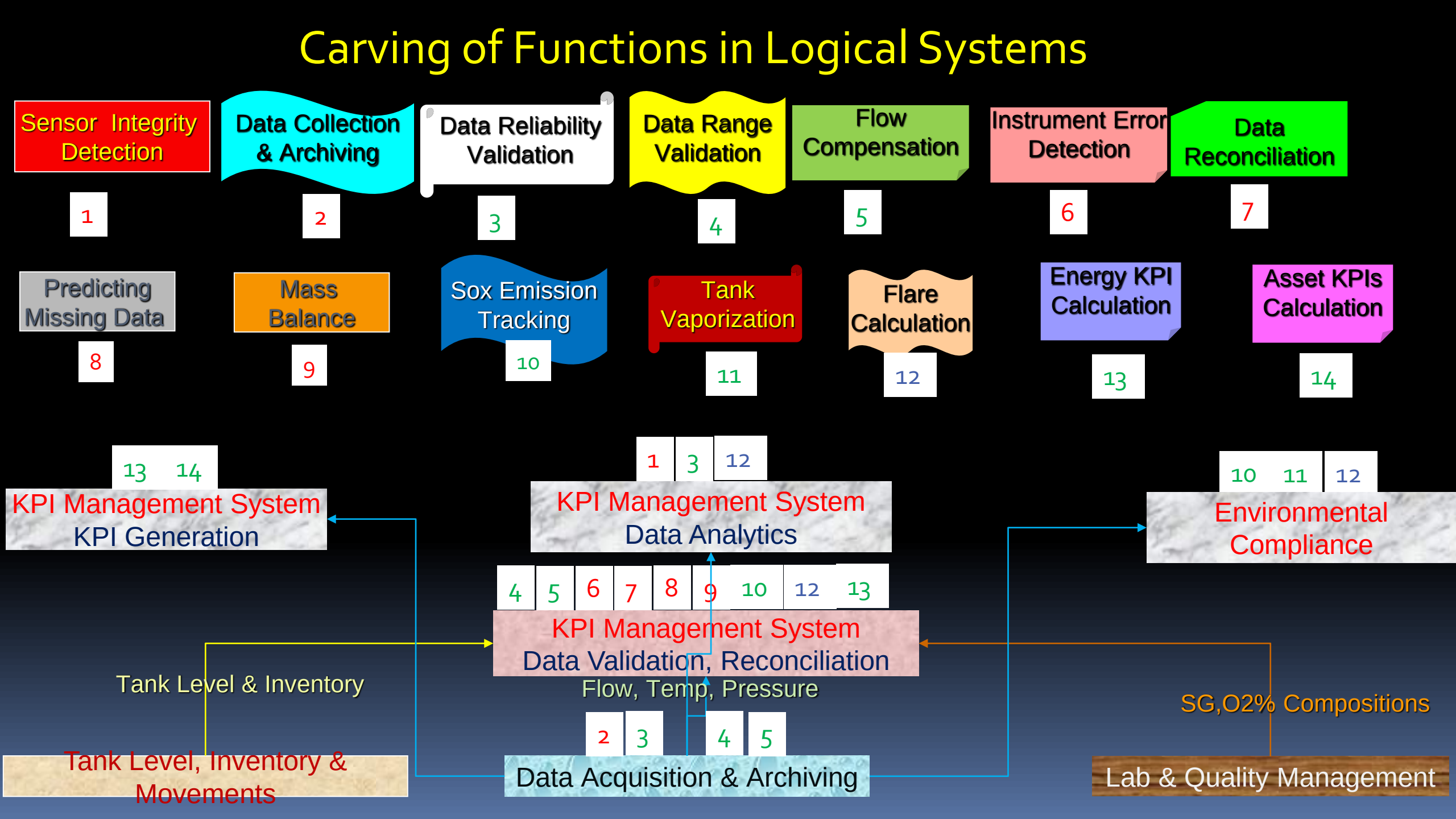
Data Visualization

Decision Generation

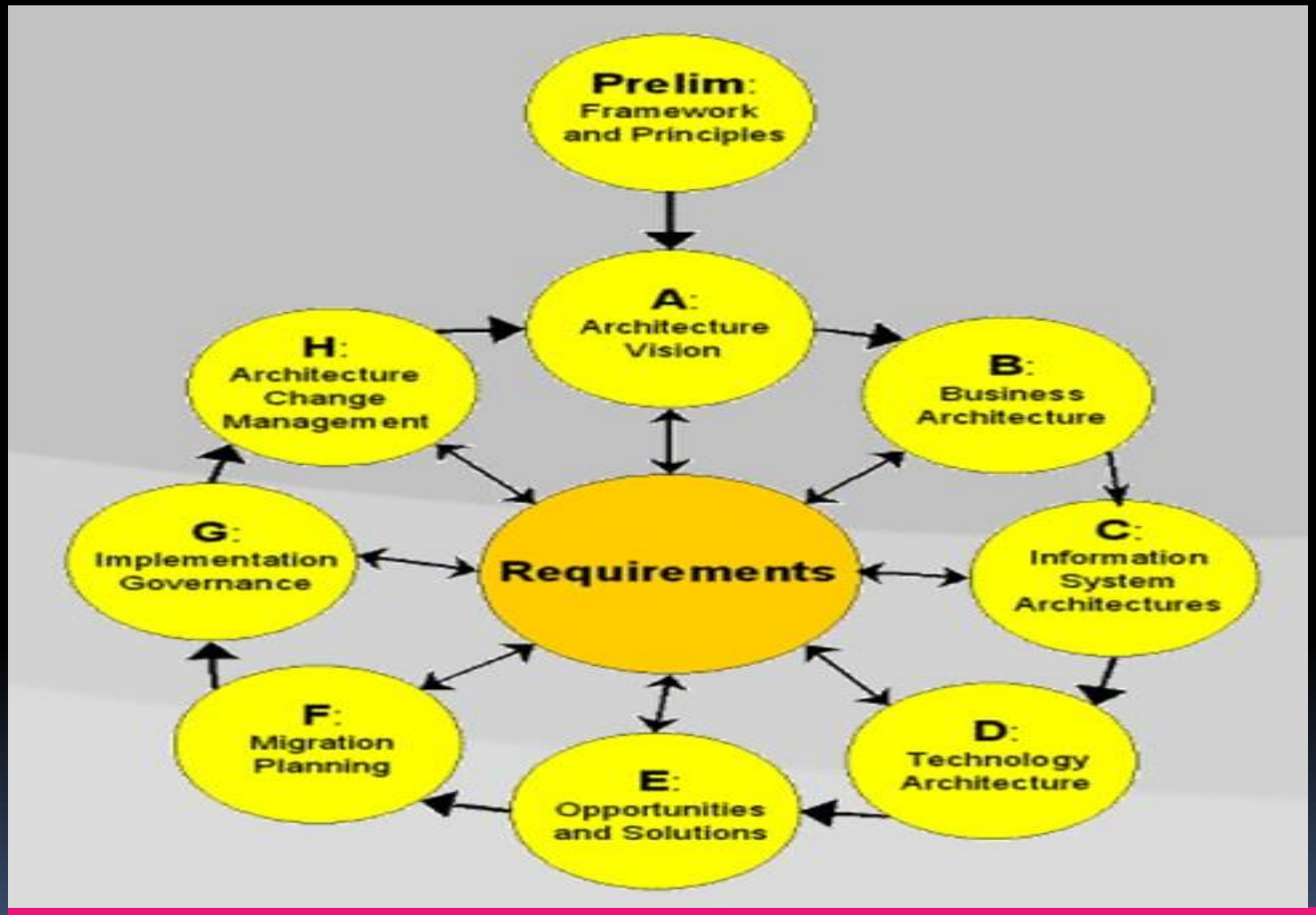
MOM & ERP Design Methodology for Business Process, Technology Solutions & Integrated Solutions



Carving of Functions in Logical Systems



Solution Methodology



Structure of the TOGAF Architecture Development Method (ADM).[1]

The Open Group Architecture Framework (TOGAF)

Engineering STDS	Integrated Solution	COTS Platform	Descriptions and
ISA 95	All	All	Design of Manufacturing Operation Management (MOM) needed for the design of business processes, decomposed functions, integrating requirements and integration architecture, data models and messaging service model.
ISO TC 184	All	All	Standardization & Integration for design, sourcing, maintenance and disposal of Automation system products and their associated services for areas such as industrial safety, information technologies, multi-media capabilities, and multi-modal communication networks.
ISA 88 & 106	Data & KPI archiving, Work Order Execution & Failure Analysis	All	Functional hierarchy {Ex. Enterprise, Site, Area, Plant, Unit, Asset, Device}
ISO 9001, 9002, 22400	Asset and Energy KPIs, Compliance and Performance Tracking	KPI Generation	KPI Identification, Formula & Integration Architecture for Quality Management System (QMS) and r Manufacturing Operation Management include as a minimum Failure, Utilization, Availability, Effectiveness, Efficiency
API 2517 2518 & 2519	Plant Wide Mass Balance, HC Losses & Emission Tracking	Data Reconciliation & Environmental Management	Evaporative Loss from Fixed Roof Tanks

Mapping of Engineering Standards with MOM Solutions & COTS

Engineering STDS	Integrated Solution	COTS Platform	Descriptions and
API 689 & ISO 14224	Work Order Execution, Failure Analysis & Root Causes	Maintenance, Reliability & KPI	Design of reliability and maintenance business processes and integrated solutions.
API 691	Reliability Management Risk Based Machinery Management (RBM	Reliability & Risk	Design of risk and reliability business processes and integrated solutions.
ISO 18435	Reliability KPIs, Bad Actors & Predictive Maintenance	Reliability & Condition Based Maintenance	Define Integration model and interfaces with operating and environmental information.
SAE AIR 5871	Proactive Machinery Prognostics & Predictive Maintenance	Reliability	Turbine Reliability Management prognostics to gas turbine
IEC 61511	Reliability of Safety Instrumented System (SIS)	Reliability	Define operation and maintenance planning for the SIS
The ISO 13381	Proactive Machinery Prognostics & Predictive Maintenance	Equipment Health Management	Identify Latent loss of functions and incipient failures

Mapping of Engineering Standards with MOM Solutions & COTS

Engineering STDS	Integrated Solution	COTS Platform	Descriptions and
API 580	Risk Based Inspection (RBI)	Integrity/RBI	Scheduling for On Stream Inspection (OSI)
API 571	Operation Integrity Constraint Management	Integrity	design of integrity management business processes and integrated
API 579	Fitness-For-Service (FFS)	Integrity	Define Integration model and interfaces with operating and environmental information.
API 754	Process Safety KPIs & Near Miss	Process Safety Management	4 Tiers of Process Safety and Near Miss KPIs needed for the design of process safety management business processes and integrated solutions.
API 584	Data Visualization	Integrity Operating Window	Design of performance anomalies, abnormal situation management, compliance management business processes and integrated solutions
ISO 17025	Quality Certification	Lab Management Information System (LIMS)	Define the requirements of testing and calibration for the lab

Mapping of Engineering Standards with MOM Solutions & COTS

Engineering STDS	Integrated Solution	COTS Platform	Descriptions and
NIMOSA	Operation Task Management, Maintenance Work Order Execution & Reliability Management,	Operation Task Management, Maintenance Work Order Execution & Reliability Management	Defining data repository for asset management and combine maintenance information/data exchange standards W/ real-time communication (OPC) to work collaboratively for the selection of the best-of-breed or preferred vendor for each task {Ex. equipment condition monitoring that handles tracking of asset data and conditions, and the computerized maintenance systems that handles the maintenance work orders). Defining Diagnostics-Extensible Markup Language (XML) that defines a format for transferring diagnostic information
MESA	All	All	Manufacturing business strategies, best practice processes to achieve those strategic objectives, and the use of enterprise solutions to support processes, measure and accelerate business success with focus on the following:

Digitization {Industry 4.0 of Today, Industry 5.0 Tomorrow}

- Provide **Simple** Solutions that focus on knowing the facts and understanding the deep issues of the problem and finds the simplest way out of it and NOT **Simplistic** Solutions that jumps to conclusions without actually bothering to take the time to understand
- Provide **Systematic** Solutions that focus on step-by-step procedures and unfold gradually constituting a System and NOT **Ad-hoc** Solutions that does not represent a careful planned Solutions
- Provide **Systemic** Solutions that focus on systemwide analysis and or set the components deeply in the System and NOT **Compartmental** Solutions that does not represent islanded islands of components

ANSI/ISA – SP 95 Technological Model

DCS Console

DCS H/ W & S/W

Control S/W

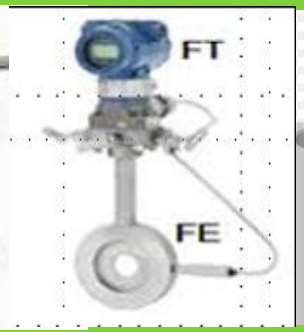
CAD H/W & S/W

Computer H/W & S/W

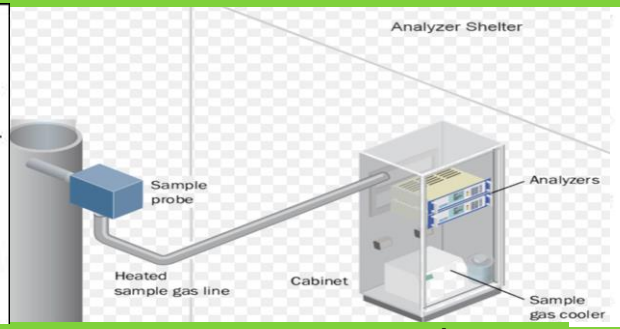
Document Scanner

Plant Automation System

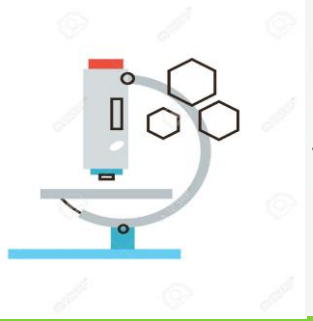
Thermocouples



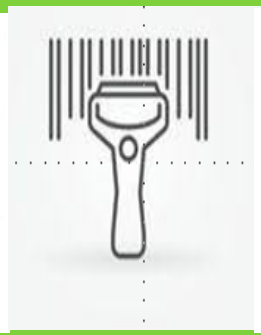
Transmitters



On-Line Analyzers

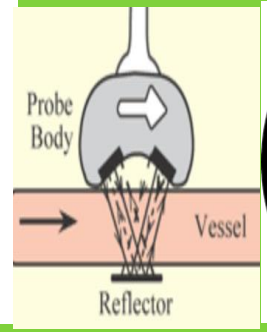


Lab Instruments



Bar Code

RFID



Ultrasonic

CCTV

Sensors, Transmitters, Actuators, Field Instrumentation & Mobility

ANSI/ISA – SP 95 Technological Model

Doc. Mangmt. S/W

Finance S/W

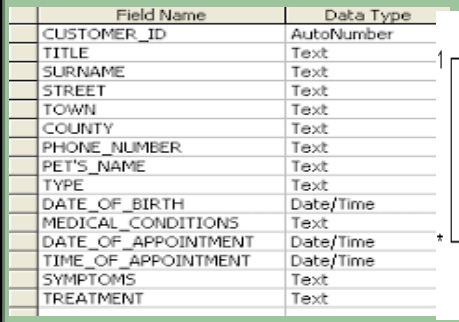
Maintenance S/W

Warehousing S/W

Human Resource S/W

Supply Chain Magmt. S/W

Enterprise Resource Planning & Supply Chain Mgmt.



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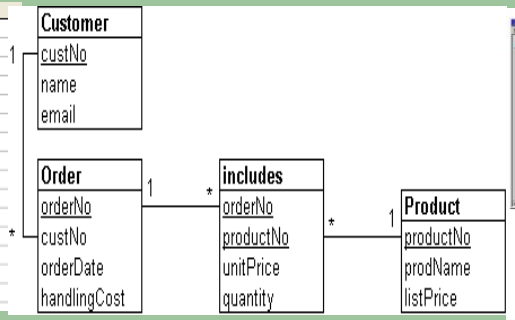
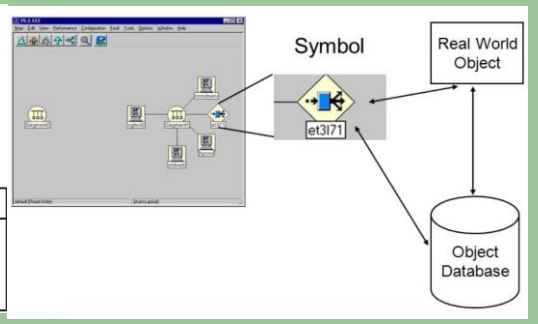
TITLE	Text
SURNAME	Text
STREET	Text
TOWN	Text
COUNTY	Text
PHONE_NUMBER	Text
PET'S_NAME	Text
TYPE	Text
DATE_OF_BIRTH	Date/Time
MEDICAL_CONDITIONS	Text
DATE_OF_APPOINTMENT	Date/Time
TIME_OF_APPOINTMENT	Date/Time
SYMPTOMS	Text
TREATMENT	Text

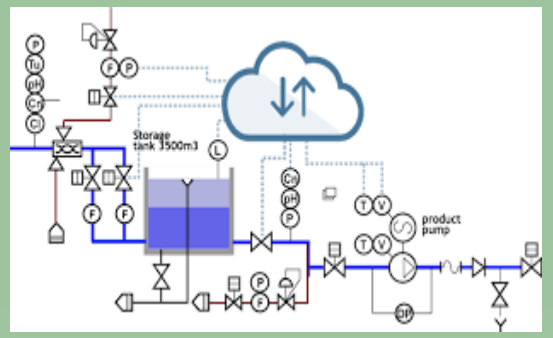
Flat Files Database



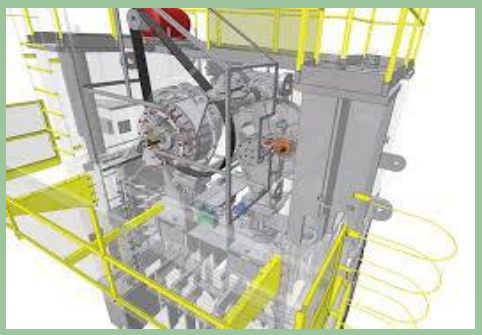
Relational Database



Object Database



Intelligent P &ID s



3 D Modeling

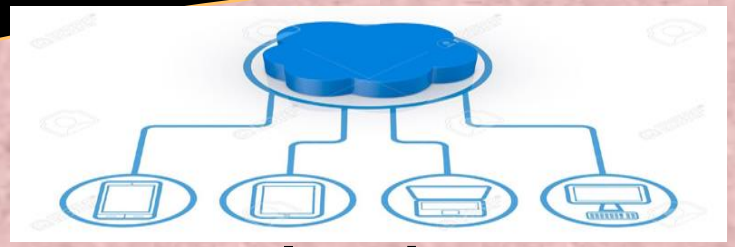
Manufacturing Operations Management

Plant Automation System

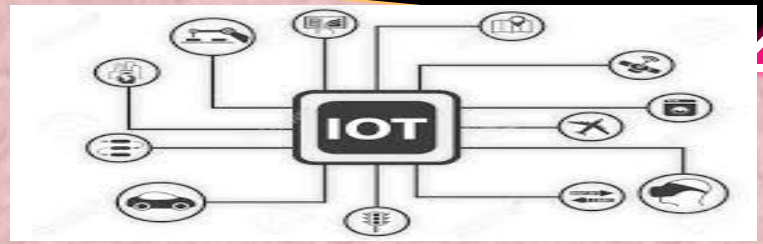
Sensors, Transmitters, Actuators, Field Instrumentation & Mobility

Industry 4.0 Logical Solution with Cloud Computing

Visualization



Cloud Computing



& IIoT.

Business Planning & Supply Chain Mgmt.

Manufacturing Operations Management

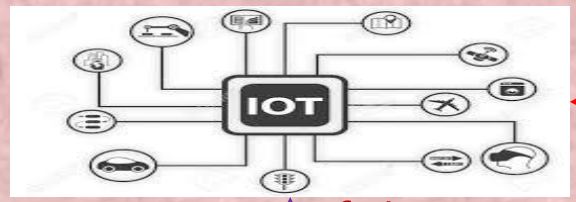
Process Automation System

Sensors, Transmitters & Mobility

Cyber Security

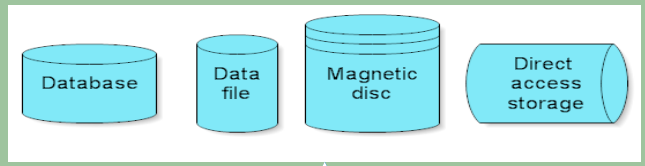
Integration

Industry 4.0 Mobility, DCS, MOM & Industry IoT Solution Solutions



Industry Internet of Things

Maintenance S/W



Flat & Relational Database S/W

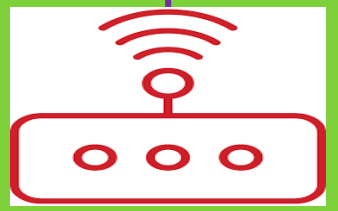
DCS

Mobiles

Hand Held Monitors

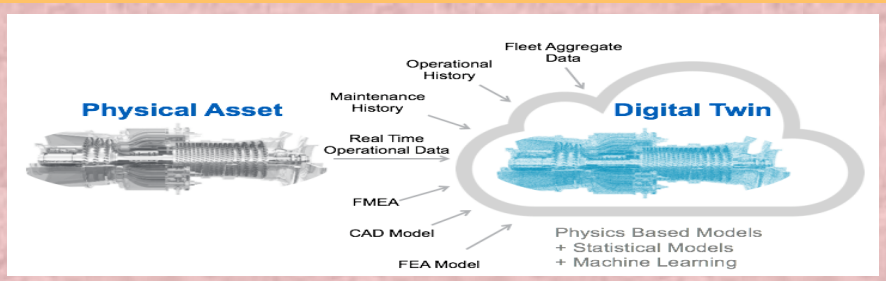
Unmanned Areal Vehicle (UAV)

Wireless Transmitters



IIoT Sensors

Industry 4.0 Simulation, Data Analytics, AI, IIoT, Cloud & Digital Twin Solutions

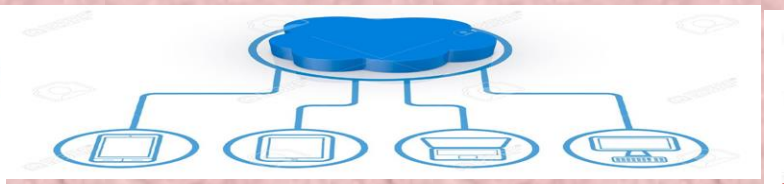


Digital Twin

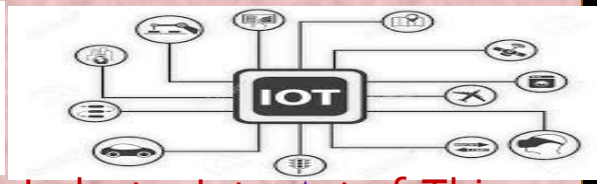
Big Data

Data Analytics

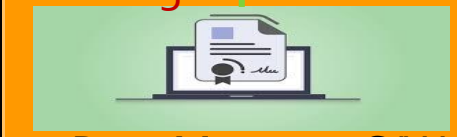
Artificial Intelligence



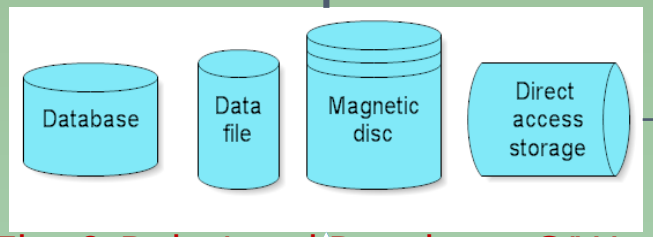
Cloud Computing



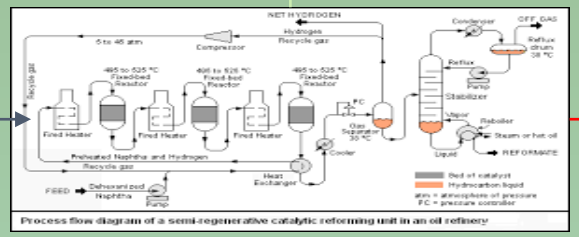
Industry Internet of Things



Doc. Mangmt. S/W



Flat & Relational Database S/W



Flow sheeting Modeling S/W

Modeling & Optimization S/W

Mobiles

Hand Held Monitors

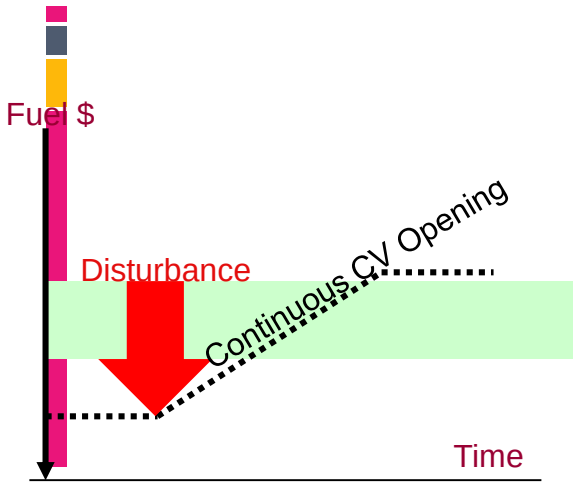
IIoT Sensors

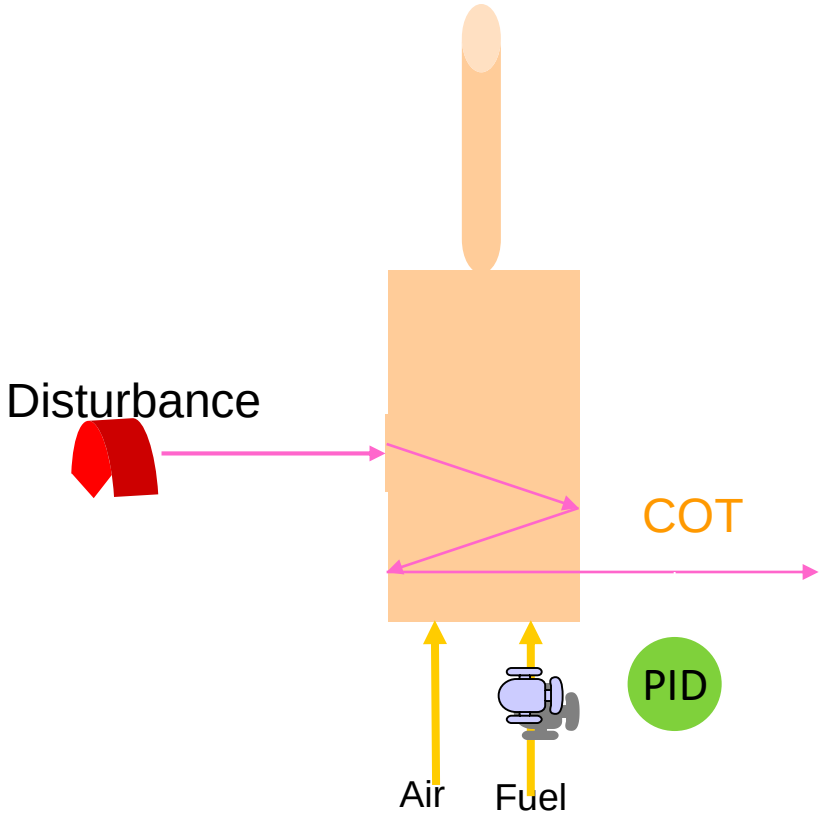
MOM Making Improvement

Before MOM

Reactive Control by DCS

- Response to Disturbance
- Bring COT To Targets
- Increase Control Valve Opening
- Increase Fuel Consumption





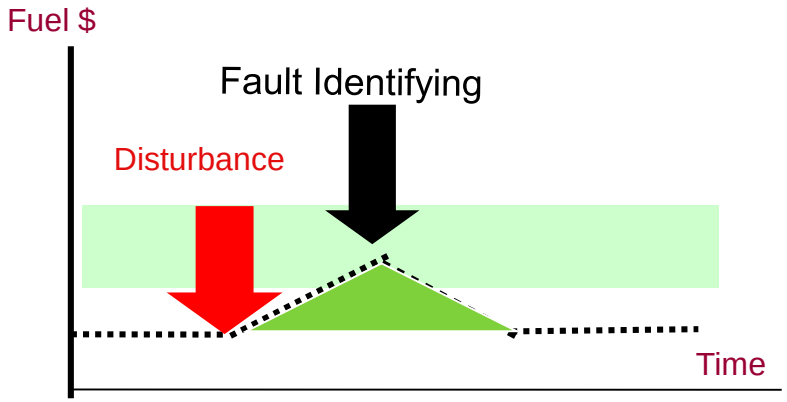
Reliable Decisions = $ Benefits

- Air or Stack Dampers Stuck Open & Wrong Air SP
- Cyclic Combustion, High Draft and Bad Insulation
- Tube Fouling, Poor Heat Transfer & Coking

After MOM

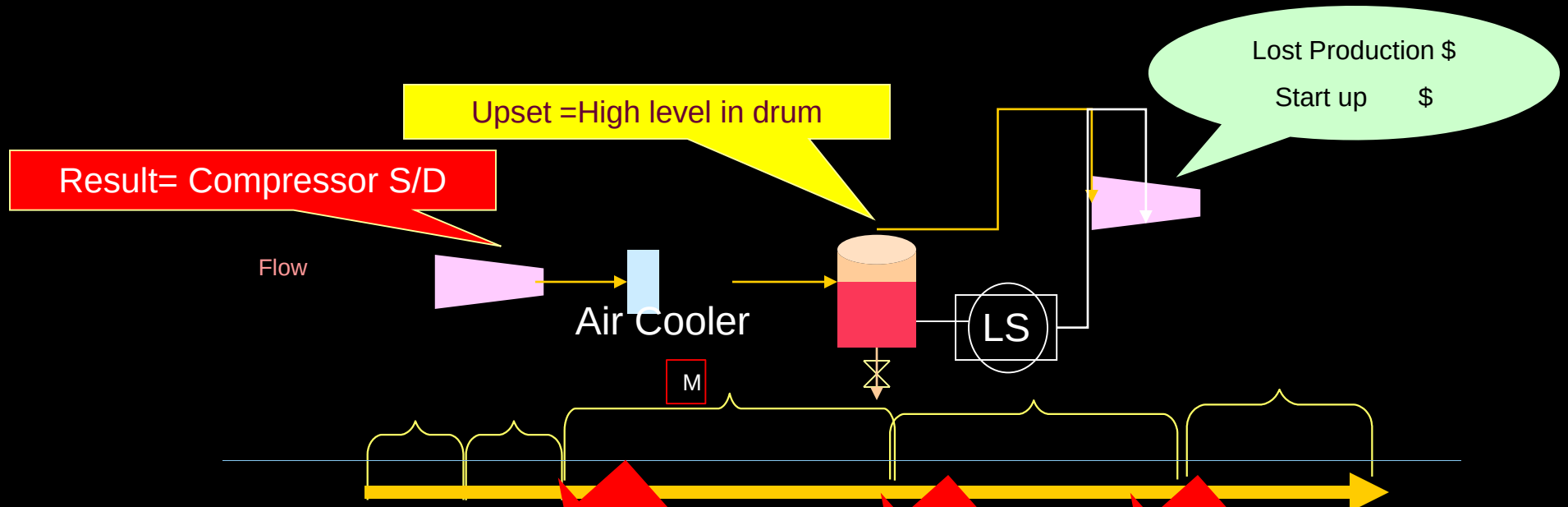
Proactive Fault identification

- Fuel, Air & Efficiency Tracking
- Incomplete Combustion & Excess O_2%
- Fouling, Air Leakage & Box Losses
- Decreasing Fuel Consumption



Operation Without MOM

Reactive & Non Automated DSS

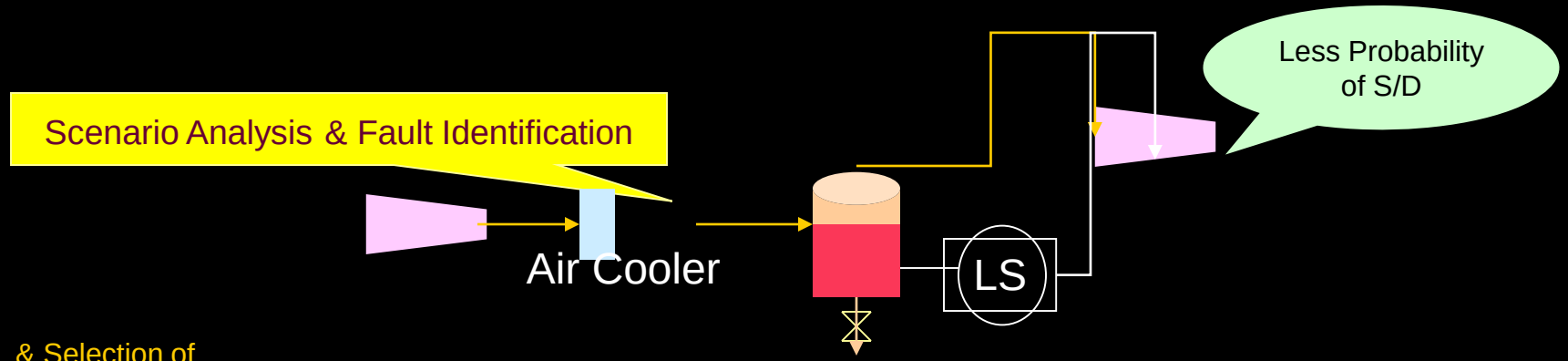


Occurrence		4 Min S/D	S/D 3 min	S/D 2 min
Notification	10 Sec High level	1 min High Alarm		Reduce level
Root Cause Analysis		1-Volume Build Up 2-Excessive Cooling 3-Tx Problem 4-Control Valve Stuck Close 5- Feed Change 6- Sluggish Response of level Control Loop	1-Reduce Feed flow 2- Turn Off A/C Fans 3 Change Transmitter 4- Fix Sticking Valve 5-Adjust Feed SG 6- Switch mode to Manual & Open LCV	
Corrective Actions				
System Dynamic to Corrective Action				

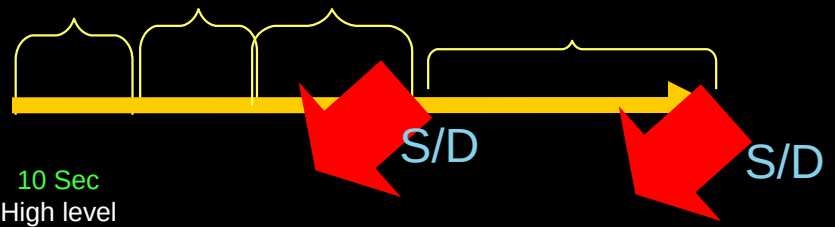
Total Time = 10 Min

Operation With MOM

Reactive & Automated



& Selection of Solution



Occurrence

10 Sec
High level

1 min
High Alarm

Notification

Root Cause Analysis

Corrective Actions

2 Min
Lighter Feed
Reduce Flow

System Dynamic to Corrective Action

1min
Reduce Level

Total Time = 4Min

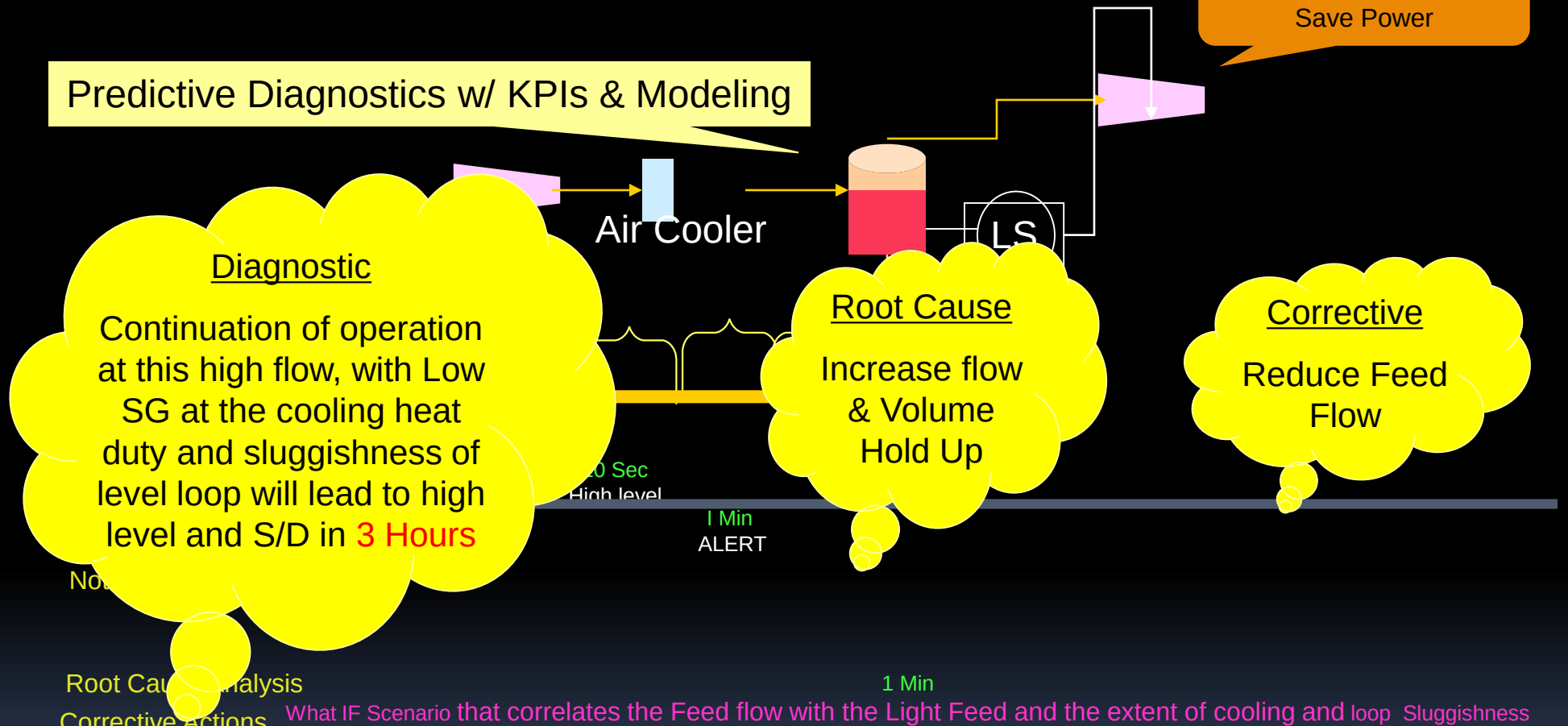
Operation With MOM

Proactive

Less Probability of S/D

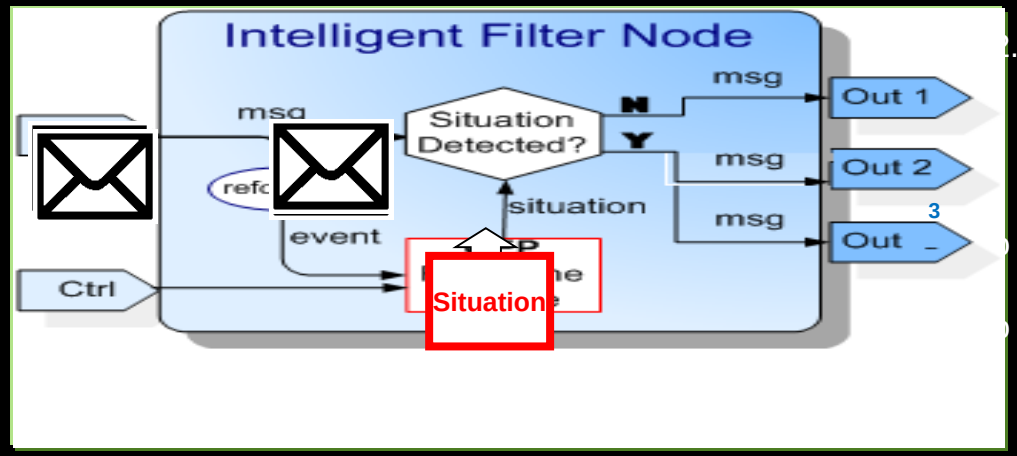
Save Power

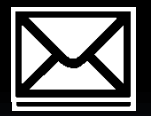
Predictive Diagnostics w/ KPIs & Modeling

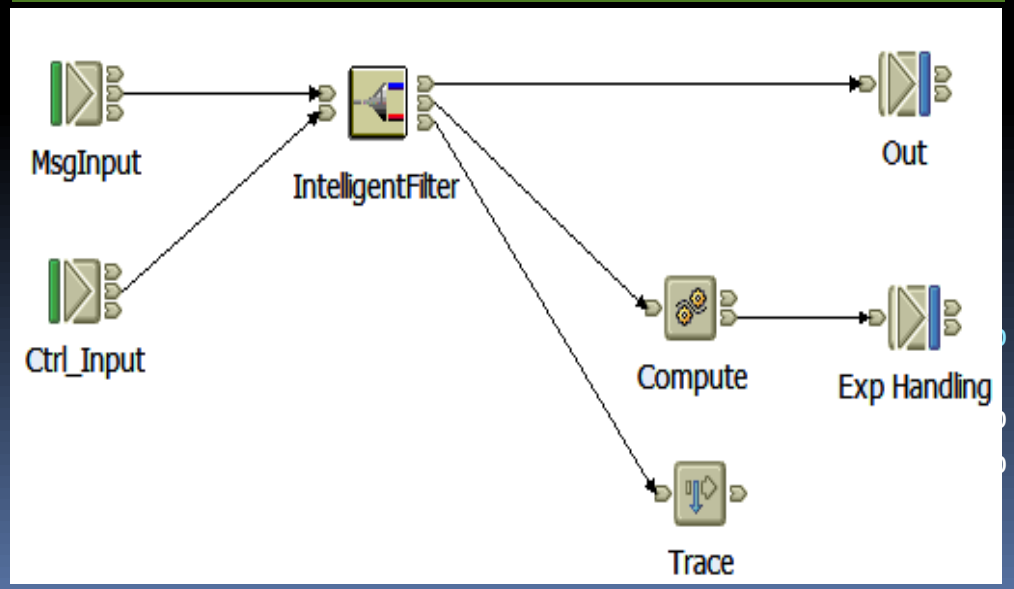


SOA- Message Orchestration with Complex Event Handling

- Input: Application Generating Input Message & Application Executing Control Logic
- Intelligent Filter Node: Situation Detection & Rt Complex Event Processing :"CEP
- Output: Three outputs (Exceptional Handling
- Tasks: Compute ,Trace
- Check: YES & NO



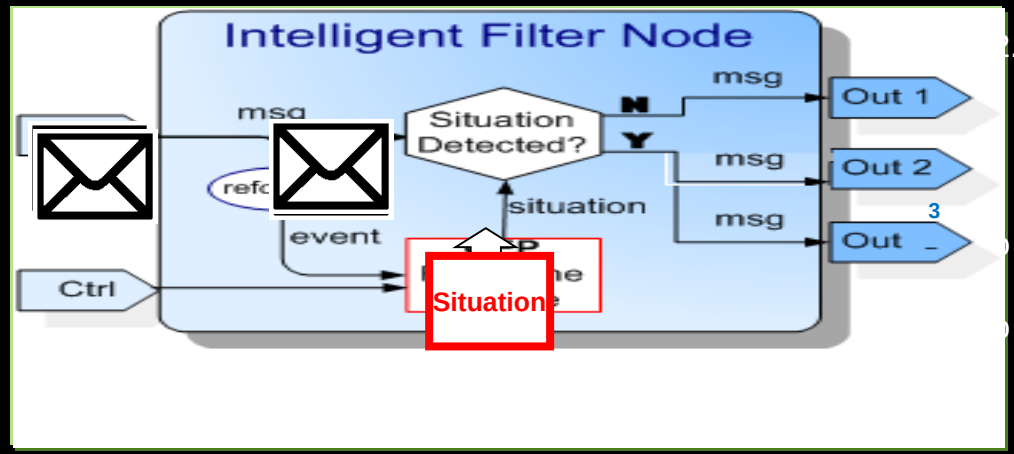


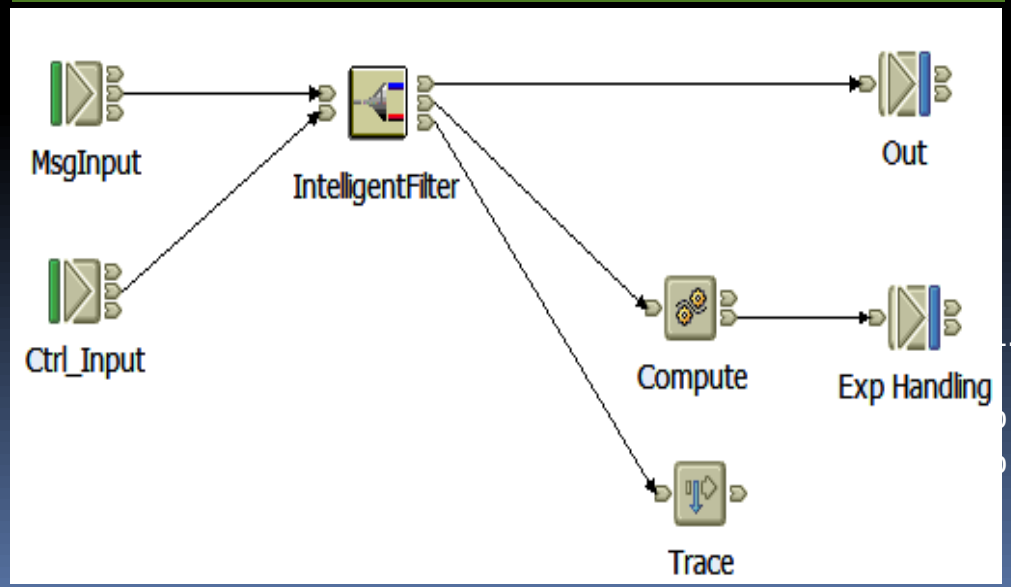


1. Msg 1 arrives From App1 W/ Command to capture event data and compare it with control target in the CEP
   - CEP: Check the event and report NO situation
   - Logical Block: {Situation Detected} Report False [NO] & Pass the message to Output 1
2. Msg 2 arrives From App1 W/ [*Corrosion Correlation}* with rule based instruction on routing, depending on the situation detected, & Command to compare the event {High value} with a control target in the CEP
   - CEP Check the event [high corrosion rate & thinning] and report YES situation
   - Logical Block: {Situation Detected}
     - Report True [YES]
     - Pass the message to Compute Remaining Life
     - Pass the message to Output 2 for Exceptional Handling to
       - Trigger flag to automatically update RBI Matrix
       - Generate Advisories {Ex. Increased chemical SP, changing OSI frequency or instruction for operation round}]
3. Msg 3 arrives From App1 W/ Command to capture event data and Bypass the CEP
   - CEP: No Check
   - Logical Block: {Situation Detected} Pass the message to Output 3

SOA- Message Orchestration with Complex Event Handling

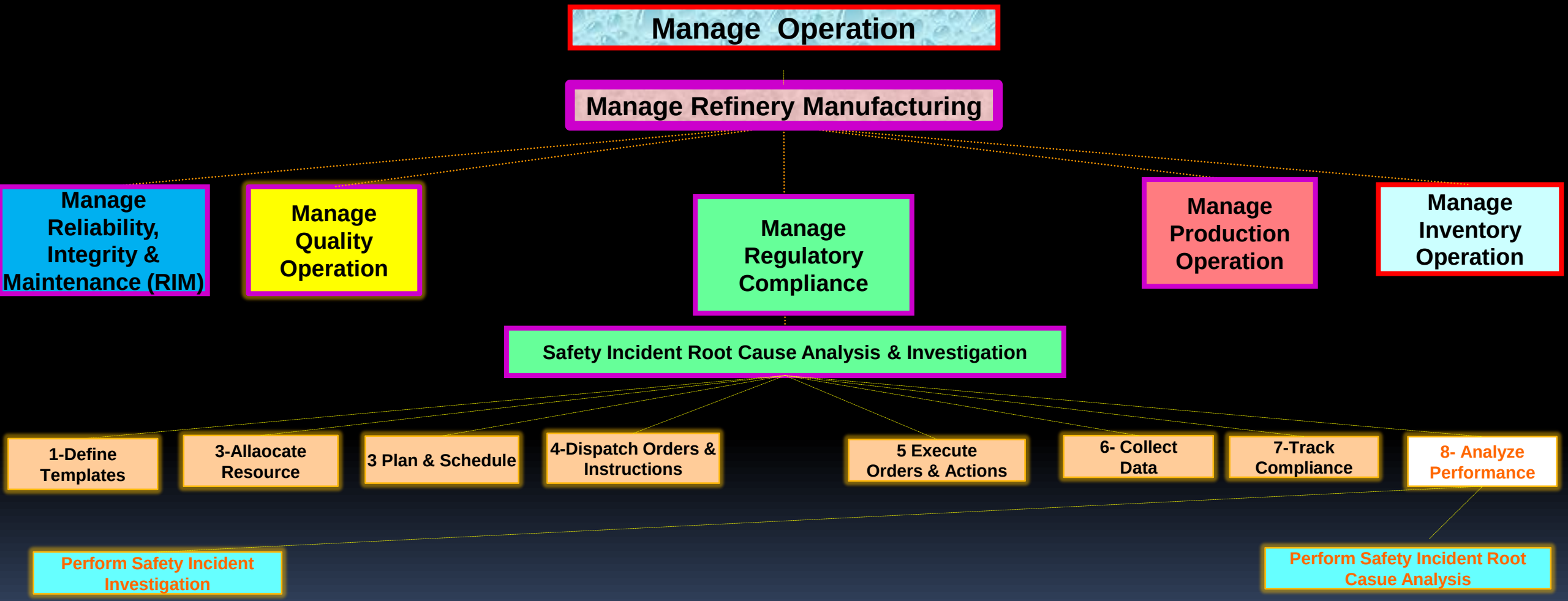
- Input: Application Generating Input Message & Application Executing Control Logic
- Intelligent Filter Node: Situation Detection & Rt Complex Event Processing :"CEP
- Output: Three outputs (Exceptional Handling
- Tasks: Compute ,Trace
- Check: YES & NO



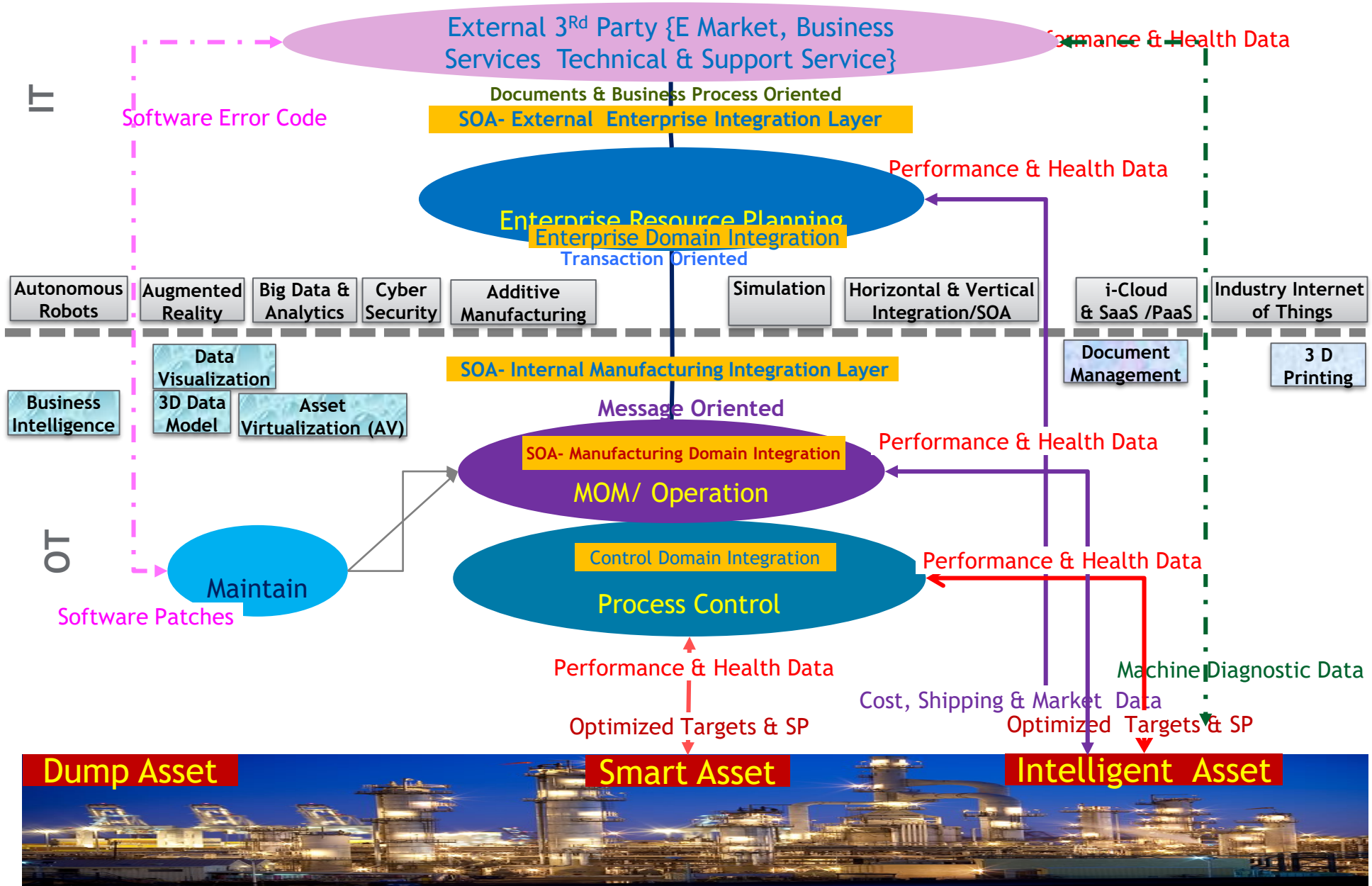


1. Msg 1 arrives From App1 W/ Command to capture event data and compare it with control target in the CEP
   - CEP: Check the event and report NO situation
   - Logical Block: {Situation Detected} Report False [NO] & Pass the message to Output 1
2. Msg 2 arrives From App1 W/ [*Aggregation, KPIs & modeling}* with rule based instruction on routing, depending on the situation detected, & Command to compare the event {High Fouling} with a control target in the CEP
   - CEP Check the event [high-high fouling] and report YES situation
   - Logical Block: {Situation Detected}
     - Report True [YES]
     - Pass the message to Compute Coking Index
     - Pass the message to Output 2 for Exceptional Handling to
       - Trigger flag to automatically update criticality Matrix
       - Generate Advisories {Ex. increased anti fouling SP, changing hot spot checking frequency or instruction for operation round and Decoking}]
3. Msg 3 arrives From App1 W/ Command to capture event data and Bypass the CEP
   - CEP: No Check
   - Logical Block: {Situation Detected} Pass the message to Output 3

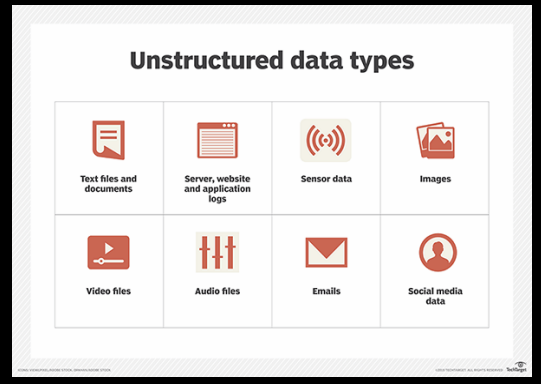
Text Analytics for Solutions for Root Cause Analysis Business Process



Typical Integration Model Digitization Solutions in the Industry



Structured Data resides in a fixed field within a record or file and it includes **data** stored in database tables and **contained in relational databases and spreadsheets , which is** easily entered, stored, queried and analyzed.



Unstructured Data includes information that doesn't reside in a traditional row-column database such as text and multimedia content {Ex. e-mail messages, word processing documents, videos, photos, audio files, books, documents, presentations, webpages and many other kinds of business documents.

Transform

Text Analysis applies Natural Language Processing, linguistically understand the text and apply statistical techniques to analyze unstructured text, extract relevant information, refine the results and then transform that information into model and structured information that can be modeled a for the purpose of business analysis, research and investigation.

Data Can Be:
Integrated
Analyzed,
Queried,
Reported,
Visualized

Users can make use **of 80 % to 90 %** of the Data that available in any Organization for Root Cause Analysis and Safety incident Investigation

Virtual Agents

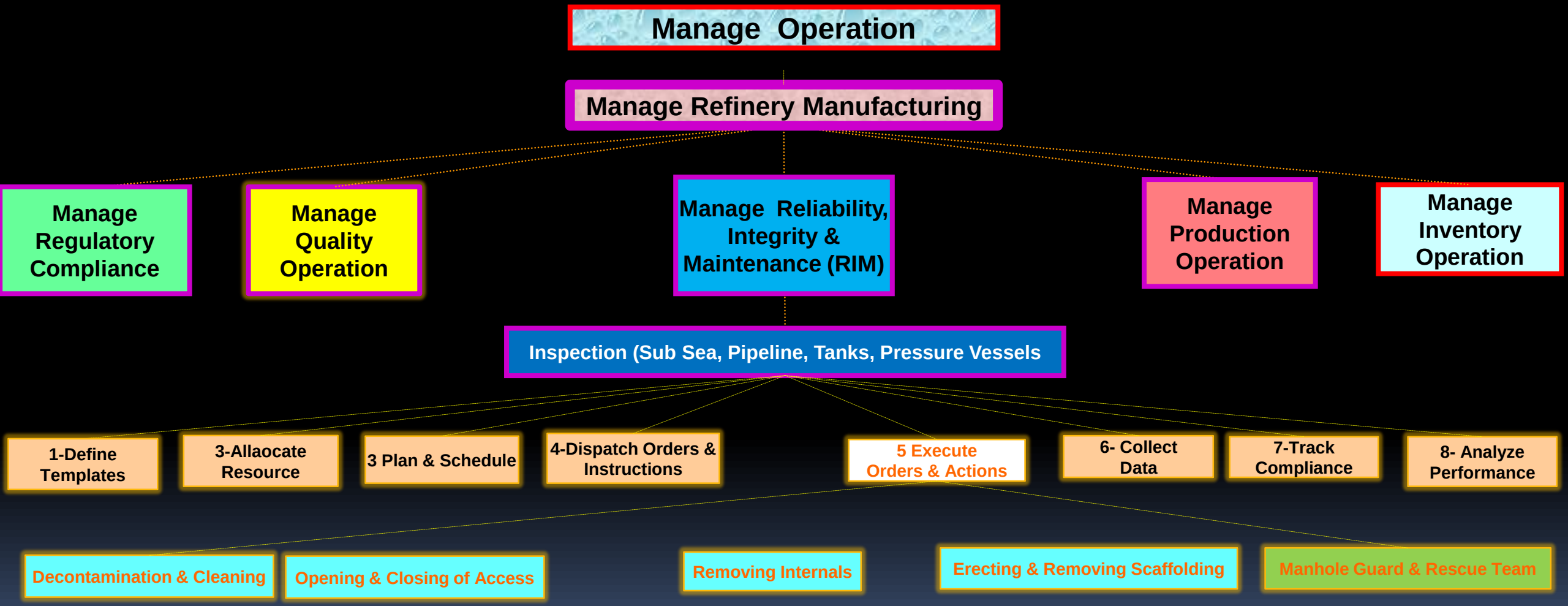
❑ Virtual Agent Functions are as follows:

- Provide Automated services to customers.
- Offers a cognitive, conversational self-service experience that can provide answers and take action.
- Allow Users to customize itself to fit specific business needs.
- Provide custom content .
- Provide deep analytics & insights on customer's engagement
- Help with the understanding of your constantly changing customer's needs.

❑ Virtual Agent Benefits are as follows:

- Reduce support cost
- Minimize your dependency on higher cost channels by letting Watson handle customer interactions.
- Improve customer satisfaction
- Personalize your customer interactions and help them take the action they need - instantly.
- Resolve customer concerns
- Increase First Contact Resolution by solving the most common customer issues on the first touch.

Robotic Solutions for Inspection Business Process



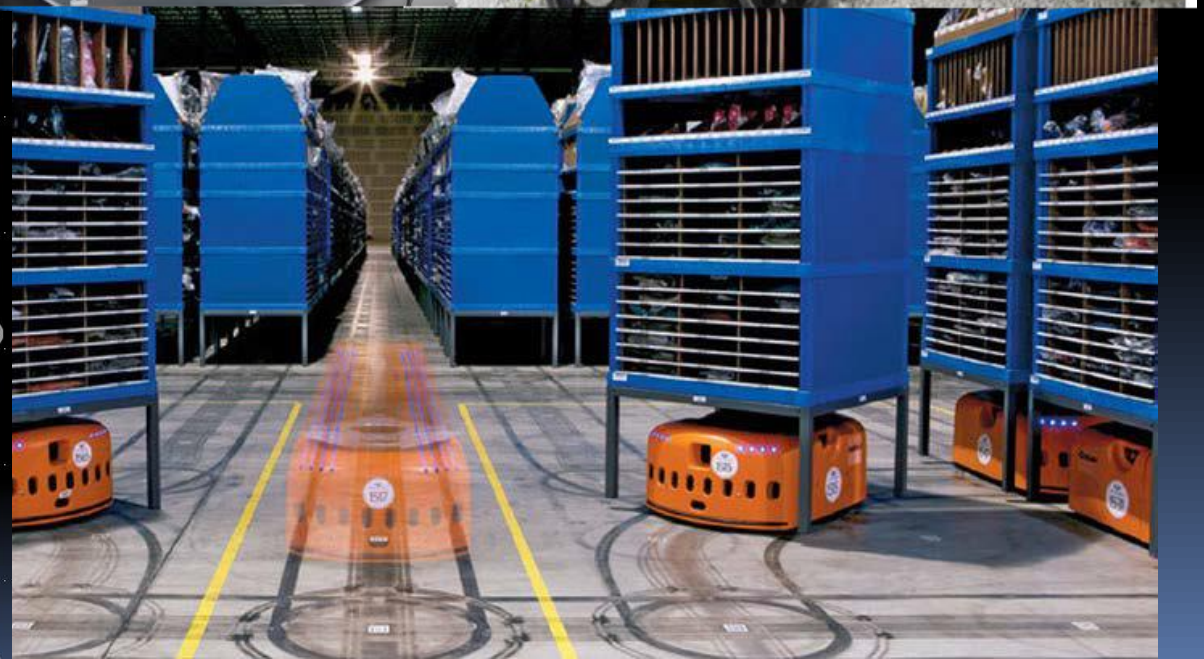
Robotics


FIRE HOSE
CONNECTION


New and innovative solutions for autonomous
subsea inspection


NREC
SENSABOT


316
B/BUILD
315
B/BUILD
314
B/BUILD
316
B/BUILD

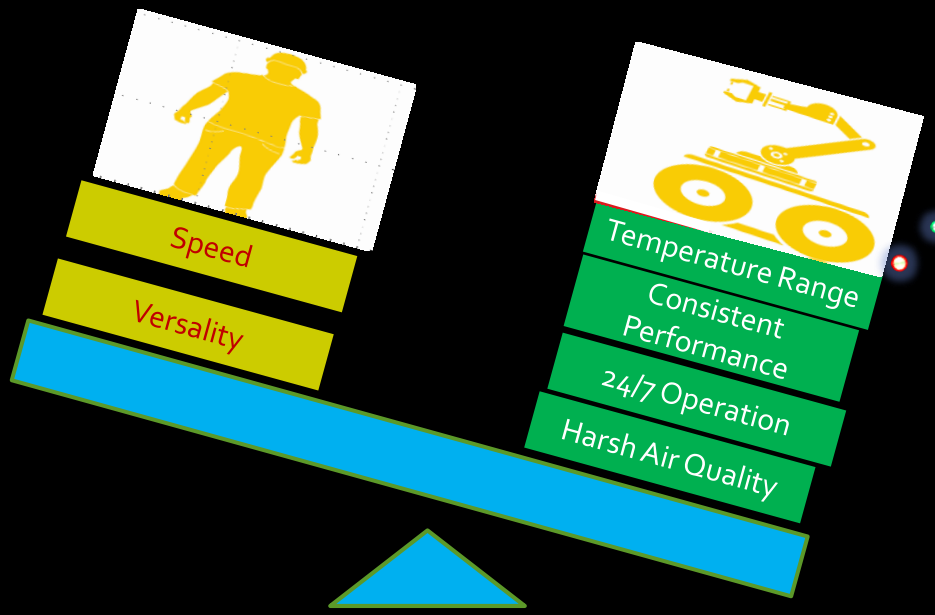


Robotic Technologies {Digitization}

Use of Robotic in performing the following inherently dangerous tasks in manufacturing, drilling, refineries that are currently done by humans and simple tasks that are difficult or expensive for humans to accomplish

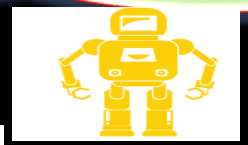
- ❑ Inspection
  - Remote Operated Vehicles (ROV) in Subsea and Marine Deepwater Equipment
  - Autonomous Underwater Vehicles (AUV) for Subsea Infield Inspection And Pipeline Inspection
  - Seep and containment loss detection, meteorology/oceanography (METOC),
  - Routine Inspection Tasks in Harsh or in Remote Frontier Areas
  - Remotely Operated Aerial Vehicles (ROAVs) to Assess inaccessible structures that needs working at heights such as, Flares, Chimney, Vents
  - Internal Inspection Of Tanks and Pressure Vessels
  - Structural and fabric assessments
- ❑ Safety
  - Operations in Confined Spaces and Hazardous areas
  - First Response in case of Fire, Explosion or Valor Release
- ❑ Surveillance

Robotic Solutions Analysis

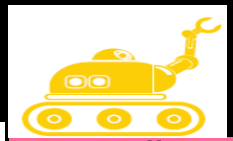


Challenges :
1-IECEx, ATEX or ANSI/API ratings for explosive atmospheres
2-Facitlites design NOT Suited for Robotics but only for Humans {Ladders}

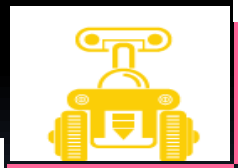
1 Robust Sensors & Detectors {Hydrocarbon, Hydrogen Sulphide, Sound & Vibration}
3-Cameras {High Definition, IR& Thermal }
2- Customized Communication Protocols
4-Robot Version of Ladder Access.



Robotized Facilities

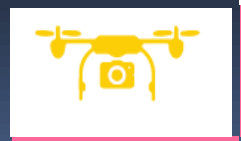


Normally Unmanned Facilities



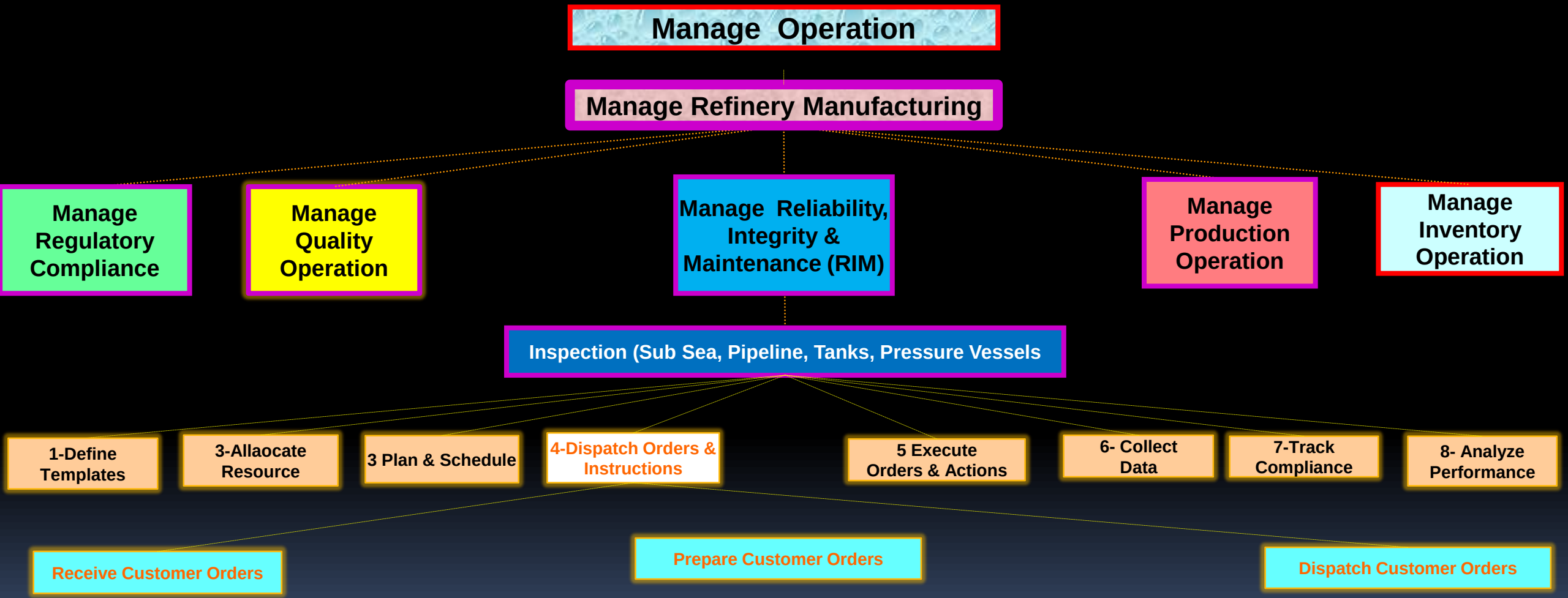
Autonomy

Maintenance

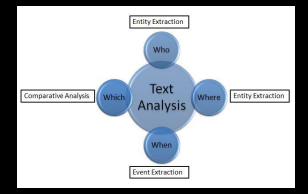


Surveillance & Inspection

Virtual Agents Solutions for order Dispatching Business Process



Text Analytics



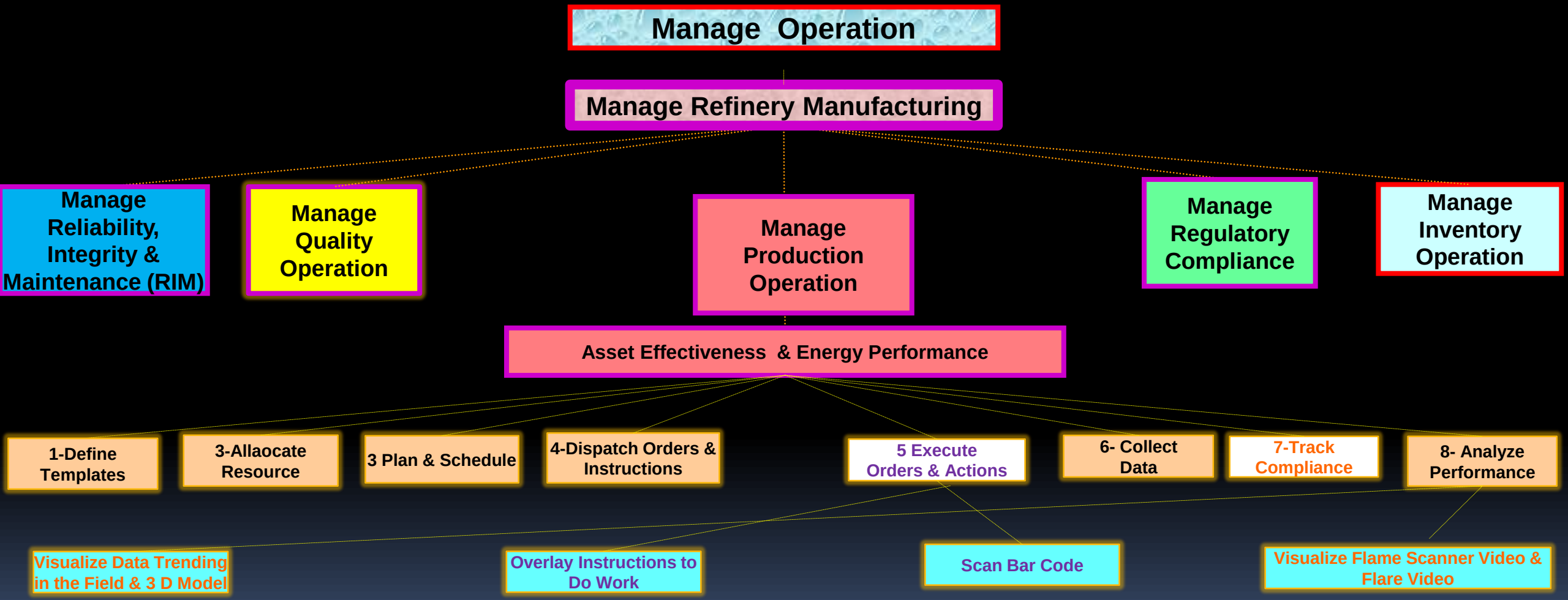
❑ Functions of Text Analytics are as follows:

- Examine Text written communication and Specifications
- Uses text mining and natural language processing algorithms to extract meaning in huge amounts of text.
- identify patterns and topics of interest,
- Take practical action based the learning process.

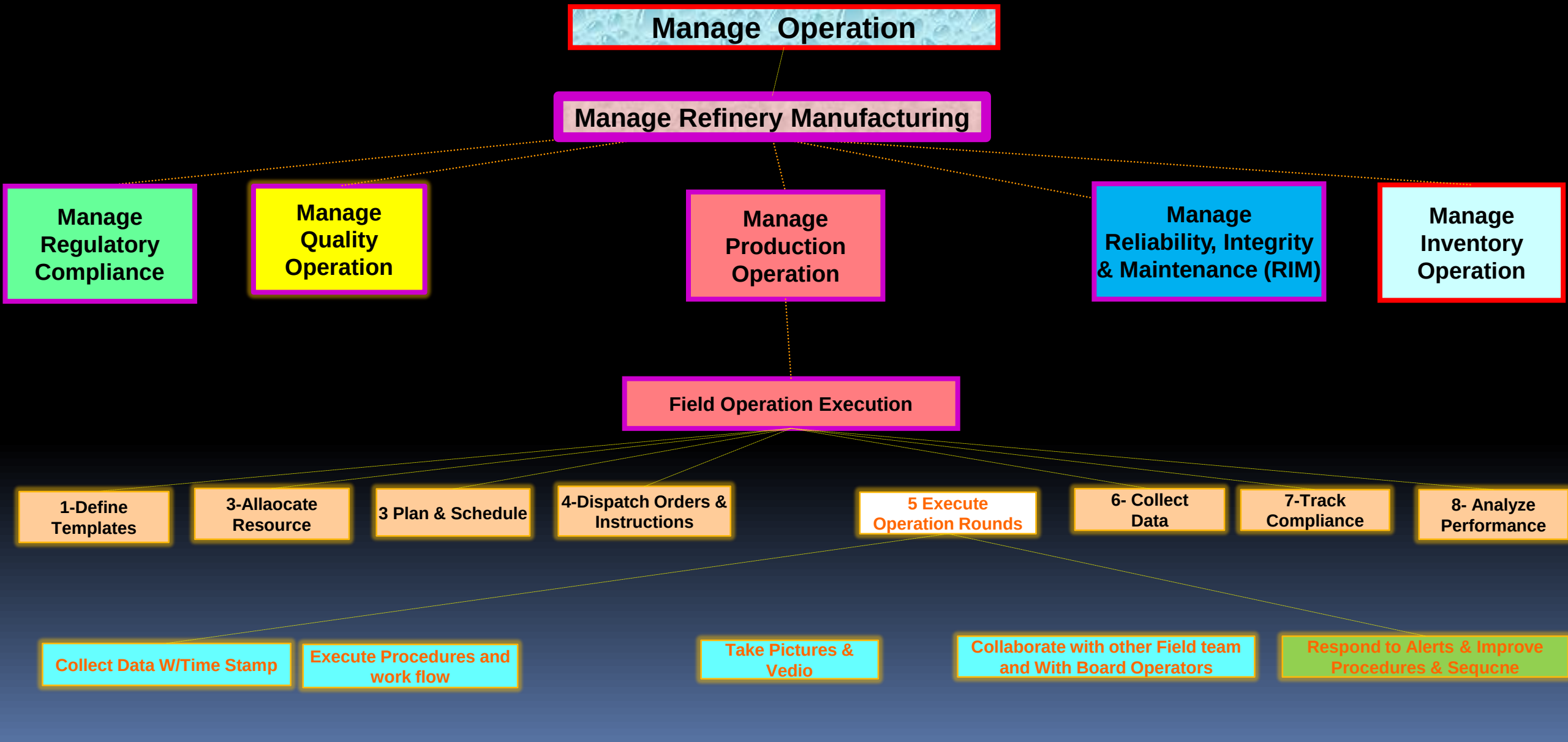
Benefits of Text AAnalytics are as follows:

- Capture insight and wealth of information available in in recorded interactions such as e-mails, online reviews, tweets, call center agent notes, survey results, and other types of written feedback all hold insight into your customers. There is also a that can easily be turned into text.
- Unlock the meaning from all of this unstructured text and uncover patterns and themes, to define the requirements of the customers
- Provide an early warning of troubles and complains
- Provide valuable information from data that isn't easily quantified in any other way.
  Convert the unstructured thoughts of customers into structured data that can be used by business.

Augmented Reality for Solutions for Operation Tracking Business Process



Mobility Solutions for Operation Execution Business Process



Connected Workers Industry 4.0

Procedures and Work Flow Parsed in Authorization Tools

Procedures and Work Flow Deployed in Smet Phones W/ Inline Text, Image, Video, Voice Recognition,

Procedures and Work Flow Triggered by Control Room, Machine & Mobility Platform to define WHAT TO DO?

Machine & Teams are Collaborating by Completing Work Steps and Queuing Steps for others

Realtime Alerts are triggered for Warning

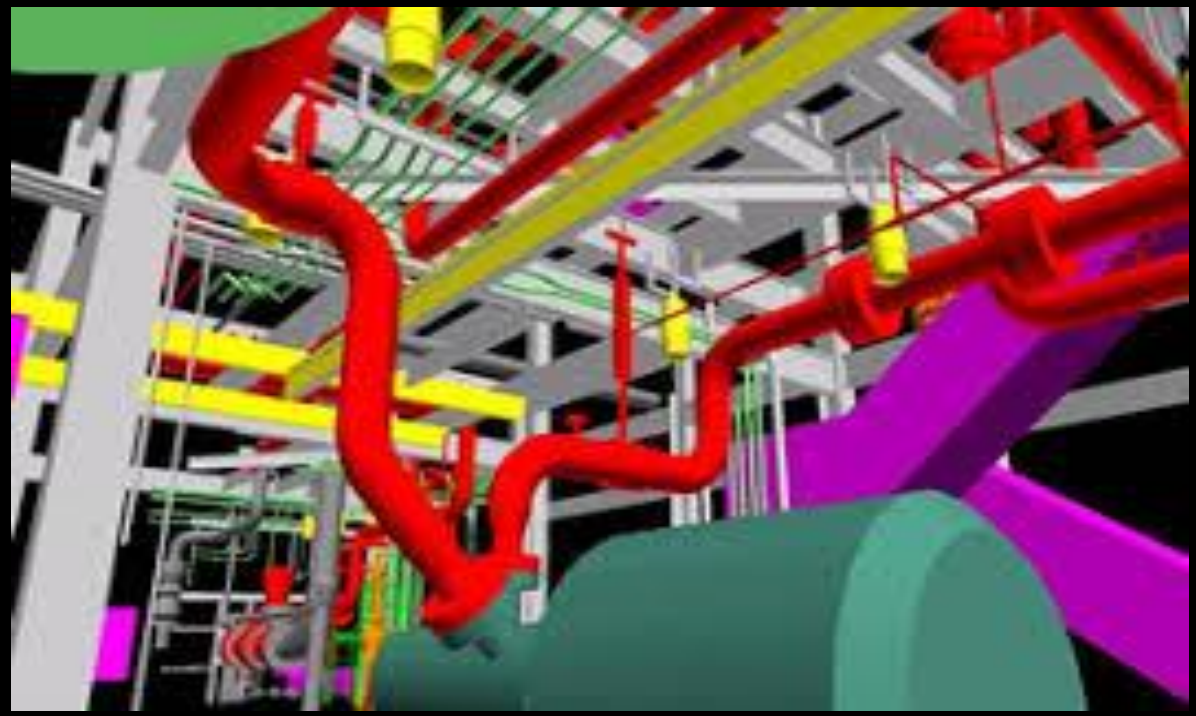
Realtime Are Collected with Timestamp for each step

Use Collected Data to Compare Actual Versus targets per plant and groups

Users provide Feedback that is combined with Comparative Analysis

Improved Procedures and Work Flow are deployed

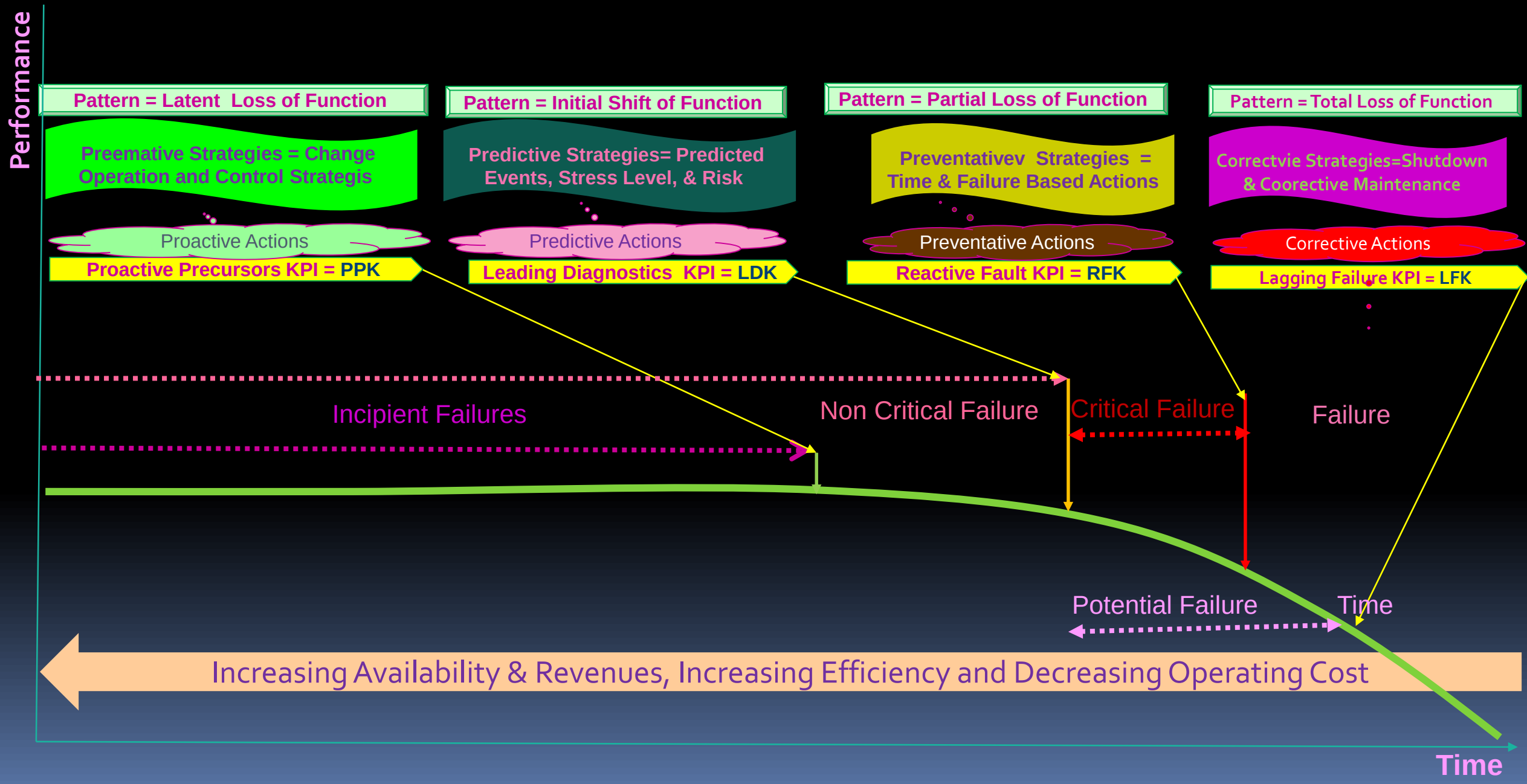
Laser Scanner Technologies {Digitization}



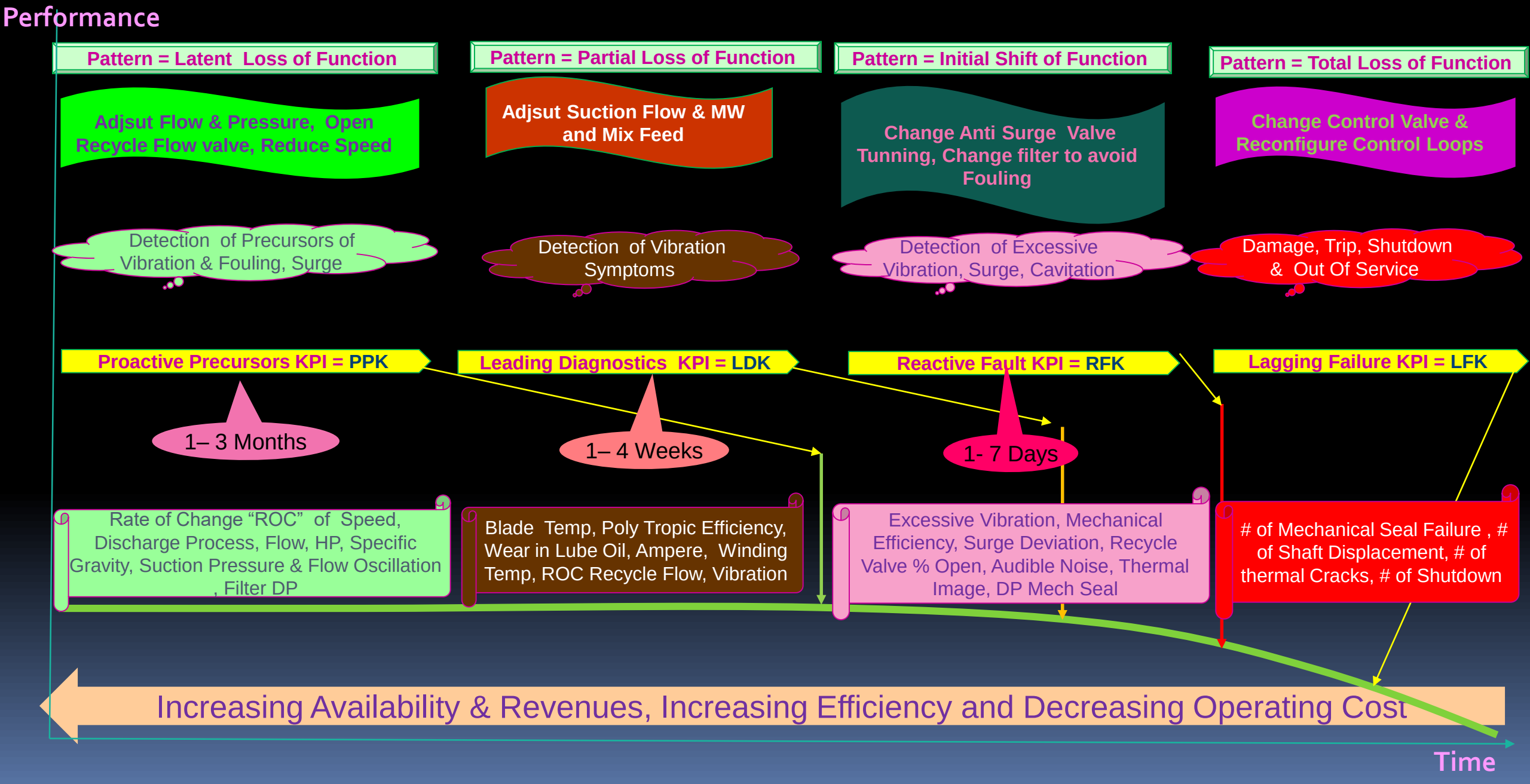
Laser scanners digitize geometrical features of facilities to provide point cloud representations for:

- ❑ Obtaining remotely, measurements of an area for maintenance or new installation
- ❑ Identifying deformations monitoring.
- ❑ Providing 3D modeling for maintenance, inspection, safety, design and modification projects,
- ❑ Performing containment analysis and volume calibration.

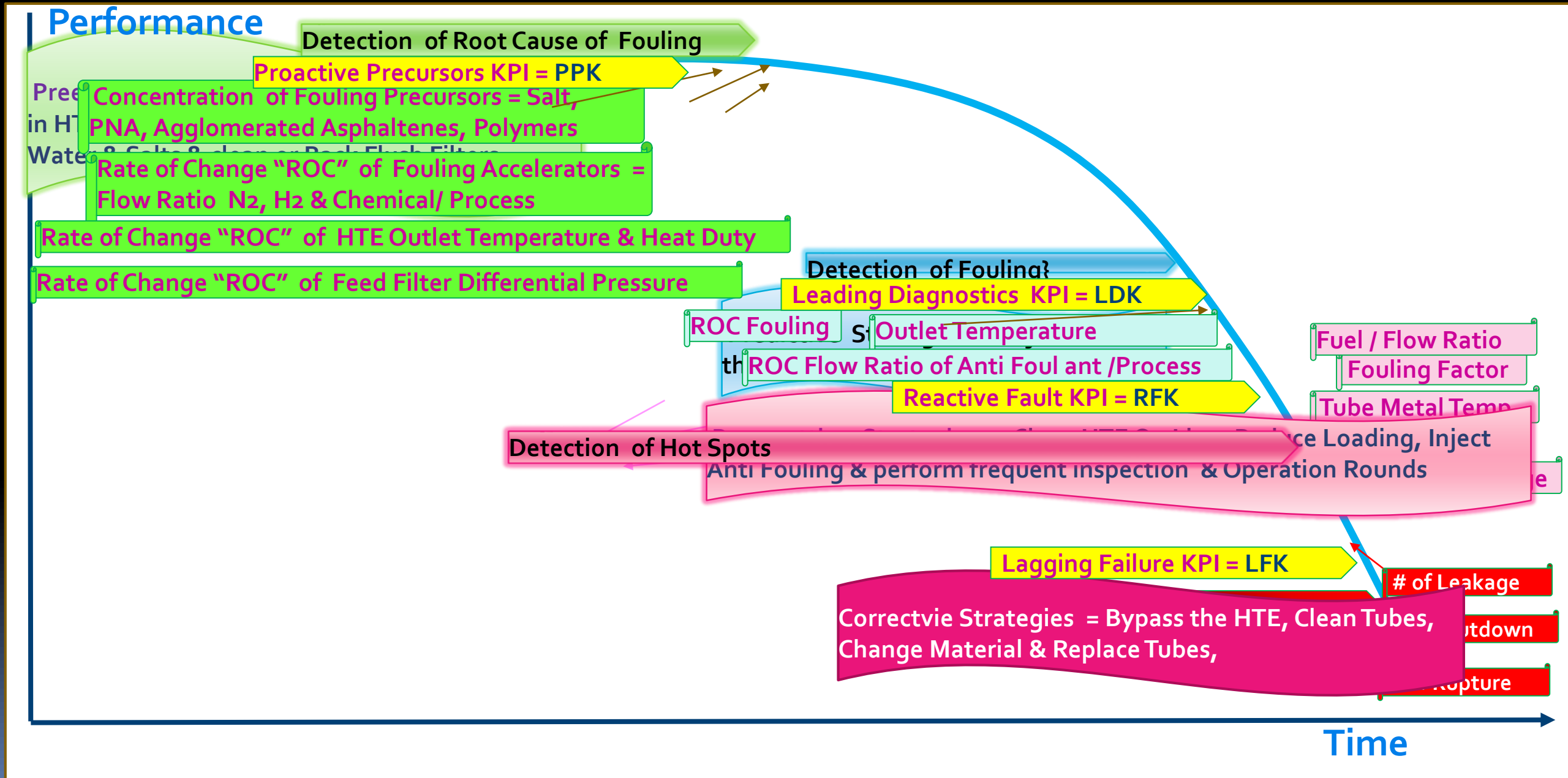
“Asset Performance Vs Time Relationship Modeling”



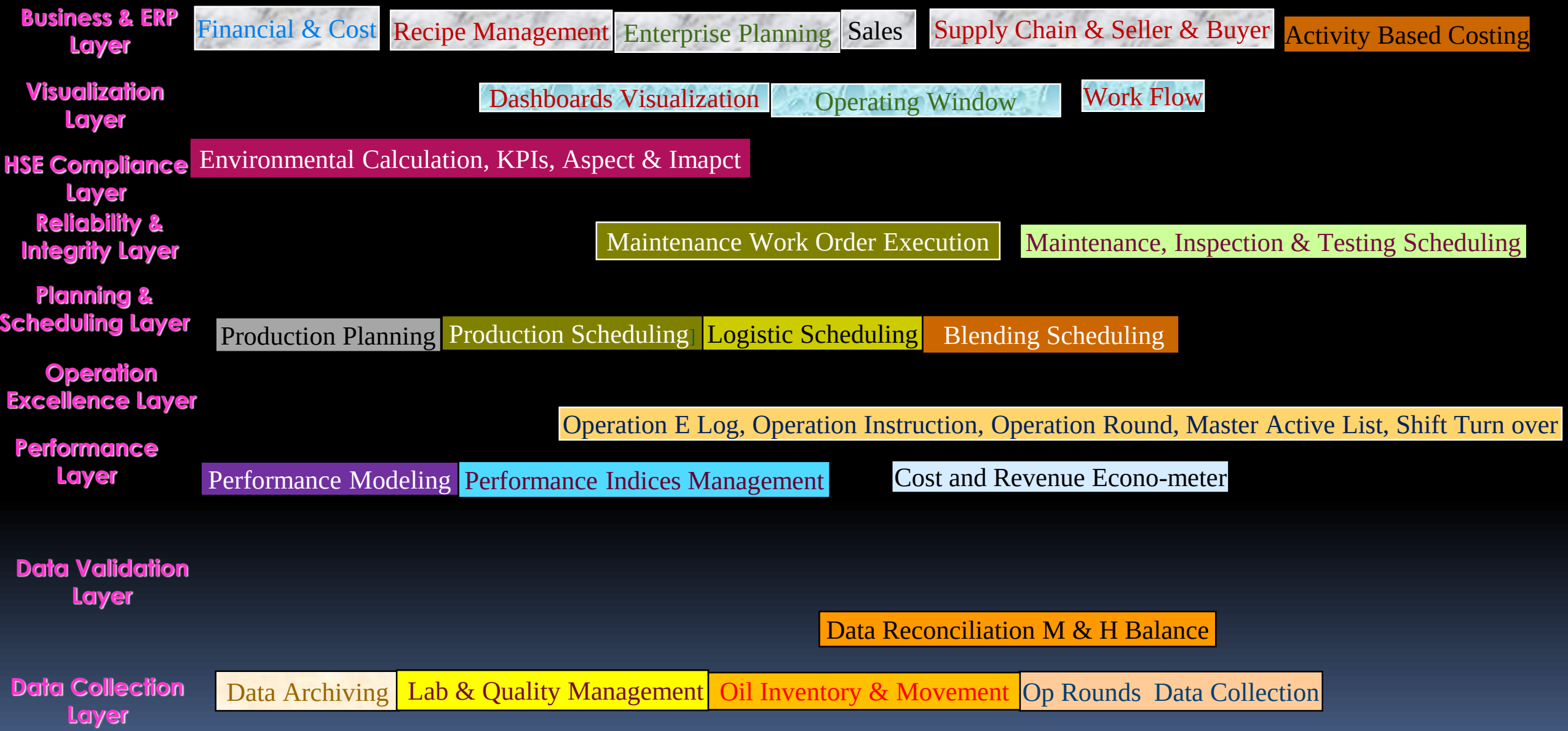
Proactive Performance Deterioration, Vibration & Surge Detection for Compressor & Turbines



Proactive Operation wit Digitization



RMIS/MOM System & Vendor COTS Architectural Model



RMIS/MOM System & Vendor COTS Architectural Model

Business & ERP Layer
- Financial & Cost
- Recipe Management
- Enterprise Planning
- Sales
- Supply Chain & Seller & Buyer
- Material Management

Visualization Layer
- 3-D Asset Virtualization
- Dashboards Visualization
- Operating Window
- Document Management
- Work Flow

HSE Compliance Layer
- Environmental Calculation, KPIs, Aspect & Imapct
- Crisis Management & Response to Emergencies]
- Work Permit
- Process Safety KPIs, Near Miss, Incident Tracking, Event Archiving& MOC
- Operation Risk & Job Hazard Analysis

Operation Excellence Layer
- Operation E Log, Operation Instruction, Operation Round, Master Active List, Shift Turn over
- Management of Change
- Constraint-Based Operation & Abnormality Operating Procedures
- Activity Based Costing

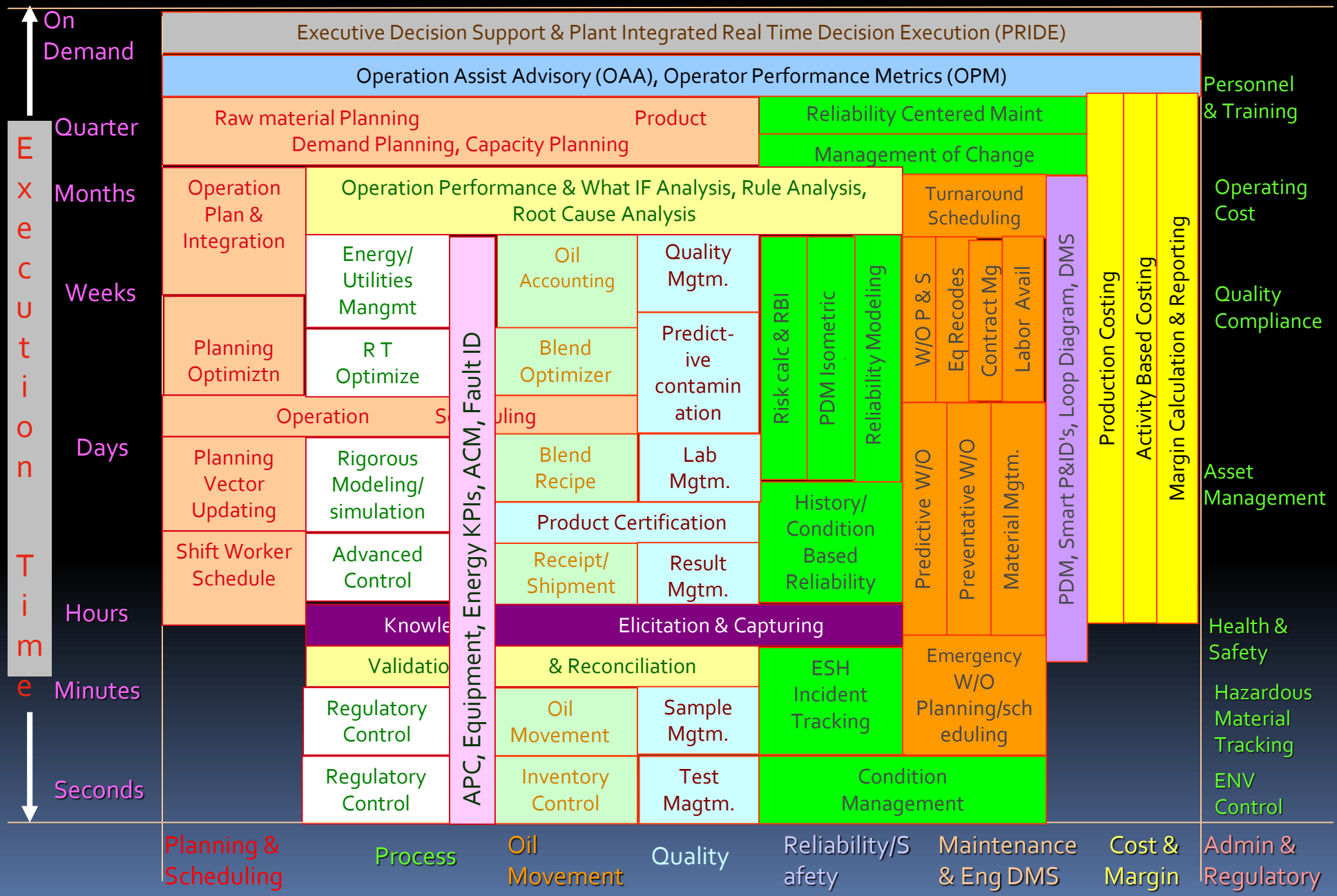
Reliability & Integrity Layer
- On Stream Inspection & Risk Based Inspection
- Maintenance, Inspection & Testing Scheduling
- Reliability Modeling, Analytics, FEMCA, RCA, RCM
- Maintenance Work Order Execution
- Fault Identification & Operation Assist Advisories
- Predictive Diagnostics
- Analyzer Performance & Reliability

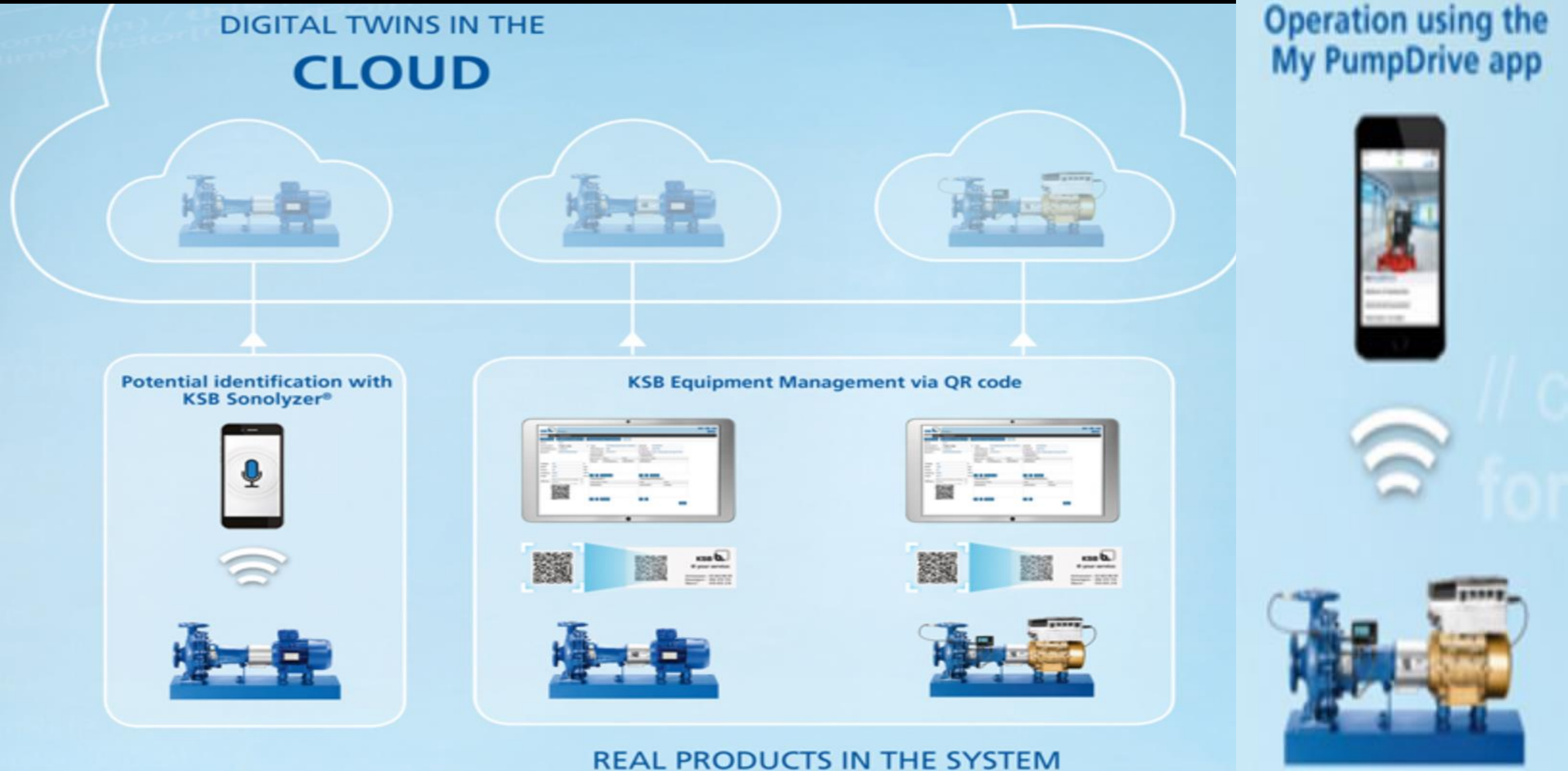
Performance Layer
- Dynamic Targeting
- Target Setting
- Personnel Productivity & Utilization
- Cost and Revenue Econo-meter
- Performance Modeling
- Performance Indices Management
- Inferential Calculation
- Emission Monitoring
- Statistical Process Control

Data Validation Layer
- Sensor Conditioning
- Data Quality & Reliability Check
- Data Reconciliation M & H Balance

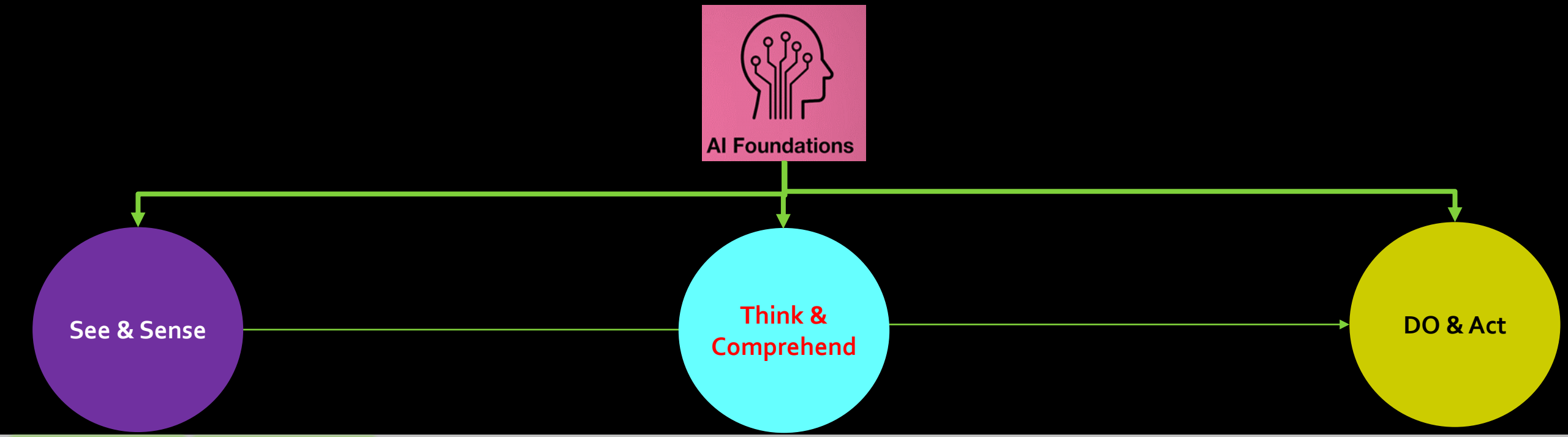
Data Collection Layer
- Data Archiving
- Lab & Quality Management
- Statistical Quality Control
- Oil Inventory & Movement
- Blending Optimization
- Alarm Rationalization
- Op Rounds Data Collection
- Control Performance Monitoring

MOM Three Dimension Architecture Model {Time-Functional & Users}




DIGITAL TWINS IN THE
CLOUD
Potential identification with KSB Sonolyzer®
KSB Equipment Management via QR code
REAL PRODUCTS IN THE SYSTEM
Operation using the My PumpDrive app

Artificial Intelligence (AI) & Digital Twin Strategies



Data Collection & Alerting

Computer Generation & Audio Processing

Natural Language Processing

Knowledge Elicitation & Representation

Machine Leaning & Expert Sytems

Control , Modeling Optimization

Artificial Intelligence Technologies

Identify Analytics

Intelligent/ Virtual Agents

Cognitive Robotics &

Speech Analytics

Recommendation Systems

Data Visualizations

Digitized Solutions

Digital Twin for Steam Turbine

- See [Updating & Learning]
  - Gathering Operating Data such as *Rotor Temperature*, *Rotor Speed*, *Steam Temperature* as well as Environmental Data
  - Apply Data in a Hybrid Model with Physical and Digital Capabilities such as machine & Bassein Learning for Metal Fatigue and Creep to generate accumulated Knowledge on Damages that could happen to the Rotor.
  - Issue Warning on the Problems when the Captures Value Hits a Threshold & Issue Alerts that Predicts the Problems
  - Reach to a Fleet of Hundreds of Equipment using the Techniques of Similarity Validation Model (SVM) to assist in the predication by learning with other similar Equipment.

- Think [Reasoning & Optimization
  - Give Options based on 5000 Simulation Runs based on the Knowledge collected from the Fleet Data, History Data, life Model Dara and Forecast data of Revenue and Cost
  - Reason on each options based on Risk, Cost and Confidence.
  - Generate Manual and Auto Options using Application Running on the Control Systemin the Edge.

- Do [Informing, Acting and using the Edge Control]
  - Inform and Execute the MANAUL Option by prescribing the Load Rate, the Ramp Rate, the Steam Temperature for Operator Entry
  - Execute the APP Option by downloading it to the CS on the Edge that provide much more precise solutions by monitoring the load and ramp rate and allying them with the Steam rate to ensure that the Thermal Stress on the Rotor is minimum and get the 25 % Reduction and to Start up the Turbine much faster

Digital Twin

- Benefits
  - Predict Failure Proactively Patterns of Equipment
  - IDENTIFY Mitigation Events
  - Forecast Opportunities for Problem Solving
- Problem
- Failure of Rotor of Steam Turbines
- Installation
  - South California
- Strategy
  - Gathering Data
    - Utilizing Operation Data
    - Utilizing Environmental Data
  - Utilizing Living Models that Drives Business Outcomes
  - Failure Models
  - Bussian Learning
  - Similarity validation Models

HOneywell & UOP Digital Twin & Connected Plants

Reactor Models

UOP Modeling & Optimization

UOP Catalysis Service

Data Analytics

Cloud Gateway & Messaging Bus

Manufacturing Operations Management

IIoT Sensors in the Field

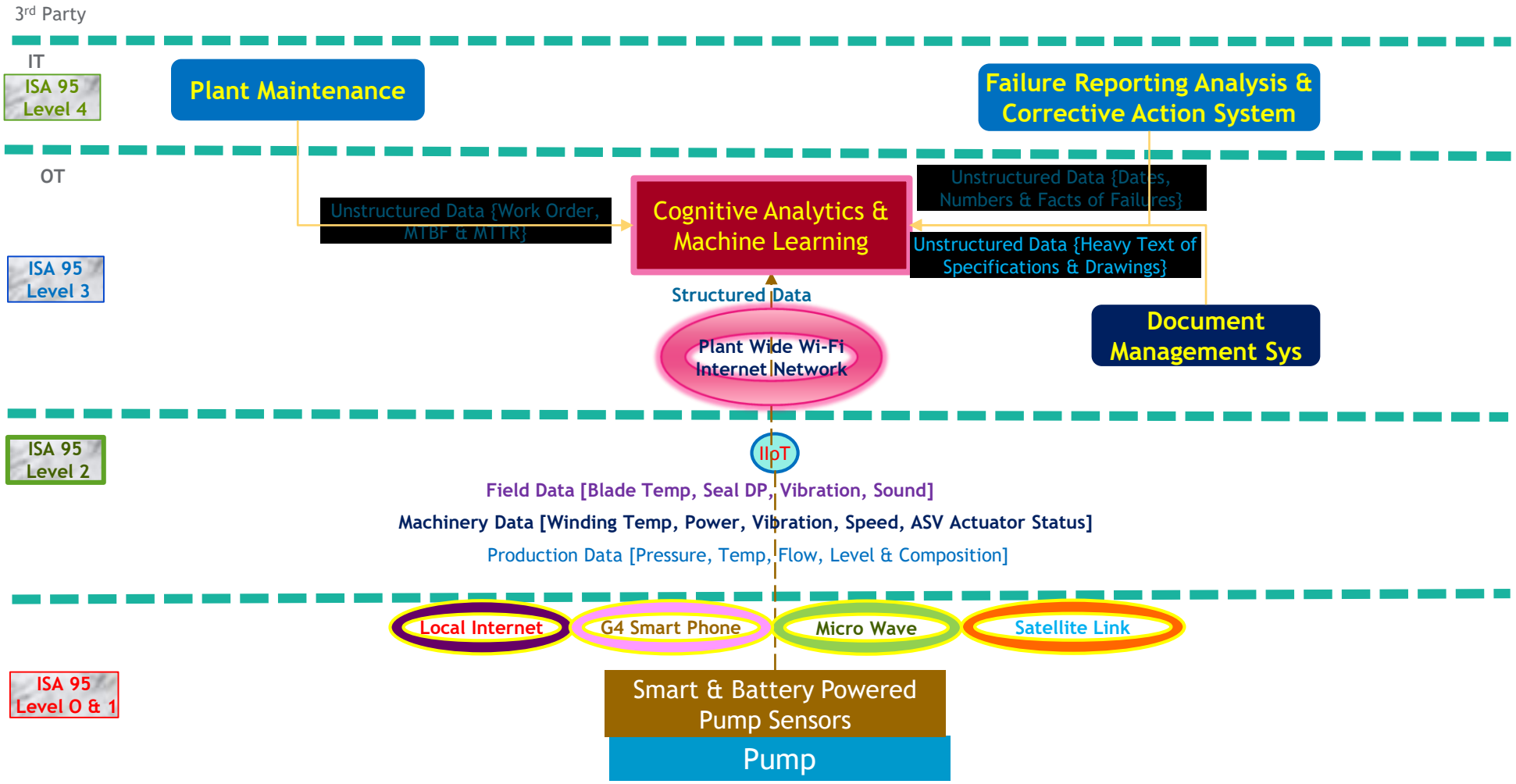
Smart Phone

Wireless Sensors

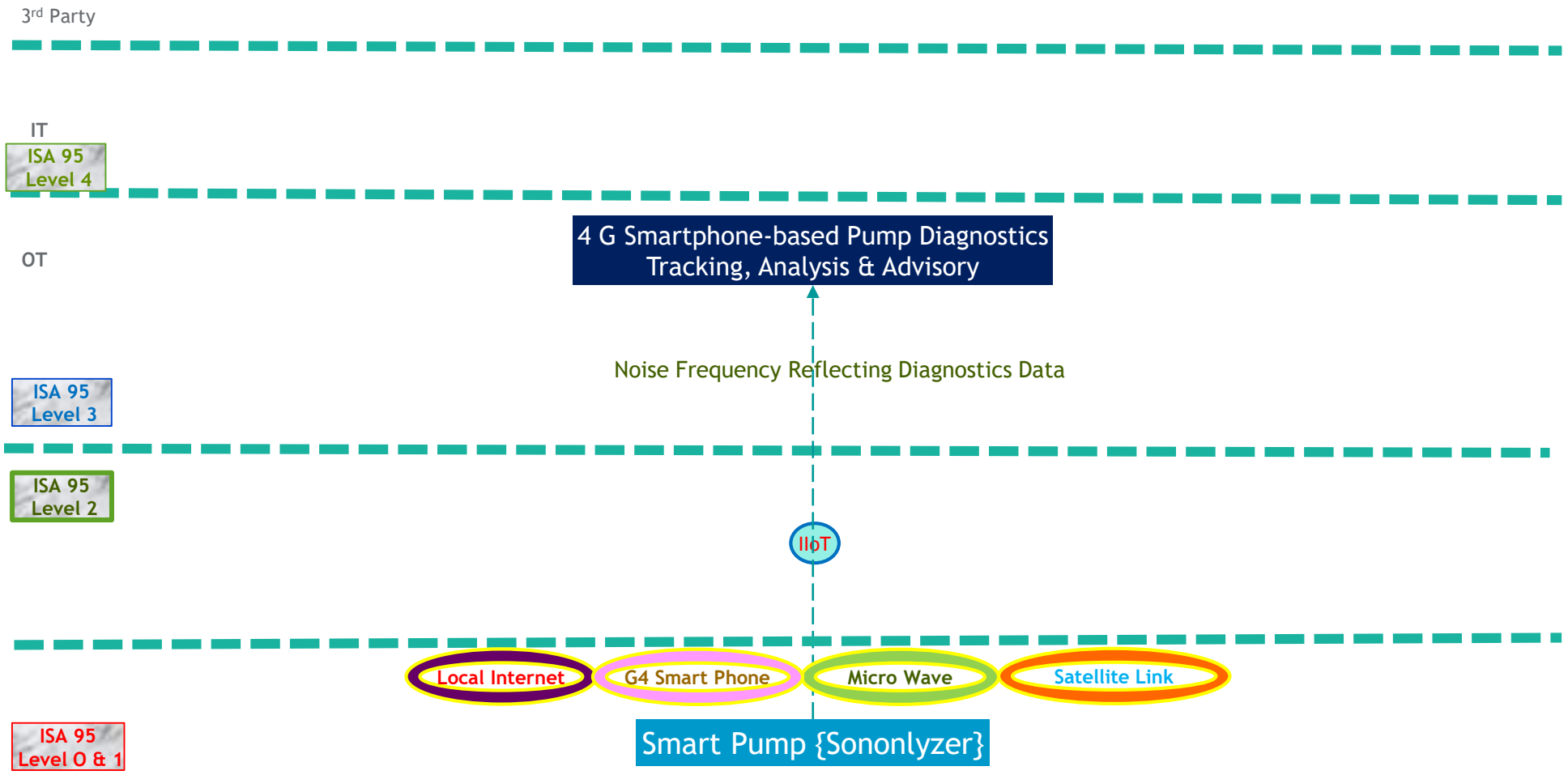
Embedded Sensors in Equipment


Honeywell
UOP

Tracking of Proactive Pump Diagnostic & Failure Prediction {W/Smart Pump Sensor, IIoT & Data Analytics}

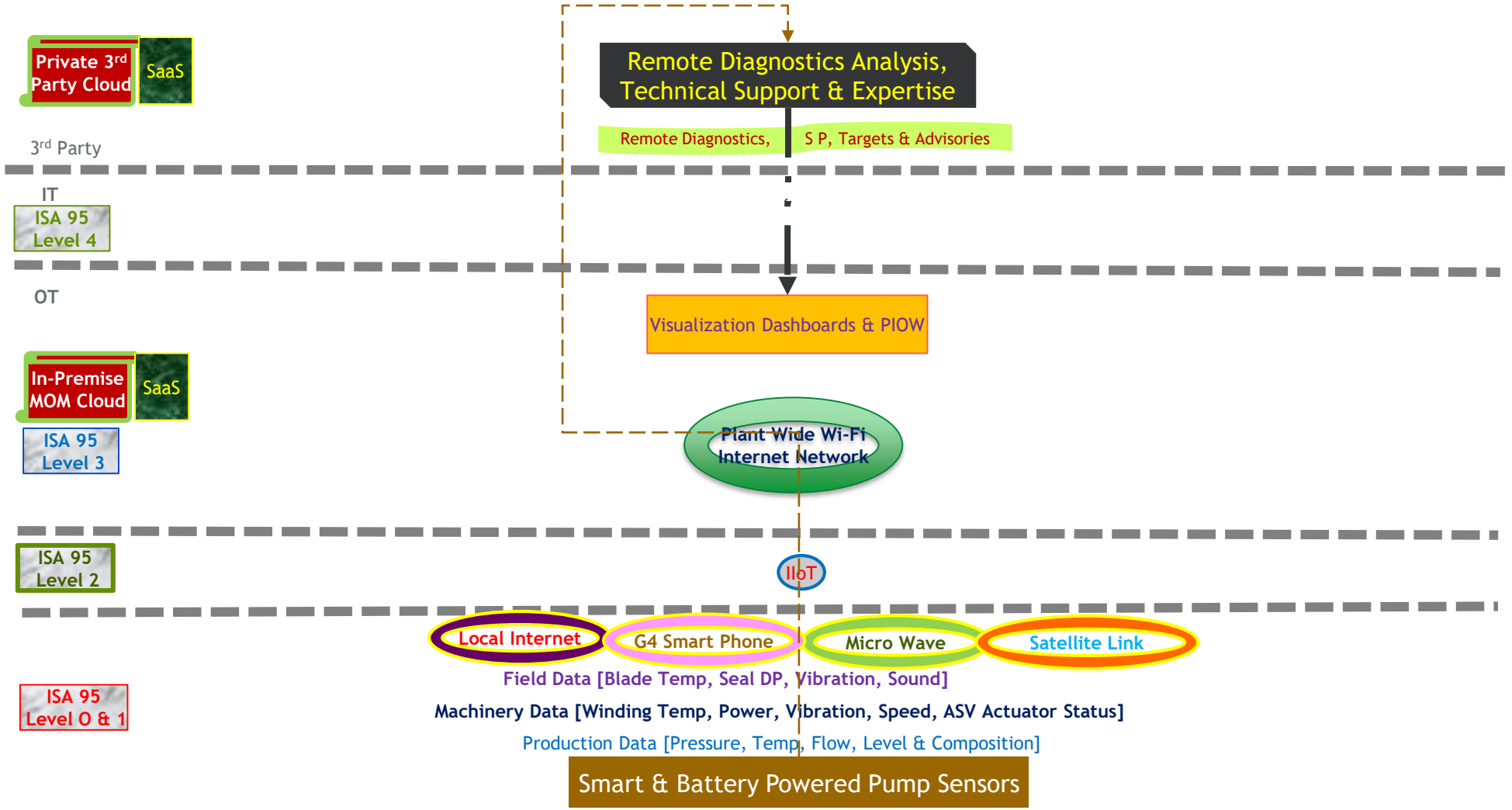


Tracking & Analysis of Pump Operation & Energy
{W/Smart Pump, IIoT, Smart Phone & Algorithm}



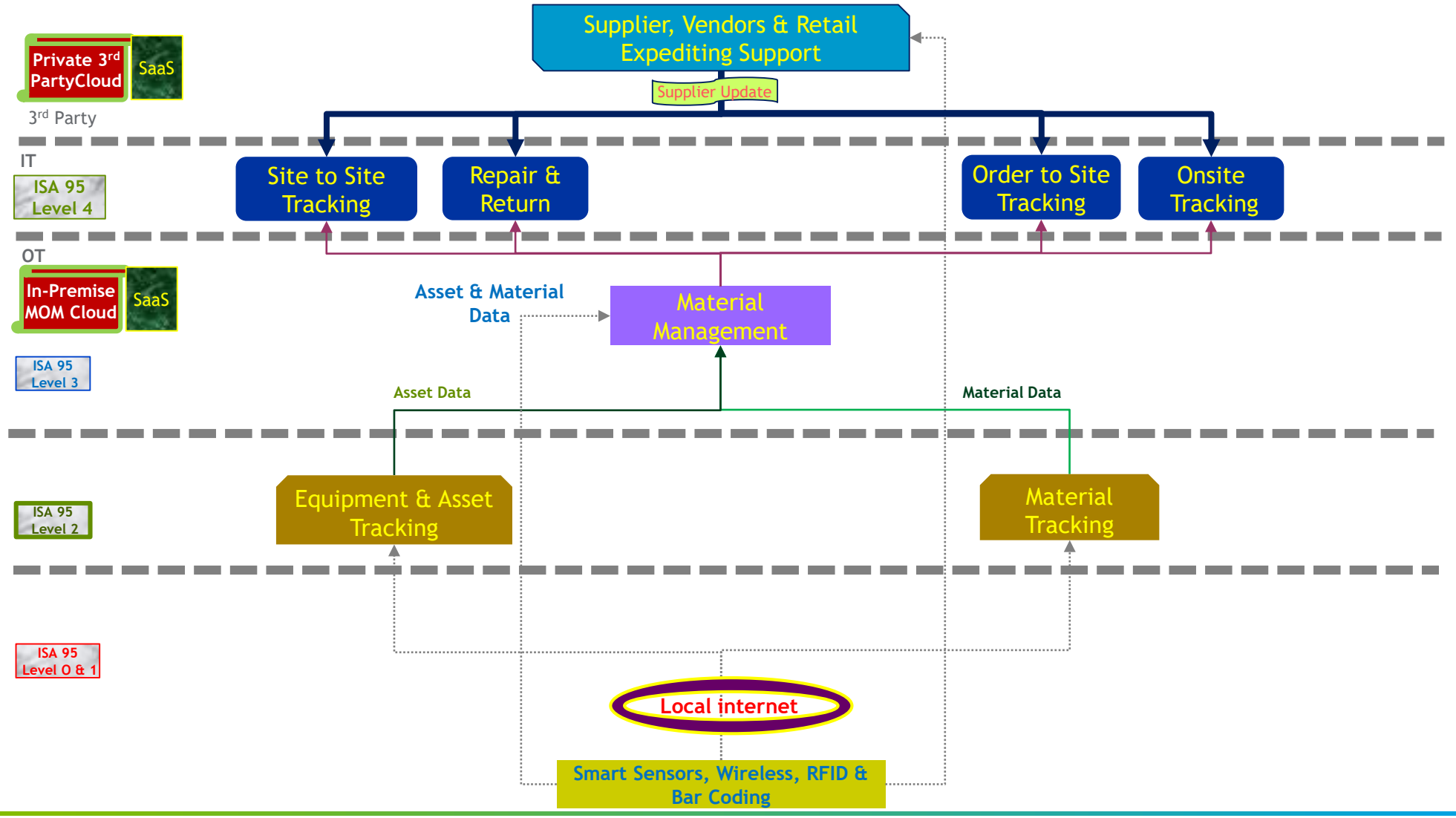
Remote Pipeline Pigging Inspection

Remote Tracking & Analysis for Asset Diagnostic
{W/Smart Pump Sensor, IIoT & Private Cloud}

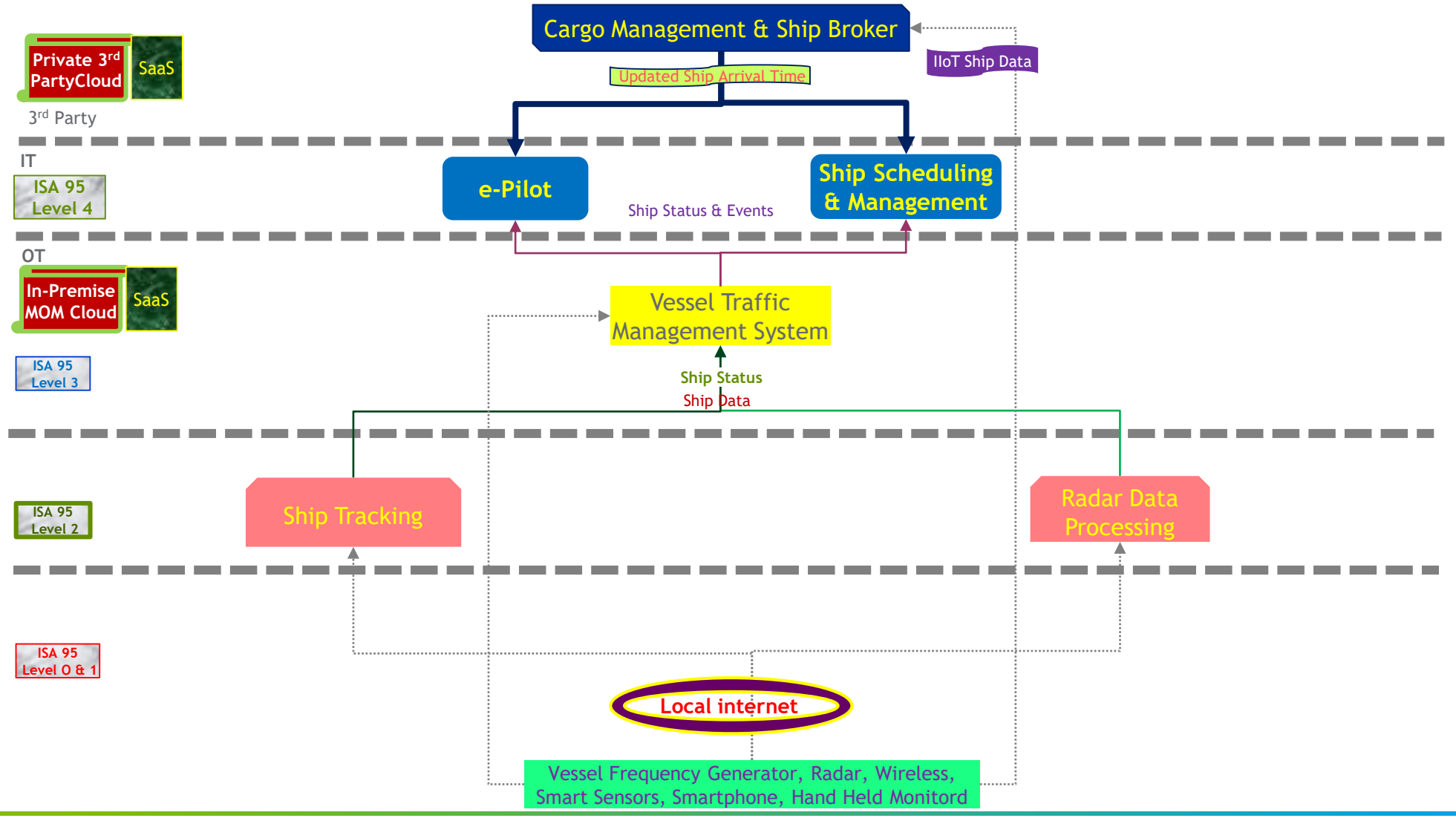


- KSB Sonolyzer is a New Smart Phone Application brings Digital Industry straight to Smartphone
- KSB Sonolyzer is a Mobility and/or IIoT Solutions
  - Measures the noise frequency of the asynchronous motor in just a few seconds [Measurement takes just 20 seconds]
  - Uses an estimation algorithm to analyze the noise & decide whether the operating point is inside or outside the part-load range
  - Checks whether there are potential energy savings to be made, thus enabling an increase in pump efficiency.
- KSB Sonolyzer can be used not only on KSB pumps but also on rotating equipment produced by many other manufacturers

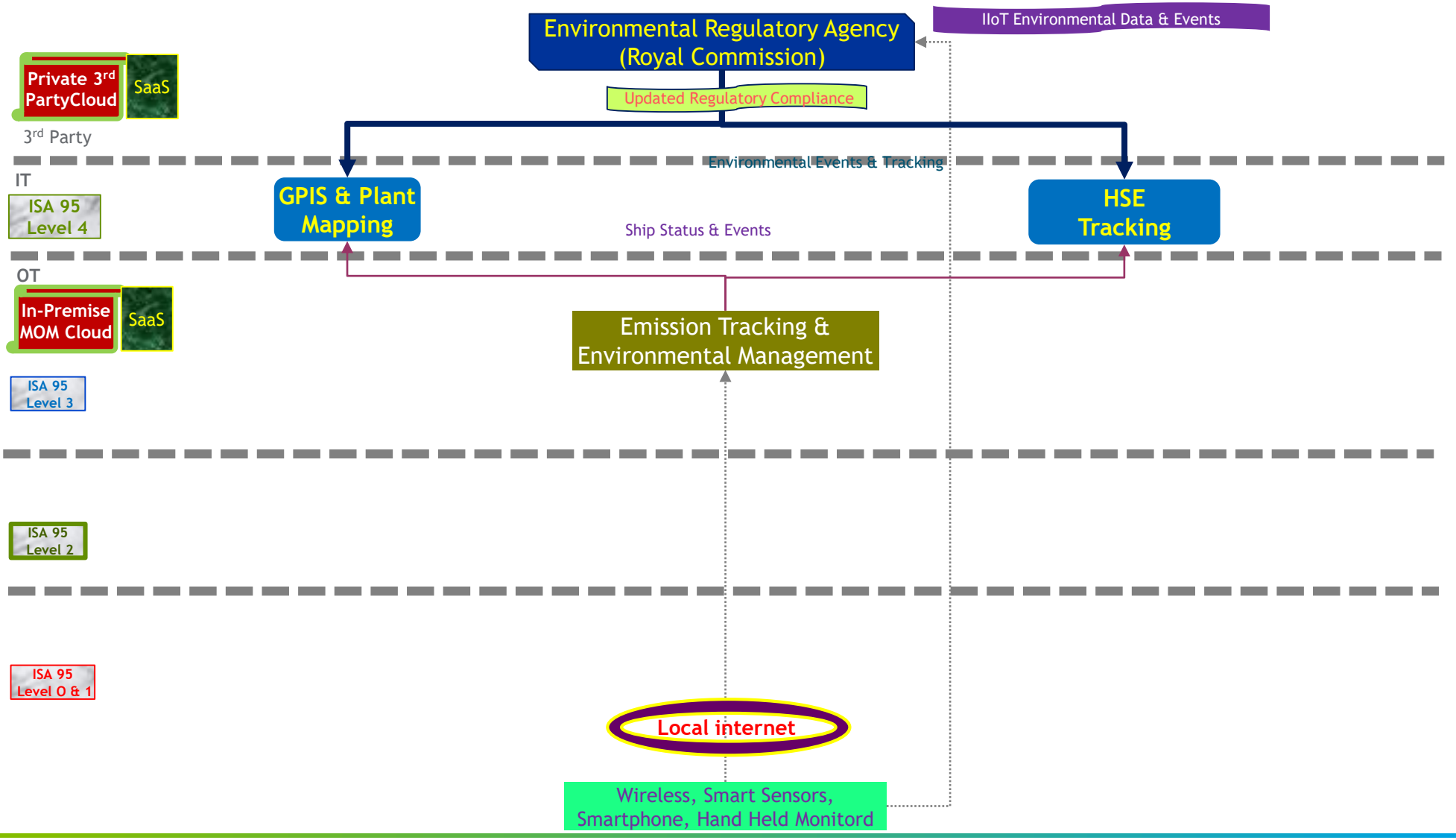
Material & Asset Tracking @ Construction Site & Supplier Advisories



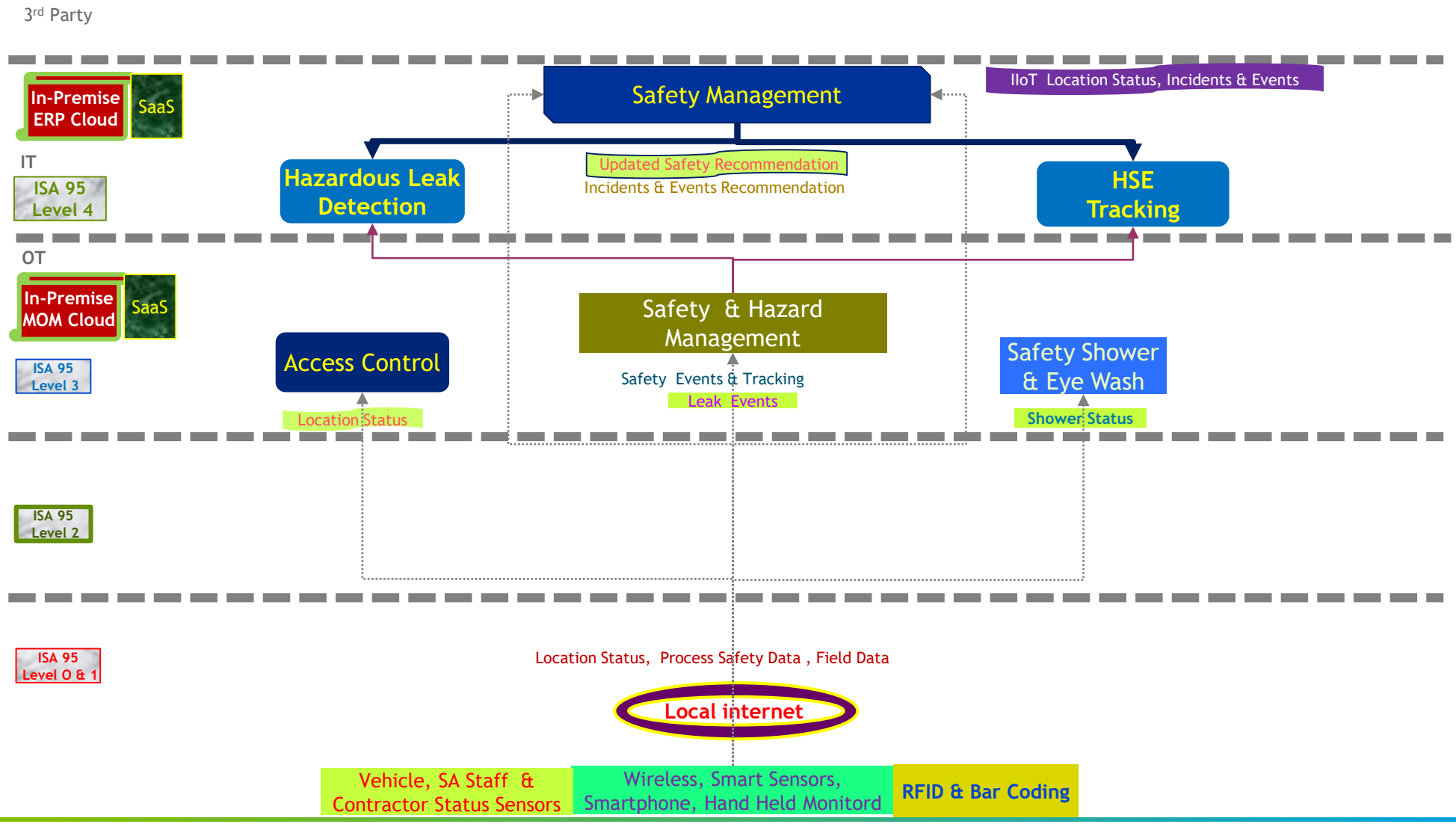
Ship Tracking @ Sea & Ship Broker Advisories



Environmental Tracking & Regulator Agency Advisories

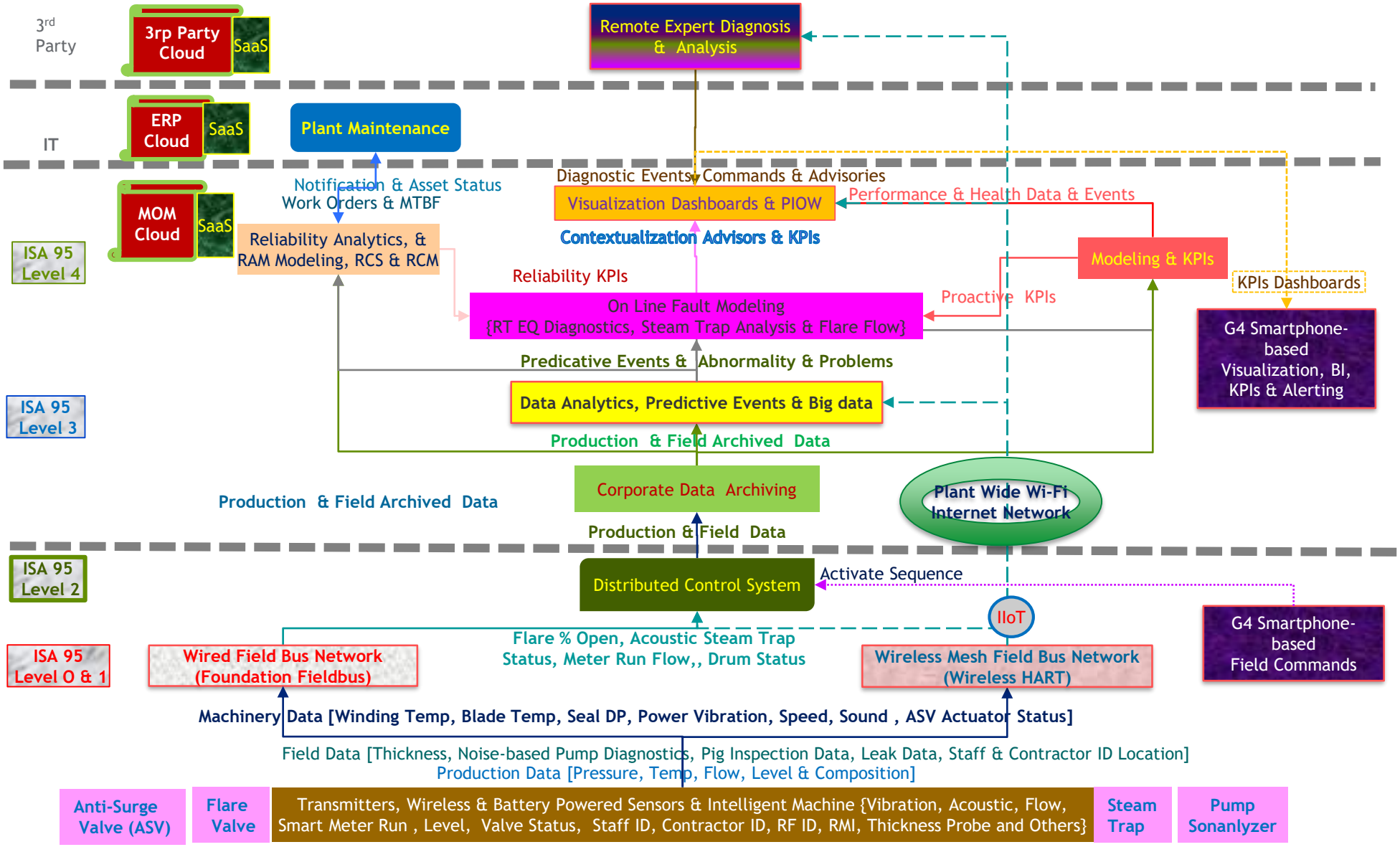


Safety Tracking & Supervisory Advisories



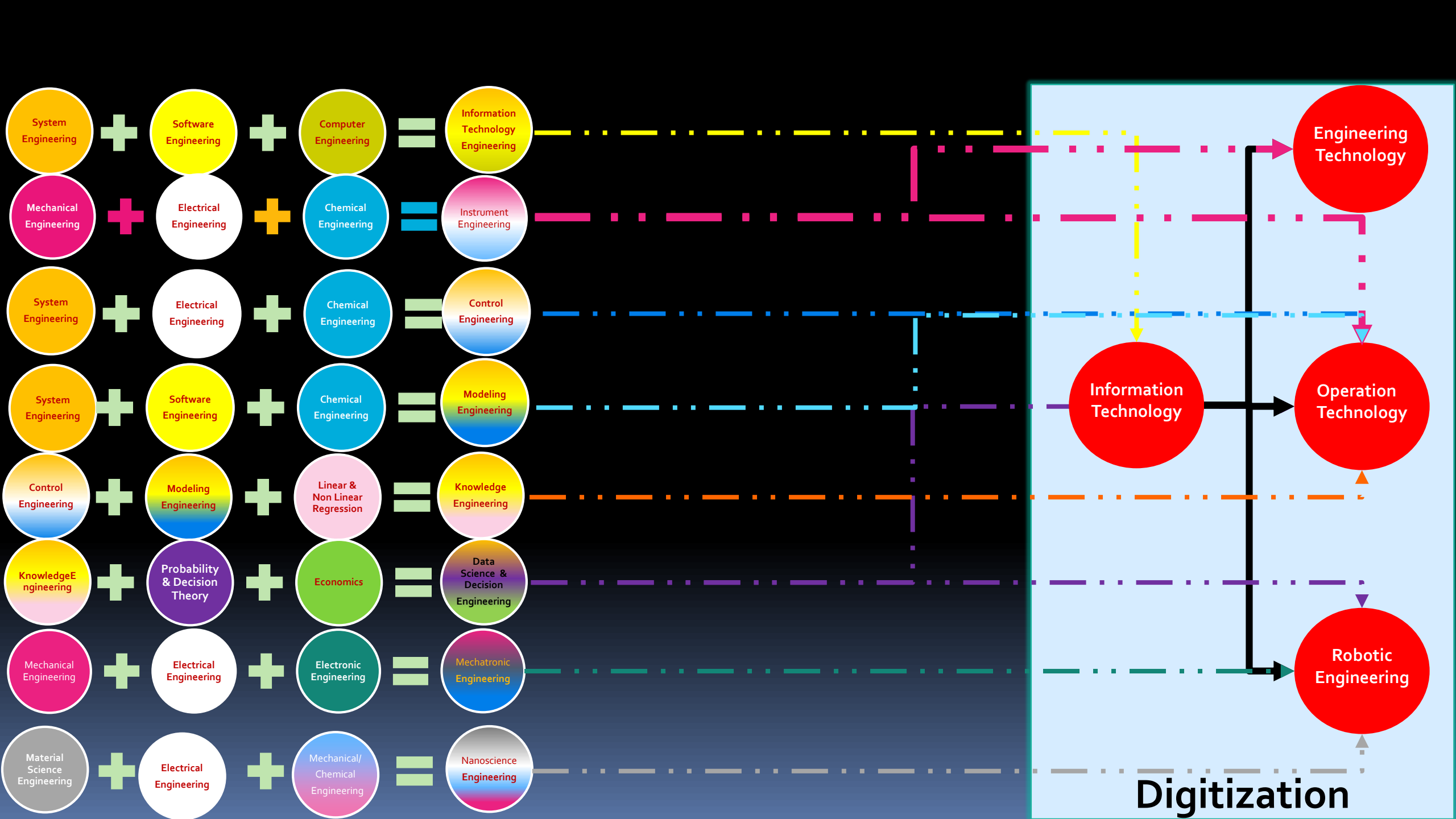
Remote Machine Diagnostics [Hybrid Solution for Tracking, Analysis & Advisory]

{Modeling, Analytics, SOA, Cyber Security, IIoT, Smartphone, Cloud}

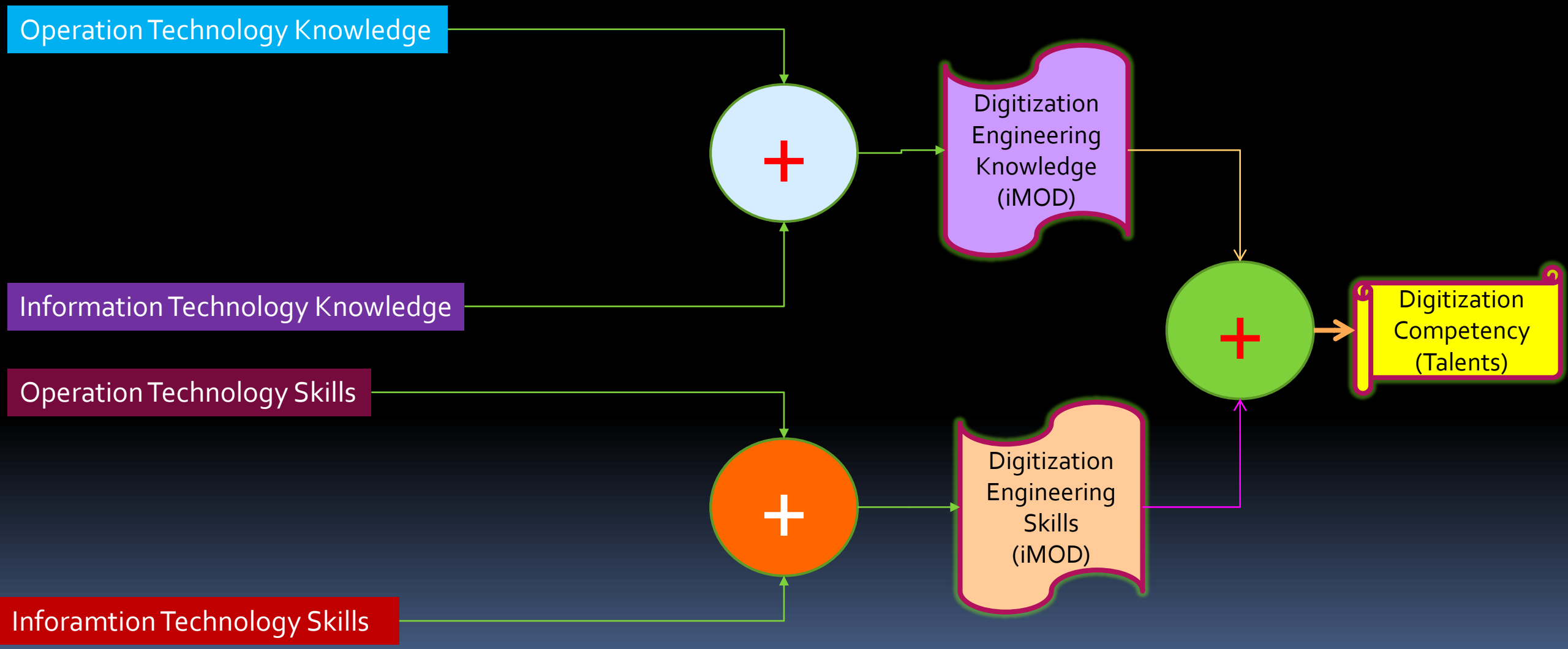


“Digitization Table of Contents”

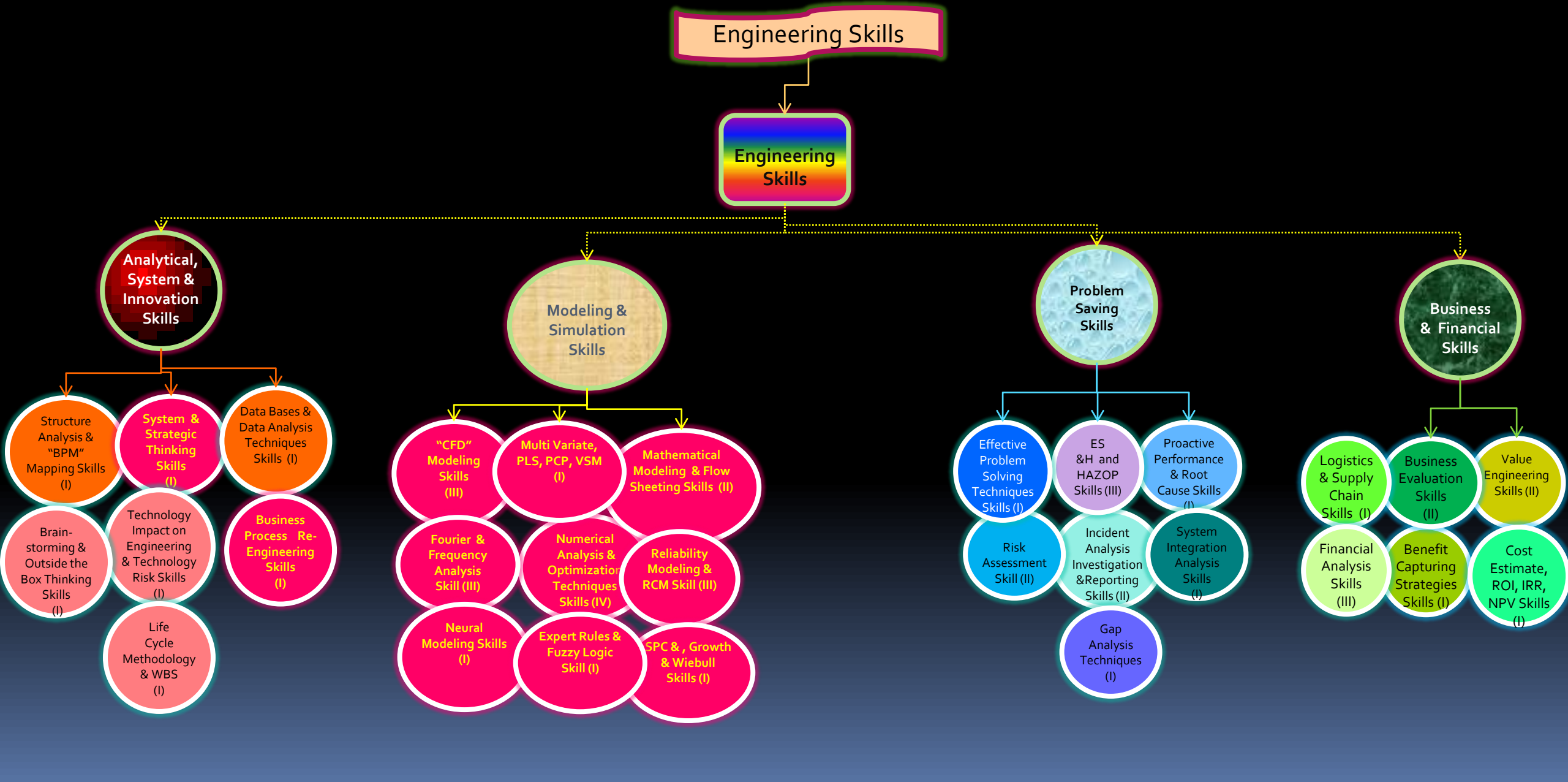
1. Block Chain


System Engineering
Software Engineering
Computer Engineering
Information Technology Engineering
Mechanical Engineering
Electrical Engineering
Chemical Engineering
Instrument Engineering
System Engineering
Electrical Engineering
Chemical Engineering
Control Engineering
System Engineering
Software Engineering
Chemical Engineering
Modeling Engineering
Control Engineering
Modeling Engineering
Linear & Non Linear Regression
Knowledge Engineering
KnowledgeE ngineering
Probability & Decision Theory
Economics
Data Science & Decision Engineering
Mechanical Engineering
Electrical Engineering
Electronic Engineering
Mechatronic Engineering
Material Science Engineering
Electrical Engineering
Mechanical/ Chemical Engineering
Nanoscience Engineering
Engineering Technology
Information Technology
Operation Technology
Robotic Engineering
Digitization

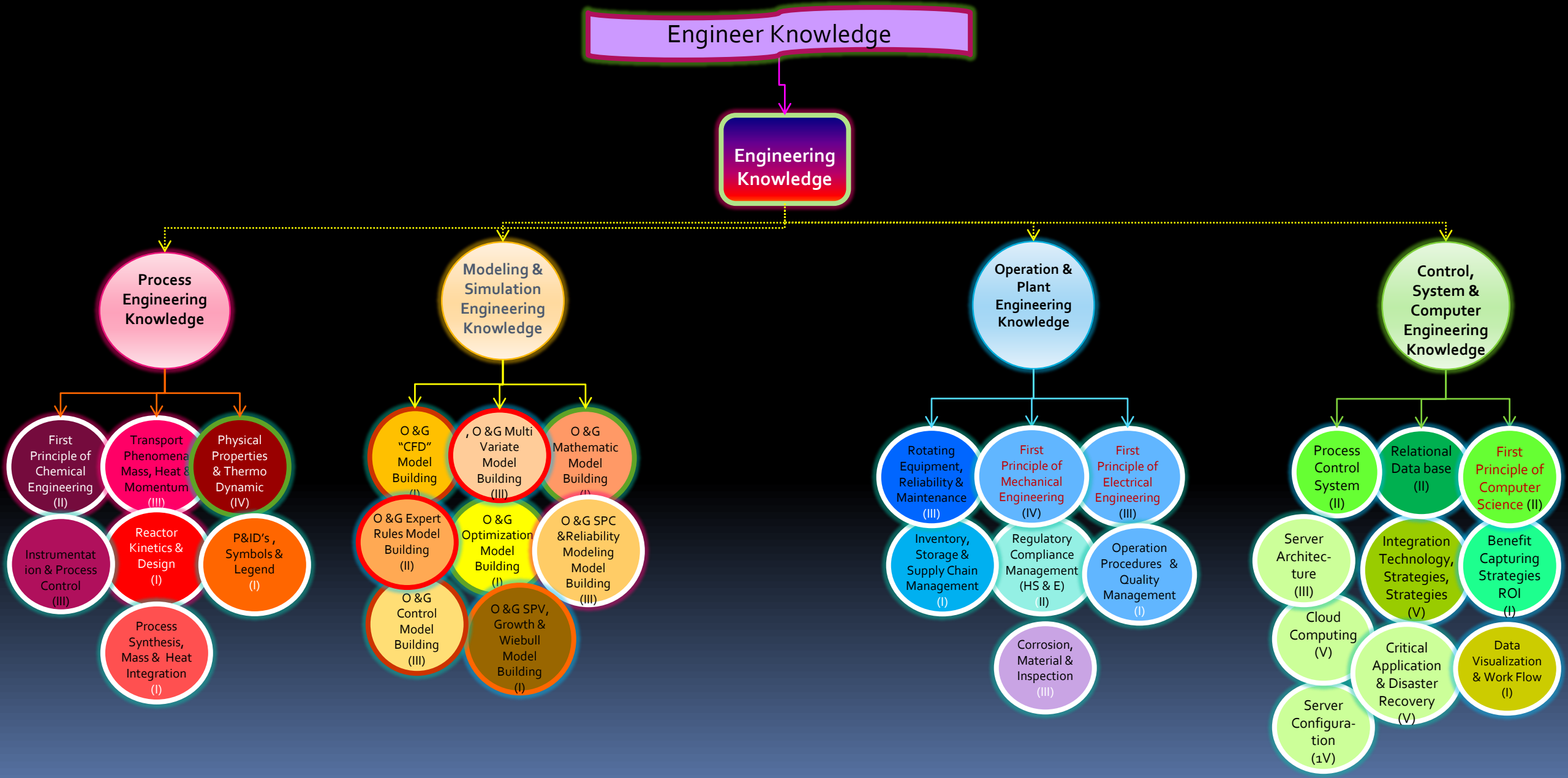
MOM Engineer Competency (Talent) Model



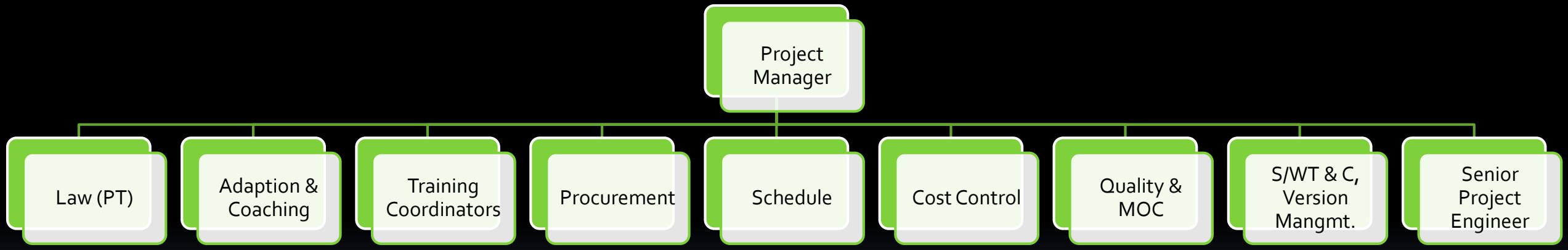
Knowledge Engineer Skill Model



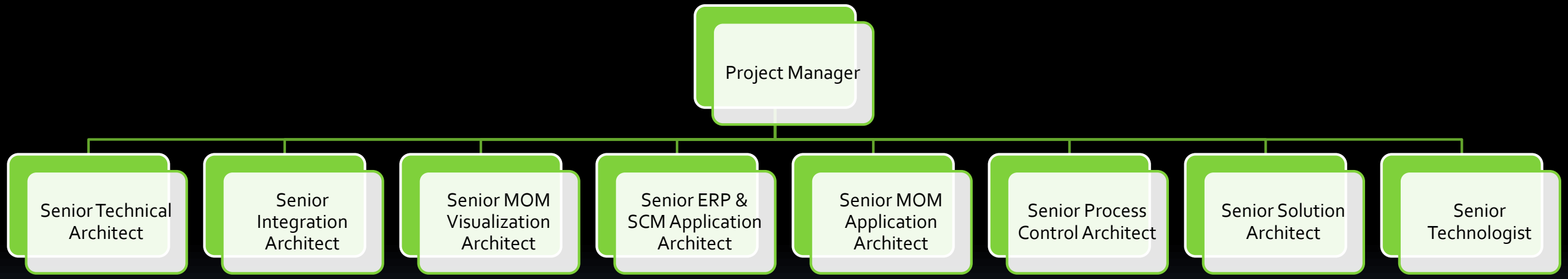
Knowledge Engineer Competency Model



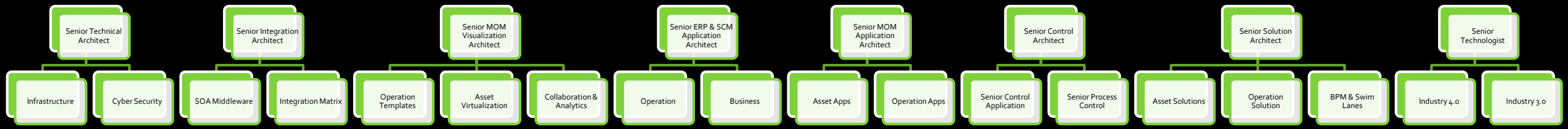
Industry 4.0 Digitization Competency Model



Industry 4.0 Digitization Competency Model



Industry 4.0 Digitization Competency Model

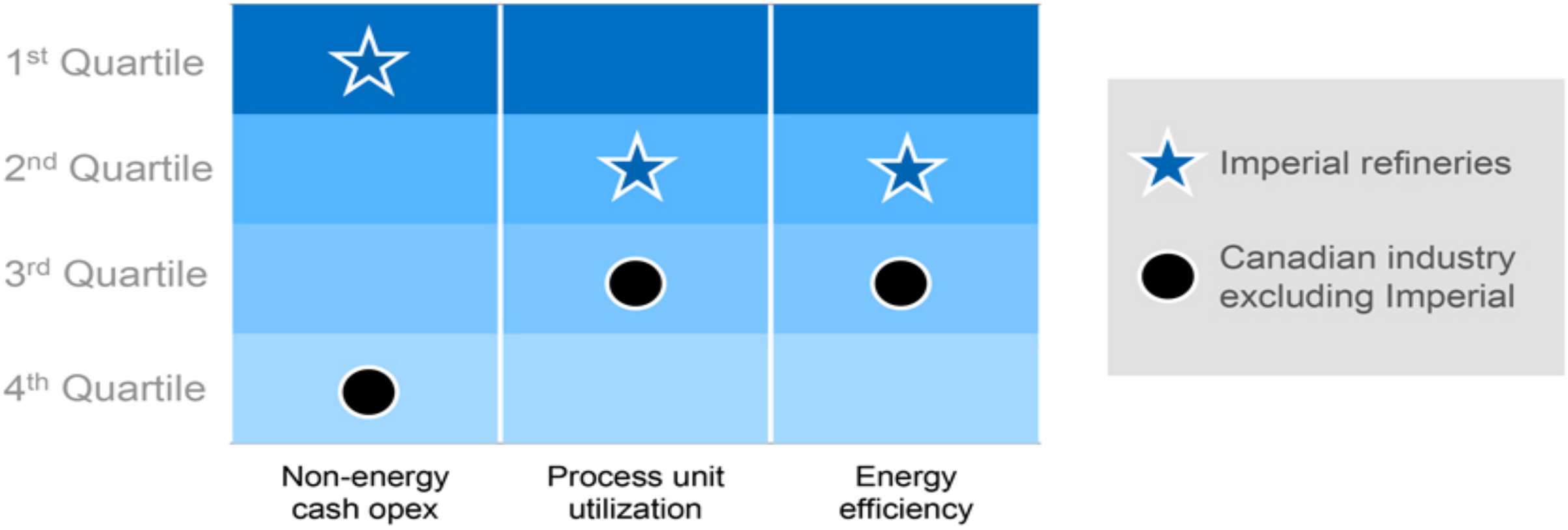


1. Switch to learning mode, and encourage employees to do the same
2. Train fully, then follow up
3. The C-suite should collaborate and stick together
4. Have a North Star
5. Don't try to fix everything at once
6. Don't rely on technology
7. Prepare technical assistance
8. Have a hype squad
9. Be transparent

Competing in the 4th Quartile of Solomon Benchmarking

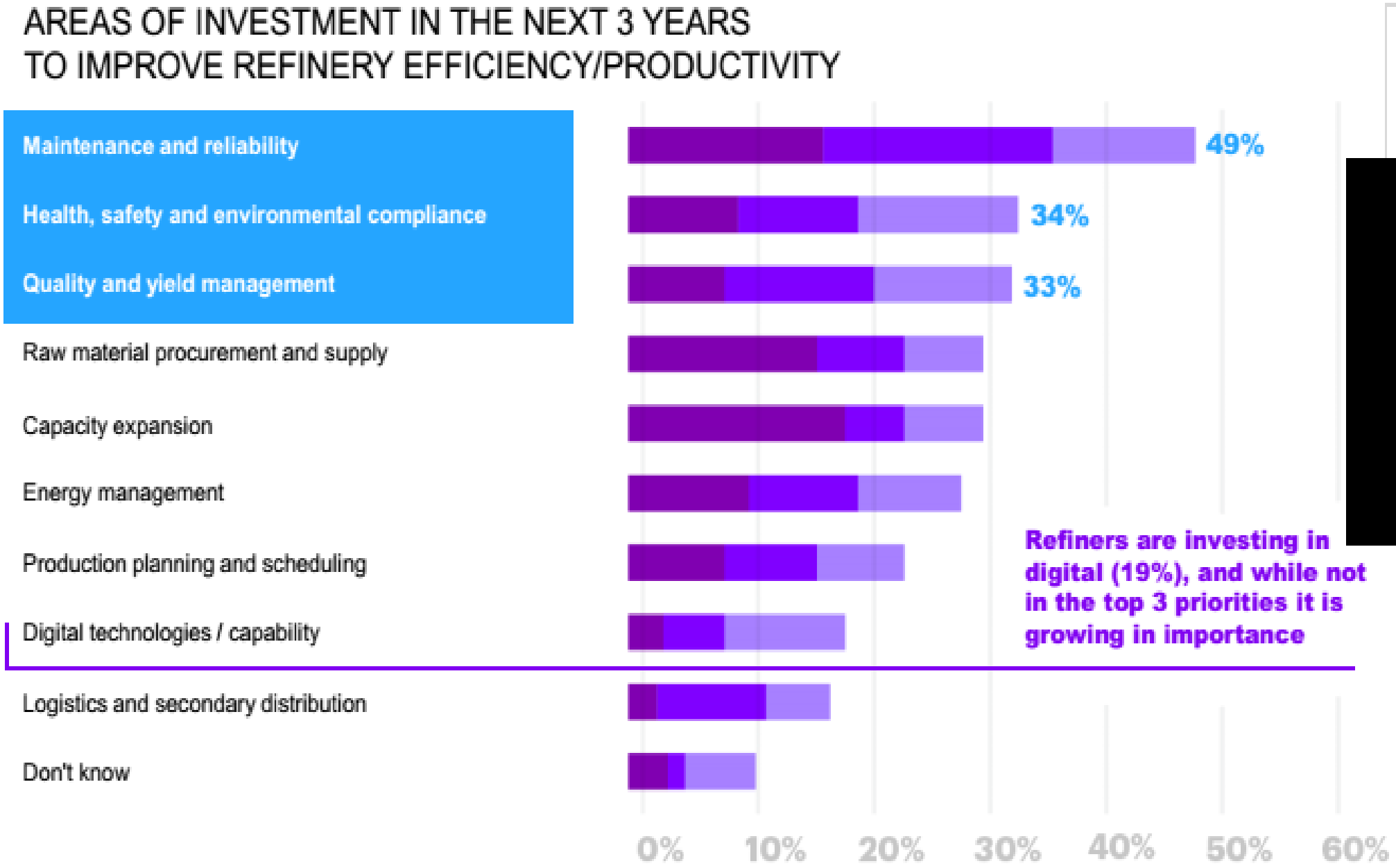
Solomon refining performance ranking

Strong performance in North America, industry-leading in Canada

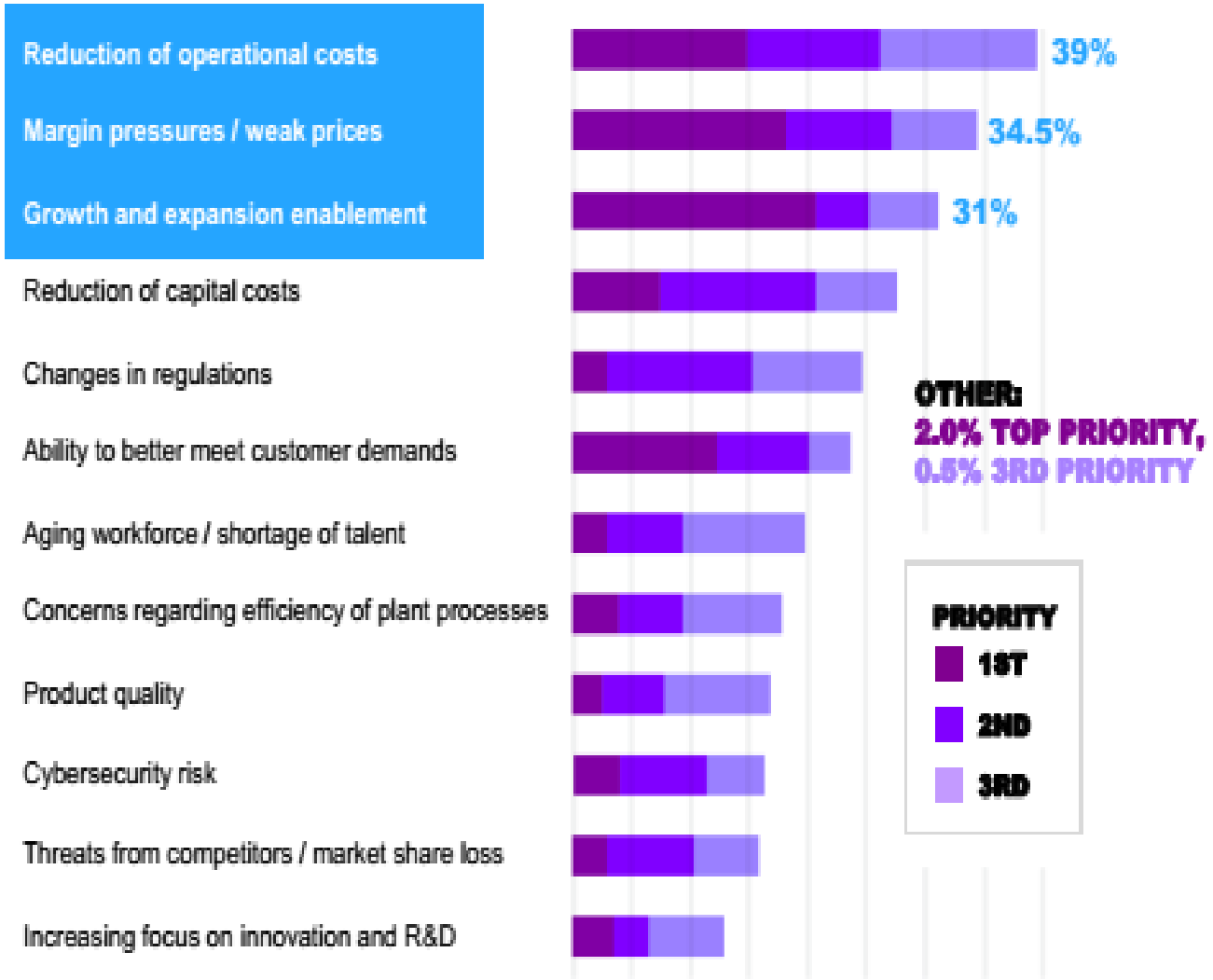


Source: 2014 Solomon survey, includes 96 refineries in North America, 13 in Canada

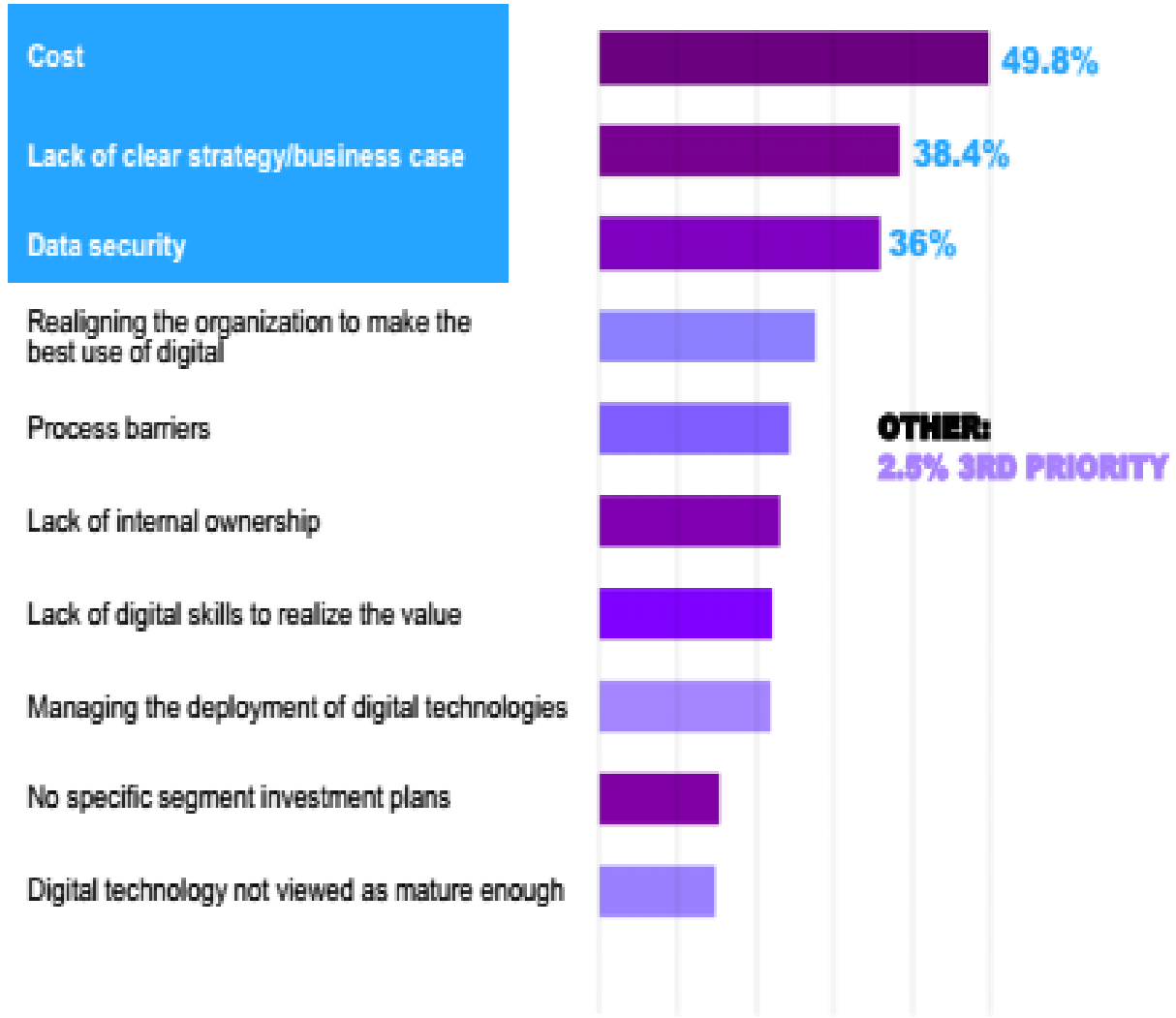
AREAS OF INVESTMENT IN THE NEXT 3 YEARS TO IMPROVE REFINERY EFFICIENCY/PRODUCTIVITY



PRIORITIES OF DIGITAL TO REFINERS



BARRIERS TO ADOPTION OF DIGITAL IN REFINING



MOM/ERP Strategies for Benefit Generation

Abnormalities	Plant Instance	Cost Penalty	MOM Application Strategy
Safety Incidents	Explosion	Replacement $, Insurance Premium	Near Miss Explosion Index
Environmental Violations	High Emission	Emission Penalty	Emission Modeling & Root Cause
Environmental Incident	Catalyst Spill	Clean up $	Catalyst Leakage Management
Unplanned Shutdown	Overpressure	Less Revenues, High Start Up $	Proactive Shutdown Index
Equipment Failures	Tube Failure	Maintenance, Lost Revenues	Proactive Diagnostics & Inspection
Less Equipment Life	Wrong Seal	Spare $	Asset Management and fault detection
Compressor Trip	Excessive Vibration	Lost Revenues. High Maint $	Risk factor and Proactive Diagnostics
Performance Violations	Heater Efficiency Drop	High fuel $	Efficiency & COT Fault Identification
Performance Degradation	Tray Efficiency Drop	High Steam $, CONP	Separation Recovery Fault Identification
Increased Energy	Tube Fouling	CONP, Cleaning $	Fault identification of Energy variance
Performance Giveaway	Polytropic Efficiency Drop	High Power $	Operation Scenarios for HP/SCFD

Improvements Solutions by RMIS {MOM/ERP}

Plant Performance Indices	Performance Improvement Areas
Energy Intensity Index	Energy = 30% ↓
Maintenance Cost, $/EDC	Reliability = 75% ↑
	Maintenance =15% ↓
High Cost, $/EDC	Inventory = 5 % ↓
	Efficiency = 10% ↑
Refinery Utilization, %	Yields/Sep = 2% ↑
	Throughput = 0.5% ↑
Personnel Cost, $/EDC	Personnel ↑

Increased Margin $

Return on Investments (RoI) on Digitization

Accenture and Solomon Associates, has reported in a Recent Study that Digitization Technology can realize Return on Investment (RoI) through the following improvements with $!4 Trillion to be injected in the Global Economy :

- Increasing Production Throughput (+5-25%)
- Improving Asset Utilization (+ 3-5%)
- Decreasing Asset Downtime (-1-5%)
- Increasing Maintenance Productivity (+10-15%)
- Reducing Total Maintenance Costs (-15-30%)
- Optimizing Energy/Run Costs (-5-15%)
- Optimizing Material Costs (-5-25%)
- Improving Equipment Availability (+5-10%)
- • Optimizing Inventory (-15-20%)
- Extending Asset Lifecycle/Age (+15-20%)

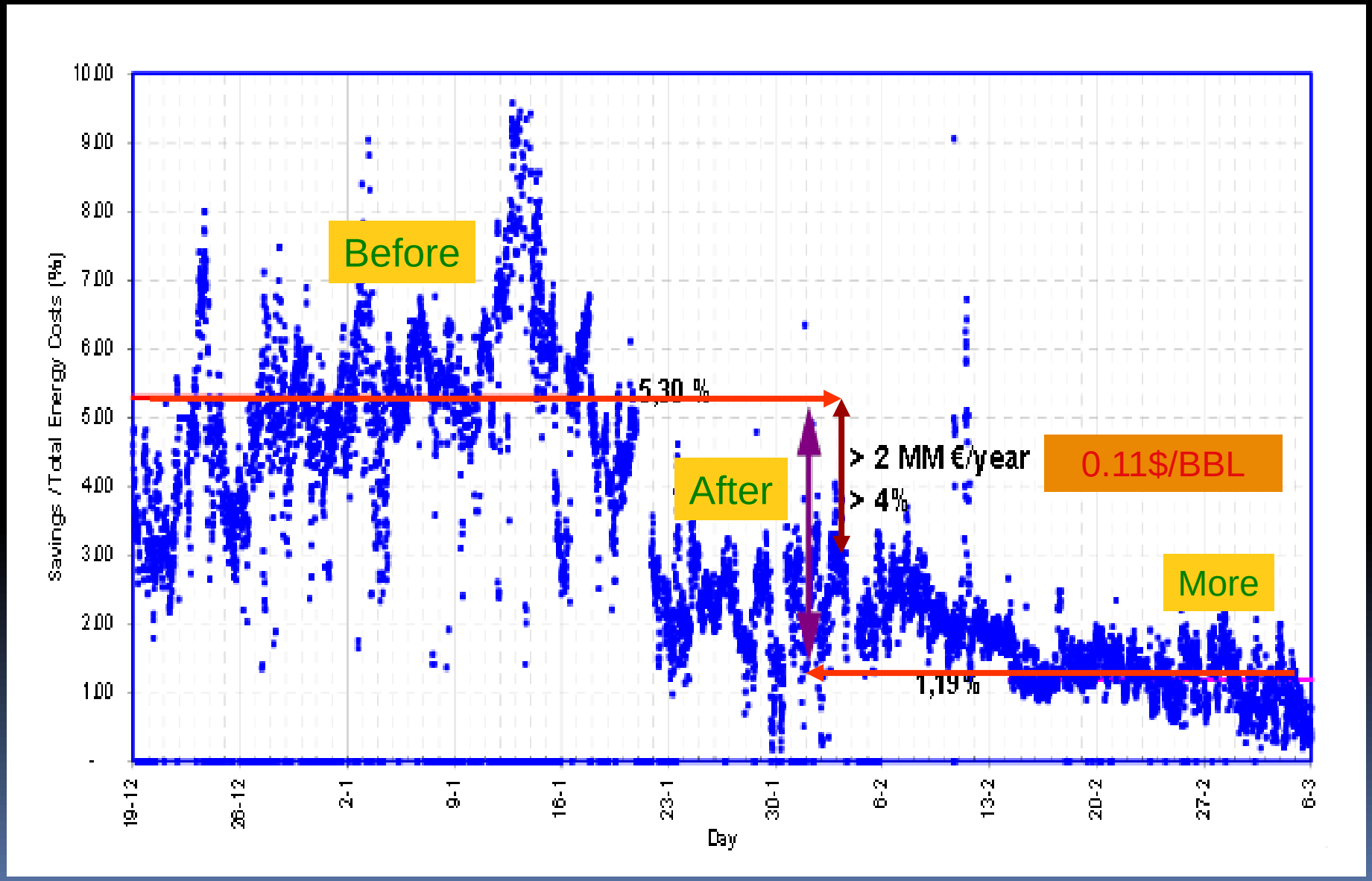
Benefits of Automating Manufacturing Operation

- O.3-0.60 $/BBL Koppal ” HP Magazine,
- O.1- 0.15 $/BBL Gap Gemini & Ernst Yong, 2002
- O.15- 0.5 $/BBL i2 Technology
- 0.11 $/BBL Ripsol Refinery / Spain
- O.15- 0.25 $/BBL Saudi Aramco Refineries

CAPITAL	(30,008,715)	IRR	84.1%
EARNINGS	42,590,298	INTESREST RATE	9.00%
Earnings/Cap	142%	NPV (15%)	194,510,214
		PAYOUT	0.7YEARS
Economic Added Value		EAV	648.2%

Benefit Data from Refinery Audit in Spain

REPSOL YPF



Chemical plant simulation via augmented reality

INVESTORS


LIGHTSPEED
VENTURE PARTNERS


aramco
energy ventures


AIRBUS VENTURES


Schlumberger


KPCB
KLEINER
PERKINS
CAUFIELD
BYERS


First
Round


ANDREESSEN
HOROWITZ


BESSEMER
TRUST

TAHNKYOU