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Making ERP "real time" with Industry 4.0

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Introduction to Industry 4.0 and its role in transforming ERP into a real-time system.

Problem statement (by client)

"My ERP is an offline post-facto system, which does not give me real-time insights to take prompt actions. **Can we make our ERP real time so we can take timely actions and save cost?**" A next-generation leader of an Indian multinational conglomerate asked us.

Solutions and enablers

Indeed, Industry 4.0 (I4.0) enhances a siloed ERP to work like a real-time system by interconnecting the ERP with physical systems such as equipment and sensors to provide real-time data. This integration can drive operational and business insights to take timely actions and save costs.

In this solution brochure, you will learn about the Industry 4.0 core philosophy (Physical to Digital to Physical), the most effective Industry 4.0 enablers and how others are taking the Industry 4.0 journey.
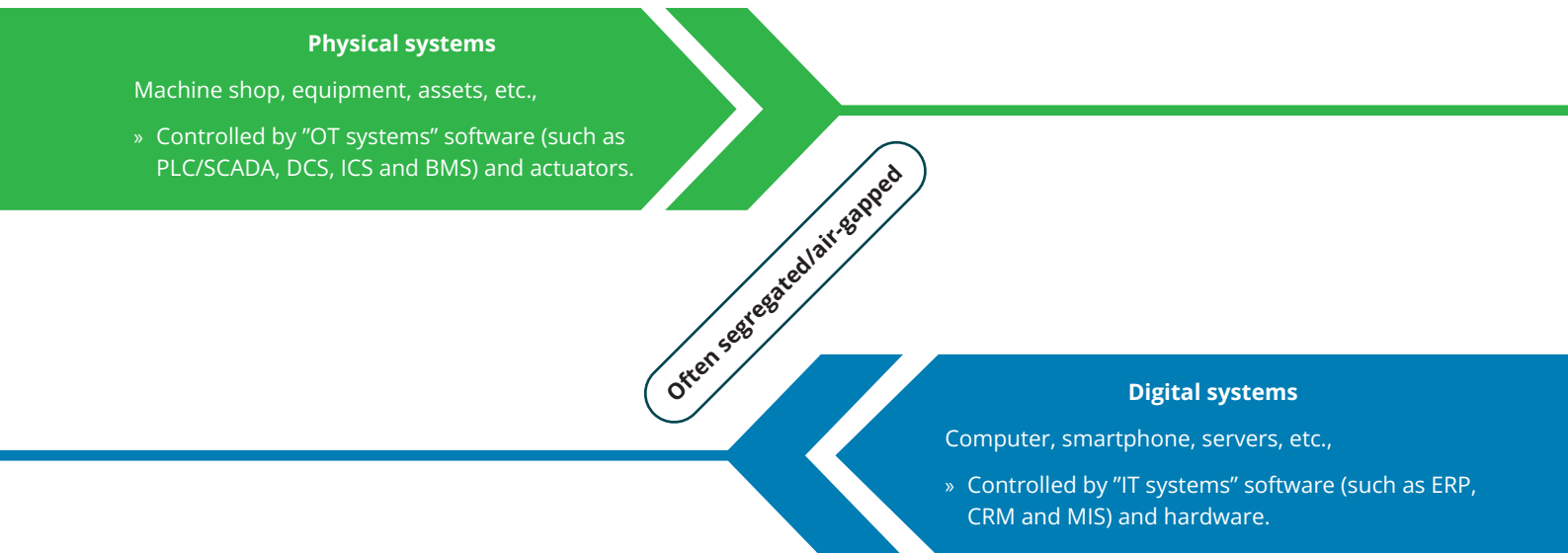
Q 1: What is Industry 4.0?

To understand it more deeply, let us begin with some questions we usually hear from our clientele. It is preceded by the following first three industrial revolutions:

Industry 1.0:   Mechanical power by water and steam
Industry 2.0:   Mass production by electrification
Industry 3.0:   Automation by electronics

Industry 4.0 is the fourth Industrial Revolution focused on using the **power of synergy between "physical systems" and "digital systems"** by interconnecting them **to work together** in "real time," at higher efficiency and **save costs**.

Q 2: What do you mean by the physical systems and the digital systems?

Figure 2: Basics traits of digital and physical systems

Physical systems

Machine shop, equipment, assets, etc.,

» Controlled by "OT systems" software (such as PLC/SCADA, DCS, ICS and BMS) and actuators.

Often segregated/air-gapped

Digital systems

Computer, smartphone, servers, etc.,

» Controlled by "IT systems" software (such as ERP, CRM and MIS) and hardware.

Corollary questions: I also hear about Industry 5.0 (I5.0). What is that? Should we not aspire to go directly for Industry 5.0?

Currently, **Industry 5.0 is evolving** and will take some time to mature. Its core values focus on sustainability, human-centricity and resilience.

How is Industry 5.0 different from Industry 4.0?

As you read this solution brochure, you will find that Industry **4.0 focuses on efficiency and productivity,** primarily **to reduce cost and improve quality,** while emphasizing less on the core focus areas of Industry 5.0 mentioned above. We know the above statements are somewhat vague, but that is the level of maturity Industry 5.0 has achieved.

Can you give a few examples of Industry 5.0 and explain why we cannot go directly for Industry 5.0?

To get a sense of the Industry 5.0 direction, refer to an article published by the European Commission.[1] The article **extends** the aforementioned core values to promote a circular economy (efficient use of natural resources), address climate change (optimise power consumption) and benefit workers and society through different solutions. In short, Industry 5.0 will help build a more planet-, human- and society-friendly ecosystem. In this ecosystem, Industry 4.0 will serve as a foundation and facilitate us in meeting the evolving Industry 5.0 aspirations.

Figure 1: Human-centric behavior of Industry 5.0

"Physical systems" are made of "physical objects" such as equipment, machines and assets. These physical systems are monitored and controlled by Operational Technologies **(OT systems)** such as Programmable Logic Controller (PLC), Supervisory Control and Data Acquisition **(SCADA)**, Distributed Control Systems **(DCS)** and Industrial Control Systems **(ICS). "Digital systems"** are the systems which **process discrete information in binary format (0 and 1)** and **are controlled by "IT systems".**

You must have noticed **a gap between digital systems and physical systems** blocks in Figure 2, which says, "often segregated/air-gapped". The reason for the segregation/gap is the **"weaker"** cyber-threat handling capability of **OT systems** (which grew to work in a closed network setup) compared with the **"stronger"** cyber-threat handling capability of **IT systems** (which grew to work in widely connected networks). **This incompatibility** between OT and IT systems **creates significant segregation, often resulting in air-gapping** to avoid any connection between OT and IT networks.
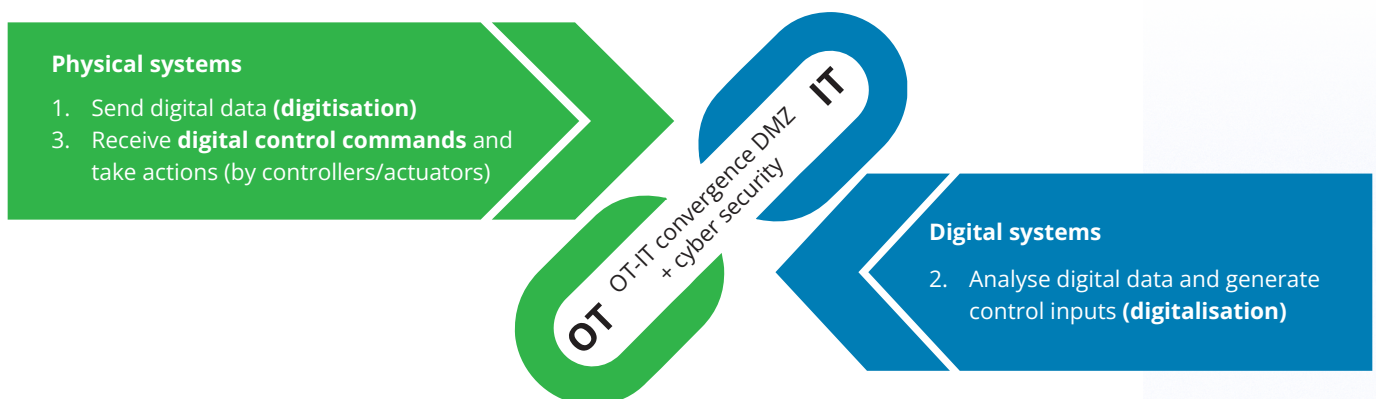
> **The fundamental issue identified by Industry 4.0 is the need to bridge the gap between IT and OT systems with secure connectivity. Due to this issue, IT and OT systems were unable to synchronise during the Industry 3.0 revolution, which is now being addressed in the context of the Industry 4.0 revolution.**

Q 3: How do we bridge the gap between OT and IT systems to create the synergy we discuss?

We recommend interconnecting **OT and IT systems at** a central Demilitarised Zone **(DMZ)** with meticulously planned integration policies and cyber-security controls to safeguard the OT systems. The convergence area is shown at the centre of Figure 3. Here, we also see a **three-step approach** (1. **digitisation,**

2. **digitalisation** and 3. generating and using **digital control commands) creating synergy** to deliver larger values using **"multiple enablers"** from both OT and IT systems to maximise efficiencies and save costs.

Figure 3: Industry 4.0 philosophy of interconnected physical and digital systems to deliver larger values.

Physical systems

1. Send digital data **(digitisation)**
3. Receive **digital control commands** and take actions (by controllers/actuators)

OT-IT convergence DMZ + cyber security

IT

OT

Digital systems

2. Analyse digital data and generate control inputs **(digitalisation)**

Q 4: What are the Industry 4.0 "key enablers"

we should consider to get the highest ROI from our Industry 4.0 investment?

Figure 4: Upstream and downstream key enablers of Industry 4.0

Physical systems
Downstream Industry 4.0 enablers monitor and control physical systems and deployed on OT network

Downstream I4.0 enablers

1. **Digitisation** (Sensorisation, e-logbook, CCTV, drones Visual AI, PLC/SCADA, DCS integration, etc.)

2. **Open-source historian** (local data storage and on-premise real-time, dashboards, alerts, etc.)

3. **Edge computing and 5G** (local real-time control, local data processing, analytics and intelligence, remote connectivity and internet reliability by redundancy)

Upstream Industry 4.0 enablers

1. **Data analytics and intelligence** (Conditional, multivariate trend, predictive GenAI, Agentic-AI)

2. **Control tower** (MIS, Intelligence, and cross-function/facility visibility, and decision support centre)

3. **Digital Twin** (Real-time monitoring, simulations, and optimisation

OT-IT convergence DMZ + cyber security

IT

OT

Digital systems
Upstream I4.0 enablers work on digital systems and are mostly deployed on IT systems/Cloud

Key Industry 4.0 enablers, journey steps and key benefits

Key **downstream** (close to physical systems) Industry 4.0 **enablers and baby steps** for you to take the journey:

1. **Digitisation:** Consider the following elements to digitise:

   a. Sensorisation > Put sensors to capture key data

   b. Digitise analogue meters > Replace with digital meters

   c. Digitise manual entries > Mobile worker solutions

   d. Connect controllers/PLC/SCADA in Open Platform Communications (OPC) protocol

2. **Bring open-source historian:** Migrate from propriety historian to bring speed, portability and scalability

3. **Adapt edge computing and 5G:** Bring computing power and network connectivity next to physical systems and get real-time visibility, intelligence and control

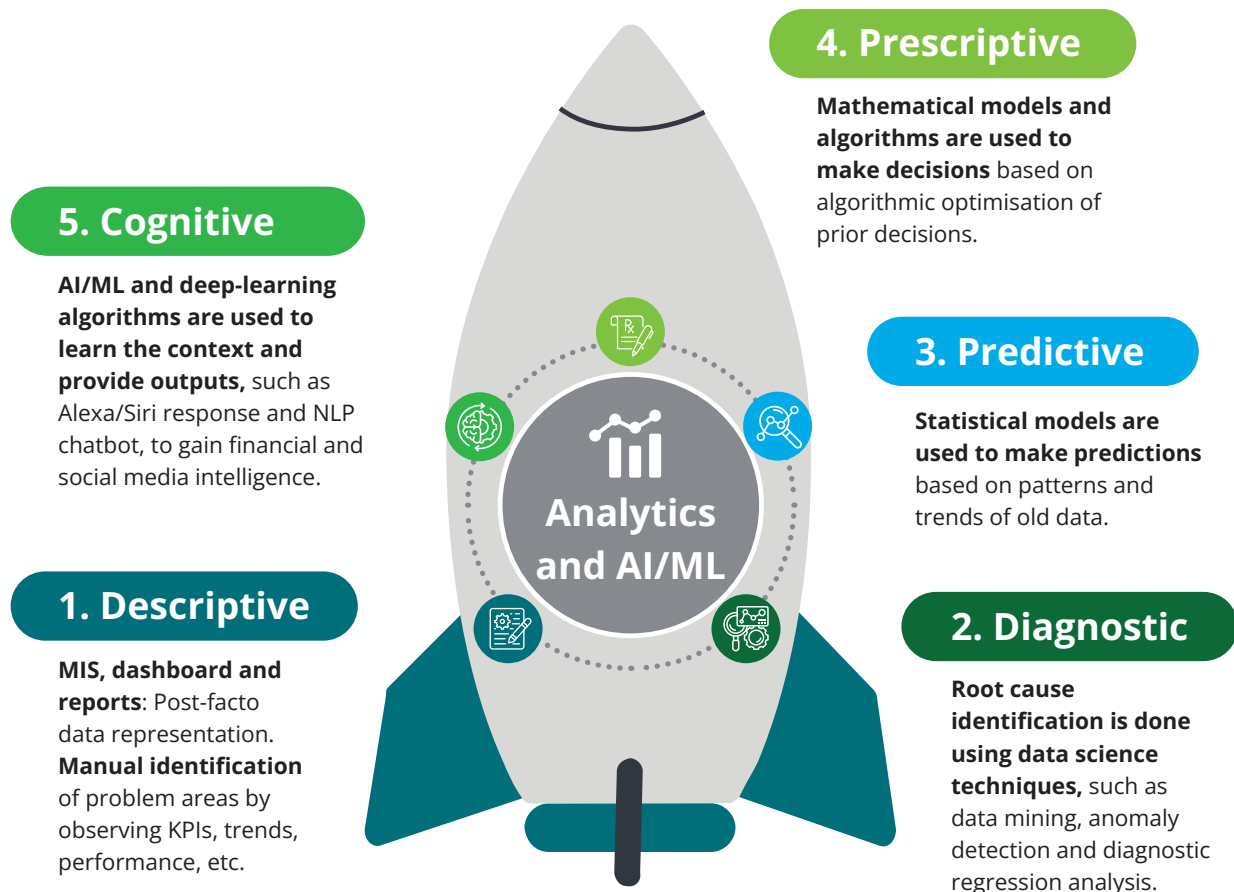**Figure 5: Digitisation, 5G and edge computing illustration**

Evaluate yourself: How to know if you are on the right path

Most organisations send data only from the OT system to the IT system for reporting and dashboarding purposes. It is not sufficient to reap the benefits of Industry 4.0. **If your OT and IT systems are integrated or are being integrated to exchange data in real time and allow bi-directional data transfers, you are on the right path.**

Key **upstream** (on-premises, cloud and mobile computing) Industry 4.0 **enablers and baby steps** for you to take the journey:

Figure 6: Upstream and downstream key enablers of Industry 4.0

1. **Data analytics and intelligence:** Model your digital data to get the types of intelligence you need, as given below:

4. Prescriptive

Mathematical models and algorithms are used to make decisions based on algorithmic optimisation of prior decisions.

5. Cognitive

AI/ML and deep-learning algorithms are used to learn the context and provide outputs, such as Alexa/Siri response and NLP chatbot, to gain financial and social media intelligence.

3. Predictive

Statistical models are used to make predictions based on patterns and trends of old data.

Analytics and AI/ML

1. Descriptive

MIS, dashboard and reports: Post-facto data representation. **Manual identification** of problem areas by observing KPIs, trends, performance, etc.

2. Diagnostic

Root cause identification is done using data science techniques, such as data mining, anomaly detection and diagnostic regression analysis.

2. **Control tower:** Consider the following elements to achieve:
   a. Real-time (no manual) data flow up to data-lake
   b. Data models spanning across functions/departments
   c. Online internal and external collaboration features
   d. Efficiency by GenAI and automation by Agentic-AI

3. **Digital Twin (DT):** Simulate physical systems and make decisions:
   a. Part/Component DT: CAD/CAE/CAM
   b. Product/Asset DT: Simulate functionality, manufacturability, maintainability, etc.
   c. System/Unit DT: End-to-end integrated system simulation (mostly 3D) for workstation, plant, etc.
   d. Process DT: Simulate process parameters and performance in base metal, chemical, O&G, etc.

We identify the top five problem areas addressed by Industry 4.0, their potential losses, expected benefits and ROI as follows:

Table 1: Top five problem areas addressed by Industry 4.0, their potential losses and expected benefits

S. No.	Targeted problem areas	Potentials losses	Expected benefits	Typical ROI (months)
1	Operational and maintenance challenges, equipment breakdown and high maintenance turnaround time	Reduced OEE: 1–2%	2–5%	12–18
2	Production cost optimisation: Raw material-specific consumption and energy-specific consumption	Increased cost of production: 0.5–1%	0.05–0.10%	18–24
3	Higher cost of outsourced operations and services	Higher cost of services: 10–20%	10–20%	06–12
4	Operational disruptions due to system complexity and user mistakes	Operational disruptions: 0.5–1%	0.25–0.75%	06–12
5	Cross-functional supply chain visibility challenges	Waiting time: 2–5%	1–2%	12–18

Important notes

1. The numbers in Table 1 are provided for awareness purposes. Due to our commitment to client data privacy, we cannot share specific details; however, we can assist you in finding similar publicly available information.

2. The above list is non-comprehensive in number. The number of issues to be addressed by Industry 4.0 enablers generally ranges from 15 to 45, depending on an organisation's specific target "to-be" state and the level of investment committed.
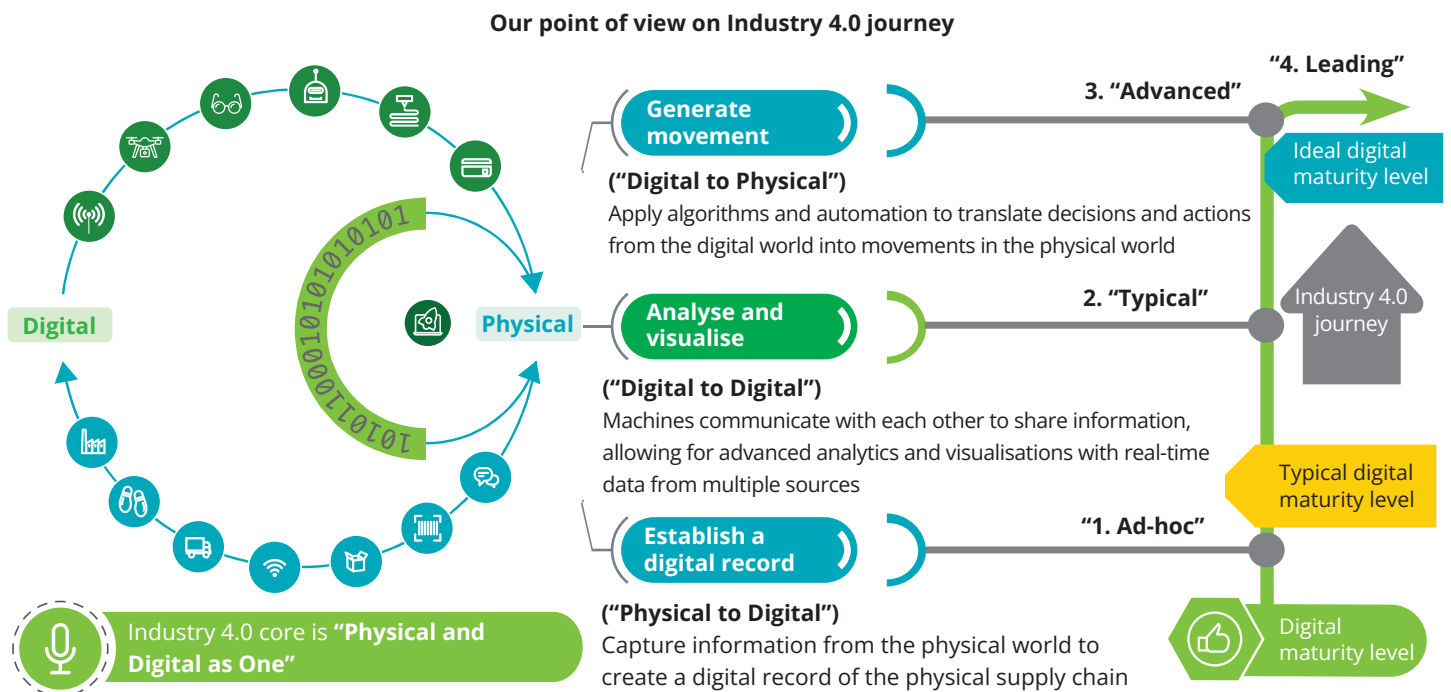
Q 5: How do we take the Industry 4.0 journey? How are others doing the same? How do we understand where we are on the journey, as a few initiatives are in progress?

To begin your journey, it is essential to understand your current maturity level (as-is), which could be categorised as Ad-hoc, Typical, Advanced or Leading. Next, identify your desired future state (to-be) based on your business priorities. Lastly, follow a well-defined Industry 4.0 roadmap to close the gap between your current (as-is) state and your desired (to-be) state. Figure 7 illustrates our perspective on this journey.

Figure 7: Industry 4.0 philosophy, journey and digital maturity levels during the journey

Our point of view on Industry 4.0 journey

Generate movement

("Digital to Physical")
Apply algorithms and automation to translate decisions and actions from the digital world into movements in the physical world

Analyse and visualise

("Digital to Digital")
Machines communicate with each other to share information, allowing for advanced analytics and visualisations with real-time data from multiple sources

Establish a digital record

("Physical to Digital")
Capture information from the physical world to create a digital record of the physical supply chain

Industry 4.0 core is **"Physical and Digital as One"**

3. "Advanced" "4. Leading"
Ideal digital maturity level
Industry 4.0 journey
2. "Typical"
Typical digital maturity level
"1. Ad-hoc"
Digital maturity level

In Figure 7, the highest maturity level is **Leading**. Organisations with this maturity level implement similar solutions to gain business advantages, save quantifiable costs and scale their businesses. They also publish case studies along with quantified benefits in multiple organisations such as Gartner, Forrester, IDC and World Economy Forum (WEF). The **WEF Global Lighthouse Network** offers case studies and quantified benefits that will help you make an informed decision about embarking on the Industry 4.0 journey.

A few rapid-fire questions along with their answers.

Q6. How long does it take to create an Industry 4.0 roadmap with a business case?

Typically, it takes 3 to 4 months.

Q7. Is creating the roadmap and business case necessary before we start any Industry 4.0 initiative?

No, we can begin with a business-critical initiative in alignment with the expected roadmap based on our experience.

**Q8. Can it be combined with my overall digital transformation strategy and AI strategy?**

Yes, aligning these initiatives to avoid reworks and patchwork is important. You should have a single AI strategy to which your IT systems, OT systems and Industry 4.0 solutions should feed data and take advantage.

Q9. I have an upcoming greenfield project where we do not have any "as-is" situation to study. How can we decide on the Industry 4.0 strategy and roadmap in this case?

For greenfield projects, where the "as-is" situation is unavailable, you should consider industry best practices and the most successful Industry 4.0 solutions to define your "to-be" state. Based on the defined "to-be" state, you should create your Industry 4.0 roadmap, design your facilities and then begin the procurement process. The underlying theme should be "smart from the start".

We understand that you still may have more questions.

Let us consider a use case that aligns with our vision statement, "Making ERP real time with Industry 4.0." We can take advantage of Oracle Fusion ERP and Oracle's other cloud services, as these solutions are natively integrated with the ERP. This integration reduces the effort and cost of connecting the ERP to Industry 4.0 solutions. Similar considerations can be applied to other organisations' ERP systems, as the Industry 4.0 approach is platform-agnostic.
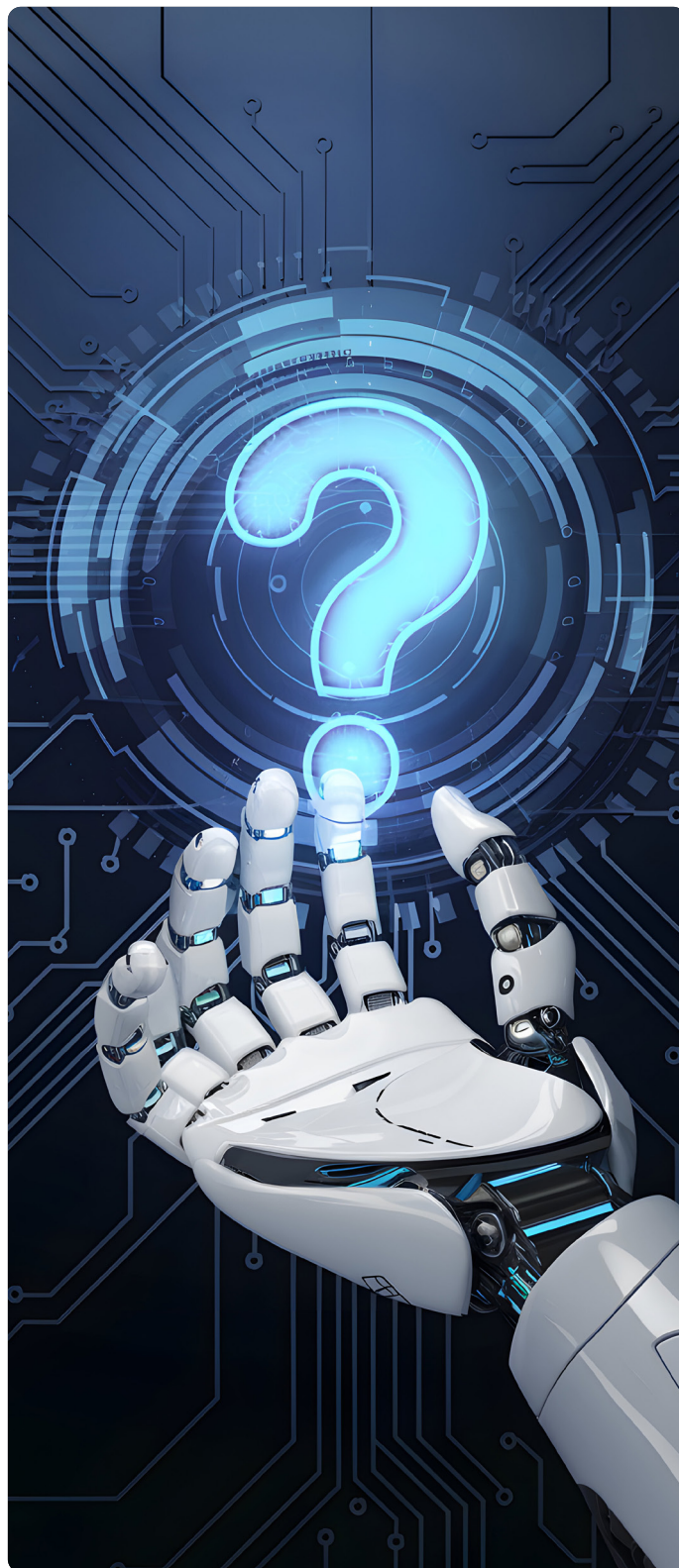
Use case of "Making ERP real time with Industry 4.0" powered by Oracle Stack

The bigger picture of our vision statement

When we draw a bigger picture of our vision statement, **"Making ERP real time with Industry 4.0," we bring OT and IT systems** to work together and deliver the desired value to realise our vision. Figure 8 illustrates such an amalgamated picture, **bringing** the synergy of real-time interactions of OT and IT systems.

Figure 8: The bigger picture of our vision, "Making ERP real time with Industry 4.0" on Oracle Stack
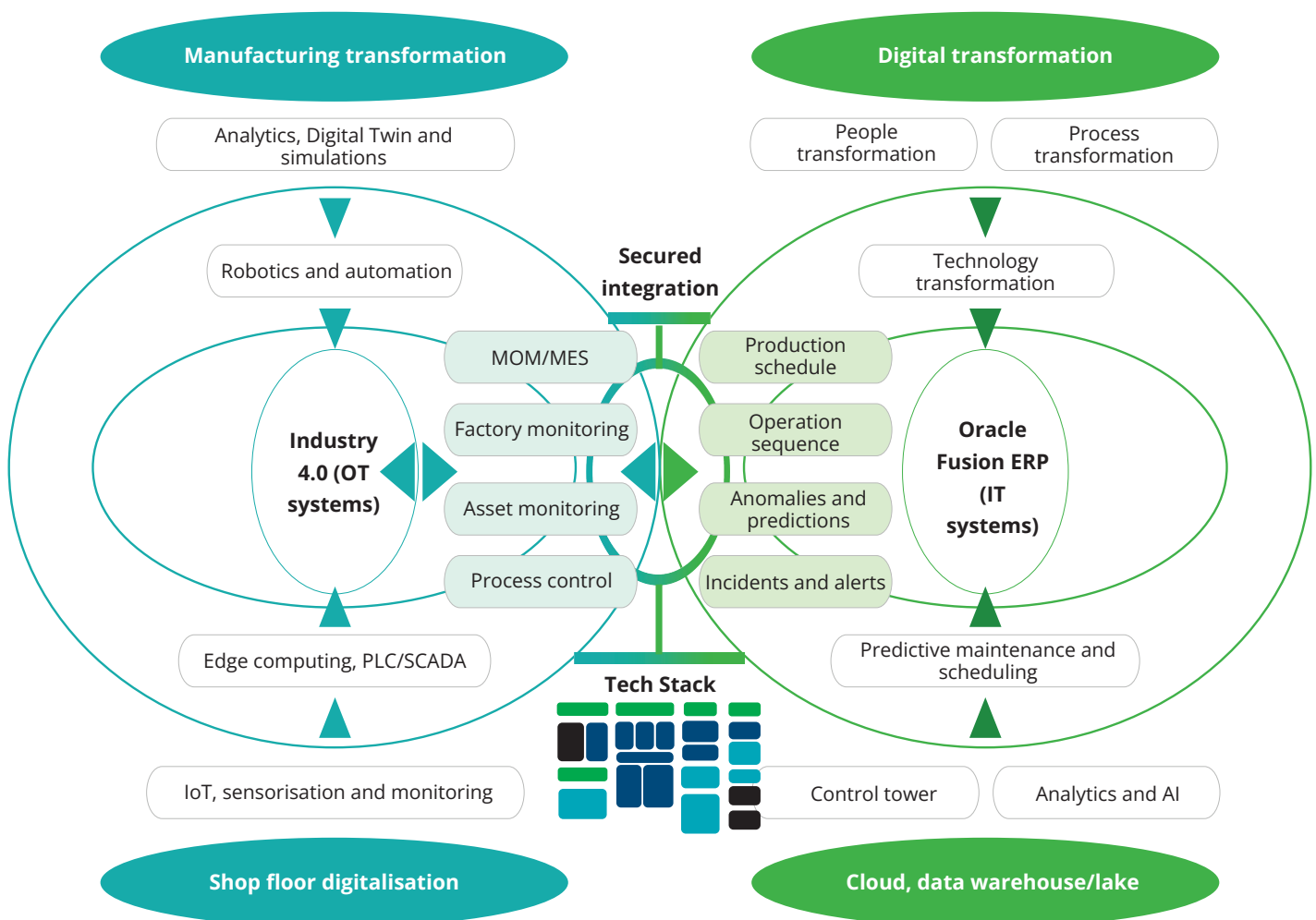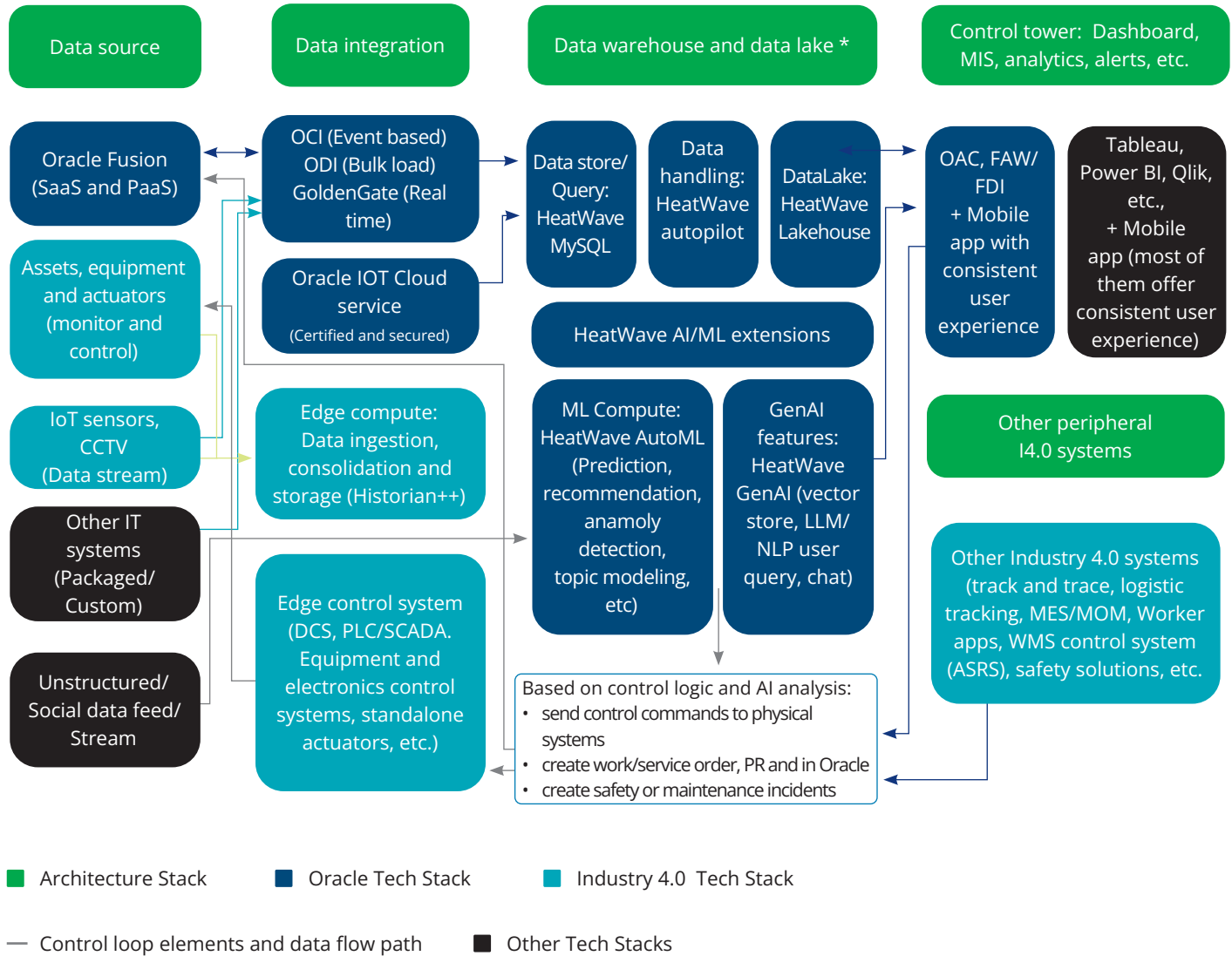

How can Oracle Stack power our vision?

Oracle cloud services are powerful enough to play a major role in bringing life to our vision, as illustrated in Figure 9, given below. This figure identifies key Oracle Tech Stack components and connects dots with other technical components we may need to bring in to implement Industry 4.0.

Figure 9: Next-level details of Oracle Tech Stack and other components we may use to bring life to our vision.

Data source	Data integration	Data warehouse and data lake *	Control tower: Dashboard, MIS, analytics, alerts, etc.

Oracle Fusion (SaaS and PaaS)

OCI (Event based) ODI (Bulk load) GoldenGate (Real time)

Data store/ Query: HeatWave MySQL

Data handling: HeatWave autopilot

DataLake: HeatWave Lakehouse

OAC, FAW/ FDI + Mobile app with consistent user experience

Tableau, Power BI, Qlik, etc., + Mobile app (most of them offer consistent user experience)

Assets, equipment and actuators (monitor and control)

Oracle IOT Cloud service (Certified and secured)

HeatWave AI/ML extensions

IoT sensors, CCTV (Data stream)

Edge compute: Data ingestion, consolidation and storage (Historian++)

ML Compute: HeatWave AutoML (Prediction, recommendation, anamoly detection, topic modeling, etc)

GenAI features: HeatWave GenAI (vector store, LLM/ NLP user query, chat)

Other peripheral I4.0 systems

Other IT systems (Packaged/ Custom)

Edge control system (DCS, PLC/SCADA. Equipment and electronics control systems, standalone actuators, etc.)

Other Industry 4.0 systems (track and trace, logistic tracking, MES/MOM, Worker apps, WMS control system (ASRS), safety solutions, etc.

Unstructured/ Social data feed/ Stream

Based on control logic and AI analysis:
- send control commands to physical systems
- create work/service order, PR and in Oracle
- create safety or maintenance incidents

■ Architecture Stack ■ Oracle Tech Stack ■ Industry 4.0 Tech Stack

— Control loop elements and data flow path ■ Other Tech Stacks

Q10: How can we effectively embark on our Industry 4.0 journey in a way that demonstrates tangible benefits in our financial records, even if we start with small, incremental steps?

Baby steps, but strategically smart from the start

Figure 10: Recommended smart baby steps, without pretext, to begin the journey without losing time
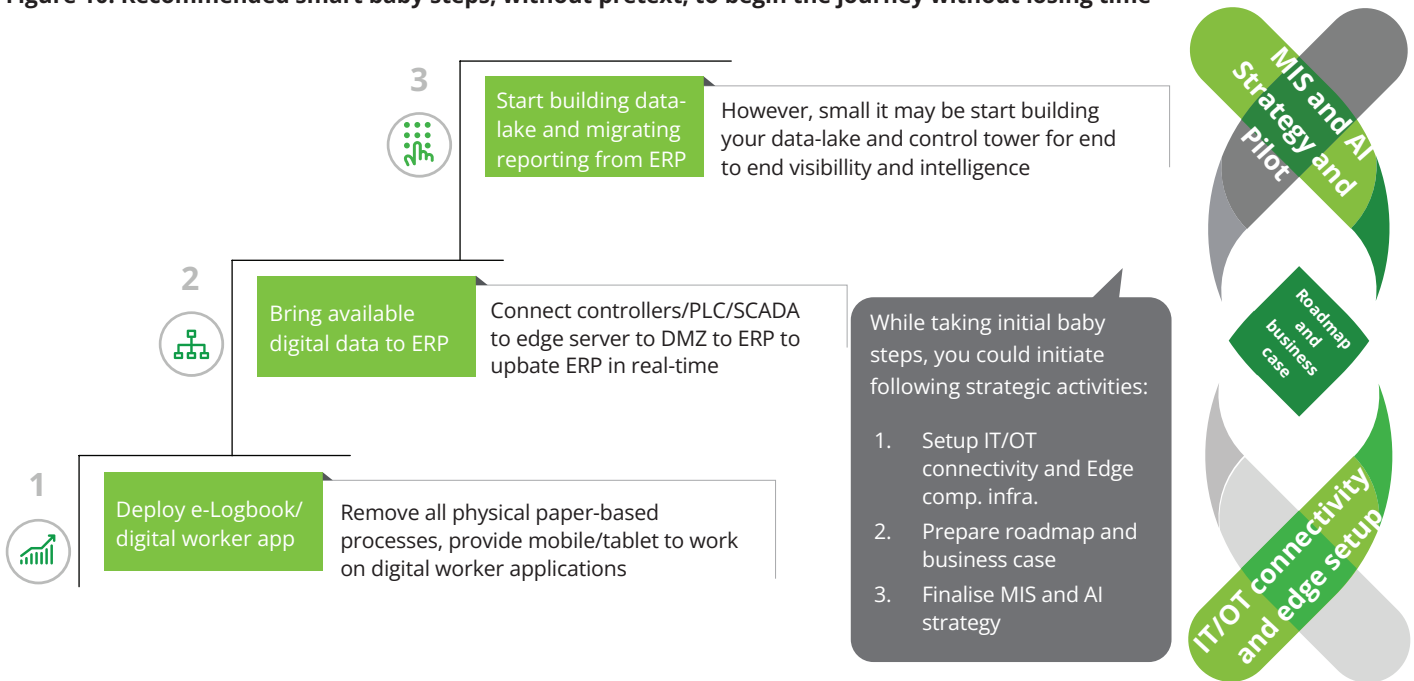
3 — Start building data-lake and migrating reporting from ERP — However, small it may be start building your data-lake and control tower for end to end visibillity and intelligence

2 — Bring available digital data to ERP — Connect controllers/PLC/SCADA to edge server to DMZ to ERP to upbate ERP in real-time

1 — Deploy e-Logbook/ digital worker app — Remove all physical paper-based processes, provide mobile/tablet to work on digital worker applications

While taking initial baby steps, you could initiate following strategic activities:

1. Setup IT/OT connectivity and Edge comp. infra.
2. Prepare roadmap and business case
3. Finalise MIS and AI strategy

MIS and AI Strategy and Pilot

Roadmap and business case

IT/OT connectivity and edge setup

Figure 10 recommends the **baby steps you may take before detailed strategies are made.** As you pause and deliberate about every step, you will realise **these steps are being suggested after careful analysis of many factors, such as constraints, dependencies, ease of adaptability, change management and rate of adaption, cost and expected ROI as we witnessed over the years.** Take an example **of step 1, which is to quickly deploy an e-Logbook or Digital worker app;** this deployment will give you fast results and enhance user experience to accelerate adaptability, say in a few weeks. **It will boost your organisation's confidence in the Industry 4.0 journey. It is a win-win value proposition in terms of cost, time, effort, people, technology and possibly everything else.**

The baby steps and strategic activities have been carefully identified and recommended in a particular kick-off sequence

based on our extensive experience to make you successful. **Why remain uncertain** about embracing the vision of **'Making your ERP "real time" with Industry 4.0? Contact us** and ask any questions; we would love to hear from you.

Figure 11: Services offered by Deloitte!

Advise (consulting) → Implement (project execution) → Operate (support services)
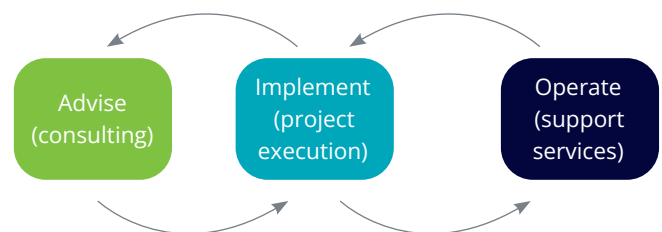
What can we do for you?

We can provide the offerings shown in Figure 11, whether individually or in combination.

Connect with us

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