

In collaboration with  
NEOM



# The Lighthouse Operating System: Driving Responsible Transformation

WHITE PAPER  
APRIL 2025

# Contents

Foreword	3
Executive summary	4
1 Why a new industrial operating system is needed	5
1.1 Building on traditional improvement methodologies	6
1.2 A shared vision: Developing and scaling an open industrial operating system	7
2 The Lighthouse Operating System: A holistic, end-to-end approach	8
2.1 A new operating system standard designed for the practitioner	10
2.2 Six fundamental operating principles applicable to all industry	10
2.3 Five levels of operational maturity to Lighthouse excellence	12
2.4 Collective learnings from industry leaders demonstrating excellence	14
2.5 The six principles of the Lighthouse OS	15
2.5.1 Adaptable and robust processes	15
2.5.2 Connected and transparent flows	16
2.5.3 End-to-end synchronization	17
2.5.4 Embedded sustainability	18
2.5.5 Learning organization	19
2.5.6 Accelerated digital and data	20
2.6 The missing link: Connecting capability development and operations excellence	21
2.7 From incremental gains to systemic change: Applying the Lighthouse OS	21
3 Developing the operating system through application	23
3.1 Shop-floor improvement – with Koç Holding	24
3.2 End-to-end supply-chain diagnosis – with Tata Steel	26
Conclusion and call to action	29
Contributors	30
Endnotes	32

## Disclaimer

This document is published by the World Economic Forum as a contribution to a project, insight area or interaction. The findings, interpretations and conclusions expressed herein are a result of a collaborative process facilitated and endorsed by the World Economic Forum but whose results do not necessarily represent the views of the World Economic Forum, nor the entirety of its Members, Partners or other stakeholders.

# Foreword



**Kiva Allgood**

Head, Centre for Advanced Manufacturing and Supply Chains; Member, Executive Committee, World Economic Forum



**Vishal Wanchoo**

Chief Executive Officer, OXAGON, NEOM

What if manufacturers around the world could access a proven, scalable system to accelerate their transformation – one built on the successes of the most advanced industrial sites? This is the vision behind the Lighthouse Operating System, a next-generation industrial operating system that distills the hard-earned lessons of the world's leading manufacturing sites into an actionable framework for the entire sector.

This journey began as a collaboration among the World Economic Forum, NEOM and a group of pioneering industry partners, focused on developing the Next Generation Industrial Operating System (NGIOS) – a framework for integrating digitalization, sustainability and workforce transformation into core manufacturing operations.

As the work progressed, it became clear that manufacturers needed more than just a blueprint: they needed a practical, tested system to bridge the digital maturity gap across industries and regions. With the backing of 189 Lighthouse factories recognized by the Forum's Global Lighthouse Network (GLN), the initiative evolved into the Lighthouse OS – a structured, scalable way to embed best-in-class operational practices across industrial organizations.

The need for this transformation is clear. While some companies have mastered the use of artificial intelligence (AI), automation, digital twins and sustainability-focused innovations, many

others – especially small and medium-sized manufacturers – struggle to scale these solutions effectively. The Lighthouse OS addresses this challenge by capturing what works, why it works and how to implement it at scale, equipping manufacturers with the tools and knowledge to drive tangible business outcomes, resilience and long-term competitiveness.

At its core, the Lighthouse OS is designed to be intuitive, adaptable and reflective of real-world industrial operations. It is not a theoretical model but a system built for and by manufacturers, validated through the insights of industry leaders who have already navigated complex digital transformations. Whether on the shop floor or in the boardroom, the Lighthouse OS provides a common language and structure for continuous improvement, ensuring that transformation efforts deliver lasting impact.

To bring this vision to life, we have assembled a coalition of Forum industry partners and Lighthouse sites, whose expertise will ensure the Lighthouse OS remains grounded and focused on delivering measurable results. This white paper marks the first step in an iterative process – develop, test, refine and scale – with the goal of making the Lighthouse OS openly accessible to manufacturers worldwide. By working together, we can unlock a new era of industrial excellence, ensuring that no company is left behind in the Fourth Industrial Revolution.

# Executive summary

The Lighthouse Operating System shows the way to excellence in manufacturing.

The manufacturing sector is undergoing a critical transformation, driven by the rapid evolution of digital technologies, sustainability imperatives and shifting market dynamics and customer expectations. Legacy operating methodologies, while foundational, are no longer sufficient to address the increasing complexity and volatility. This white paper presents the Lighthouse Operating System (Lighthouse OS), a structured, open-source framework designed to integrate best-practice operational excellence with digital and sustainable practices to drive responsible industry transformation.

Building upon the Global Lighthouse Network (GLN),<sup>1</sup> a World Economic Forum initiative that identifies and recognizes the most advanced operational sites in the world, the Lighthouse OS aims to define a new way of working and build an improvement engine that helps manufacturers follow the path to excellence. If Lighthouses represent the current benchmark of operational excellence, then the Lighthouse OS is the structured approach that will enable more organizations to reach that level by providing guidance, best practices and a clear roadmap for transformation.

The Lighthouse OS is structured around six core principles, which represent how operations are run day-to-day: adaptable and robust processes; connected and transparent flows; end-to-end synchronization; embedded sustainability; learning

organization; and accelerated digital and data. These principles are mapped within a five-step maturity model, ensuring organizations can systematically progress towards operational excellence.

The journey towards a successful Lighthouse OS requires a paradigm shift. The Lighthouse OS is being designed to be simple, practical and intuitive, ensuring accessibility for manufacturers at various levels of operational maturity. Its ambition is to be self-guided and open-sourced to foster collaboration and continuous improvement across industries.

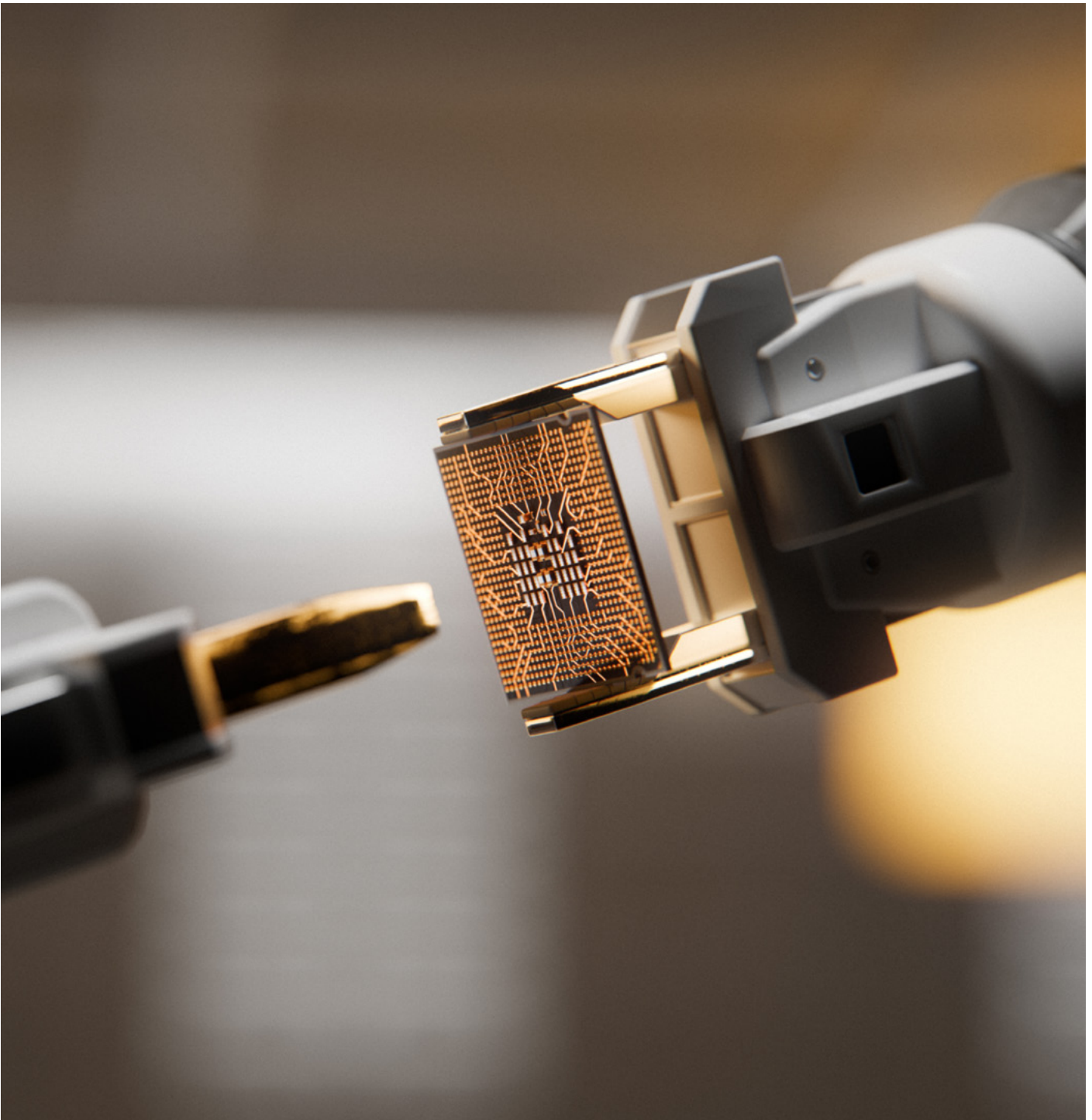
Moving forward, the initiative will focus on expanding pilot projects, validating the Lighthouse OS value and developing a digital platform to facilitate widespread adoption. The vision is for this platform to serve as a dynamic repository of best practices, enabling organizations to benchmark their progress, access relevant knowledge (e.g. use cases) and explore tailored recommendations for implementation viewed from the perspective of the operating principles.

Manufacturers, technology providers and the public sector are invited to participate in the Lighthouse OS initiative, shaping the future of industrial operations. By engaging with this global effort, organizations can gain critical insights, drive continuous improvements and contribute to a more resilient, sustainable and digitally enabled manufacturing ecosystem.

1

# Why a new industrial operating system is needed

It is time for a new approach to manufacturing, one that unleashes the possibilities of emerging technologies and sustainability.



The ambition driving the Lighthouse Operating System (Lighthouse OS) initiative is to refresh, revise and even reinvent the global production systems of the past for the digital age – essentially, to create a gold-standard reference framework that serves as a problem-solving engine to drive improvement and performance, open-sourced and shared with the world.

This framework has been built in collaboration with the World Economic Forum Global Lighthouse Network (GLN) to ensure that the resulting approach not only learns from industry leaders and their experiences but also supports a connected journey for manufacturers. The starting point is understanding where manufacturing is today and how it got there. At a high level, five drivers are shaping manufacturing:

- **Customer:** To meet the rising demand for mass personalization and instant delivery, manufacturers must adapt. Customization has evolved from the selection of features to a situation in which products are often uniquely tailored to individual needs. This shift challenges manufacturers to handle greater flexibility in production while ensuring quality – often at lower volumes.
- **Supply chain:** Managing increasingly complex supply chains requires resilience and real-time transparency. Supply-chain disruptions,

geopolitical tensions, multiple information flows, resource constraints and global competition demand proactive steering to maintain efficiency and competitiveness across the end-to-end supply network.

- **People:** Managing the growing complexity of human–machine interaction is essential. AI and robotics are reshaping human roles in real time, blurring the lines with more seamless interfaces, enhancing performance while making work safer, more effective and innovation-driven, keeping work business-focused while also meaningful and satisfying.
- **Planet:** Sustainability is no longer optional; manufacturers must balance efficiency with environmental responsibility. Modern social and environmental pressures demand action on climate change and resource scarcity. Achieving true sustainability requires a complete redesign of the business model – from design to production, use and reuse.
- **Technology:** The four business themes above look to technology to unlock the hidden potential. Harnessing digital solutions and data can drive and accelerate progress in everything, from improving operational productivity on the shop floor to achieving an overall competitive advantage throughout the end-to-end business.

## 1.1 Building on traditional improvement methodologies

For decades, manufacturers have relied on established methodologies such as Lean, Six Sigma and the Theory of Constraints to drive continuous improvement. These approaches are epitomized for many through the powerful Toyota Production System, where “flows in a Toyota factory are rigidly scripted, yet at the same time Toyota’s operations are enormously flexible and adaptable”.<sup>2</sup>

While this insight dates back to the late 1990s – and other foundational management approaches go back even further – the core principles remain relevant. Continuous improvement is still rooted in structured, scientific experimentation, challenging the status quo by continually refining standards.

Today, digital and data unlock new levels of flexibility and agility while maintaining control over quality and delivery. The complication is that the emerging technologies can appear highly conceptual, and the improvement methodologies are not especially well designed to capture that digital opportunity.

Therefore, the key question is, how can an industrial operating system be designed that can act as a reference framework for industrial companies to drive improvement, integrating the best of the production system with the best of the digital IT/OT system under a single platform?

As today’s digital technology opens the opportunity for a truly synchronized and seamless end-to-end execution of industrial operations, a new, first-of-its-kind approach to operations is needed, one that connects the siloed approaches of the past. The new approach must capture the granularity of the production process through use cases while seamlessly connecting them into a holistic, end-to-end framework enabling the better steering and balancing of the overall system.

Achieving this high ambition will likely require more than incremental evolution. It demands a step change in thinking – a current-forward, future-back approach.

## 1.2 A shared vision: Developing and scaling an open industrial operating system

In 2024, the World Economic Forum, in collaboration with NEOM and 11 industry partners across a wide range of industries, launched an initiative to create a next-generation industrial operating system, which has evolved into the

Lighthouse Operating System. The work is currently being co-created, developed and piloted with a community of partners and will be shared with the world in an open-sourced approach to encourage ongoing improvement and collaboration.

TABLE 1 Partners in the Lighthouse Operating System initiative

 <p>NEOM</p>	 <p>BAIN &amp; COMPANY</p>	
 <p><b>BOSCH</b></p>	<p>Johnson &amp; Johnson</p>	<p><b>TATA STEEL</b></p>
 <p>engro</p>		 <p><b>TULIP</b></p>
<p><b>ETH zürich</b></p>		

Source: <https://initiatives.weforum.org/lighthouse-operating-system/>

2

# The Lighthouse Operating System: A holistic, end-to-end approach

Industry leaders in the Lighthouse OS initiative are linking demonstrated use cases to six fundamental operating principles, laying out pre-validated pathways to achieve excellence.

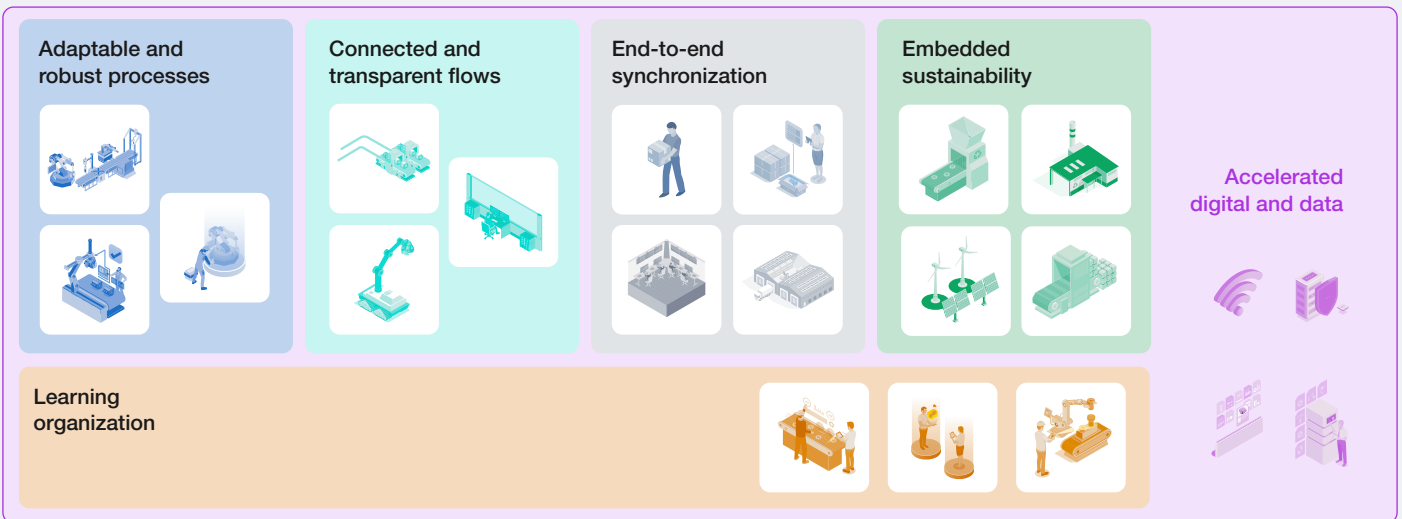


FIGURE 1 | The multilevel structure of the Lighthouse OS

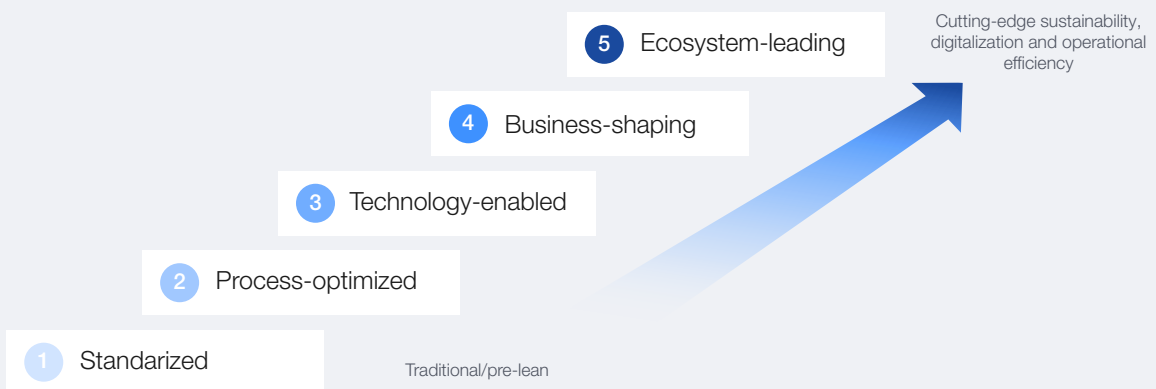
Six operating principles and ...



required capabilities



... mapped to five levels of maturity



At the heart of the Lighthouse OS is a guiding framework for responsible industrial transformation – a new way of working that unlocks potential across industries and regions. While the core principles and key elements are well defined, the framework itself is still evolving, particularly in how these elements interconnect and align with the overarching GLN framework, which focuses on assessing the impact and outcomes of digital transformation. The structure follows a multilevel approach, starting with a set of fundamental principles, breaking down into key improvement areas and supported by a library of documented capabilities (tools, techniques and best practices) mapped across different maturity levels. As this work progresses, the goal is to refine how these components come together to provide a structured, scalable approach – one that enables manufacturers to build capabilities in a standardized,

consistent and sustainable way, while also tailoring transformation pathways to their specific needs (see Figure 1).

In this way, the Lighthouse OS will create a blueprint for outsourced process innovation and problem-solving throughout industry, helping industry players to chart their interlinked journeys to accelerate and successfully deploy and scale emerging technologies. It will also help them customize their approach to the current state and future ambition of their organizations, helping them to achieve maximum customer and business impact. The Lighthouse OS helps manufacturers to avoid costly missteps while fostering a dynamic, evolving standard for system-driven industrial excellence that adapts flexibly and complements existing operating systems.

## 2.1 A new operating system standard designed for the practitioner

The Lighthouse OS is being designed with the goal of being simple, practical and intuitive:

- **Simple:** So that the frames of the operating system are easily recognizable by the user and reflect how they manage day-to-day operations. That way, the user can easily see where they fit into the overall system and their role in the overall improvement.
- **Practical:** To keep it solution-focused on the tools and techniques by which a user can improve their industrial system. In this way the user can focus on use-case implementation and bottom-up operational performance improvement.

- **Intuitive:** To structure those tools and techniques into a logical order of implementation matched against the required business capabilities, so that users understand the enablers needed before tackling the next step of implementation. This is the essence of the systems approach.

These goals stem from the need to apply the Lighthouse OS to everything, from process-level continuous improvement to step change and large-scale transformation across the business.

## 2.2 Six fundamental operating principles applicable to all industry

The Lighthouse OS is based on six operating system principles (Figure 2) designed to represent all core capabilities and activities within day-to-day operations, structured in a way that mirrors how factories and value chains operate in reality – building on the production-system capabilities required for operating individual workstations: **adaptable and robust processes**; production lines: **connected and transparent flows**; covering supply chains: **end-to-end synchronization**; and covering capabilities for sustainable industrial operations: **embedded sustainability**. At the core lies a focus on people: **learning organization**.

All the above are enabled through **accelerated digital and data**, capabilities boosting the information flow throughout the business.

These operating-system principles not only address the aforementioned challenges but also reflect how industry operates. Inspired by NEOM's research and adapted to mimic leading industry operations at Lighthouse sites by a team of cross-industry experts, they continue to be pressure-tested with leading global companies in multiple sectors and refined through early-stage development pilots.

FIGURE 2 | Six operating principles mirroring how factories and value chains operate in reality

### Adaptable and robust processes

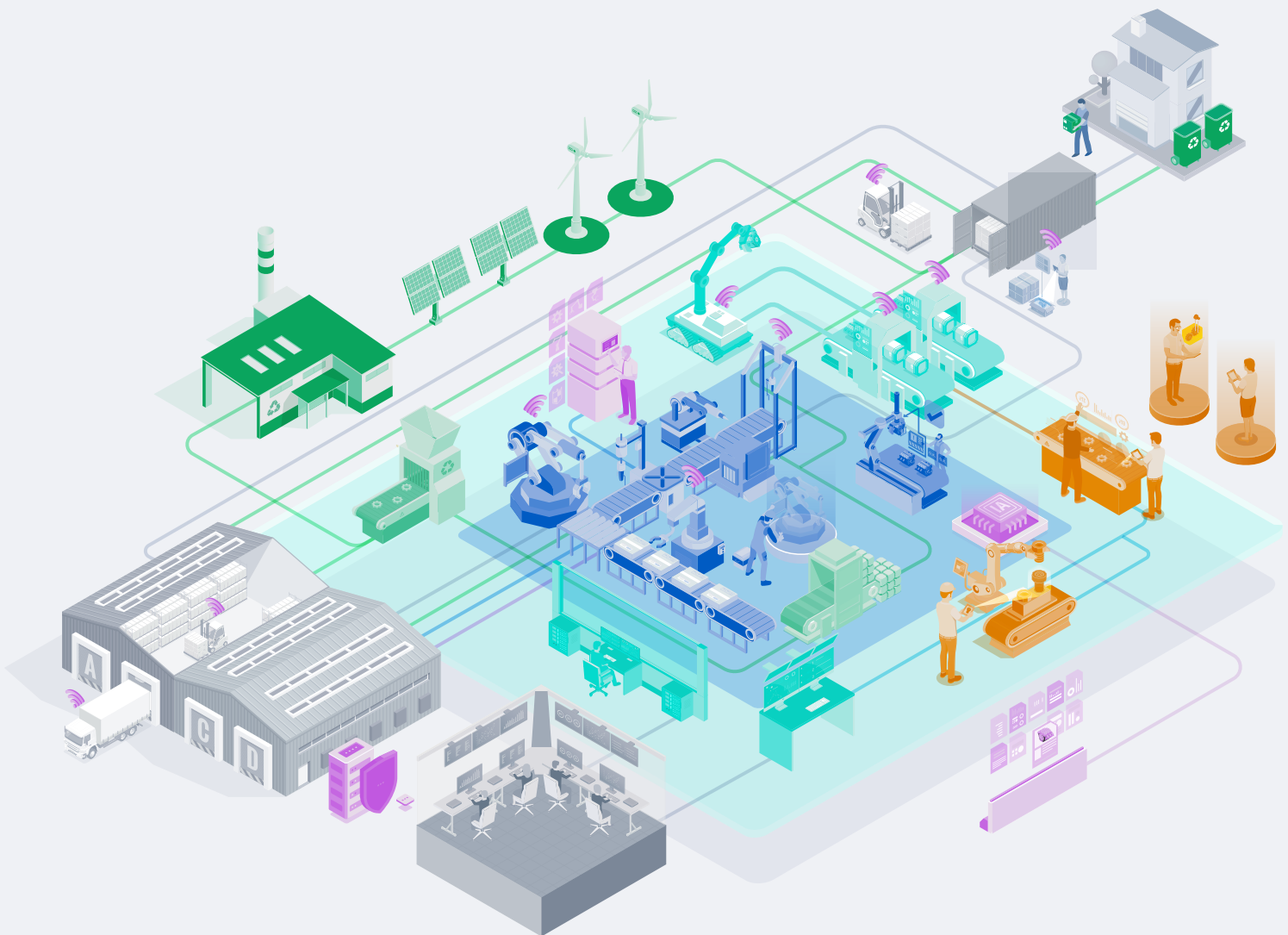
Workstations and processes that are value-adding, flexible, on-time, robust, deliver high quality and are safe to operate

### Connected and transparent flows

Balanced lines/processes with JIT material flow and real-time performance visibility and steering according to customer demand

### End-to-end synchronization

Order-to-delivery that intelligently optimizes the end-to-end supply chain to meet customer and business needs



### Learning organization

Organizations that empower their people to learn and develop through technology to achieve distinctive competitive advantage

### Embedded sustainability

Where all product and operations are designed for recirculation of resources while minimizing carbon emissions and pollution

### Accelerated digital and data

Customer-centric organizations that use data and digital technology to accelerate information flow, steering operations to meet and exceed expectations

## 2.3 Five levels of operational maturity to Lighthouse excellence

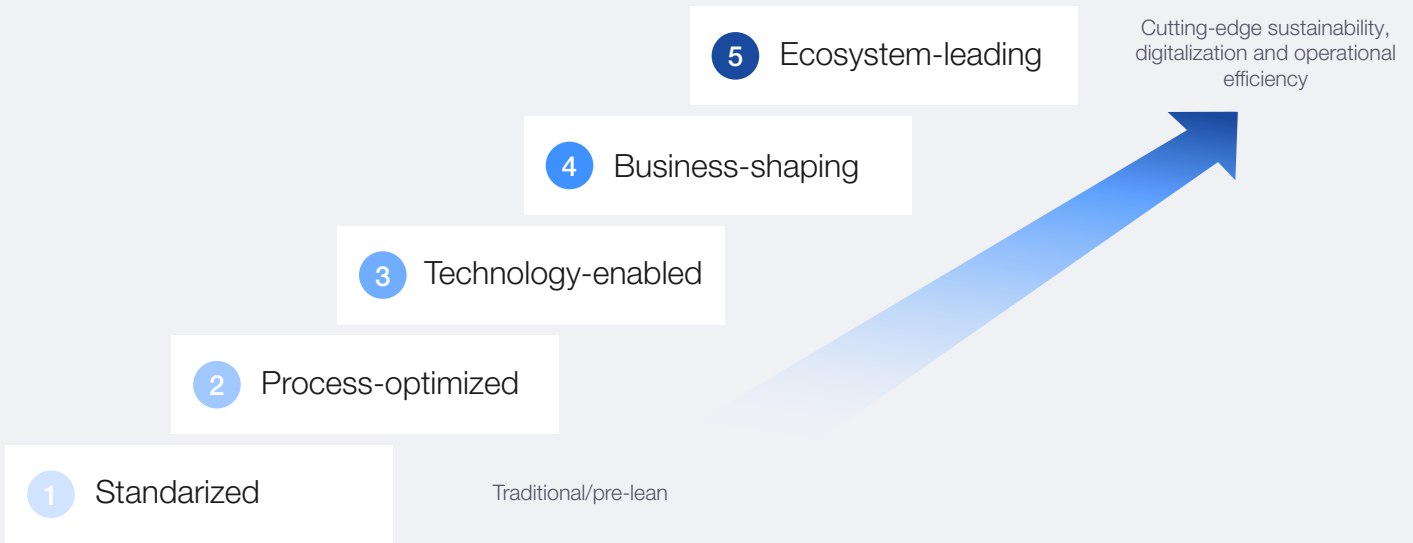
Organizations naturally have different starting points in their journey to operational excellence, depending on which industry they come from, what their core business goals are and how mature their operational capabilities are. The Lighthouse OS combines operational excellence, digital transformation and sustainability through its five-step maturity model (Figure 3) where the experience and best practices of leading companies are mapped against and codified into the five capability maturity levels.

The governing logic is that each capability builds on the previous one, forming a foundation for the next while ensuring the long-term sustainability of the one before. Together with the data from verified use cases, this creates pathways of capability development in a systematic way that can easily be understood. These pathways within the framework are practical and solution-focused: rather than focus on predefined technologies, they describe the capabilities necessary to be successful. This ensures that the OS will remain valid and robust for the foreseeable future through updates to the capabilities and community feedback.



FIGURE 3 | Codified maturity levels for an exemplary capability within the Lighthouse OS

Five-step maturity model



Example: Connected and transparent flows: Assessment criteria and scoring levels for the capability of synchronized material flow

1	2	3	4	5
<p><b>Standardized</b></p> <p><b>Basic pull</b> system or <b>first-in-first-out (FIFO)</b> lanes for <b>main components</b> implemented through Kanban loop/cards and/or supermarket</p> <p><b>Defined</b> inventory levels between processes (incl. safety stocks) – based on experience</p> <p>Production plan with <b>standardized slots for A types</b></p> <p>Milk runs with <b>standardized schedules</b> in place across entire plant (e.g. every hour) – supported by <b>adaptive material-handling carts</b> (e.g. shelf/tube/kit carts)</p> <p><b>Standardized</b> boxes and pallets</p> <p><b>Standardized</b> storage routines in place and material stored <b>close to production cells/workstations</b> – <b>minimizing</b> walking distances for shop floor staff</p>	<p><b>Process-optimized</b></p> <p>✓ Criteria from level 1</p> <p>+</p> <p><b>Advanced pull</b> system enabled by <b>electronic</b> Kanban/supermarket for material flow control established (e.g. via barcodes)</p> <p>Inventory levels between processes <b>regularly reviewed</b> and <b>optimized</b> – inventory drivers fully <b>understood</b></p> <p>Production plan considering <b>A and B types</b> of products – allowing for minimization of work in progress (WIP)</p> <p>Milk run schedules <b>dynamically aligned</b> with production speed (takt)</p> <p>Material supply via <b>circular transportation containers</b> – allowing for <b>waste reduction</b></p> <p>Material stored <b>seamlessly within production cells/workstations</b> (i.e. walking distance fully eliminated)</p>	<p><b>Technology-enabled</b></p> <p>✓ Criteria from level 2</p> <p>+</p> <p><b>Digital Kanban/supermarket</b> established through identification tag system (e.g. via radio-frequency identification [RFID] or Bluetooth Low Energy [BLE]) allowing for <b>traceability</b></p> <p>Material flow parameters (e.g. inventory levels, FIFO lengths) <b>automatically optimized</b> through digital tools</p> <p>Production plan <b>further optimized for all product types</b> (A, B and C) through digital tools (e.g. long-term customer demand analysis)</p> <p>Material supply largely through <b>automated guided vehicles (AGVs)</b> – operated by AGV control centre</p>	<p><b>Business-shaping</b></p> <p>✓ Criteria from level 3</p> <p>+</p> <p><b>Smart material management</b> in place leveraging machine learning (ML) tech to <b>automatically derive</b> suggestions for improvement (e.g. automatic optimization of Kanban/supermarket)</p> <p>Material flow parameters <b>measured in real time</b> via <b>smart devices</b> (e.g. sensors) and connected to <b>manufacturing execution system (MES)</b> – artificial intelligence (AI)-driven algorithm to <b>optimize synchronization</b> with production flow and overall supply chain</p> <p>AGVs able to <b>automatically prioritize</b> material transports via <b>smart inventory management</b> based on insights from MES</p>	<p><b>Ecosystem-leading</b></p> <p>✓ Criteria from level 4</p> <p>+</p> <p><b>Entire material supply</b> (intra- and inter-plant as well as beyond/from and to suppliers) <b>run, synchronized, and optimized completely autonomously</b> by self-sufficient and IoT-driven flow planning agent (e.g. AI robot), able to steer multitude of autonomous subagents (e.g. drones)</p>

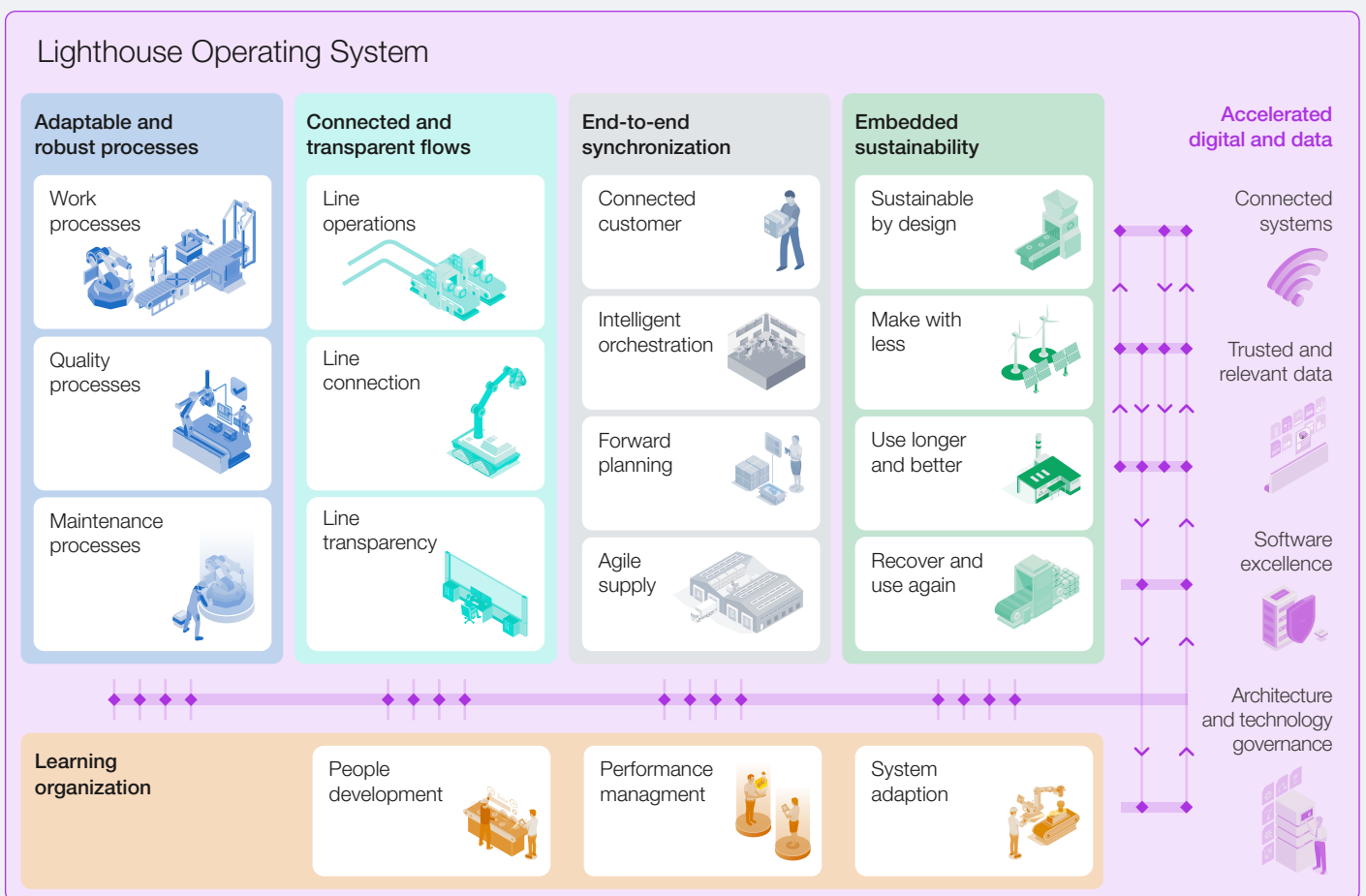
Source: World Economic Forum

## 2.4 Collective learnings from industry leaders demonstrating excellence

Few companies have yet mastered the full spectrum of what an advanced operating system can achieve. However, harnessing the collective learnings and aspirations of many industry leaders – each excelling in different areas – creates a unified pathway to accelerate progress that achieves what has been accomplished by the best in a fraction of the time. It also sets a roadmap for even greater advances.

Each of the six principles shown in Figure 4 is brought to life with a case study of an industry-leading company and partner within the Lighthouse OS initiative. All are already embracing these elements in their existing operations – demonstrating that while the framework is still under development, individual parts of the system are already being practised. This also highlights that each principle represents an open-ended journey with more potential for improvement still ahead.

FIGURE 4 Lighthouse operating principles: An overview of key areas informing the current OS framework



Source: World Economic Forum

## 2.5 The six principles of the Lighthouse OS

### 2.5.1 Adaptable and robust processes

First, individual value-adding processes must balance the standardization required to achieve efficiency and quality with the adaptability needed to cope with changing demands or external disruptions. By leveraging advanced technologies like flexible robotics and predictive maintenance, manufacturers can achieve flexibility without compromising quality or consistency.

This principle captures key activities at workstation and machine level during the transformation process of a product or material. These processes need to be standardized to ensure quality but adaptable to changes in the required work step

and robust enough to deal with adverse outside influences such as input variations. Key areas that are captured in this principle are:

- **Work processes:** Creating standardized yet flexible and adaptable workstations/unit operations and processes, enabled by flexible automation, digital standard operating procedures (SOPs) and worker guidance
- **Quality processes:** Establishing quality by design and smart quality control enabled by real-time feedback on production
- **Maintenance processes:** Ensuring high availability of equipment at low cost of maintenance, using remote monitoring, predictive algorithms and other data-driven approaches

FIGURE 5 Maturity model excerpt – adaptable and robust processes

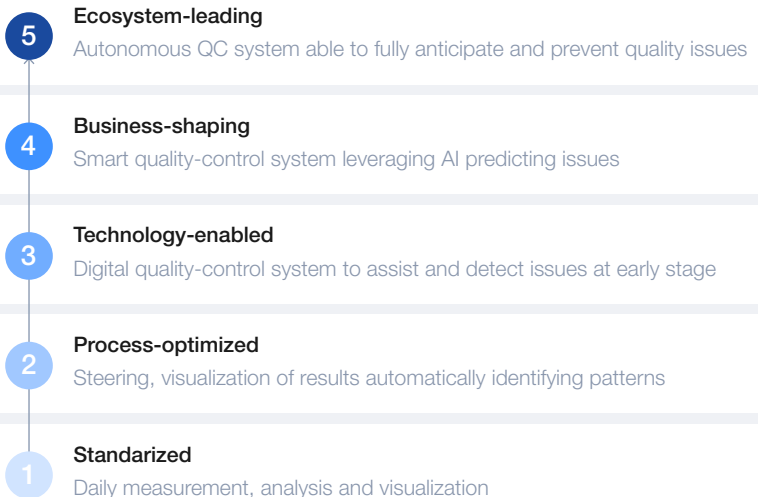


Engro Polymer & Chemicals enhanced operational efficiency through adaptable, robust processes by leveraging digital technologies, agile practices and data-driven decision-making. They developed capabilities step by step, first implementing adaptive advanced process control to support operator decision-making. Building on this, they introduced digital-twin technology in another area to generate data-driven insights for process optimization. Through this iterative approach, Engro continuously refined its operational practices, ensuring flexibility, efficiency and resilience in their process.

Demonstrating:  
**Adaptable and robust processes**

Excerpt from capability:  
**Intelligent quality control**

Quality processes



Source: Engro Corp. (2024). Adaptable and robust processes case study

## 2.5.2 Connected and transparent flows

Connecting material and information flows across the entire factory enables seamless communication and balancing of production steps, from incoming materials to outgoing products. Real-time transparency – achieved through the internet of things (IoT) and advanced monitoring systems – ensures synchronization between production steps, reducing delays and inefficiencies.

This principle represents the capabilities at the factory-flow level to allow for a fully connected manufacturing ecosystem, extending and integrating individual processes into a production flow. It is the connection of multiple adaptable and robust processes into one continuous flow of

production through fixed and flexible connections of workstations. This will ensure continuous material and information flow within the factory. Key processes are:

- **Line/in-plant operations:** A plant and production-line layout that ensures maximal flexibility and optimal balancing of work content in each step
- **Line connection:** An interconnected planning of material and information flows across all production steps that enables the reaction to demand changes on a line level
- **Line transparency:** Full visibility on production status for workers and machines to enable steering of the in-plant flow and support synchronization throughout the end-to-end supply chain

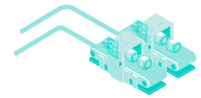
FIGURE 6 Maturity model excerpt – connected and transparent flows



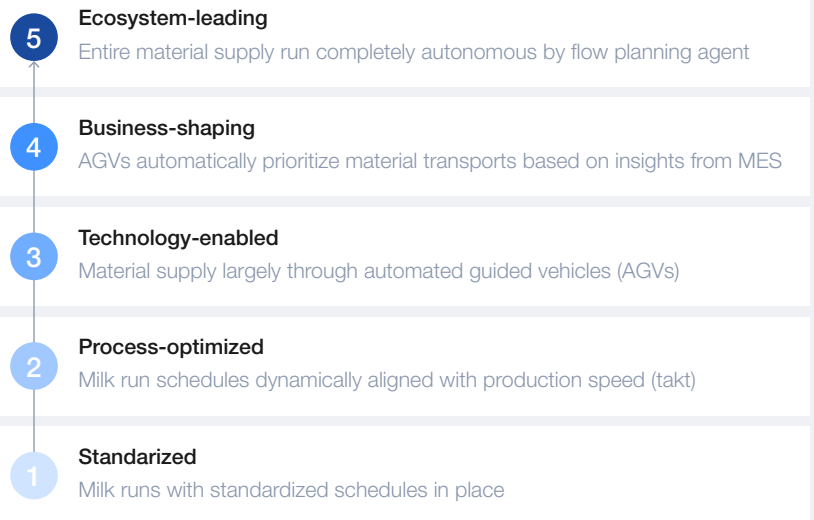
Demonstrating:  
**Connected and transparent flows**

Excerpt from capability:  
**Synchronized material flow**

Line operations



Foxconn Industrial Internet's Viet Nam site demonstrates connected and transparent production through a fully connected manufacturing ecosystem by integrating production steps with digital technologies. Initially, process automation enhanced individual workstations, ensuring adaptability in production. Building on this, vision-based positioning and design-for-excellence integration enabled seamless transitions between production steps. Logistics evolved from insular AGV solutions to an integrated manufacturing execution and warehouse management system, synchronizing all flows across the factory. By interconnecting processes, Foxconn created a continuous, self-balancing production flow, allowing real-time transparency and decision-making.



Source: Foxconn Industrial Internet. (2024). Connected and transparent flows case study

## 2.5.3 End-to-end synchronization

This principle extends transparency to the entire supply chain, aligning operations from raw materials to final delivery. Advanced planning and integrated systems allow manufacturers to anticipate and mitigate supply disruptions and respond to shifts in demand and changing customer requirements in a reliable, consistent and agile way.

Orchestration, planning and adaptation of the manufacturing value chain all rely on data-driven end-to-end synchronization. The ability to optimize, plan and steer in response to change as well as continuously adapt across the entire value chain is vital. This synchronization must be in tune with customer demands, supply-chain partners and sustainability needs. An end-to-end approach ensures that every part of the manufacturing process

works harmoniously, from raw materials to finished products. The key building blocks of end-to-end synchronization are:

- **Connected customer:** Linking operations execution directly to the customer experience to ensure a close link to overall business goals
- **Intelligent orchestration:** Overall integration of all key supply-chain processes and high-level steering into a unified operating platform to enhance value and business outcome
- **Forward planning:** Predictive planning spanning the entire order-to-delivery cycle that anticipates shifts in demand and supply and adapts appropriately
- **Adaptive supply:** Direct and short flows with redundancy built in to achieve resilience and flexibility

FIGURE 7 Maturity model excerpt – end-to-end synchronization

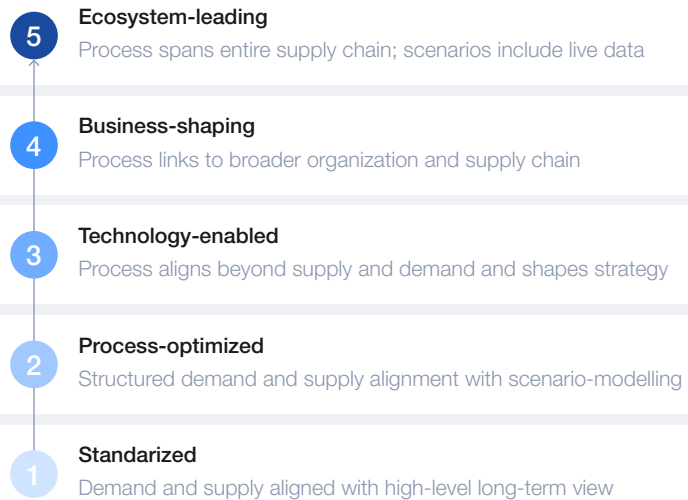
## Johnson & Johnson

Johnson & Johnson enhances end-to-end synchronization by using generative AI to unify data insights throughout its complex supply chain. Project Agent Alpha integrates multitechelon inventory optimization (MEIO) and process mining, ensuring seamless coordination from planning to distribution. Initially, process mining identifies inefficiencies by analysing execution patterns. Building on this, MEIO optimizes inventory levels through AI-driven insights. This approach enables intelligent orchestration, aligning supply-chain processes with strategic goals. By continuously adapting to market dynamics and customer demands, Agent Alpha fosters a resilient, responsive supply chain, ensuring efficient operations, minimized disruptions and improved service levels.

Demonstrating:  
**End-to-end synchronization**

Excerpt from capability:  
**Integrated business planning**

Intelligent  
orchestration



Source: Johnson & Johnson. (2024). End-to-end synchronization case study

## 2.5.4 Embedded sustainability

Sustainability is woven into every stage of the operating system, from designing recyclable products to optimizing resource use and reducing emissions. By adopting circular economy practices and tracking environmental impact, manufacturers can achieve both regulatory compliance and long-term competitive advantage while creating a positive impact on the environment. Within three years, 65% of businesses expect a positive impact on greenhouse gas (GHG) emissions and 56% a positive impact on cost.<sup>3</sup>

Sustainability is one of our most important societal needs where manufacturing companies can have a huge impact. Most companies underestimate the impact of their own segment of the value chain, especially if considered from an end-to-end perspective, from product design to end-of-life. In operations, key sustainability areas are:

- **Sustainable by design:** Designing products with sustainable materials and for multiple life cycles, enabling repair, reuse and remanufacturing models
- **Make with less:** Running operations as efficiently as possible in terms of energy, water and material use, reducing emissions and capturing value from materials otherwise considered waste
- **Use longer and better:** Redesigning business models around circular principles and supporting customers to extend the useful product life as much as possible to maximize value capture
- **Recover and use again:** Ensure recirculation and recycling of products and materials at their end of life to close the resource cycle and extract value otherwise lost

FIGURE 8 Maturity model excerpt – embedded sustainability



Schneider Electric advocates sustainability throughout the entire product life cycle with its design, make, use and recover framework. By embedding circular-economy principles in the design phase and incorporating eco-friendly materials, Schneider ensures a sustainability-first mindset from the outset. Throughout the manufacturing process, real-time environmental monitoring and optimized resource management in packaging, material usage and logistics work together to minimize operational impacts. Furthermore, Schneider extends product life cycles through strategic refurbishment initiatives. This synchronized approach to sustainability across all production stages fosters an intelligent ecosystem that not only reduces environmental impact but also upholds the highest standards of operational excellence.

Demonstrating:  
**Embedded sustainability**

Excerpt from capability:  
**Material efficiency**

Make with less



Source: Schneider Electric. (2024). Embedded sustainability case study

## 2.5.5 Learning organization

Successful organizations are proactive and agile, fostering adaptability in both people and systems to meet evolving challenges and opportunities. By addressing workforce scarcity and skill gaps, they use technology to design targeted learning journeys, accelerating competence and ensuring resilience. This approach also empowers employees to thrive and grow in a rapidly changing environment.

Importantly, at the heart of operations are the people running the business. Enabling them to be proactive and drive continuous improvement across the entire system is crucial for staying competitive – a true learning organization. This learning is not limited to humans but also includes the tools and technologies

that increasingly augment people in their tasks. By using data, both employees and systems engage in self-learning, boosting productivity and quality. Learning organizations need to master three key areas of competencies:

- **People development:** How to create a high-performing organization with a culture of excellence and continuous learning
- **Performance management:** How to translate customer needs and company goals into specific targets in operations to make their contribution visible and tangible for each employee
- **System adaption:** How to systematically drive continuous improvements by fostering experience exchange and problem-solving methods – both for humans and machines

FIGURE 9 Maturity model excerpt – learning organization

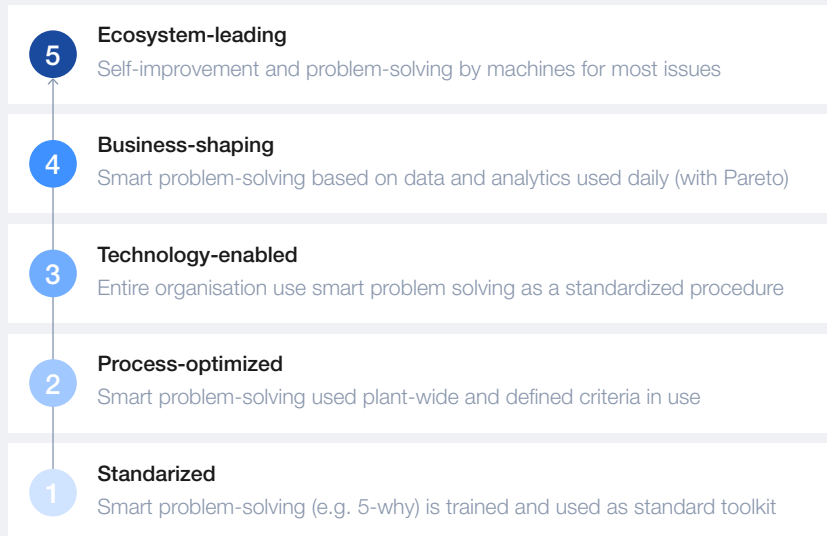
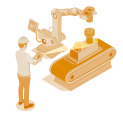


A power-tool manufacturer established a new facility in Mexico with a vision of embedding lean principles and empowering front-line workers with digital tools from the start of production. To enhance process accuracy and workforce capability, the company focused on reducing scrap, improving production tracking and streamlining communication. Committed to a learning organization, process engineers – without coding experience – developed an AI-powered optical character recognition system for batch verification. This initiative improved accuracy, minimized waste and fostered a culture of continuous improvement, enabling rapid problem-solving and scalable innovation on the shop floor. This was supported by Tulip, a Fourth Industrial Revolution technology provider.

Demonstrating:  
**Learning organization**

Excerpt from capability:  
**Smart problem solving**

System  
adaption



Source: Tulip Interfaces. (2024). Learning Organization case study

## 2.5.6 Accelerated digital and data

A digital backbone that focuses on the relevant data enables smarter, accelerated decisions. By using trusted data, unified, interoperable platforms and advanced analytics, manufacturers can unlock operational insights that were previously out of reach, as traditional analysis took too long – rendering insights obsolete before they could be acted upon. Such an approach drives the scalability and efficiency of operations and boosts a company's ability to meet and exceed customer expectations. Importantly this approach also holds the key to unlocking the opportunity to autonomous production and supply-chain systems – the future of operations.

All previous principles are supported and connected through a digital layer that allows data to be exchanged and efficiently processed across functions and the supply chain. This layer accelerates improvements and transformations across all areas by providing the insights required to make decisions and trigger actions. Key areas within this principle are:

**Connected systems:** Intelligent and efficient connectivity and automation across all relevant hardware devices and convergence of the IT and OT networks layers, unlocking additional data opportunities between the two

**Trusted data:** Clear data strategies, organizational set-ups and definitions on how data is generated, managed and used for improved business outcomes in an ever-evolving technology landscape

**Software excellence:** Intelligent and efficient automation supporting innovation and continuous improvement through modular and reusable software with interoperable platforms and rapid application development such as using no-code/low-code or frontier technologies as AI agents

**Architecture and technology governance:** Architecture design considerations that are at the foundation of what makes a plant smart and future-ready include being secure, with a reliable, scalable, extensible architecture that fits the evolving demands of the market

FIGURE 10 Maturity model excerpt – accelerated digital and data



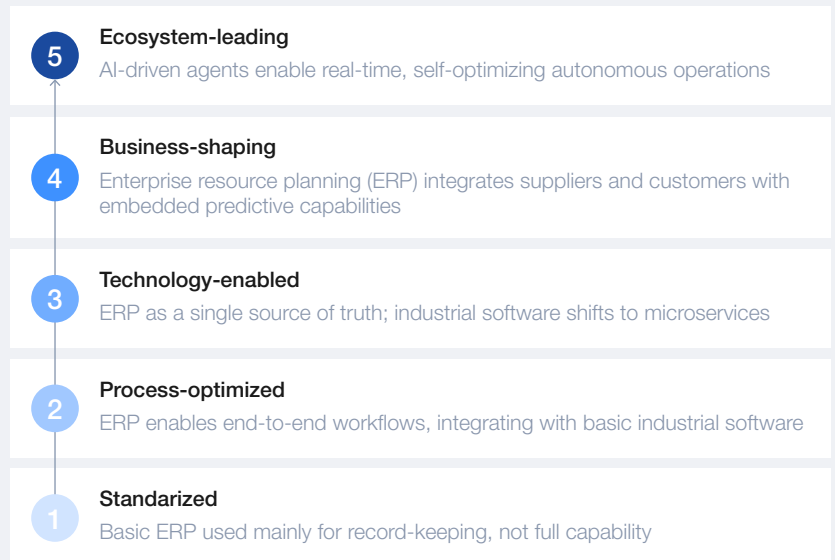
Demonstrating:  
**Accelerated digital and data**

Software excellence

Excerpt from capability:  
**Software excellence**



Bosch strengthens its digital backbone by integrating lean principles with a robust data-driven foundation, enabling seamless connectivity, optimization and decision-making across its global production network. Its industrial application system ensures modular, scalable solutions, enhancing IT/OT integration and interoperability. Trusted data strategies, including a semantic stack, digital twins and a centralized data lake, enable predictive insights and real-time decision-making. Connected hardware and a secure, scalable architecture ensure adaptability to evolving demands. Bosch's international production network (IPN) management view provides end-to-end value-stream visibility, driving Fourth Industrial Revolution transformation through intelligent automation, advanced analytics and a unified, self-optimizing digital ecosystem.



Source: Bosch. (2024). Accelerated digital and data case study

## 2.6 | The missing link: Connecting capability development and operations excellence

The Lighthouse OS offers a unique way for organizations to select improvement levers relevant to their business. As documented by use cases from the GLN and others, best practices and educational materials are locked into the system. They will map against the underlying key performance indicators and across five levels of maturity, thus creating a continuously updated and contextually relevant knowledge repository adaptable to a company's needs in a modular way. The goal for the Lighthouse OS blueprint is therefore to actively support the development of industrial capabilities.

The examples above illustrate these principles in action, but many more practices and use cases have already been documented. The goal is to strengthen the connection between recognized

Lighthouses and the operating system, capturing their operational excellence in an evolving framework. Documenting these pathways to implementation creates a roadmap for other companies to follow, accelerating capability development and enabling them to achieve Lighthouse-level excellence in their own operations.

Thus, the value of the Lighthouse OS for most companies lies not in applying the six core principles individually but in integrating them into a holistic approach. The value will be found in the much deeper insights enabled by the Lighthouse OS structure, which supports a new way of working and maps capabilities across levels of operational excellence, and in its flexibility to be adapted to the context of the organization in which it is being used.

## 2.7 | From incremental gains to systemic change: Applying the Lighthouse OS

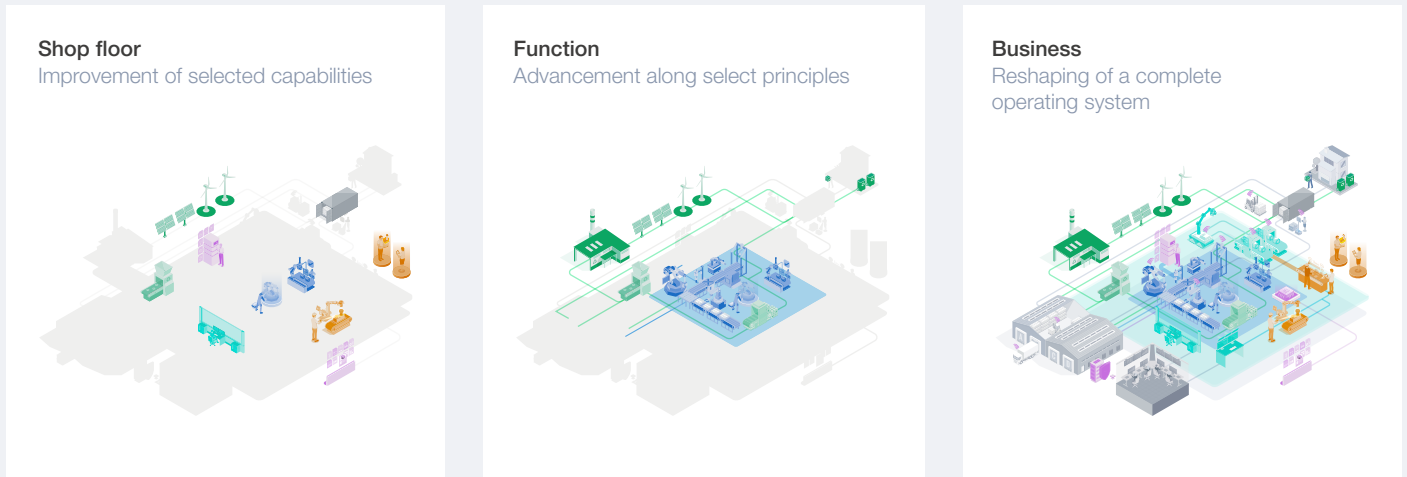
The Lighthouse OS maturity levels serve as the underlying logical structure for driving operational excellence. As the operating system continues to evolve, it aims to enable organizations to assess their current performance against external benchmarks and best practices, helping them identify gaps in their operational practices and opportunities for improvement – all within the frame of the six operating principles. These scopes can be embedded into a wider programme of shop floor improvement, spanning wider production networks or used to support country-level transformation programmes.

The Lighthouse OS is designed as a new way of working and to support continuous process

improvements, enable step-change advances across operational departments or business areas and facilitate wider transformations that reshape the entire operating system. While for large organizations this can offer a fresh perspective on established practices, for medium or small organizations it can help to establish them and accelerate their journey towards best-in-class operations.

In the context of large-scale industry or country-level industrial transformation, the Lighthouse OS can be used as a central guiding framework to improve their programmes' efficacy and to be used as a tool to assess, measure and track transformational progress, with industrial policies and an operating model to support it.

FIGURE 11 | Applying the Lighthouse OS: A scalable framework



Source: World Economic Forum

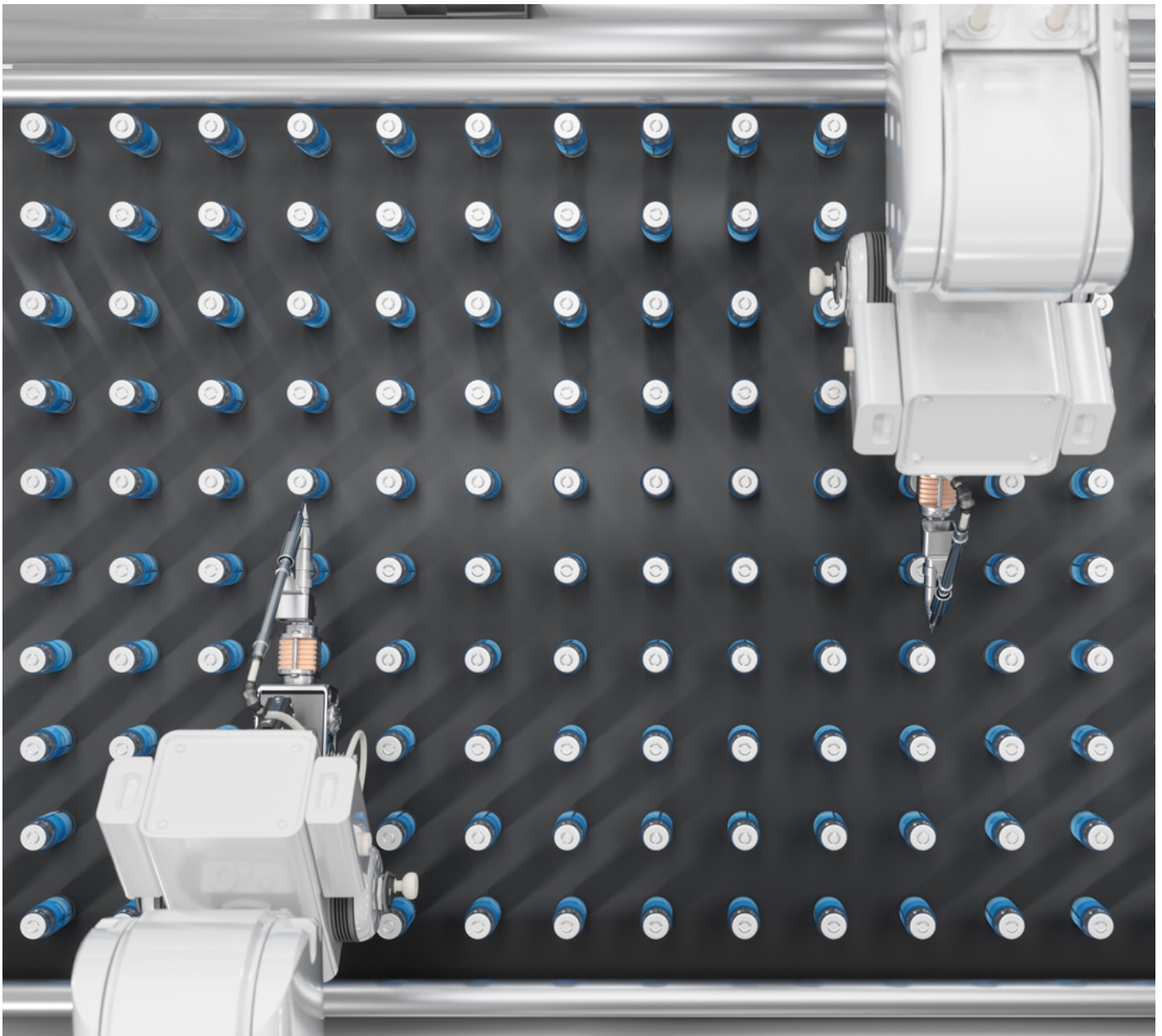
As its application is refined and expanded, the system is intended to be deployed in a self-guided way – focusing on what truly matters and breaking down silos to enable direct access to

value. No company will adopt the entire system, but the modular design ensures scalability, allowing organizations to implement what best fits their needs and maximize impact.



### 3 Developing the operating system through application

Two pilots demonstrate the Lighthouse OS application to be a flexible framework for diagnosing business challenges and driving targeted improvement.



The initiative is not only designing the Lighthouse OS but also actively testing, refining and validating its framework through real-world applications in different industries and geographical areas. In 2024, it was applied to the scope of shop-floor improvement and end-to-end supply-chain diagnosis in collaboration with Koç Holding and Tata Steel – both companies with several Lighthouse sites in the GLN – yielding valuable insights that further shaped its development.

Moving forward, the focus is on accelerating and scaling refinement through an increasing number of

development pilots. This next phase aims to validate the system by welcoming more organizations to participate in testing it through application.

The goal is to demonstrate the operating system's value by showcasing the insights gained by organizations that applied it, the actions it enabled and the shift in the organizations' approach to problem-solving. Rather than prescribing specific actions, the system is designed to guide people in how to think, empowering them to navigate challenges independently.

### 3.1 Shop-floor improvement – with Koç Holding

On the shop floor, the Lighthouse OS can be used to inform and identify the relevant tools to focus on to implement improvements. Plant managers and team leaders can use the Lighthouse OS maturity logic to quickly identify their current level of maturity with regard to a specific capability and focus on the principles and practices that are most critical to unlocking the next level of maturity.

Beko Corporate, part of Turkey's Koç Holding and a Fortune 500 company, is a partner in this initiative. It piloted the current version of the framework on the shop floor to validate it, with the aim of improving the operational performance in

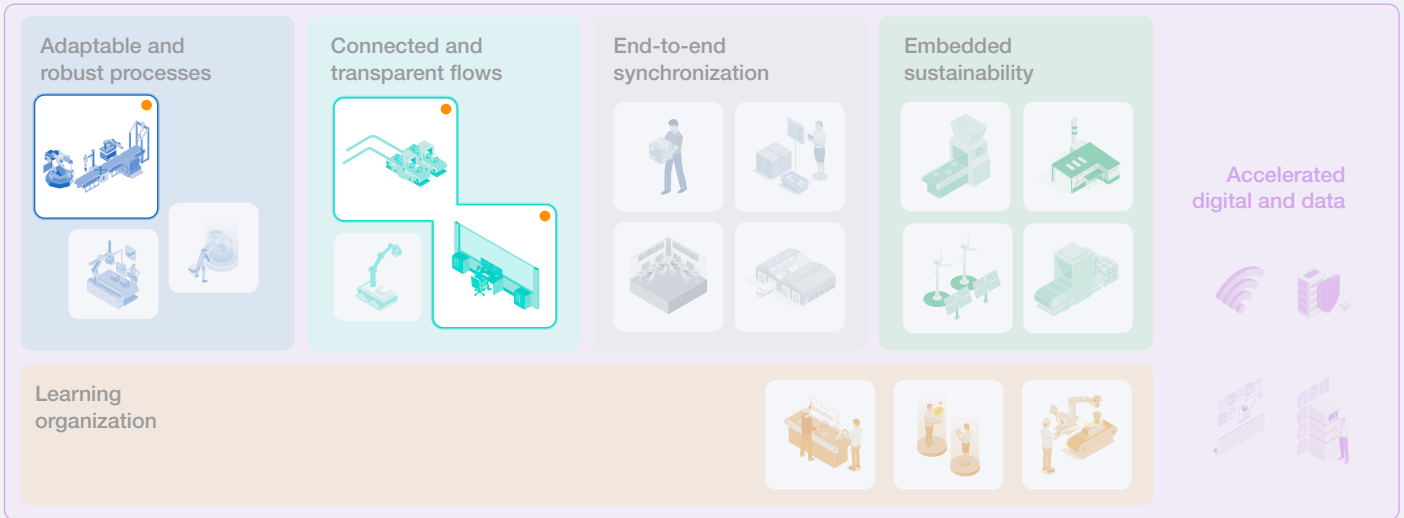
its cooking-appliance production line at its facility in Bolu, Türkiye. Clearly defined targets for cost reduction and top-level support were essential to the successful pilot application.<sup>4</sup>

In the first stage, the five-step maturity model was used to evaluate the Bolu production facility against the principles and elements of the Lighthouse OS framework. The assessment focused on the principles of adaptable and robust processes and connected and transparent flows, aligning with the factory's ambition to improve conversion costs. This evaluation highlighted the current maturity level and ambition and identified high-priority Lighthouse OS practices (see Figure 12).

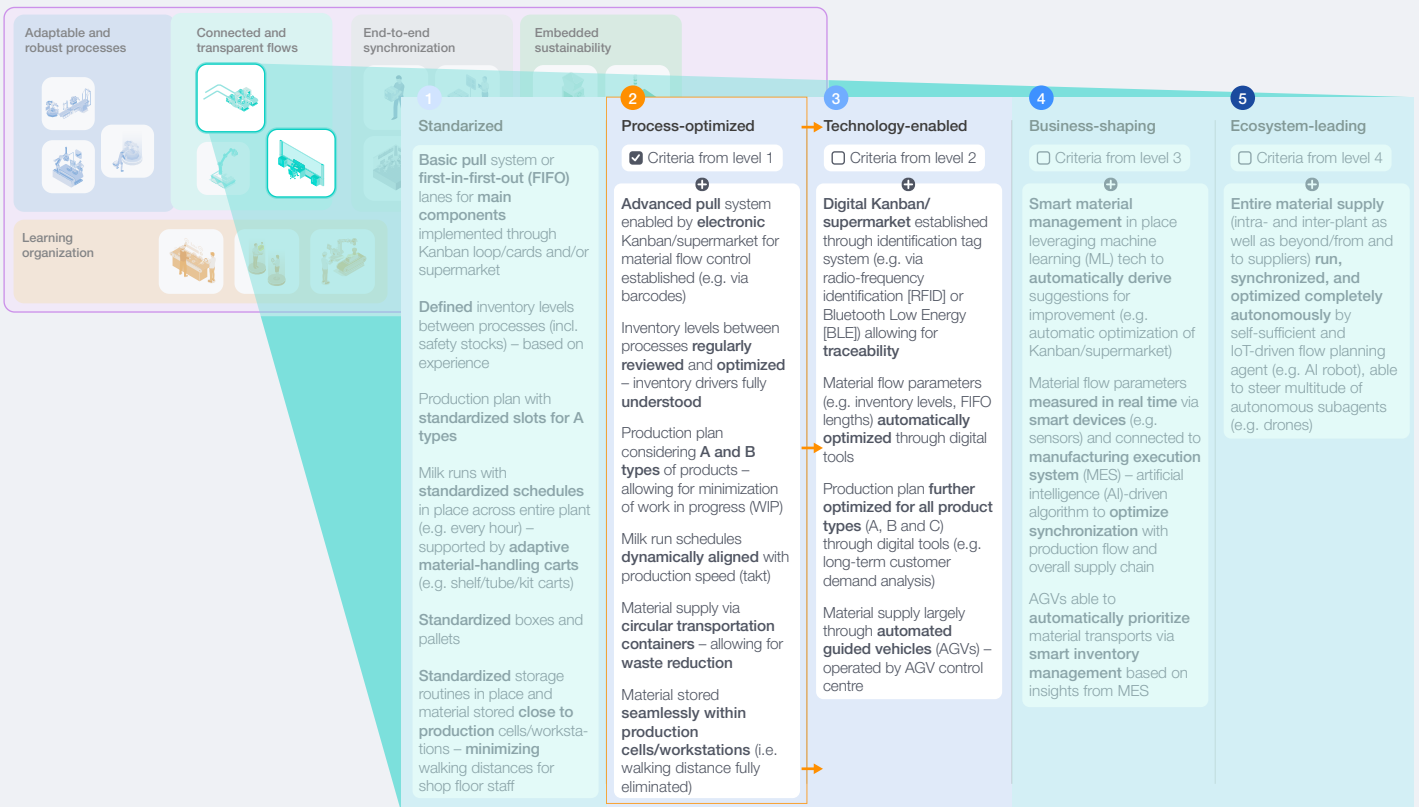


FIGURE 12 | OS maturity levels used to identify capability gaps and drive continuous improvement

1. Use Lighthouse OS framework principles and capability areas to identify key improvement needs



2. Use Lighthouse OS maturity levels to identify current state and capability gaps to develop for the next step



Source: World Economic Forum

Through a mostly self-guided approach, where the current version of the Lighthouse OS capabilities maturity model was shared with operations subject-matter experts, Beko identified the current state of practice and impactful next steps along the improvement path.

The assessment revealed that in the first step, the Bolu facility could achieve the most significant improvements by enhancing maturity in the areas of work and maintenance processes (principle: adaptable and robust processes), as well as in line operations (principle: adaptable and connected production).

In further reviews, the underlying practices were prioritized based on their expected impact on Beko's operational goals (i.e. conversion cost reduction). To simplify this identification, prioritization of improvement areas and implementation planning, the Lighthouse OS maps all capabilities to use cases and best practices and to industry-standard key performance indicators (e.g. overall equipment effectiveness [OEE], defect rate).

Next, Beko's prioritized improvement opportunities were validated through in-depth analysis by internal subject-matter experts (e.g. shop-floor observations, cycle-time analysis, inventory-data analysis).

The process also used existing knowledge, continuous improvement activities and established tools (i.e. design for assembly and plant simulation).

As a result of this three-month pilot, the Beko team confidently set ambitious targets, including a capacity/efficiency increase of more than 20% on its high-runner production line. Progressing to implementation, it created a plan to achieve these goals without adding further headcount, accompanied by a significant rebalancing of the production flow to synchronize production schedules and material flows.

Through the Lighthouse OS approach, materials and tools, and using common governance processes for continuous improvement, organizations can review their progress against the framework and track and identify further areas of prioritized action on their journey to operations excellence.

This project created an opportunity to validate the Lighthouse OS framework's value in its ability both to educate the organization by applying it and to unlock improvement potential in a self-guided way. While still evolving, the framework and content showed strong potential, and future collaborations will further refine its effectiveness, making it an even more valuable tool for advancing global manufacturing.

## 3.2 End-to-end supply-chain diagnosis – with Tata Steel















To unlock the full potential of the framework, organizations can apply it to drive deep, systemic change across entire functions, plant operations and even the end-to-end supply chain. When implemented across multiple plants, this approach creates a ripple effect that enhances efficiency, synchronization and competitiveness at an enterprise level.

Achieving this level of transformation requires more than operational tweaks – it demands a bold mindset shift. Leaders must embrace a transformational approach, ensuring not just system upgrades but also cultural alignment, so improvements are sustainable and drive lasting impact.

A prime example of this is the pilot with Tata Steel, which rigorously tested the end-to-end synchronization principle using its own operations as a benchmark.<sup>5</sup> This real-world application led to the development of a structured methodology, equipped with powerful tools and techniques to help businesses assess and elevate their end-to-end industrial performance.

At the core of this methodology is a high-impact framework that breaks down the principle into four key elements and 14 critical capabilities – providing a clear roadmap for businesses to drive synchronized, scalable and sustained growth (see Figure 13).

FIGURE 13 | Structure of the principle of end-to-end synchronization

Elements			
<p><b>Connected customer</b> Delivery engagement in a manner that evokes positive emotions and strives to make customers feel understood, valued and appreciated</p>	<p><b>Intelligent orchestration</b> Overall integration of all key supply-chain processes and high-level steering into a unified operating platform to enhance value and business outcome</p>	<p><b>Forward planning</b> Predictive planning spanning the entire order-to-delivery cycle that anticipates shifts in demand and supply and adapts appropriately</p>	<p><b>Agile supply</b> Direct and short flows with redundancy built in to achieve resilience and flexibility</p>
Required capabilities			
<p> <b>Magic customer moments</b> Data-driven personalized delivery to delight the customer</p>	<p> <b>Managed product portfolio</b> Product life-cycle management minimizing complexity and maximizing revenue</p>	<p> <b>Predictive demand sensing</b> Continuous demand forecasting based on range of sources and sensing shifts</p>	<p> <b>Rapid product industrialization</b> Product development driven by customer and operations insights</p>
<p> <b>Frictionless order management</b> Omnichannel seamless order process, with prompt issue solving</p>	<p> <b>Integrated business planning</b> Long-term strategic planning, integrating trends, financial goals and supply-chain footprint</p>	<p> <b>Adaptive supply planning</b> Continuous tactical optimization of production and supplier capacities against forecasts</p>	<p> <b>Resilient supplier network</b> Robust supply base through supplier management, simulated flow scenarios</p>
<p> <b>Responsive field services</b> Proactive servicing with performance tracking to drive insights</p>	<p> <b>Holistic performance steering</b> Common collaborative real-time data platform for business intelligence (BI) driving action</p>	<p> <b>Maximized order pipeline</b> Dynamic order book across planning horizons considering inventory and lead times</p>	<p> <b>Flexible operations footprint</b> Responsive manufacturing network balancing quality, customer needs and supplies</p>
		<p> <b>Pull-order scheduling</b> Flow-based scheduling balancing decoupling inventory achieving smooth product mix</p>	<p> <b>Dynamic logistics delivery</b> Getting right product to right customer at the right time</p>

Source: World Economic Forum

To turn strategy into action, the team co-created a powerful suite of tools designed to diagnose, design, plan and orchestrate large-scale transformation. A structured, data-driven approach was developed to unlock efficiency and synchronization across the enterprise. One key element was the detailing of the five-step maturity model, which assesses each capability by identifying the current state and defining a clear path to the target level, ensuring continuous progress. Alongside this, a holistic visualization tool was created to provide a dynamic, system-wide view that highlights the vertical synchronization needed to operate the end-to-end system as a single, seamless entity. Additionally, a key performance indicator (KPI)

improvement framework was introduced to uncover inefficiencies and loss points, enabling teams to quantify opportunities and activate the right improvement levers for maximum impact.

To ensure real-world applicability, the framework was put to the test with more than 20 senior executives from key functions at Tata Steel. This rigorous pressure testing refined the approach, ensuring it is fit for purpose and fully aligned with business realities. The process not only validated the framework but also sharpened its effectiveness in driving enterprise-wide synchronization and transformation. Through this hands-on validation, three critical insights emerged regarding the end-to-end synchronization principle:

**1. A connected customer is the foundation for success:** The connections serves as the primary source of the voice of the customer. Understanding the full customer journey, identifying key touchpoints and creating magic moments within it, can differentiate a business in a competitive market. However, the real advantage comes from linking this customer-centric insight to the entire supply chain, ensuring that every function – from production to logistics – operates with the customer experience in mind.

**2. Vertical synchronization is mission-critical, beyond traditional horizontal end-to-end orchestration:** A truly responsive and agile supply chain does not just optimize individual functions it seamlessly connects the customer at one end with agile supply at the other, creating a continuous feedback loop. This ensures that changes in demand, preferences or disruptions are reflected across the entire system in real time, allowing businesses to react faster and more effectively.

**3. Finally, data and digital capabilities are the backbone to drive impact:** Without high-quality data, businesses operate in the dark – unable to anticipate demand shifts, optimize supply or enhance customer experiences. A seamless data flow across the entire ecosystem enables predictive planning, intelligent orchestration and real-time decision-making. Companies that integrate digital tools effectively create a unified operating platform, ensuring every function works together to drive efficiency, resilience and customer satisfaction.

By structuring both the problem and solution in a simple, practical and intuitive way, the approach enabled the entire organization to align and execute change effectively. This successful implementation not only demonstrated its impact within Tata Steel but also proved its adaptability for a broader range of manufacturing industries. With a structured methodology that simplifies complexity and accelerates transformation, the framework is ready to help businesses across sectors achieve seamless end-to-end orchestration at scale.



# Conclusion and call to action

Manufacturers are urged to join the collaboration and help establish a global reference standard for advanced manufacturing and supply chains across industries.

The aim of the Lighthouse Operating System is to set the basis for a new way of working and building capabilities in operations, specifically designed by manufacturers for manufacturers and inspired by leading practitioners such as those in the GLN. Its success depends on community support, making industry collaboration essential. By putting collective knowledge to work, the system offers a structured starting point to create a learning platform to navigate solutions and scale transformation.

Codifying learnings into a first iteration of the Lighthouse OS framework was a pivotal step, and the ongoing task of updating and refining it will be crucial. Currently, the Lighthouse OS is still in the design-and-testing phase, presenting a valuable opportunity for the community to collaborate and shape its development. On this journey, maintaining simplicity, practicality and intuitiveness is crucial.

## **The Lighthouse OS platform: Digital, open-source, community-fed**

In the long term, the initiative aims to transform the Lighthouse OS into an independent, open-source digital platform to facilitate rapid scaling and widespread adoption – promoting holistic collaboration among manufacturers, governments, solution providers, academia and other stakeholders, delivering unique value to each stakeholder.

The platform will take an end-to-end approach, using the Lighthouse OS framework and making its knowledge accessible to operations practitioners globally. Sustained by its community members,

it will provide a common language and structure, accelerating the development of the core operational capabilities needed to drive impact.

Looking ahead, the ambition is to use this foundation for a country-level industrial transformation, driving widespread adoption and integration of advanced operational practices and technology to enhance efficiency, sustainability and innovation across industries.

## **Call to action for operations decision-makers**

The Lighthouse OS presents a transformative opportunity for the future of operations. Operations executives and decision-makers are encouraged to critically assess their current operating systems, testing alignment with the Lighthouse OS's six principles and its integration of operational excellence, digitalization and sustainability. As the Lighthouse OS is an evolving concept, stakeholders are urged to provide feedback and help identify gaps and unrecognized solutions.

Manufacturers, technology providers, academia and the public sector are invited to collaborate in testing, refining and co-creating the operating system. The aim is to establish together a global reference standard for advanced manufacturing and supply chains, driving unprecedented improvements and enabling responsible transformation across industries.

Learn more and join the community on the Forum's [Lighthouse Operating System web page](#) and upcoming events to dive deeper into the Lighthouse Operating System.

# Contributors

## Authors

### Mark Hallum

Director Advanced and Clean Manufacturing, NEOM

### Tahar Kerkeni

Initiative Lead, Lighthouse Operating System, Centre for Advanced Manufacturing and Supply Chains, World Economic Forum

### Eike Ketelsen

Head of Advanced Manufacturing Transformation, NEOM; Project Fellow, Centre for Advanced Manufacturing and Supply Chains, World Economic Forum

### Markus Plack

Head of Circular Economy, NEOM

### Bart Talloen

Executive Fellow, Centre for Advanced Manufacturing and Supply Chains, World Economic Forum

### Federico Torti

Initiatives Lead, Centre for Advanced Manufacturing and Supply Chains, World Economic Forum

## Acknowledgements

### Acknowledgements

#### Veronique Adenis

Director, Supply Chain Technology and Innovation Insights, Johnson & Johnson

#### Stefan Aßmann

Chief Digital Officer, Division Industrial Technology, Bosch

#### Edward Atkins

Strategic Alliances Lead, Tulip Interfaces

#### Jayanta Banerjee

Group Chief Information Officer, Tata Steel

#### Martin Bräucker

Project Director, Bosch

#### Thomas Frost

Expert Partner, Bain & Company

#### Jörg Gnamm

Senior Partner and Head of Global Manufacturing and Industry 4.0, Bain & Company

#### Robert Hentschel

Vice-President, Partner, Siemens Advanta

#### David Hosie

Director, Supply Chain, Johnson & Johnson

#### Nadim Jalbout

Principal, Siemens Advanta

#### Aditya Jetly

Manager, Strategy and Analytics, NEOM

#### Sarajit Jha

Chief Business Transformation Services and Digital, Tata Steel

#### Baoyang Jiang

Director, Industrial Artificial Intelligence, Foxconn Industrial Internet

#### Vügar Kerimoğlu

Head of New Generation Manufacturing Technologies, Koç Holding

#### Hervé Kling

Director, Enterprise Supply Chain Excellence, Johnson & Johnson

#### Ruben Kloesgen

Innovation Manager, Schneider Electric

#### Thomas Kwasniok

Partner, Bain & Company

#### Zongchang Liu

Vice-President and Chief Data Officer, Foxconn Industrial Internet

#### Roey Mechrez

Head of Ecosystem, General Manager, Tulip Interfaces

#### Bilal Mustafa

Vice-President, Operations, Engro Corp

**Torbjørn Netland**

Professor and Head of Chair of Production and Operations Management, ETH Zürich

**Stephane Poittevin**

Senior Vice-President, Global Supply Chain, Schneider Electric

**Najam Saeed**

General Manager, Digital Transformation, Engro Corp

**Ahmad Shakoor**

General Manager, New Venture Division, Engro Corp

**Pratulkumar Shinde**

Vice-President, Partner, Siemens Advanta

**Stefan Silberstein**

Expert Senior Manager, Bain & Company

**Henrik Sonneburg**

Senior Partner, Siemens Advanta

**Emrah Yılmaz**

Director Design and Integration, Koç Holding

# Endnotes

1. World Economic Forum. *Global Lighthouse Network*. <https://initiatives.weforum.org/global-lighthouse-network/home>
2. Spear, S., & Bowen, H. K. (1999, September–October). Decoding the DNA of the Toyota production system. *Harvard Business Review*. <https://hbr.org/1999/09/decoding-the-dna-of-the-toyota-production-system>
3. World Economic Forum. (2025, January 9). *Circular transformation of industries: Unlocking economic value*. [https://reports.weforum.org/docs/WEF\\_Circular\\_Transformation\\_of\\_Industries\\_2025.pdf](https://reports.weforum.org/docs/WEF_Circular_Transformation_of_Industries_2025.pdf)
4. World Economic Forum. (2024). *Development pilot with Koç Group*.
5. World Economic Forum. (2024). *Development pilot with Tata Steel*.



---

COMMITTED TO  
IMPROVING THE STATE  
OF THE WORLD

---

The World Economic Forum, committed to improving the state of the world, is the International Organization for Public-Private Cooperation.

The Forum engages the foremost political, business and other leaders of society to shape global, regional and industry agendas.

---

**World Economic Forum**  
91–93 route de la Capite  
CH-1223 Cologny/Geneva  
Switzerland

Tel.: +41 (0) 22 869 1212  
Fax: +41 (0) 22 786 2744  
contact@weforum.org  
www.weforum.org