Executive
Perspectives

AI as the new performance divide

Chemicals

March 2026

Introduction

We meet often with CEOs to discuss AI—a topic that is both captivating and rapidly changing. After working with over 2,000 clients for more than two years, we are sharing our most recent insights in a new series designed to help CEOs navigate AI. With most sectors going through major shifts, the focus in 2026 is on how to leverage AI to fully transform organizations and create new sources of competitive advantage.

The chemicals sector is under pressure. Overcapacity and weak demand are squeezing margins, while customers expect greater performance, resilience, and sustainability. **AI offers a new set of levers** that can help chemical companies **reimagine operations, accelerate innovation, improve commercial performance,** and create sustainable competitive advantage, while **unlocking meaningful EBITDA uplift.** Against this backdrop, three questions matter most for chemical leaders:

- What does it mean to operate as an AI-first chemicals company end to end?
- How are leading chemical players using AI today to drive productivity, margin improvement, and growth?
- What pragmatic steps should companies take to move from isolated pilots to a scaled transformation?

Advances in agentic AI, as well as predictive and generative AI, are enabling chemical companies to **move AI from a support tool to a foundational capability—and the leaders are already creating value.**

In this Executive Perspective, we outline how AI-first chemical companies can unlock end-to-end transformation and sustained value creation

Executive summary | AI-first chemical companies will emerge as the winners from the current industry downturn

WHY
AI adoption is critical given the headwinds impacting the industry

- The chemical industry is under pressure from overcapacity and sluggish demand, compressing margins
- Customer expectations, including for sustainability, raise investment needs, driving weak returns
- AI and computing advances can improve profitability and enhance competitive advantage to help chemical companies weather the downturn and come out stronger

WHAT
AI-first companies are raising efficiency and efficacy across functions, strengthening the investment case

- AI is reshaping the value chain[1], scaling discovery, improving predictions and decision making, and automating workflows
- The impact is already tangible across functions such as R&D (molecule discovery), operations (real-time optimization, predictive maintenance, capability building, and knowledge retention), and commercial (sales support), with a longer-term upside in reshaping the overall business model
- The enhanced efficiency that AI brings strengthens the investment case for chemical companies to selectively deploy AI capabilities to boost long-term profitability

HOW
A dedicated transformation focused on priority workflows can drive measurable impact

- Winning the AI race needs a clear North Star and disciplined roadmap; leadership must own the ambition, with explicit accountability, governance, and value targets
- Sustained value creation requires AI deployment where it drives the greatest P&L impact, starting small in high-impact workflows and scaling and sustaining impact
- A successful transformation requires a strong foundation with standardized data platforms and an upskilled workforce that is equipped to drive the adoption and move from pilots to scale

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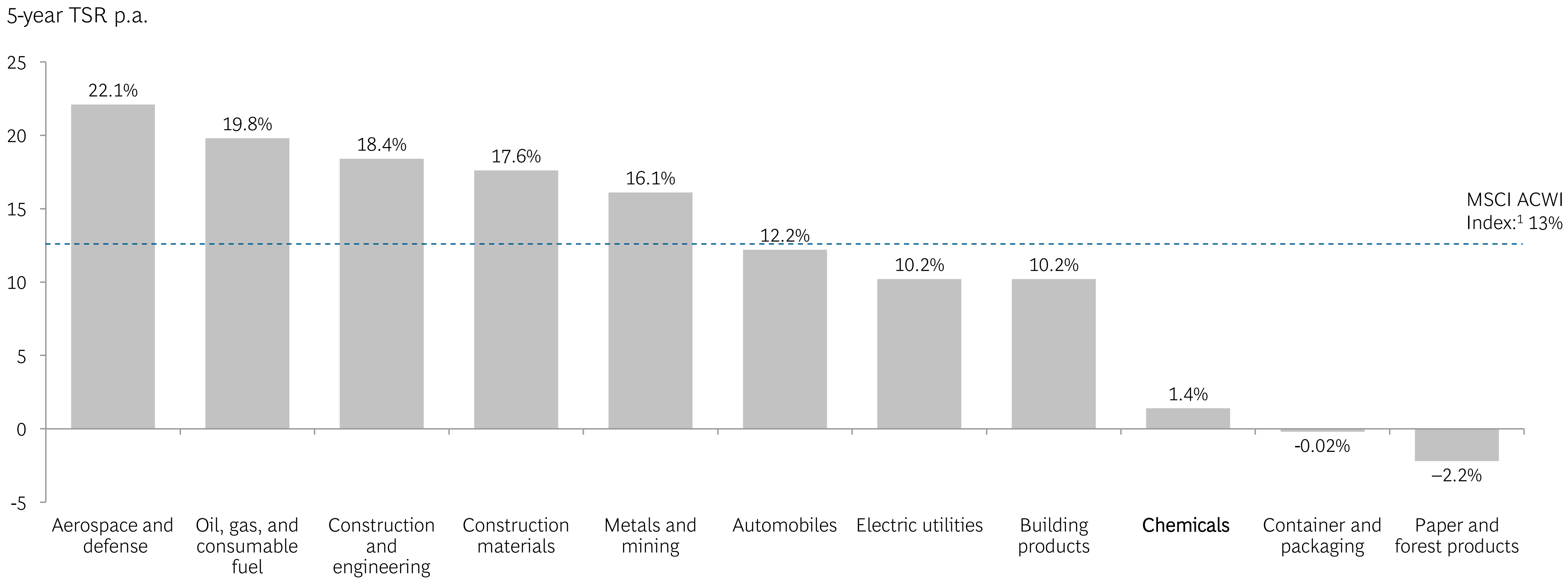
[1] The AI impact on business support functions and related examples are excluded from this slideshow.

Value creation in chemicals lags that of other industries, with shareholder returns falling to the bottom quartile

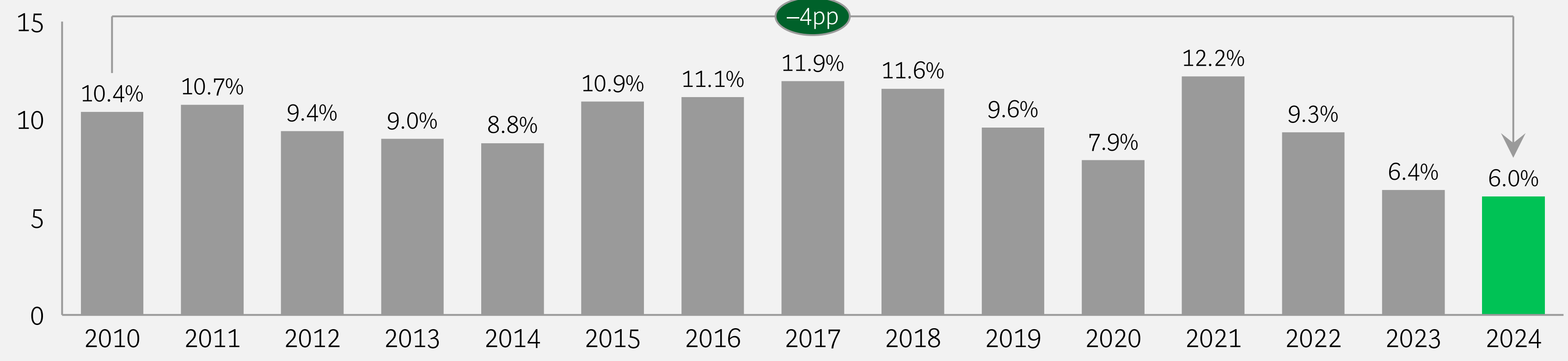
Median five-year TSR for asset-heavy industries, 2021–2025



1. MSCI (Morgan Stanley Capital International) ACWI (All Country World Index) captures large and mid cap representation across Developed Markets and Emerging Markets countries.
Note: TSR = total shareholder return.
Source: S&P Capital IQ; BCG analysis.

EBIT margin and ROCE declines from 2010 to 2024 are showing structural pressures on the chemical industry

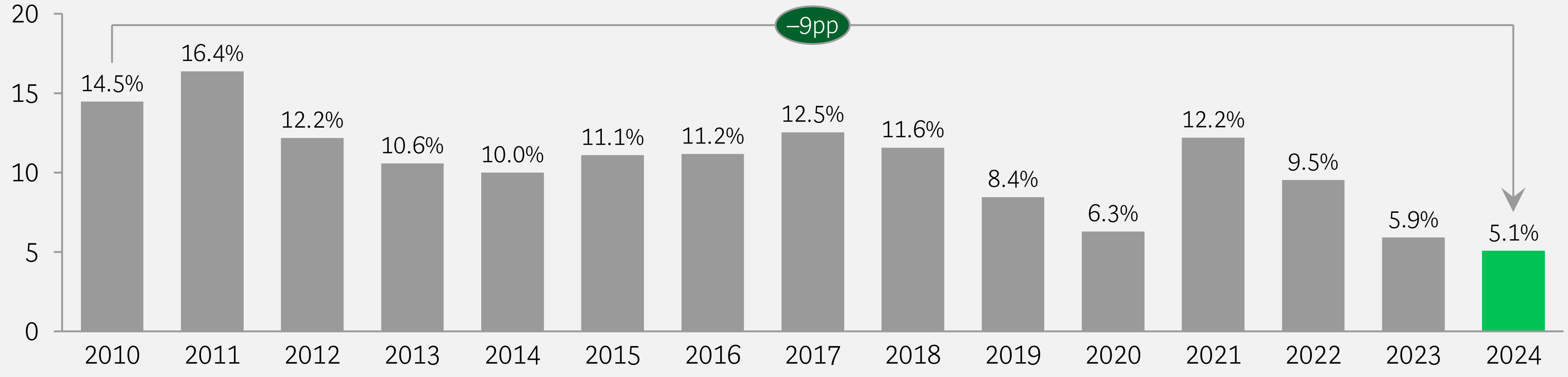
EBIT margin, 2010–2024[1]



EBIT margins are dropping due to structural challenges: Post-COVID rebound stabilized below earlier averages

Industry economics are tightening **persistent overcapacity and rising costs outweigh operational improvements**

ROCE, 2010–2024[1]



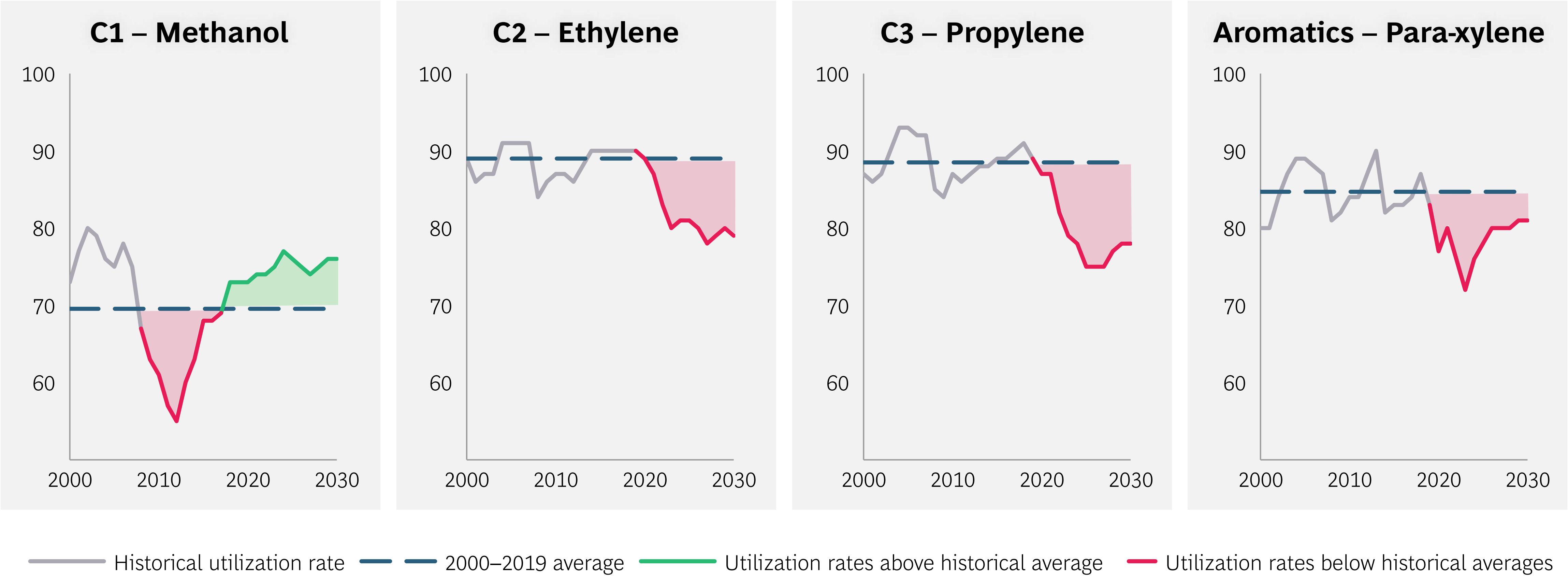
Over 15 years, **ROCE is sloping downward** even after accounting for cyclicality

Incremental capital is generating less value, raising hurdle rates for reinvestment decisions and **forcing harder capital-allocation tradeoffs**

1. Average of available data of the top 50 global chemical companies by revenue.
Note: EBIT = earnings before interest and taxes; ROCE = return on capital employed.
Source: S&P Capital IQ.

The profitability outlook continues to look challenging- with some key value chains expected to operate below historical rates

Historical and expected utilization rates (%)



Source: NexantECA; ChemCom; BCG analysis.

Rapid advances in AI and high-performance computing have the potential to fundamentally transform the chemicals industry

Not exhaustive[1]

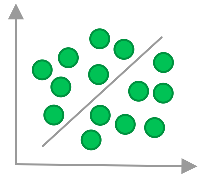
Deterministic | **Probabilistic**

Rule-based

Systems **follow a programmed set of rules**

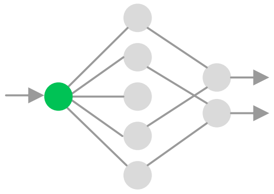
When reactor temperature exceeds a fixed threshold, **system automatically triggers a safety interlock**

Machine Learning



Deep Learning

(via multi-layer neural networks)

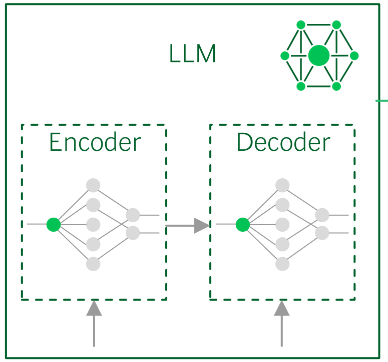


Systems automatically **learn from data w/o being explicitly programmed**, e.g., to predict values or identify correlations

ML models trained on sensor and process data **predict fouling or decoking risk weeks in advance,** enabling planned maintenance before downtime

Generative AI

(e.g., via transformer-based model)

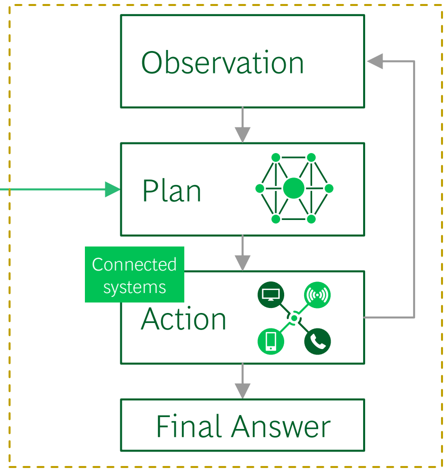


Systems **use existing content to create new variations**

GenAI **synthesizes historical cracker operations data** (e.g., sensor trends, lab results) to **draft shift handovers** and s[2] for off-spec production

Agentic AI

(e.g., using Gen AI and tools)



Systems **respond to environments** and prompts, to plan then **auto-execute tasks**

Agentic AI monitors cracker constraints and economics, **selects optimal setpoints, triggers execution** via connected control systems

1. Simplified representation of evolution in AI capabilities 2. Root Cause Analysis;

🟩 Chemicals-specific examples

AI is already driving a step change in the efficiency and efficacy of core functions in the chemical industry's value chain

Examples

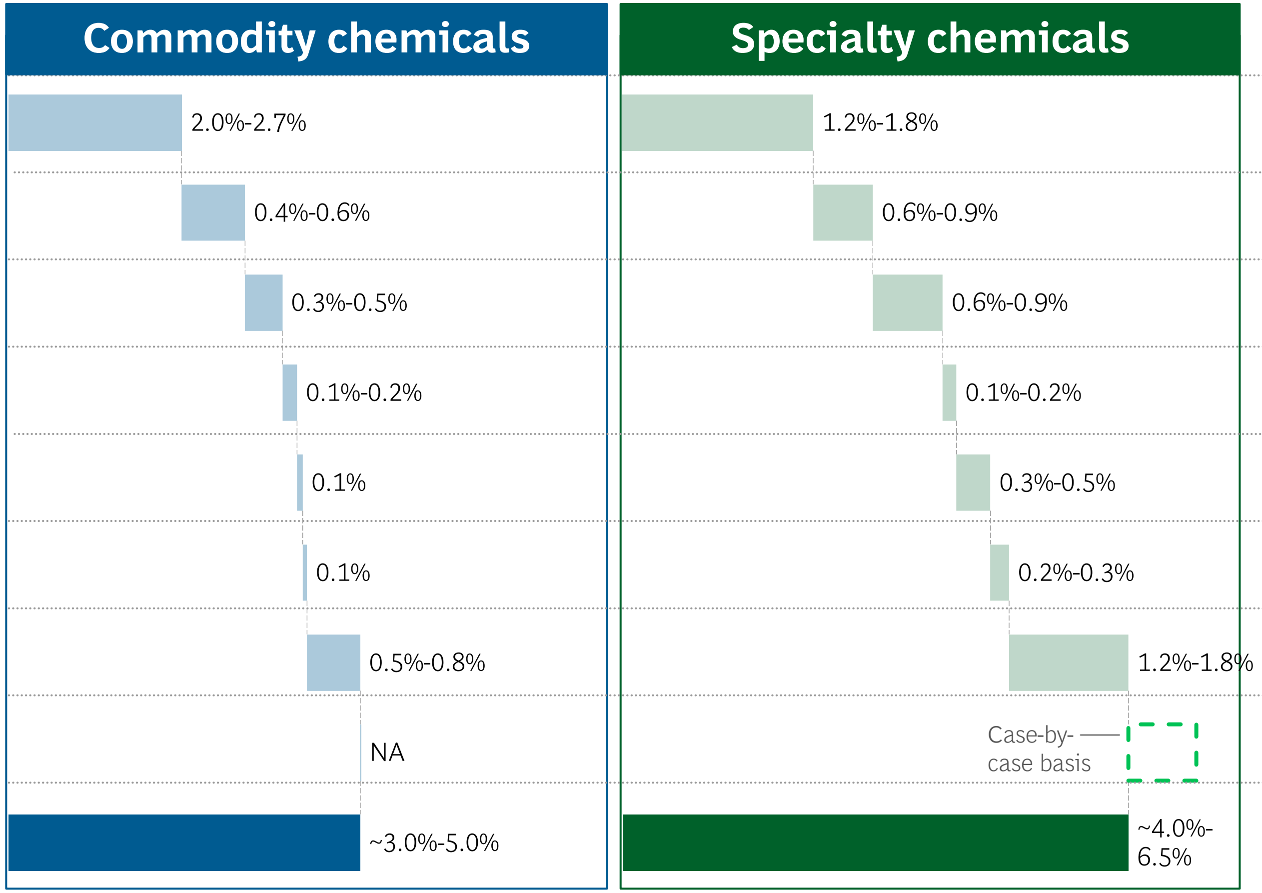
	Current operation	AI-driven change
Research and development	• Product development cycles **constrained by expert-dependent knowledge, fragmented access to historical experimental data and results,** and time-intensive physical experimentation	• **Data-driven, AI-assisted R&D** leveraging **integrated historical results** to recommend the next experiments and accelerate molecule and formulation discovery
Procurement	• **Fragmented procurement driven by demand forecasts** and manual specifications management, with limited spending transparency and high raw-material complexity	• **AI-enabled spending transparency and classification**, specification harmonization and demand aggregation, plus **automated supply-market intelligence** and RFP generation
Operations[1]	• **Manual set point tuning and operator-led decisions**, reliance on tribal knowledge, and limited closed-loop optimization • Time- and schedule-based maintenance; **issue driven, reactive interventions, and limited condition visibility**	• **Closed-loop, AI-driven operations with continuous set point optimization** to improve throughput, stability and reduce waste • **Condition-based and predictive maintenance and planning** to improve reliability and asset availability
Supply chain and logistics	• **Limited planning accuracy** and **scenario capability**, leading to manual replanning and delayed response to disruptions	• **Always-on supply planning agent** that monitors supply, inventory, capacity, and logistics; detects disruptions; runs scenarios; and pushes an updated, feasible plan in near real time
Marketing and sales	• Relationship-led marketing and selling, **reliant on manual processes and limited real-time customer insight**	• **AI-enabled sales copilots and service automation,** increasing productivity, improving quality of interaction, and reducing costs to service
Technical functions (e.g., HSE)	• Safety management primarily oriented toward issue detection, relying on **manual inspections, planning, and reporting**	• **AI-driven continuous monitoring and risk prediction**, with **automated triggers** preventing safety incidents

[1] Includes production, maintenance, repair, and operations.

Note: Only core chemical functions are reflected. RFP = request for proposal; HSE = health, safety, and environment.

AI transformation has the potential to unlock an EBITDA margin uplift of more than 3% for chemical players

Expected EBITDA[1] margin (pp of revenue) uplift from full potential AI transformation



Optimization levers	Commodity chemicals	Specialty chemicals	Key takeaways
Operations	2.0%-2.7%	1.2%-1.8%	**Large value pool in both segments**, higher in commodity: bigger variable cost base
Procurement	0.4%-0.6%	0.6%-0.9%	**Higher in specialty**- more fragmented, negotiable categories
Supply chain	0.3%-0.5%	0.6%-0.9%	**Higher in specialty**- SKU/service complexity creates planning, inventory, and logistics value
Support function and administration	0.1%-0.2%	0.1%-0.2%	**Modest in both segments:** similar benefits driven by automation in finance, HR, IT, and legal
Sales and marketing productivity	0.1%	0.3%-0.5%	**Material in specialty** due to larger sell/serve footprint; minimal in commodity.
R&D and technical functions	0.1%	0.2%-0.3%	**Higher in specialty** given greater R&D, technical service and stewardship intensity
Commercial excellence	0.5%-0.8%	1.2%-1.8%	**Higher in specialty:** pricing power, mix driven by application specificity, customer requirements
New product and molecules	NA	Case-by-case basis	**Specialty-only** incremental upside depends on degree of innovation and time-to-market.
Total	~3.0%-5.0%	~4.0%-6.5%	

[1] Analysis assumes the typical P&L split of a commodity and specialty chemical company and associated AI-driven improvement.

Note: NA = not applicable, ranges are rounded- line items may not sum due to rounding

Source: BCG experience and analysis.

..by enabling several high-impact applications across the full value chain[1]

Examples

① R&D

- Pattern-based grade and formulation design
- 🔍 Generative molecule discovery and lead optimization
- AI lab assistants and documentation automation
- Experiment prioritization and design optimization

② Procurement

- AI-driven spending and cost-lever identification
- Predictive demand and category forecasting
- Intelligent negotiation support
- Predictive supplier-risk monitoring
- GenAI-powered contract-leakage recovery

③ Operations

- 🔍 Real-time optimization
- 🔍 Digital twin simulation
- Dynamic turnaround-scheduling optimization
- Asset-performance management and predictive maintenance
- GenAI-based technician copilot

④ Supply Chain and Logistics

- 🔍 Constraint-optimized production scheduling
- AI-enabled planning intelligence
- 🔍 Integrated logistics network and transport optimization
- Dynamic inventory-level optimization and rebalancing

⑤ Marketing and Sales

- 🔍 AI-powered pricing and cross-selling assistant
- Customer service automation and issue resolution
- AI-driven sales coaching and knowledge augmentation
- Content generation and campaign acceleration
- 🔍 AI digital platforms for new business builds

⑥ Other technical functions

HSE	Capital engineering and projects	Product stewardship and regulatory affairs
Automated HSE reporting and compliance	GenAI process-engineering copilot	Automated chemical classification and labeling
🔍 Predictive incident and risk detection	Construction planning and optimization	Intelligent SDS authoring and maintenance

Common business support functions (e.g., legal, HR, and IT)2

🔍 Deep dives follow

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1. Highest-ROI mix of use cases will differ by business model. 2. Material opportunities exist in these functions as well, but they are not specific to the chemical industry and, therefore, not covered in this document.
Notes: SDS = safety data sheet.
Source: BCG analysis.

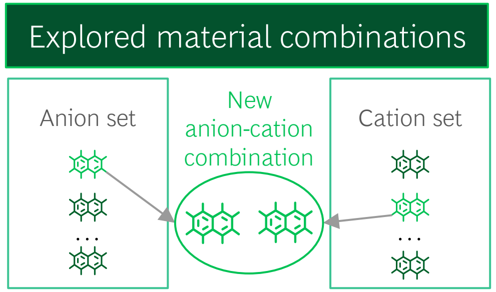
R&D | AI discovered a hundred times more high-potential molecular candidates that outperformed existing compounds

The challenge

- Carbon capture required solvents (that is, IL) with a highly specific, hard-to-optimize set of properties
- Manual chemical discovery was slow and resource intensive, with millions of combinations that were beyond human-exploration capacity or tacit institutional knowledge

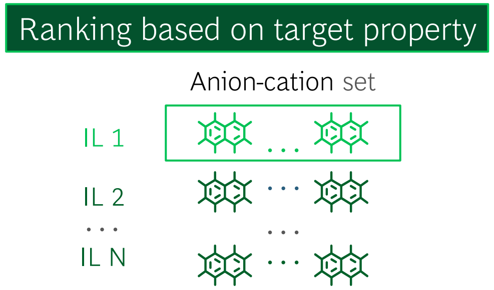
How AI played a role

AI generated and evaluated a vast number of theoretical molecules, expanding the search space beyond human feasibility



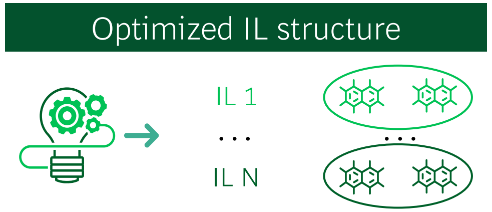
Explored material combinations

AI predicted and ranked candidates against target properties, rapidly narrowing down the **options to the most promising ones**



Ranking based on target property

AI autonomously generated the optimized IL structure and **assessed its scientific feasibility**



Optimized IL structure

Outcomes and benefits

Candidates predicted with AI vs. conventional options

5%–10%
OPEX savings potential

10%
Capex reductions

Higher CO_2 removal potential

Note: IL = ionic liquids.
Source: BCG analysis.

Primary AI improvement levers: Exploration and discovery Prediction and foresight Decision optimization

Operations | AI optimized cracker operations, improving yield and efficiency; agentic AI could be further leveraged for closed-loop operations

The challenge

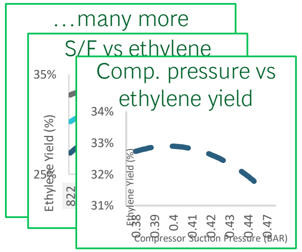
The operational performance of a chemical cracker was challenged due to:

- **Limited ability to manage hundreds of interdependent** process variables and KPIs manually
- **Suboptimal operating points** driven by heuristics
- **Lack of a clear link** between KPIs and economic value

How AI played a role

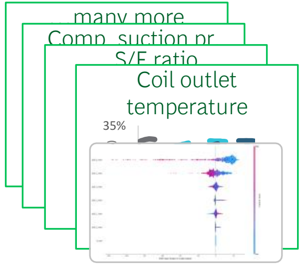
An AI ML model **determined the operating parameters to maximize cracker margin**

Parameter relationships were fed into the model…



Incorporates more than 1,000 variables and multiprocess dependencies

…driving the optimization of critical parameters



Model was selected based on historical data and initial results of data analysis

- **AI generated a dashboard** to provide a strong visualization of plant conditions and optimized KPIs

User interface of a dashboard showing KPIs and their economic impact

An agent executed approved parameter changes directly through APC and DCS, with operator override

Outcomes and benefits

~$8–$15 per ton
↑
Gross margin

Impact was derived from:

- ✓ Improved performance on **KPIs** that deliver the highest economic impact
- ✓ Improved cracker **yield**

A similar outcome was expected in other chemical manufacturing processes

Note: APC = advanced process control;
DCS = distributed control system.
Source: BCG analysis.

Primary AI improvement levers: Prediction and foresight Task automation Decision optimization

Operations | AI enabled a step change in asset performance through real-time monitoring of condition and predictive maintenance

The challenge

- **Time-based or reactive model:** Failures are addressed postimpact or through defined schedules; limited early warning
- **Unplanned downtime:** Production losses are from unexpected failures and slow root-cause analysis
- **Weak asset prioritization:** Maintenance is not aligned with business risk and value
- **Limited expertise scalability:** Reliance on few experienced technicians; knowledge is not institutionalized
- **Performance gaps:** KPIs are focused on lagging metrics, such as MTTR vs. forward risk indicators

Note: MTTR = mean time to repair;
RUL = remaining useful life; TCO = total cost of ownership.
Source: BCG analysis.

How AI played a role

Condition-monitoring AI-fused sensor and operating context predicted failure risk and triggered prioritized maintenance actions in real time:

- ✓ Data ingestion (from multiple sensors, operations, and history)
- ✓ Anomaly detection
- ✓ Failure prediction and risk scoring (e.g., probability of failure and RUL)
- ✓ Risk-based asset prioritization (in terms of criticality and likelihood)
- ✓ Prescriptive recommendations (what to do and when)
- ✓ Alerts and work order generation, as well as scheduling
- ✓ Feedback loop to continuously improve models

Delivered **role-based dashboards and alerts** (fleet, plant, and line level) to scale across sites with minimal upfront data, improving as data maturity increases

SF-03 Upcoming gearbox bearing failure
PL-02 Replace worn belt
SF-01 Motor almost one houring run

+3-5% OEE – 20-40% downtime reou. – 10% TCO reduction

SF-03
Upcoming gearbox bearing failure.
High likelihood of unplanned downtime.

SF-03 Inspect gearbox, monitor vibration.
PL-02 Schedule belt replacement
SF-01 Check cooling oil level and upgrade ventilation.

Likely failure in 5-8 days

Create a work order for gearbox inspection and bearing replacement.
Inform the maintenance team of the issue.
Replace the worn gearbox bearing.

User interface of AI-generated dashboard

Outcomes and benefits

3–5% ↑
Increase in overall equipment effectiveness

20%–40%
Decline in unplanned downtime ↓

10% ↓
Lower equipment TCO

Primary AI improvement levers: Prediction and foresight Task automation Decision optimization

Supply chain and logistics | AI enabled the optimization of a polymer producer's production wheel using margin and operational constraints

The challenge

A polymer producer was facing structural S&OP challenges such as:

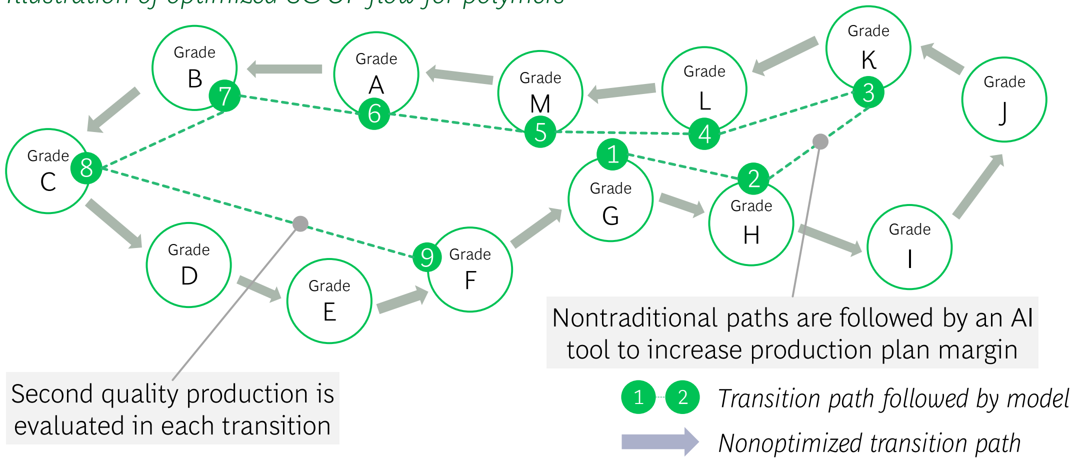
- **Large number of grades and customer complexity,** complicating production and allocation decisions
- **Siloed planning across functions,** leading to suboptimal end-to-end decisions
- **Inaccurate forecasts and limited scenario capability,** driving stock imbalances, service losses, and inefficient production plans

Note: S&OP = sales and operations planning; SMAPE = symmetric mean absolute percentage error.
Source: BCG analysis.

How AI played a role

Continuously evaluated about 10^{15} combinations and over 50,000 plans for a 60-day horizon; beyond human planning capabilities

Illustration of optimized S&OP flow for polymers



Nontraditional paths are followed by an AI tool to increase production plan margin

Second quality production is evaluated in each transition

① ② *Transition path followed by model*

Nonoptimized transition path

Demand and order data
Supply data
Market information
Inventory
Operations data

Demand planning agent
Supply planning agent
Inventory planning agent

AI based S&OP solver

Customized and optimized decision views

Outcomes and benefits

$8–$10
per ton
Gross margin

+4%
Improvement in customer service levels

~15%
Decline in forecasting SMAPE

Primary AI improvement levers: Prediction and foresight Task automation Decision optimization

Marketing and sales | An AI-supported sales approach boosted cross-selling, reduced churn for a global B2B specialty chemical distributor

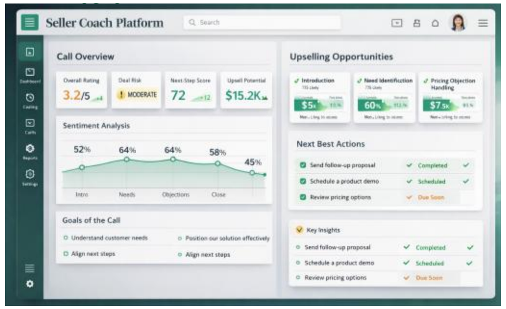
The challenge

A specialty chemical player was facing structural weaknesses in its commercial (sales) model due to:

- Complex product portfolio with over 15,000 products and high variation between countries
- Long tail of fragmented customers, limiting effective prioritization and coverage
- Inefficient handoffs between field sales, inside sales, and technical teams

How AI played a role

Digital front-end provided a single pane of support for sales



User interface for seller's scorecard after coaching session (illustrative)

- ✓ Real-time seller coaching and support
- ✓ Example recommendations:
  - How reps spend time
  - Suggested cross-selling techniques
  - Potential opportunities

Intelligence layer provided AI-powered cross-selling and helped prevent churn

- **Six AI models** (enriched with business rules and triggers) observed customers from different perspectives and generated customer-specific product leads for cross-selling
- **Early-warning model** helped reduce churn and down selling

Agentic layer provided a feedback loop and seller training

- Agents continuously refined recommendations based on sales outcomes to better prepare sellers for customer meetings

Primary AI improvement levers: Exploration and discovery Prediction and foresight Decision optimization

Outcomes and benefits

3%–5% ↑
Increase in EBITDA in pilot segments

30–40
New leads per sales rep per month

98%
Sales rep satisfaction[1]

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[1] In an anonymous survey, 98% of sales reps responded that a tool or logic "meets" or "exceeds" expectations.

Source: BCG analysis.

Marketing and sales | An AI-enabled digital platform launched a customer performance-improvement business for a specialty chemical leader

The challenge

With an established restaurant chemical business, a specialty chemical producer sought to expand into operations technology to grow share of wallet. The challenge stemmed from:

- **Adjacency leap:** Moving from chemistry and product-led value to selling shift outcomes (e.g., SoS and labor productivity)
- **Market reality:** Value in operations technology is driven by in-store execution, but key drivers are difficult to pinpoint
- **Product development:** Building a differentiated digital platform that makes these drivers visible and delivers ROI at scale

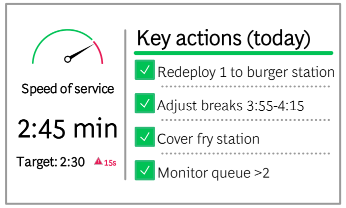
1. From a five-year business case about a go-to-market path.
Note: SoS = speed of service; GM = general manager; DM = district manager; POS = point of sale.

How AI played a role

AI powered a differentiated **digital platform** that uses site data to **identify and continuously improve customer performance**

Action layer

- **Turned insights into role-based next-best actions** for GMs and DMs, and learned from outcomes



Speed of service

2:45 min

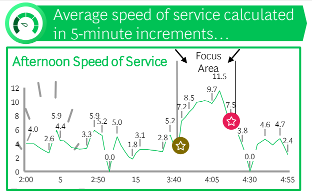
Target: 2:30 ▲15s

Key actions (today)

- ☑ Redeploy 1 to burger station
- ☑ Adjust breaks 3:55-4:15
- ☑ Cover fry station
- ☑ Monitor queue >2

Intelligence layer

- **Flagged performance deviations,** and pinpointed the highest-impact drivers and constraints to focus on


Average speed of service calculated in 5-minute increments…

Data layer

- **Ingested POS, labor, and order data, as well as video data,** and standardized it into actionable operational metrics

Primary AI improvement levers: Exploration and discovery   Task automation   Decision optimization

Outcomes and benefits

>$1B
Annual target for platform revenue[1]

3%–6% ↑
Increase in sales per labor hour

HSE | AI enabled a critical change in chemical manufacturing safety by shifting from reactive management to real-time intervention

The challenge

Onsite safety and risk management for a chemical manufacturing firm faced gaps due to:

- Reactive incident detection, where issues were identified only *after* escalation
- Limitations to manual monitoring, wherein scale and complexity of operations exceeded what safety personnel could effectively monitor in real time
- Passive CCTV systems, limited to recording without real-time risk detection or analytics

How AI played a role

Deployment of an AI computer vision platform on the company's existing camera infrastructure

Ran over 20 **specialized real-time safety scenarios**, with customizable detection parameters to **find violations early**

Provided **continuous incident logging and safety trend analytics** for deeper insights

Sent prompt alerts via mobile notifications and audio alarms **for immediate response**

Demonstration video capturing safety violations at chemical plant


Safety Monitoring Overview

2 Critical safety violations detected!

56 ALERTS TODAY

18 CRITICAL ALERTS

Active Safety Violations

No PPE — 3m ago — C1

Uncovered Flame — 1h ago — C3

Event Log

Time	Severity	Type	Area	Camera	
Apr 20 AM	Critical	No PPE	C1	Camera 04	Review
Apr 20 AM	Major	Uncovered Flame		Camera 03	Review
Apr 23 AM	Major	Slip Hazard		Camera 05	Review
Apr 14 AM	Minor	Equipment Failure		Camera 02	Review
Apr 02 AM	Minor	Spill Hazard		Camera 03	Review

View All

Intuitive dashboard showing multiple active safety scenarios

Outcomes and benefits

30%–50%
Decline in near-miss incidents ↓

Up to
90%
increase in incident-reporting rate

>50%
Faster response time in intervention

Primary AI improvement levers: Prediction and foresight   Task automation   Decision optimization

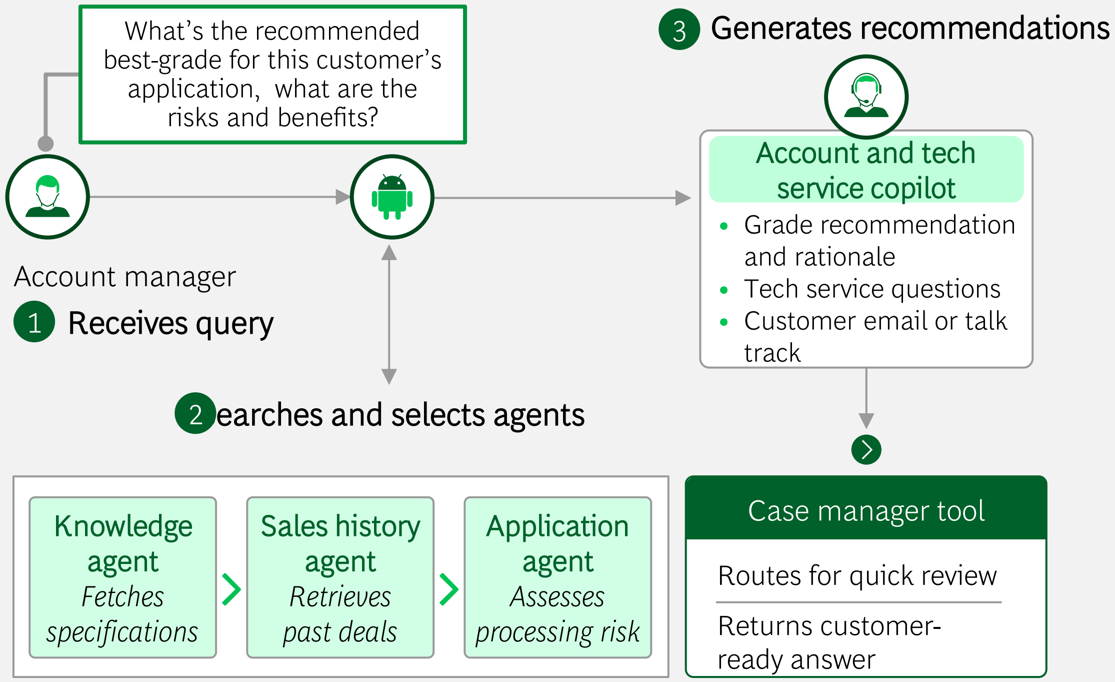
Note: CCTV = closed-circuit TV.
Source: BCG analysis.

Case study | Agentic systems are driving the next era of productivity through the autonomous orchestration of cross-functional workflows

Case study 1

Integrating tech service and account management

AI agents unify technical and commercial contexts across systems to deliver a single, customer-ready recommendation



What's the recommended best-grade for this customer's application, what are the risks and benefits?

Account manager

1 Receives query

2 earches and selects agents

Knowledge agent *Fetches specifications*

Sales history agent *Retrieves past deals*

Application agent *Assesses processing risk*

3 Generates recommendations

Account and tech service copilot

- Grade recommendation and rationale
- Tech service questions
- Customer email or talk track

Case manager tool

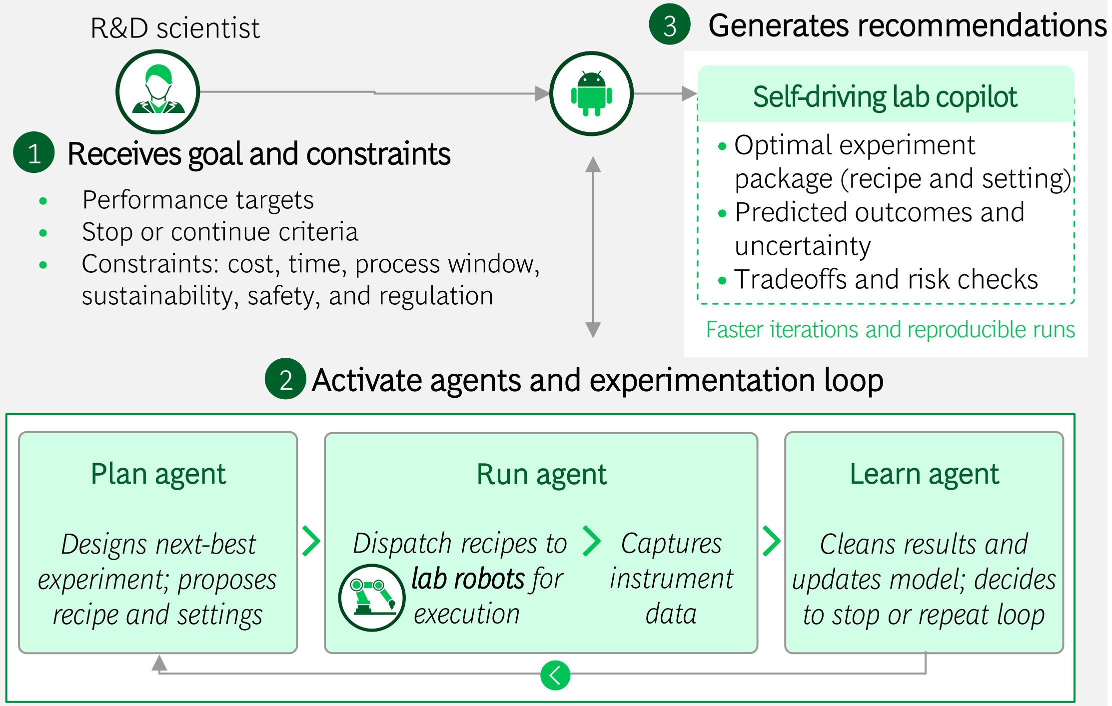
Routes for quick review

Returns customer-ready answer

Case study 2

Integrating lab planning, automation, and data analysis

AI agents connect lab robotics, analytical instruments, and data capture to continuously plan, run, and learn from experiments



R&D scientist

1 Receives goal and constraints

- Performance targets
- Stop or continue criteria
- Constraints: cost, time, process window, sustainability, safety, and regulation

3 Generates recommendations

Self-driving lab copilot

- Optimal experiment package (recipe and setting)
- Predicted outcomes and uncertainty
- Tradeoffs and risk checks

Faster iterations and reproducible runs

2 Activate agents and experimentation loop

Plan agent *Designs next-best experiment; proposes recipe and settings*

Run agent *Dispatch recipes to* ***lab robots*** *for execution* › *Captures instrument data*

Learn agent *Cleans results and updates model; decides to stop or repeat loop*

Robotics

Agent orchestrator

Source: BCG analysis.

Leading companies focus on taking five key steps to unlock the full potential of AI in their organizations

What future-built companies do differently	
Pursue a phased multiyear ambition	Actively engage the C-suite in the AI agenda Appoint chief AI and data officers Rapidly scale validated AI pilots
Reshape and reinvent for P&L impact	Focus more on P&L impact than on tool deployment Redesign work end to end (vs. point automation) Reimagine customer journeys and value propositions
Secure and enable necessary talent	Structure AI learning programs Increase AI upskilling commitments Facilitate greater employee involvement in shaping and adopting AI
Implement an AI-first operating model	Put strategic workforce planning for AI in place Adopt mature and responsible AI guardrails and governance Ensure shared business-IT ownership of AI implementation
Use fit-for-purpose technology and data	Implement standard templates and enterprise-wide data models Enable a synergistic, enterprise AI platform as an efficient backbone

Source: BCG Build for the Future 2025 Global Study (n = 1,250).

Leading companies emphasize reshaping and inventing, rather than deploying, when implementing AI transformations

Less mature companies focus on deploying point solutions;
leaders redesign workflows and create AI-native offerings

DEPLOY

Applications that use AI to streamline day-to-day work, improve productivity, and free up capacity for higher-value activities

For example, **automating routine but critical work by turning lab and plant notes into draft reports**, incident write-ups, test summaries, and handover notes**.**

RESHAPE

Transformations that redesign end-to-end workflows and processes to improve decisions, speed, and performance

For example, **helping teams diagnose off-specification batches** by synthesizing key data, surfacing likely causes, and recommending next checks to reduce scrap and accelerate resolution.

INVENT

Offerings that use AI to create new customer value propositions, services, and business models

For example, **a performance-based service** that monitors operating conditions, recommends treatment actions, and helps customers reduce downtime while **creating a new revenue stream.**

Reshaping and inventing starts with understanding which activities will be transformed and which skills and operating model are required

Illustrative

0

What work will be owned by people, AI, or both?

Human

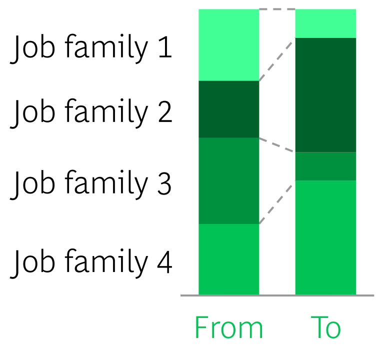
Human and AI

Fully automated

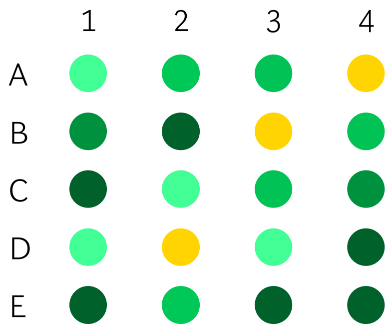
1

What skills and roles do I need and in what quantity?

Work redesign and demand forecast



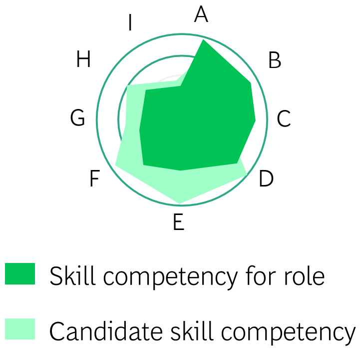
Job skill matrix with proficiency



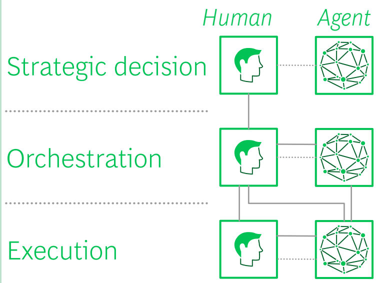
2

How do I embed these skills in my organization?

Employee skill mapping



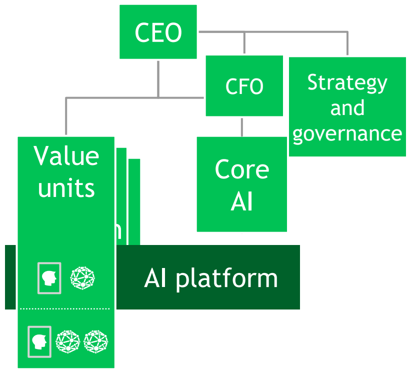
Roles, responsibilities, and governance



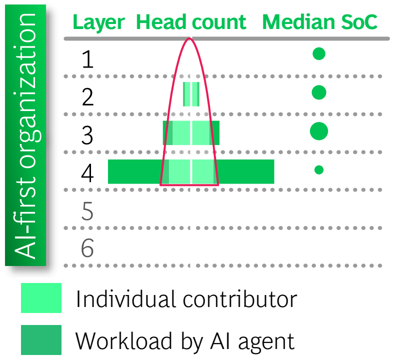
3

What are the implications of the operating model?

Organization structure

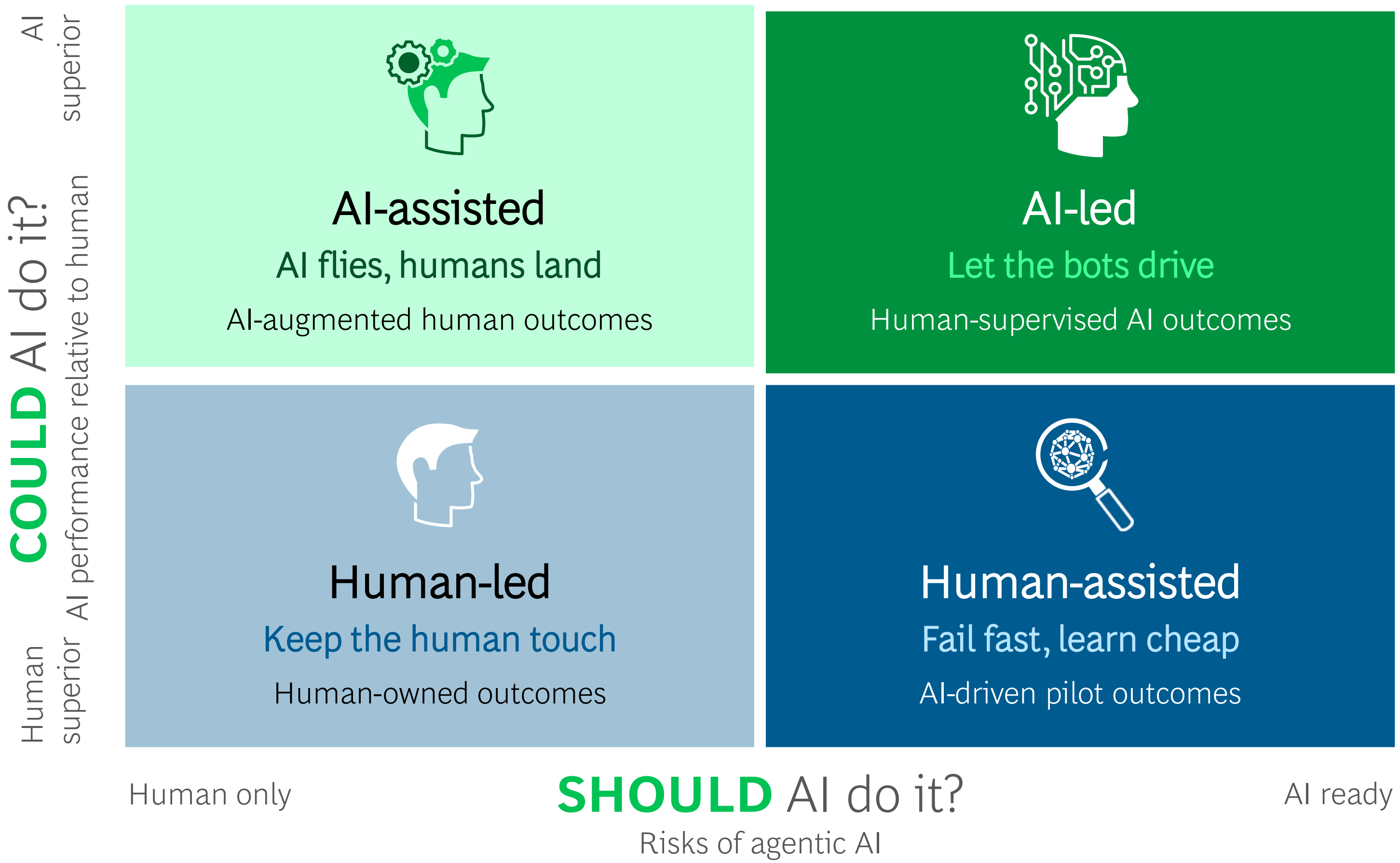


Span of control



1 Work ownership | Two questions define which activities need to be transformed: *Could* and *Should* AI do it?

AI-first matrix



AI-assisted

AI flies, humans land

AI-augmented human outcomes

AI-led

Let the bots drive

Human-supervised AI outcomes

Human-led

Keep the human touch

Human-owned outcomes

Human-assisted

Fail fast, learn cheap

AI-driven pilot outcomes

COULD AI do it?

AI performance relative to human

AI superior

Human superior

SHOULD AI do it?

Risks of agentic AI

Human only

AI ready

Questions for categorization

COULD AI do it?

AI performance relative to human performance

Depends on

- Technical feasibility
- Accuracy and robustness
- Speed and scale

SHOULD AI do it?

Risks of agentic AI

Depends on

- Regulatory risk
- Ethics and safety
- Financial merit
- Cultural preference

2 Skills and roles | There's a clear shift in the skill sets required as judgment-based product development capabilities rise in importance

Examples

Skill area	Skills required today	Skills required in the future
Process engineering	• **Process design and scaling expertise** (to create flow sheets, simulations, and design specifications) • **Operability and process safety by design** (to implement a control philosophy and safety margins)	• **Model reasoning and defensibility** (to outline assumptions, uncertainties, and audit-ready rationale) • **Engineering workflow product ownership, AI-assisted process design** and optimization (to define requirements, prioritize use cases and drive adoption)
R&D	• **Chemistry and formulation expertise** (to translate customer needs into product concepts) • **Experimentation and validation discipline** (to assist with scale-up validation and IP-ready documentation)	• **AI-assisted discovery and screening** (for candidate generation, property prediction, and faster narrowing) • **R&D workflow product ownership** (to embed AI into experiment planning, data capture, and decision-making workflows)
IT and digital	• **Data engineering and integration capability** (to enable MES, LIMS, and ERP connectivity, data quality, and access) • **Secure and reliable solution delivery** (to ensure cybersecurity, compliance, and run support)	• **AI product engineering and MLOps at scale** (to deploy, monitor, retrain, and govern models in production) • **Workflow integration, validation, and auditability** (to embed AI in MES, LIMS, and ERP processes)
Program management	• **Program delivery discipline** (to coordinate project scope, schedule, budget, and vendors) • **Change management and value tracking** (to oversee training, communications, and benefits delivery)	• **AI value portfolio leadership** (to prioritize use cases, manage stage gates, and scale proven winners) • **AI operating model, governance, and guardrails** (to define decision rights, risk tiers, human-in-the-loop controls, and benefits tracking)

Note: MES = manufacturing and execution system; LIMS = laboratory information management system; ERP = enterprise resource planning.

3 Embedding skills | AI agents and solutions can enable simplified hybrid workflows to provide the necessary automation with checks and balances

Exemplary human-agent supervision flow in chemical sales (e.g., pricing and margin management)

Strategic decision layer (L2)

Human-led

e.g., sets pricing and discount guardrails, margin targets, account priorities, and contract policy

Orchestration layer (L3)

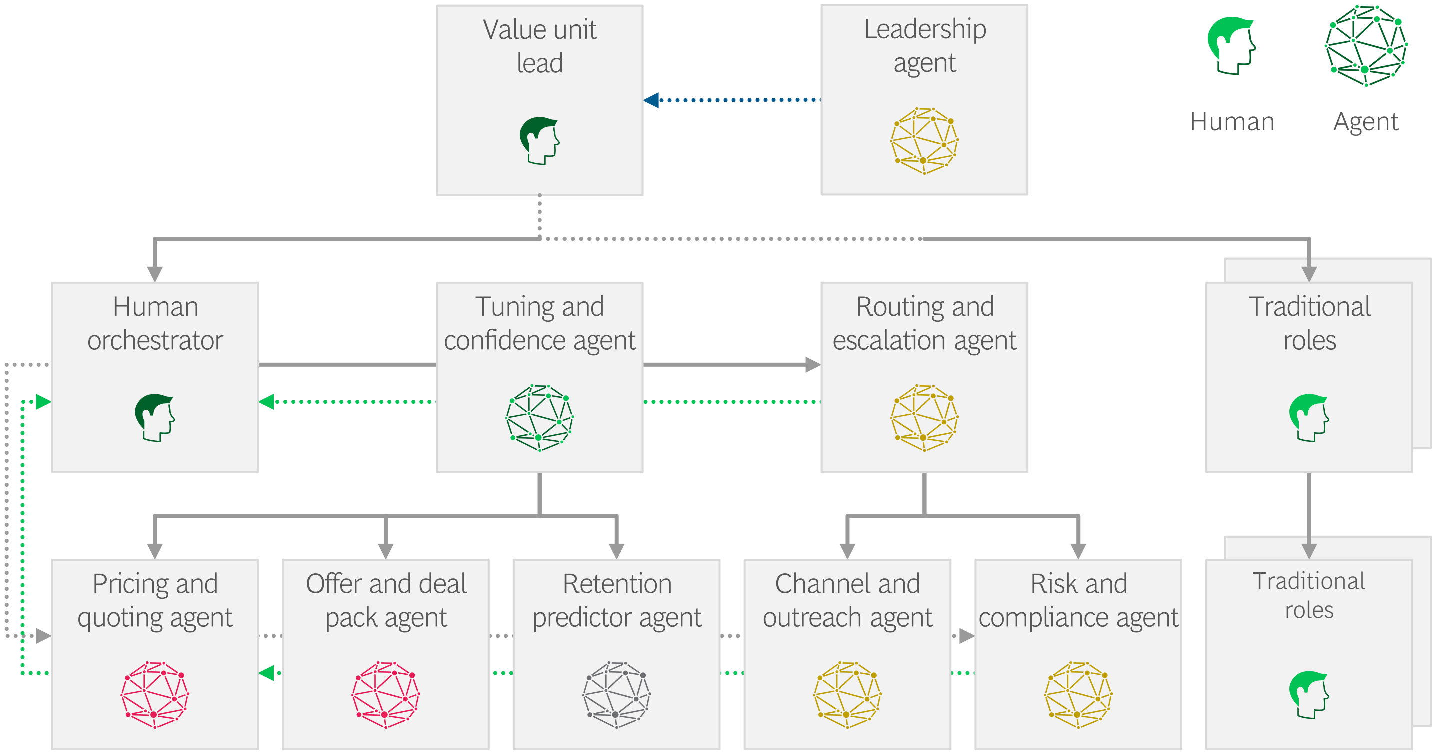
Co-led and split responsibilities

e.g., human governs critical decisions such as exceptions to price floors and key account negotiations; agents handle the baseline by recommending price actions and offer terms based on demand, cost to serve, and risk

Execution layer (L4)

AI-led

e.g., generates and delivers personalized quotes and offers packages, drafts customer communications, and monitors orders and inquiries; detects risk and compliance triggers



Value unit lead

Leadership agent

Human

Agent

Human orchestrator

Tuning and confidence agent

Routing and escalation agent

Traditional roles

Pricing and quoting agent

Offer and deal pack agent

Retention predictor agent

Channel and outreach agent

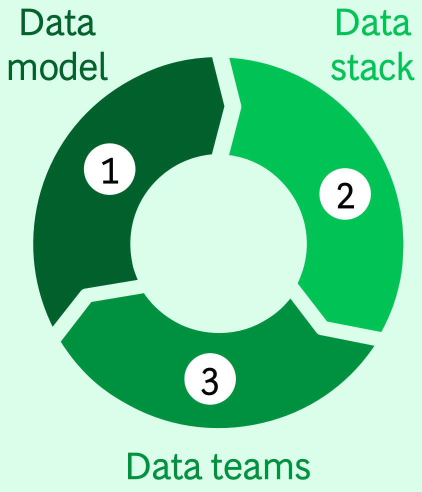
Risk and compliance agent

Traditional roles

········▶ Leadership input
———▶ Supervision and control
········▶ Oversight
········▶ Escalation
🟥 Metacontrol
🟥 Generative
⬜ Predictive
🟨 Decision and logic

Source: BCG experience.

AI-first organizations use a business context fabric and easy access to structured and unstructured data to enable the development of AI agents



1 Business context fabric

- Agents need more than data; they need **business context**, including:
  - **Objectives** – outcomes, not outputs
  - **Resources** – tools and data
  - **Constraints** – safety and specification limits and regulatory limits

2 Unstructured data ready for agent retrieval

- **Enable retrieval over unstructured data** by converting documents (e.g., contracts and network manuals) into searchable formats that agents can retrieve at runtime
- **Implement short- and long-term agent memory** (session and episodic or semantic) to retain and reuse interaction history

3 Data products for agents

- Data teams must shift towards **exposing data via APIs and model context protocol** that agents can call autonomously
- **Federated data ownership**, with business teams owning data while platforms expose it via APIs for agent consumption
- **Data-driven decision-making culture**, with shared playbooks and templates to standardize high-quality agent-supported decisions

Bringing this to life across chemical players

- **Ensure well-connected integration** across lab, plant, quality, and customer systems (e.g., ELN, LIMS, plant sensor, and batch data)
- **Mine thousands of data records daily** to surface relevant insights
- **Equip users with intuitive platforms** to interact with and supervise agents
- **Implement continuous monitoring and enhancements** to ensure the capability scales and adapts with the business

! **Key takeaway: Data must be treated as a critical enterprise asset; investing in quality, governance, and management is essential for scaling agents across chemical players**

Note: ELN = electronic lab notebook.
Source: BCG analysis.

Building an agentic ecosystem requires a new stack on top of traditional business systems and data

Illustrative

Traditional

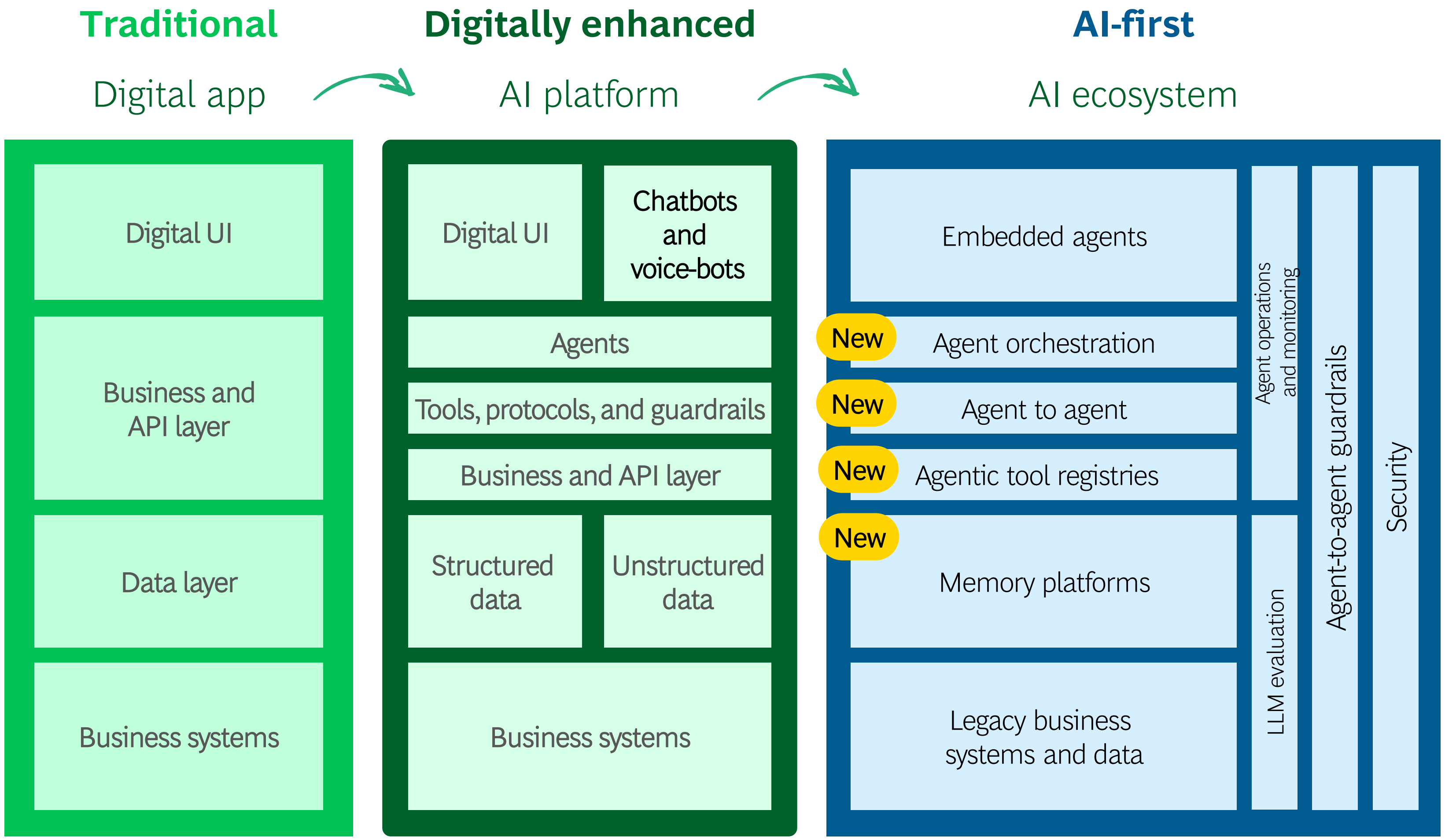
A conventional digital application architecture is organized into distinct layers with limited flexibility and integration, resulting in reduced adaptability and greater rigidity.

Digitally enhanced

An AI-driven architecture combines tools such as chatbots, agents, and protocols with traditional structures, integrating diverse data for enhanced adaptability and efficiency.

AI-first

An AI ecosystem is built around embedded AI agents, orchestrations, and tools, emphasizing secure, observable agent-to-agent interactions. It integrates legacy systems and data to boost AI-driven operations.



Traditional

Digital app

- Digital UI
- Business and API layer
- Data layer
- Business systems

Digitally enhanced

AI platform

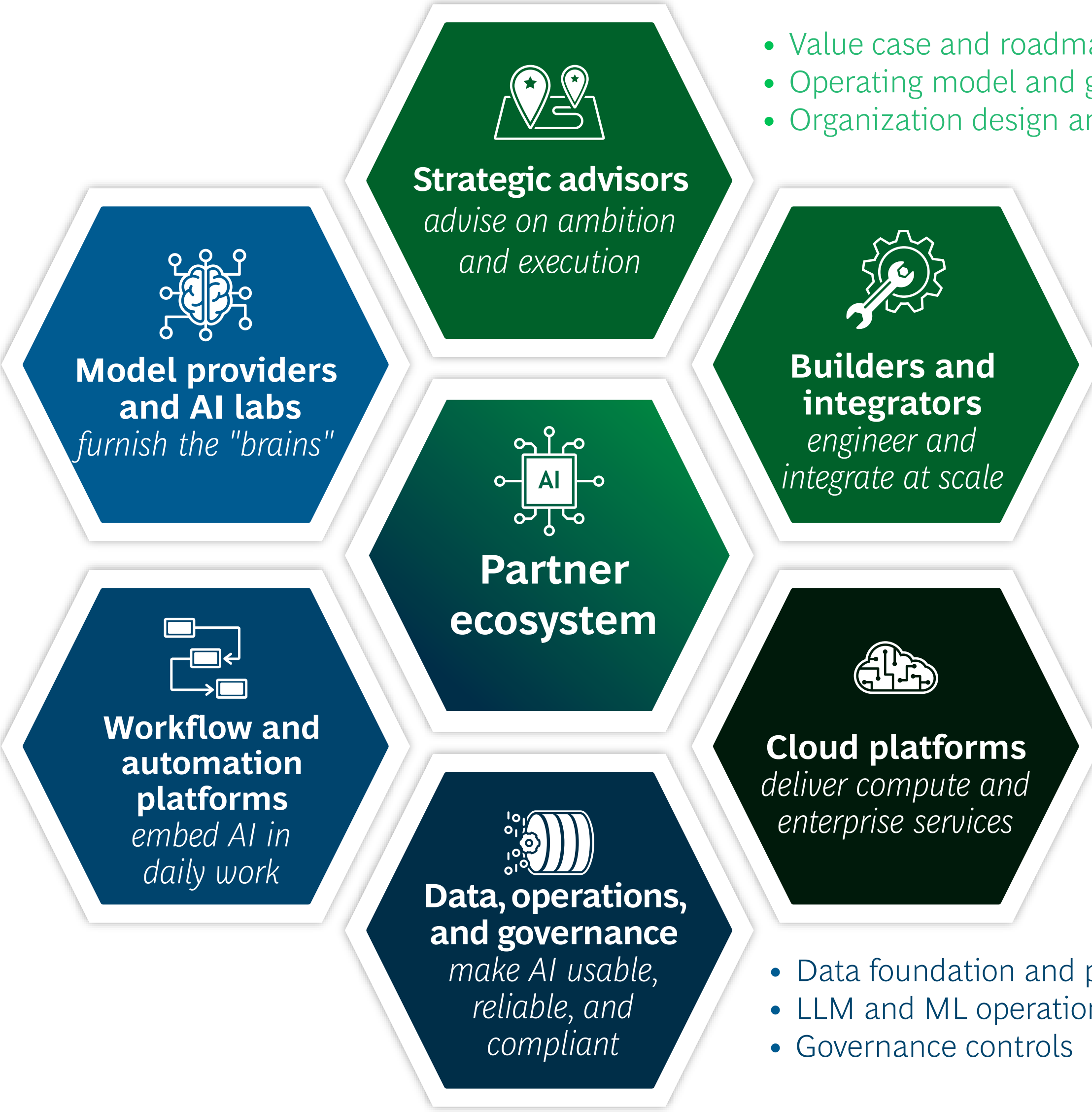
- Digital UI
- Chatbots and voice-bots
- Agents
- Tools, protocols, and guardrails
- Business and API layer
- Structured data
- Unstructured data
- Business systems

AI-first

AI ecosystem

- Embedded agents
- New Agent orchestration
- New Agent to agent
- New Agentic tool registries
- New Memory platforms
- Legacy business systems and data
- Agent operations and monitoring
- LLM evaluation
- Agent-to-agent guardrails
- Security

Best-in-class companies strategically leverage partners to accelerate AI delivery on top of traditional platforms



Partner ecosystem

Strategic advisors *advise on ambition and execution*

- Value case and roadmap
- Operating model and governance
- Organization design and change leadership

Model providers and AI labs *furnish the "brains"*

- Foundation models
- Customization
- Safety features
- Rapid innovation cycles

Builders and integrators *engineer and integrate at scale*

- End-to-end build
- Integration and migration
- Delivery factory
- Run and operate

Workflow and automation platforms *embed AI in daily work*

- Workflow orchestration
- Automation
- Adoption at scale

Cloud platforms *deliver compute and enterprise services*

- Scalable compute and storage
- Security and landing zones
- AI services

Data, operations, and governance *make AI usable, reliable, and compliant*

- Data foundation and pipelines
- LLM and ML operations and monitoring
- Governance controls

The value proposition varies across partners; it is critical to select the best in role and orchestrate capabilities across the build-buy-partner mix

Transforming to an AI-first chemical company requires focusing on prioritized opportunities before expanding and scaling

~3 months

~12 months

~18 months

Phase 1

Prioritizing opportunities

- Define **North Star** vision
- Prioritize value pools and identify **quick wins**
- Establish **governance**

Phase 2

Focusing on acceleration

- Address **foundational gaps** and outline people, operations, and a tech **roadmap**
- Conduct **pilots and quick wins** to prove value, first value captured
- **Upskill leadership** and define the shape of the organization and talent

Phase 3

Scaling lighthouse pilots

- **Transform the** prioritized scope end to end
- Institutionalize value **tracking and adoption**
- Enable large-scale **upskilling and change management**

Phase 4

Expanding and scaling

- Launch the next wave, **replicating across sites and functions**
- Move from productivity to **differentiation**
- Continuously **scale and upgrade the** foundation (including data and tech capabilities) and the workforce

Support the transformation journey with increasing investments in enterprise underpinnings, including core technology and data, people, and responsible AI

Six steps for executives to kick-start the transformation

1 **Own the change:** Anchor the AI ambition at the C-suite level, with clear top-level ownership and accountability

2 **Focus on game changers:** Prioritize AI in processes that matter the most and drive the highest P&L impact

3 **Standardize and upgrade:** Upgrade enterprise data and IT system foundation to enable rapid deployment of AI solutions

4 **Set up a focused AI delivery office:** Anchor the AI program in a central delivery team with defined ownership and measurable targets

5 **Execute operating model shifts:** Implement organizational changes, process improvements, and reskilling to align with a broad adoption of AI tools

6 **Drive cultural change:** Shape new behaviors and mindsets through leadership posture and organization-wide upskilling

BCG experts | Key contacts for chemical AI transformations

Americas


Adam Rothman


Prakash Chandrasekar


Frederik Flock


Kasey Phillips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Europe, the Middle East, and Africa


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Alexander Hogreve


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