Digital Transformation in the Chemicals Industry

Inspire and Shape

a digital world to fuel profitable growth, safely deliver innovative chemicals, and build customer intimacy like never before

Run Simple

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DON'S POINT OF VIEW

The face of the chemical industry is changing with a constant stream of mergers and divestitures. New digital leaders are emerging by leveraging innovation and embracing technology in every aspect of their business.

Don Mahoney
Vice President and
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Dear Colleagues,

Today's chemical industry leaders are faced with many challenges. How do we quickly integrate acquisitions to release promised synergies and onboard new revenue sources? How do we reduce complexity, integrate across silos, and streamline workflows across our entire global value chain? How do we resist commoditization by embedding ourselves more intimately within our customers' innovation and operations cycles? How do we rapidly enter, differentiate, and win in new markets?

Tackling these challenges requires more than doing what's always been done, but instead doing it better, faster, cheaper, and smarter. It requires a reimagining of entire business models, business processes, and the very nature of work itself.

Leading companies are positioning themselves to transform their business models to:
- **Compete on outcomes,** delivering tangible customer results vs. selling increasingly commoditized chemical products
- **Compete as an ecosystem,** integrating with both customer and supplier supply chains to unlock superior value

Business processes are being reengineered to:
- **Slash cycle times,** enabling real-time sense and response and massively simplifying operations
- **Maximize uptime,** leveraging IT/OT integration and predictive maintenance and quality management

And work is being reengineered to enable:
- **The perfect work process,** empowering workers to optimize profitability at the transactional level
- **Extended workforce engagement,** incorporating simulations, scoring, and performance-based approaches that engage, empower, and excite the entire workforce

SAP's approach to enabling this digital transformation is to provide the digital-ready platform, the high-performance applications, and the connected business networks necessary to rapidly and securely execute new business models, extend value chains, and engage with customers, employees, and partners like never before.

Our vision is to help the global chemical industry digitally transform in order to drive profitable growth, safely deliver innovative chemicals, and build customer intimacy. This document offers our point of view on where the industry must go and how SAP can help drive the digital transformation in chemicals.

Thank you for your interest, and I look forward to your feedback.

Don Mahoney

REIMAGINING

THE DIGITAL ECONOMY OFFERS INFINITE NEW OPPORTUNITIES

In a connected world where every company is becoming a technology company, smarter products and services will refocus commerce on business outcomes and blur industry lines.

Big picture: What got us here won't get us there

Why is digital transformation important to chemicals?
Our conversations with over 150 chemical companies and leaders highlight a common imperative: grow the bottom line profitably by improving agility, productivity, and innovation. The chemical industry is evolving in new and unexpected ways, yet many companies still struggle to recognize and understand how the digital economy will create opportunities and risks. Early evidence, however, is compelling. Significant value will be created by embracing new digital technologies across the chemical industry. The digital economy is real, and it's here to stay.

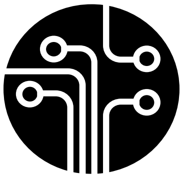
Digital leaders are emerging and early adopters are winning
We are at an important inflection point where digital technologies allow new leaders to emerge and thrive. Companies like Uber and AirBnB have introduced business models based on innovative digital technology to redefine entire industries and create unprecedented shareholder value. Within chemicals, however, large-scale digital transformation may be less understood, but it is no less important.

Early adopters of new technologies are emerging and are winning in chemicals by focusing on digital innovations and/or optimizing business processes. By rethinking their strategy and operations, companies have leveraged new digital technologies to transform and deliver impressive results. Examples include:

- **Redefining their value propositions** (what value they deliver and sell to customers) enabled by real-time digital platforms that sense and integrate end-user consumption patterns with order management and supply chain activities
- **Monetizing information and creating new services** to complement product sales
- **Improving customer intimacy** by creating compelling and simple interfaces and ecosystems that engage customers and end users
- **Accelerating innovation** by bringing a new level of analytics and collaboration to research and development

Our point of view
SAP believes that the emerging digital economy is very relevant to chemical companies. New technologies and capabilities will transform business models, processes, and fundamental work. However, this digital transformation requires a clear strategy, a robust platform, and a significant change management effort.

TODAY, EVERY BUSINESS IS A TECHNOLOGY BUSINESS



The digital economy is real, and it's here to stay

- Digital transformation is expected to drive up to €25 billion of new value per year in Europe alone for chemical companies [1]
- 58% of chemical companies are embracing digital to gain competitive advantage over industry peers [2]
- 94% of chemical executives expect to increase investment in digital capabilities in the next three years [3]
- Up to 50 billion objects may be connected to the Internet of Things by 2020 [4]
- 87% of chemical executives believe that companies failing to embrace digital face extinction [5]

REIMAGINE EVERYTHING

Fundamental changes: Five technology trends changing everything

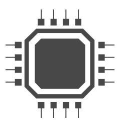
We are witnessing an era of unmatched business innovation. Five breakthrough technologies have matured and hit scale together:

HYPERCONNECTIVITY

1 

People and assets are connected, transforming established processes and interactions across the chemical ecosystem. Connecting customers, employees, suppliers, service providers, information, and assets establishes unprecedented visibility, collaboration, and insight – driving enterprise agility and workforce productivity.

SUPERCOMPUTING

2 

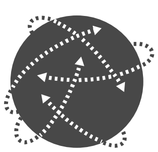
The limits of 20th century computing power are gone. Networking and in-memory computing allow for a complete reimagining of business processes. Energy-optimized supply chains, profit-driven sales order commitments, market-driven pricing, and predictive maintenance and quality are now realities.

CLOUD COMPUTING

3 

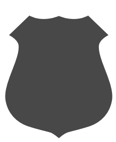
Technology adoption and business innovation move faster than ever before. Cloud infrastructures have emerged to support supplier collaboration, extended workforce enablement, asset information exchange, and regulatory conformance – transformed by the convenience, scale, and agility of cloud computing.

SMARTER WORLD

4 

Smart sensors, self-diagnosing assets, and artificial intelligence are the new normal. Critical assets will be monitored remotely, preemptively triggering repair orders. Predictive models will optimize the chemical enterprise ecosystem.

CYBERSECURITY

5 

Comprehensive security across IT, operations, and physical facilities is key. Trust remains the ultimate business currency, making cybersecurity a top priority in the design and operation of the digital chemical enterprise.

Road map to Run Simple: Steps to digitize your business

REIMAGINING

Do you have the right strategy? The starting point of the transformation journey is reimagining your business with customer outcomes and your entire ecosystem in mind.

REIMAGINE BUSINESS MODELS

Globalization, cybersecurity, regulatory pressures, and dynamic feedstock fluctuations destroy established business models without a clear road ahead. We see two new business models emerging:

- Competing on outcomes
- Competing as an ecosystem

REIMAGINE BUSINESS PROCESSES

Digital technology is transforming business process efficiency and innovation in a massive reengineering evolution. Process productivity is being driven through:

- Slashing cycle times
- Maximizing uptimes

REIMAGINE WORK

With a retiring baby-boomer workforce, the chemical industry has to drive insight to action into its millennial employees. The very nature of the work environment is digitizing with an intense focus on:

- The perfect process
- The engaged employee

PLATFORM

Do you have the right platform?

Leaders are investing in digital capabilities that are congruent with their strategy. Transforming the digital chemical industry will provide all participants the right platform to drive efficiency, accelerate innovation, and develop new business models.

Solutions must be aligned to desired business outcomes and business strategy. SAP's digital business framework is based on the five key pillars of a digital plan and architecture:

1. **Customer experience** across all channels
2. **Supplier collaboration** across all spend categories (product, services, logistics, travel)
3. **Workforce engagement,** including employees and contractors
4. **Assets and the Internet of Things** to drive real-time insights and new business models
5. **Core business processes** (finance, supply chain, asset and work management, offer to cash ...)

ROI drives this significant phase of the transition to digital. It's not about any one of the five pillars, but rather how they all interconnect to achieve business outcomes.

Over $14 billion
has been invested in the Responsible Care initiative in the past decade alone.[6]

17%
of all U.S. patents are chemistry-related. [7]

REIMAGINE BUSINESS MODELS

Energy and raw material price volatility, global shift of demand and supply centers, rapid product commoditization, and increasing regulatory requirements are here to stay and create a climate of uncertainty for the chemical industry.

Competing on outcomes

With customers getting more demanding, product lifecycles continuously shrinking, new competitors entering the market, and sustainability becoming a strategic differentiator, just selling products is not enough anymore. Instead, chemical companies need to look into selling outcomes and results.

Top performers are bundling products with value-adding services that differentiate their offerings, increasing customer loyalty and grabbing a larger share of the customer wallet. We see chemical companies:

- Moving closer to customers and tying product properties into application performance through niche product development
- Gaining insight into their customers' value chains to better understand demand patterns without POS information
- Combining sensor technology with the concept of closed-loop, cradle-to-cradle enablement to measure outcome-related parameters

Competing as an ecosystem

The chemical industry is a capital-intensive industry, and a high return on assets is one of the most important key performance indicators. However, making capital commitments in today's climate of uncertainty bears a high risk. In the face of this risk, new business models are emerging where traditional line of business outsourcing models (e.g., IT, HR, logistics) are expanding to include actual plant process orchestration, virtually eliminating the need for working capital.

- Chemical companies are emerging with no manufacturing footprint – the manufacturing process itself is not a core competency and can be outsourced to low-cost manufacturers close to sources of demand
- Companies are virtualizing their entire business by orchestrating resources on demand to meet innovation and market needs
- Leaders are establishing highly agile digital networks in which collaboration with a variety of partners – R&D institutes, toll manufacturers, 4PLs, environmental service providers – provides specific know-how and services to perfectly meet their customers' needs

Hagleitner differentiated itself from the competition by transforming its business model from selling commodity sanitizer, soaps, and towels to delivering a clean washroom technology. Leveraging smart sensors, the Internet of Things (IoT), and advanced real-time data, Hagleitner increased service levels and customer satisfaction while reducing its costs and carbon footprint. [8]

REIMAGINE BUSINESS PROCESSES

Digital technology has opened the door to a new realm of business process reengineering. The objective of profitable growth remains the same, but this evolution is slashing cycle times throughout all business processes with a keen focus on maximizing uptimes in an asset-intensive industry.

Digital chemistry

Driving sustainable growth and innovation is one of the most critical success factors for chemical companies, and digitization provides unprecedented opportunities for accelerating the product development process. Examples include:

- Knowledge hub concepts supporting predictive analytics during experimental design, driven by consolidation of data from databases, devices, and machines
- Smart labs that design, execute, and capture experiments in closed-loop processes while leveraging lab data history
- Predicting technical properties of new formulations

Digital plant

Leveraging digital technology in order to maximize uptime and optimize asset utilization in manufacturing processes represents a huge opportunity for chemical companies.

- Step changes in performance are possible through event-driven adjustments of production plans and schedules
- Predictive models are optimized for asset maintenance and product quality, and through data-driven decision support based on real-time insights

No-touch order to delivery

In today's highly dynamic, global world, meeting customer demands via agile and responsive fulfillment is pivotal to success.

- Digitized order-to-delivery provides big opportunities to chemical companies
- Companies capture demand in real time via sensors and run ad hoc simulations in sales and operations planning
- Deliveries are automatically created along with required regulatory and logistics documentation, following safe and sustainable practices

Dynamic pricing and real-time margin management

Ongoing volatility in raw material and energy prices, as well as in customer demand, provides a big challenge to chemical companies in terms of meeting their margin goals.

- Digitization allows chemical companies to simulate the effect of price changes on margin anytime, anywhere, and at any level of granularity
- Chemical companies develop real-time pricing quotes for customers and prospects and integrate this information with available-to-promise or capable-to-deliver commitments
- With the addition of the SAP Ariba Network, companies can now instantly collaborate with suppliers to combat price and supply volatility in real time

"In both the spirit of staying on top with exceptional personalized customer service, and with business goals, Asian Paints is always using valuable customer data to intelligently and strategically give customers the best experience possible." [9]

REIMAGINE WORK

The U.S. chemical industry has shed 30% of its workforce despite doubling its output.[11] In leaner workforces, the way people do their daily work fundamentally changes to management by exception, driven by alert notifications, rapid decision making with simulations, reaction-based response mechanisms, and advanced analytics for control.[11] All employees must be engaged with the ability to follow perfect work processes.

The perfect work process

All workers must strive to optimize profitability at the core transactional level. Every employee must understand how their respective job impacts corporate strategy at every level of the organization.

- Back-office processes will be fully digitized. Previously manually intensive steps in procurement, HR, inventory management, and invoicing are replaced by collaborative transactions with access to real-time analytics that support role-based decision making
- Shop floor operating instructions are now supported and/or controlled by predictive and self-learning systems that interact with plant equipment and business processes

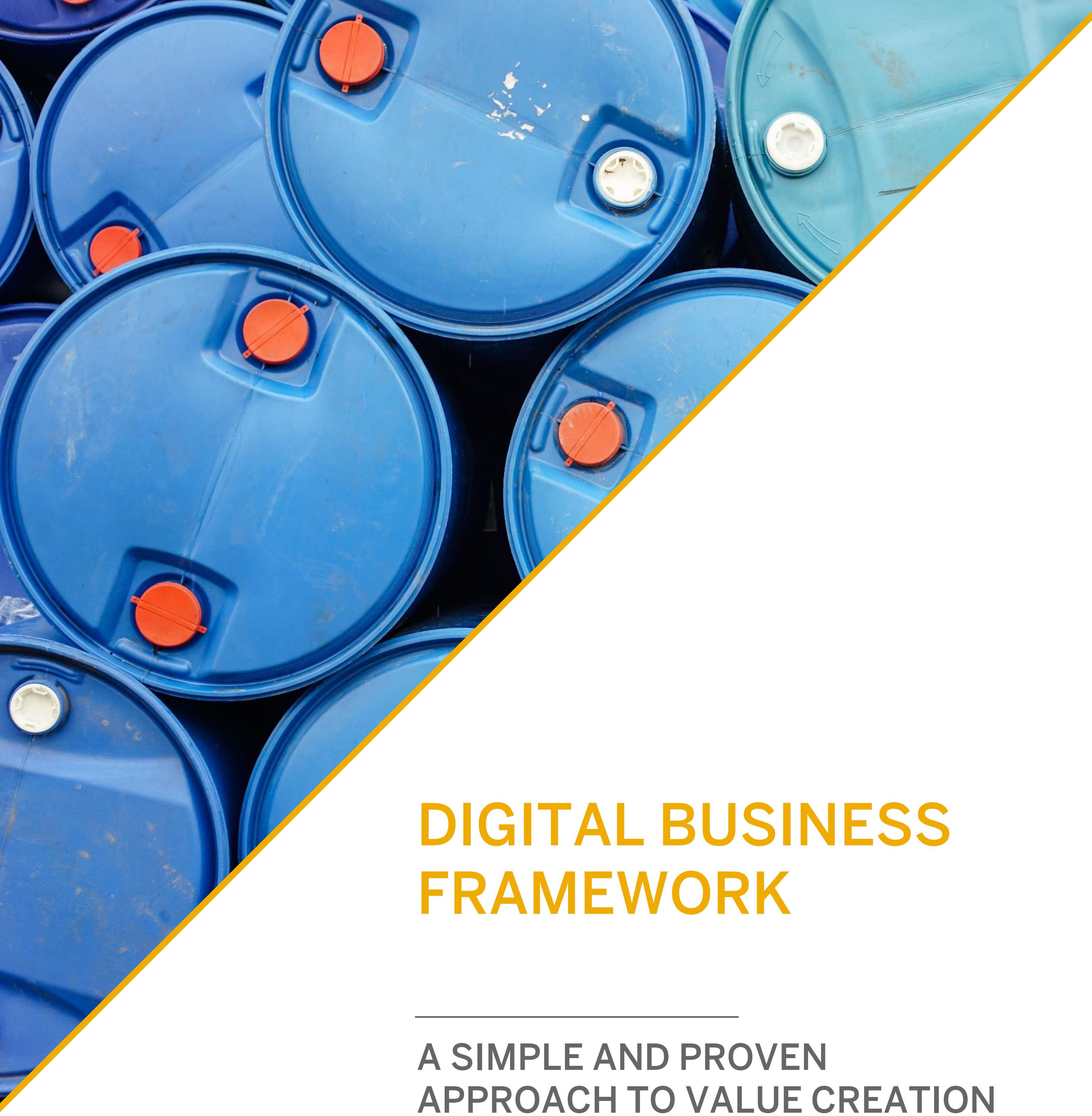
People continue to be key assets in transforming the chemical industry. Their roles will change, but their value to each partner in the network will grow.

The engaged employee

Digital employees expect a seamless and mobile-enabled work experience. Employee turnover will remain high if they are not actively engaged in the entire work experience with a sense of ownership and pride.

- Enterprise knowledge must replicate 40 years of operator experience instantly with the scan of an equipment bar code
- Predictive models and simulations must drive insight to action for all employees, without forcing them to jump to different applications or seek approvals

Givaudan drove productivity and creatively engaged its workforce while migrating to the SAP Environment, Health, and Safety Management (SAP EHS Management) application and the SAP HANA platform. The company built a robust determination engine for chemical compliance that can evaluate products in seconds, saving employees valuable time while improving consumer safety and satisfaction.[10]



DIGITAL BUSINESS FRAMEWORK

A SIMPLE AND PROVEN APPROACH TO VALUE CREATION THROUGH DIGITIZATION

Every company requires a simple approach to build a pragmatic and executable vision of its digital strategy.

SAP HANA: THE GREAT SIMPLIFIER

At the heart of a digital business is the ability to adjust course at any time. This involves two key concepts: simplification and innovation.

Simplification is all about doing what we are already doing, but **better, faster, and cheaper**. Digitizing the order entry process is a prime example – your customers should have the ability to enter orders 24x7 with an Amazon-like experience.

Innovation is all about reimagining business models and customer value by leveraging the five technology trends.

The diagram below is at the heart of the digital business transformation. The idea is very simple, but it took years to make it a reality: bringing together transactions and analytics on the same platform. Uniting structured data (e.g., finance, manufacturing) and unstructured data (e.g., text, video, voice) will change the way businesses plan, scale, and innovate.

In-memory computing is a concept brought to life by the breakthrough SAP HANA platform. While relatively young by commercial standards, SAP HANA's rapid adoption across multiple industries validates its massive potential for digital businesses.

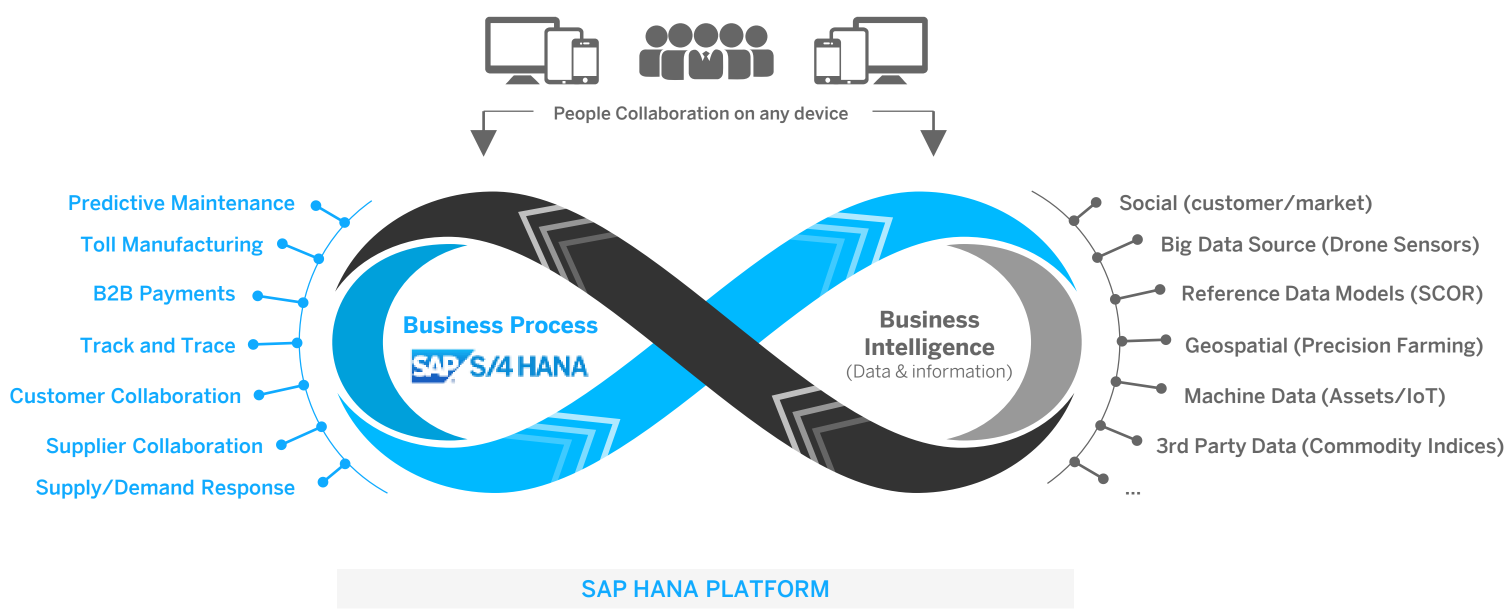
With in-memory computing, we can now finally:

- **Leverage Big Data** from assets, remote devices, suppliers, customers, and plant equipment. For example, capture and analyze the data from drones flying over acres of farmland to enable decision support and optimize fertilizer and pesticide applications at harvest time
- **Extend the business process** to interoperate with business partners in near real time via advanced cloud-based business networks
- **Modernize business processes** from finance to supply chain, enterprise asset management, and order-to-cash, running them in real time with no data replication and no batch programs

These capabilities open infinite new ways of optimizing business, driving business digitization, simplifying everything, reducing cost, and providing the agility required in a rapidly changing world.

SAP constructed an innovation road map designed to bring in-memory computing together with cloud computing and mobility. This strategy has been embraced by early adopters who are leading the transition to digital.

SMARTER DECISIONS + SMARTER TRANSACTIONS = SMARTER BUSINESS



DIGITAL BUSINESS FRAMEWORK

Every chemical company needs to think about the five pillars of a digital strategy

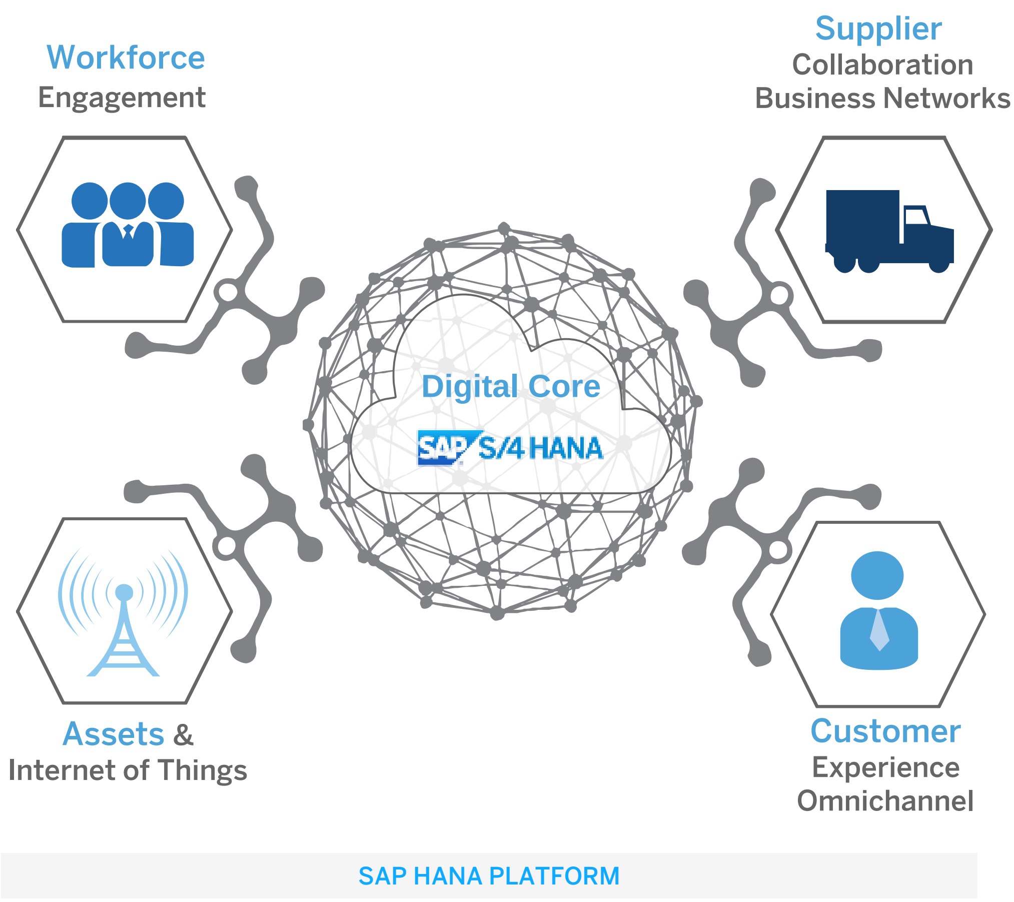
SAP understands the five pillars of digitization, and we also understand that continuously changing requirements pose big challenges for businesses. The method of reimagining business models, business processes, and work helps develop the digitization road map.

We have built the digital business framework to support the chemical industry in developing and executing on its digital enterprise strategy to become digital transformers and leaders.

Chemical companies must digitize to grow profits and reduce costs by simplifying operations. The value of the digital economy is based on how to serve the customer. Value creation often comes from edge solutions which are based on and coordinated by the digital core solutions. It is the platform for innovation and business process optimization, connecting the workforce, the Internet of Things, the supply network, and the customers.

1. Outcome-based **customer** experience
2. Re-platform **core business processes** and bring together transactions and analytics in real time to be smarter, faster, and simpler
3. Smarter and engaged **workforce** across all employees and contractors
4. Increased **supplier collaboration** to accelerate growth and innovation
5. Harness **assets** and the **Internet of Things** to drive real-time insights and new business models

Within these five pillars, chemical companies can engage their workforce in meaningful ways to address knowledge gaps created by the retiring workforce. The entire value chain will benefit from the potential of sensors, enabling better collaboration with suppliers, vendors, customers, and third-party processors (tolling companies).



THE DIGITAL CORE FOR THE CHEMICAL INDUSTRY

A new generation of ERP solution, **running in real time, integrating predictive, Big Data, and mobile,** will change how the chemical industry works, how the business is run, and how information is consumed: **the future is here.**

Advanced in-memory computing signals an end to running the business in batch mode and eliminates complex workarounds along the chemical value chain.

Real time

Real-time optimizations for inventory, supply planning, plant scheduling, logistics, and product pricing will drive business-based changes and have massive implications for how we work, how we do business, and how we organize.

Power of prediction and simulation

Every employee can gain real business insights with the help of simulation and predictive tools to drive smarter decisions, improve asset reliability, and reduce plant outages.

Agility

The ability to rapidly enter new markets, analyze and align your product portfolios, and reflect organizational changes in one-tenth the time it takes with today's systems will yield the agility required in the digital economy.

Deployment choice and lower TCO

Accessing solutions to run the core has to be simple. Chemical companies now have the choice to deploy in-house or in the cloud. In-memory computing also impacts TCO, and it will free up funds for infrastructure investment.

Consumer-grade user experience

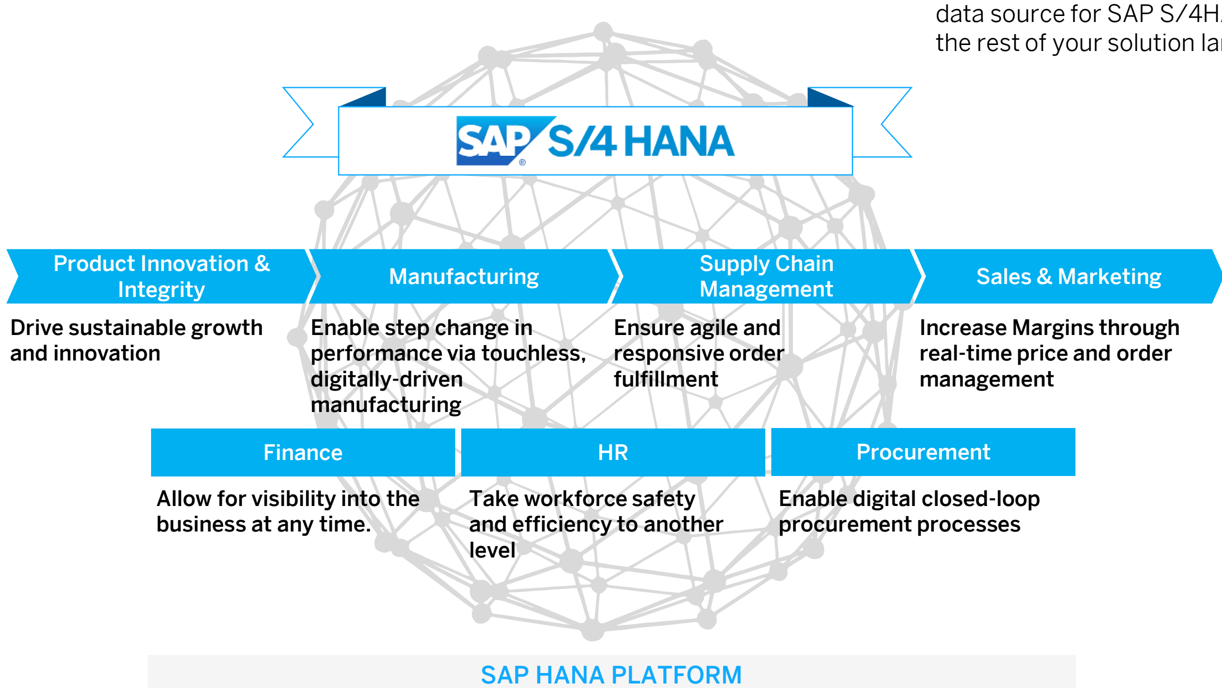
User experience is key to accepting digital change. It drives adoption, user engagement, and people productivity.

Simplify with SAP

SAP S/4HANA is the only end-to-end solution that covers all business processes and runs in-memory. It helps chemical companies run in real time for fundamentally better performance. For instance:

- Maximize production performance, output, and quality via real-time insights and predictive models
- Simulate/predict properties and performance of new products and formulations
- Make real-time, profit-driven order commitments based on ad hoc price, margin, availability, and capacity simulations for products and services
- Bring a complex ecosystem together on a collaboration platform, the goal of which is feeding an exponentially growing world population

In addition, the SAP HANA Cloud Platform can be the single enterprise data source for SAP S/4HANA and the rest of your solution landscape.



CUSTOMER EXPERIENCE

Digital technology has **changed the game.** But, customers **changed the rules.** Customers demand simple, seamless, personalized, service-driven experiences across **any** channel, **anytime, anywhere,** and on **any device as the industry moves closer to the consumer.**

Three key trends are reshaping the customer experience:

Outcome economy

The outcome economy requires a deep change in the chemical business model and new organizational and business process capabilities. It also requires a much different approach, from product development into application design and service. Customers want results, based on suppliers' knowledge and application expertise, instead of pure products. Managing a holistic offering around this outcome will open new profitable revenue sources.

Customer journey

Customers choose their own journey in multiple channels at their convenience, and the competition is only one mouse-click away. Chemical suppliers need to help and advise customers on transforming their own business, developing applications and solutions, staying competitive, and delivering against business imperatives.

Big Data and marketing/product management in near real time

Big Data allows companies to sense and respond to volatile customer demand in real time to set the next engagement points and trigger corrective actions. With the proliferation of customer-owned, connected devices, the data volume is expanding tremendously, offering new business opportunities.

93%
of customer service decision makers say that a good customer experience is one of their strategic priorities.[11]

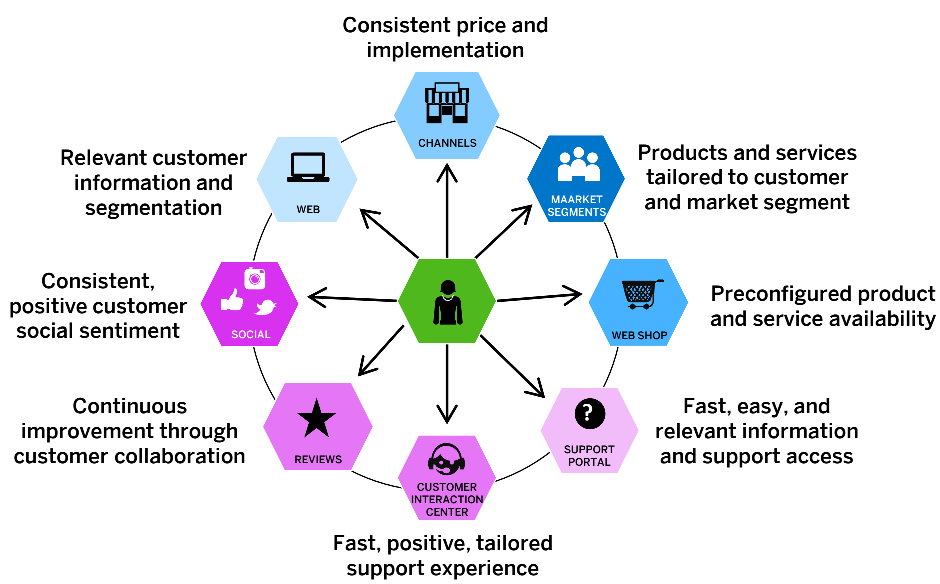
42%
of service agents are unable to efficiently resolve customer issues due to disconnected systems, archaic user interfaces, and multiple applications.[12]

88%
of all organizations have planned or will deliver a multichannel service experience.[13]

Digitize your end-to-end customer experience with SAP

A single platform that brings together marketing, sales, services, and commerce (includes the #1 omnichannel SAP Hybris solutions) to ensure seamless digitization of the entire customer experience. SAP solutions for customer engagement and commerce powered by the SAP HANA platform enable a 360-degree view of your customer, real-time interaction, and sophisticated, predictive analytics, fully integrated to the core transactional system.

- **Orchestrate business processes** across marketing, commerce, sales, and service
- **Deliver personalized experiences** in context with each interaction
- **Create a single, harmonized experience** for your customer while reducing the burden on employees
- Be prepared to **engage your customers on the channels they choose,** at any moment in their journey
- Achieve full **integration** with your core business processes, providing a unique chemicals-specific platform for omni-channel customer engagement and commerce



WORKFORCE ENGAGEMENT

The world is getting **smarter** in the digital economy. But **complexity is overwhelming the workforce** in this pursuit as the industry must deal with a knowledge gap left by a retiring workforce with years of experience.

Complexity is the enemy of workforce engagement. People are working harder than ever but not necessarily accomplishing more, because they do not have access to smart, consumer-grade technology to work faster, better, and more efficiently. Organizational complexity is driving higher costs and slowing progress. Four forces need to be addressed:

Changing of the guard

With an aging workforce, chemical companies have to devise a workforce strategy to make work in this industry attractive for the digital generation.

Contingent labor is on the rise

Chemical companies are continuing to use contractors and service providers to drive agility and lower fixed costs. The industry can outsource work, but not the responsibility for safe and compliant operations. The contingent workforce must be digitally integrated in all business processes.

Constant reorganization

Constant reorganizing to adjust to the new reality is becoming the norm, but it can't be allowed to disrupt efficient operations.

Complexity is on the rise

Companies do business in more countries across many more channels. Products and services are becoming more complex. Regulations are changing by the day. Multiple layers of management are hindering speed and agility.

41%
increase in contingent workforce spending in the past five years[14]

63%
of chemical company CEOs are concerned about the availability of skills[15]

93%
of CEOs recognize the need to change, or are changing, their strategies for attracting and retaining talent[15]

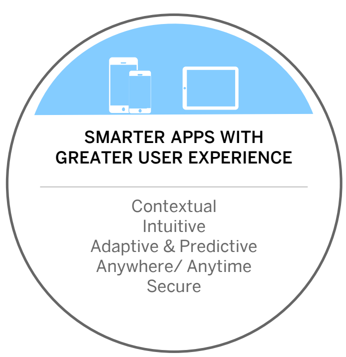
30%
of the workforce at Dow Chemical Company is over 50 years old[16]

Improve your total workforce productivity: Simplify with SAP

Digitize your workforce with SAP: SAP S/4HANA + SAP SuccessFactors + SAP Fieldglass + SAP Fiori provide the tools for total workforce engagement and advanced analytics.

- **Attracting the best people:** Recruit and onboard the best workforce, simplify their work, and ensure that regulatory and compliance requirements are met
- **Managing the total workforce lifecycle:** Manage the total workforce lifecycle from recruiting to onboarding, performance, compensation, and learning – all in one place
- **Smarter apps with greater user experience:** Enable the workforce to easily access the right information across any device and through a dramatically simplified user experience

SAP SuccessFactors



SAP Fiori

SAP Fieldglass

BUSINESS NETWORKS AND SUPPLIER COLLABORATION

B2B **transactional inefficiencies are costing $600 billion per year,** from sourcing and transacting to payment processing.

Collaboration across all spend categories will change the way chemical companies acquire products and services, outsource, and create value. Several trends are redefining the game:

Business connectivity at scale
When suppliers large and small are connected in the millions, the transactional platform becomes the de facto standard. This is already a reality (examples: SAP Ariba, Concur, Alibaba).

B2B collaboration by category
Acquiring specific types of products and services often requires a different community of suppliers using open standards set by that community (examples: agribusiness companies using standards developed by AgGateway and OADA).

User experience
Enterprise users expect consumer-grade experiences that they find on sites such as Amazon, Travelocity, and Google. Without these intuitive user interfaces, employees work around the system, negating the value of negotiated contracts and driving maverick spending.

Support for end-to-end processes
Chemical companies are looking at business networks not just to connect to suppliers, but to support end-to-end processes like toll manufacturing, plant maintenance and repair, supplier certification, order to cash, etc. This is all possible as business networks like Ariba pull business partners together and enable seamless collaboration.

$14.4 trillion
in total Value at Stake through the networked connection of people, process, data, and things over 10 years [17]

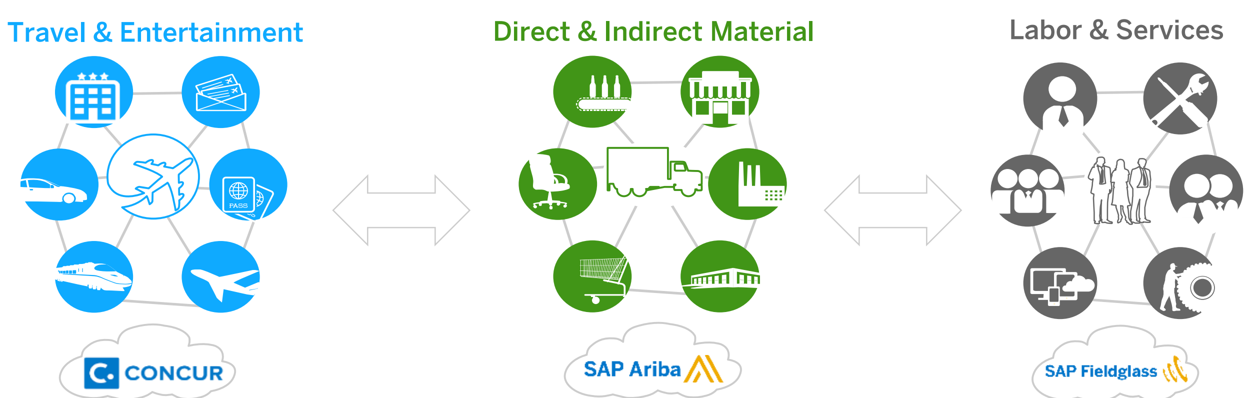
50%
of networked companies are more likely than their peers to have increased sales, higher profit margins, and be market leaders[18]

50–75%
Faster transaction cycles are being achieved with the SAP Ariba Network[19]

Simplify supplier collaboration with SAP business networks

SAP S/4HANA gives you incredible capabilities to digitize business processes across your business – and the connectivity to the business network allows you to extend those processes beyond the four walls of your business.

- Solution already at scale and covers all spend categories (direct and indirect material, labor and services, travel and expenses)
- Business networks operate on a global basis, meet data security standards, and operate with near zero downtime
- Extensive offering by leveraging services from many partners such as supply chain, financing, payment, supplier certification, etc.



ASSETS AND THE INTERNET OF THINGS

The most **dramatic change** in the digital economy will be driven by hyperconnectivity and Big Data science. These will **transform nearly every chemical company's business model.**

Chemical companies are finally understanding the full potential of the relationship between physical and digital assets and the Internet of Things. We are witnessing new use cases across the industry with breathtaking results. Below are some key trends:

Smart products drive new business models

OEMs and chemical companies are embedding sensors in their products and processes. As a result, chemical companies are becoming massive consumers of data and are using data analysis to drive new and improved business models and processes.

Data-driven business models

The transformation in the chemical industry is enabled by Big Data technology and the computing power to process massive amounts of data in real time.

Technology-driven customer engagement and engineering

Customer sales and services and engineering are spending more and more on Big Data and sensor technologies as their functions are the most transformed by these new technologies.

New alliances

Seamless collaboration is now possible around new business models involving partnerships that may not have made sense few years back. Examples include partnerships between chemical companies, energy companies, customers, and subcontractors; between chemical and technology companies; and between chemical and equipment manufactures, plus many others.

3 billion
Internet users and an expected 30-50 billion connected devices by 2020 [20,21,22,23]

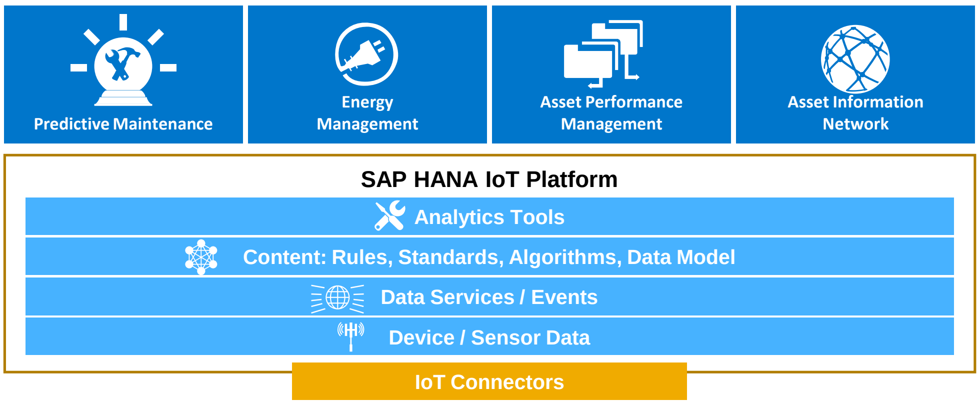
80%
of companies that invested in IoT increased revenues[24]

60% reduction
A subsidiary of large international chemical company reduced customer complaints through a shop floor label automation project by integrating a drum fill station into SAP MII, they improved safety and visibility by automating the truck loading/unloading operation with RFID sensors using the same architecture.

Connect, transform, and reimagine with SAP

With SAP HANA, Internet of Things edition, organizations can now take embedded device data, analyze this data into information in real time, and apply this information across the value chain to drive business insights and create new business models.

The SAP HANA Internet of Things platform provides the connectivity to OT systems, either directly or via partners like OSIsoft. The data is stored and processed in the platform, which provides basic functions like data services (such as operations on time series), predictive analytics, and others. Applications are developed by SAP, partners, and customers and enable use cases like load forecasting or transformer analytics.



SAP HANA PLATFORM – A NEW COMPUTING PARADIGM

SAP HANA is the ultimate simplifier and the platform for innovation and digital business

Dream, develop, and deliver with SAP HANA Cloud Platform

SAP HANA Cloud Platform provides the mobile, collaboration, integration, and analytics capabilities chemical companies need to dream big, develop fast, and deliver everywhere, with the following capabilities:

Application extensions

Extend current cloud and on-premise solutions for additional customization, enhanced business flows, and more.

Real-time analytics

Engage customers, optimize business processes, and unleash new revenues with real-time analytics apps, powered by SAP HANA.

New cloud apps

Quickly build innovative consumer-grade and industry apps for today's always-on, mobile, social, and data-driven world.

Extended storage capabilities

Holistically manage all structured, unstructured, and infinite data streams with flexible combinations of data stream processing, in-memory technology, disk-based columnar storage, and Hadoop-based storage solutions.

Data footprint reduction

Significantly reduce memory footprint and TCO. In ERP systems, we have seen ~6x reduction by SAP HANA's dictionary compression. Removing aggregates and actual and historical data separation further reduces the footprint up to ~10x.

Vickem Group

"SAP Business Suite powered by SAP HANA has transformed the way Vickem Group does business, from being reactive to very nimble. This has greatly helped our company avoid potential delays and lost sales."[25]

Asian Paints

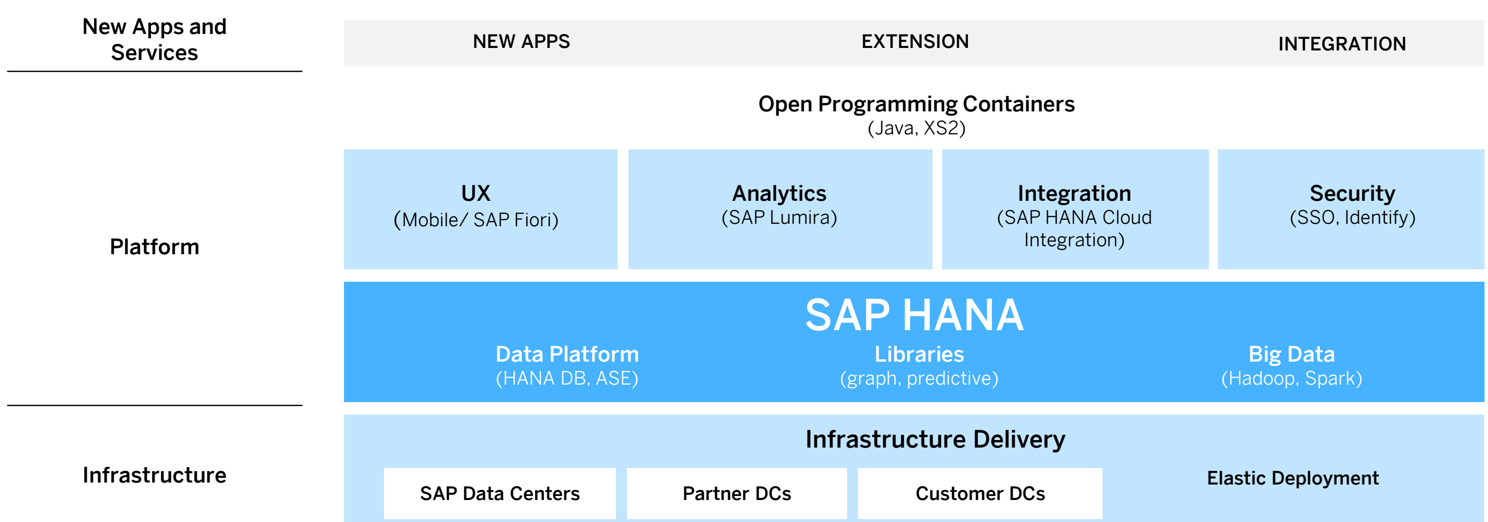
"One of the big benefits of SAP CRM powered by SAP HANA is that it serves as a foundation for driving the entire relationship with customers instantly and more precisely. It allows you to profile your customer database according to a certain set of rules, arrive at a target audience, and run real-time campaigns."[26]

Textile rubber and chemical company

"Without the real-time analysis and reporting capabilities of SAP Business Suite powered by SAP HANA, we couldn't have found a product line inefficiency that was costing the company thousands of dollars a day."[27]

The SAP HANA platform is…

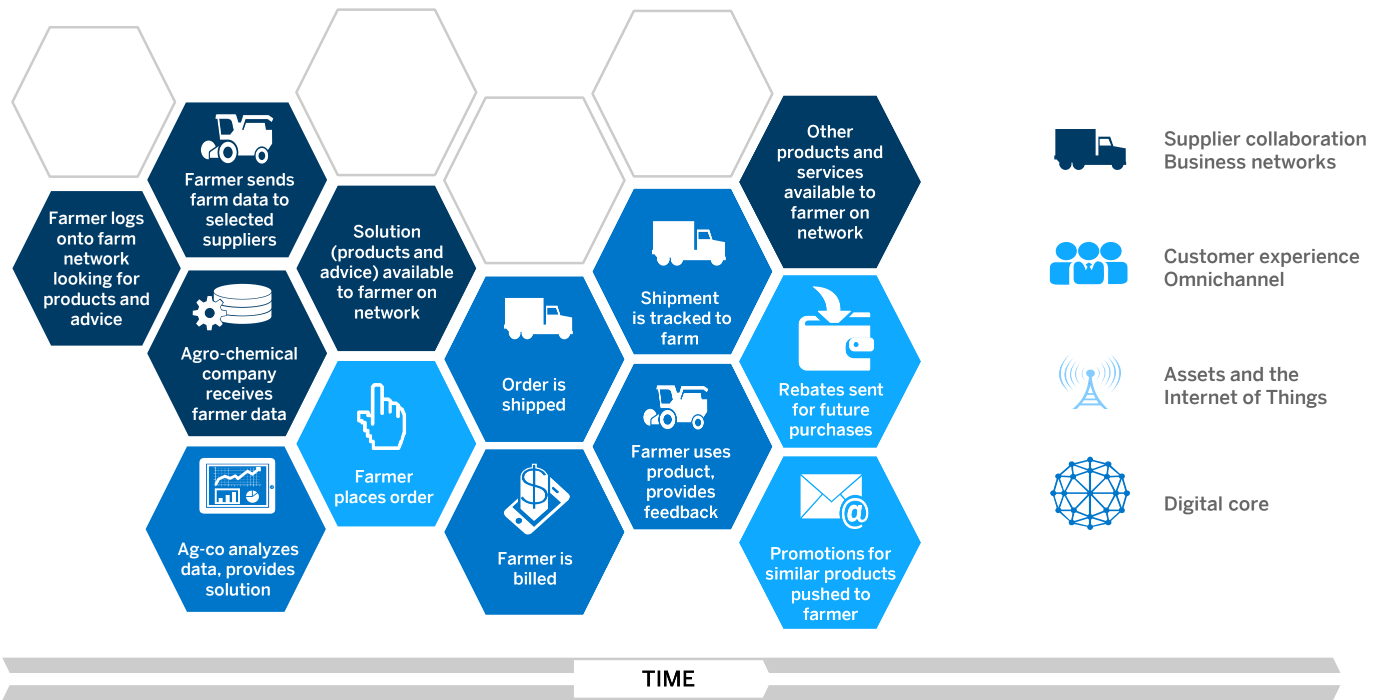
Real-time, in-memory platform • 10x data footprint reduction for ERP • Extended storage, including Hadoop • Open architecture • Developer-friendly • Embeds mobile and analytics • Secure • Cloud-ready



HOW DOES IT ALL COME TOGETHER? – EXAMPLE

While each part of the digital business framework delivers significant value as a stand-alone technology, the ultimate goal is to design the next generation of business processes that will take advantage of the entire digital framework. The agribusiness ecosystem provides the perfect example of an environment in which all business partners (farmers, the companies who sell to them, and the companies who buy from them) need to be connected via a business network to share large amounts of IoT data in order to provide an enhanced customer experience and improved customer outcomes.

PRECISION FARMING – MAXIMIZE YIELD/OUTPUT OF FARMS TO FEED FUTURE GENERATIONS



Precision farming
This process flow illustrates the way farmers, their suppliers (of seeds, crop protectants, and fertilizers), and other stakeholders do business via an innovative collaboration hub that combines the powerful capabilities of an in-memory platform, an extended business network, the Internet of Things, and a multichannel customer experience.

The farmer sends farm-related data (location, soil test results, planting/yield history, application history) to selected suppliers, who can now develop field-specific planting and application prescriptions via proprietary predictive algorithms targeting maximized farm output, and send these prescriptions back to the farmer. In the next step, the order is placed, shipped, tracked, and paid for after receipt, all enabled by highly automated, digitized processes. Farmer consumption patterns can be tracked and used for reward systems or targeted marketing campaigns run by the suppliers.

The expected benefits of this scenario are significant for all stakeholders, including:

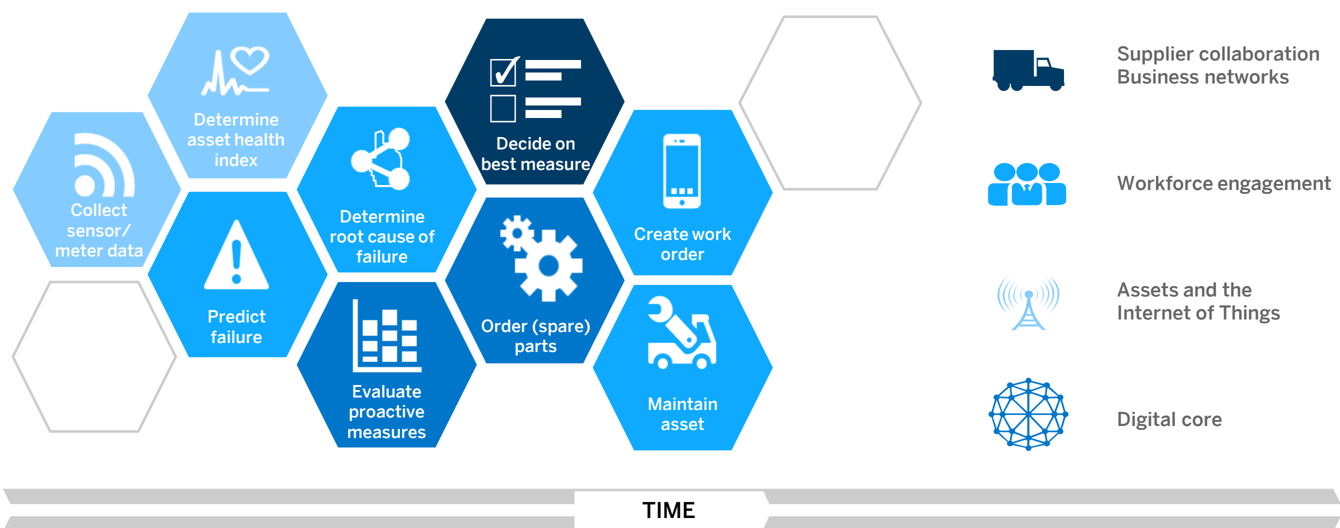
- Higher yields and margins for the farmer
- Increased revenues for suppliers of agrochemicals due to better service
- Reduced costs of service for manufacturers of farm equipment
- Reduced operating costs for all stakeholders from connectivity and process automation via collaboration hub

The **International Food and Policy Research Institute** estimates that, by 2050, we will see a 67% increase in global crop yields from agricultural technologies.[28]

HOW DOES IT ALL COME TOGETHER? – EXAMPLE

Each of the five digital business pillars delivers individual business value, but next-generation business processes will span multiple pillars to drive efficiency internally or across the business network, connect to devices, and improve asset health and performance.

USE SENSOR AND METER DATA TO PROACTIVELY MAINTAIN ASSETS



Imagine that sensor data is continuously collected and analyzed in real time to determine and monitor asset status and health. This information is also fed into advanced analytics models that can predict impending failures early enough to avoid damages and plant outages. To evaluate the proactive measures, the system needs to determine potential root causes for an expected failure. This supports the decision for the best actions, including ordering the right spare parts, assigning the right experts, and devising a cost-effective schedule.

The digital work order dispatches maintenance and provides additional plant and asset information to ensure that the right activities are conducted, at the right time, by qualified people, with the right spare parts and tools.

Every outage and failure that can be prevented or proactively managed minimizes cost and maximizes asset availability and customer satisfaction.

Real-time predictive analytics yield tangible business benefits:

- Higher return on assets
- Faster recovery time from failure
- Higher productivity and safer work
- New service revenue streams
- Competitive service-level agreements
- Higher customer satisfaction

Predictive maintenance enables even more innovative asset management scenarios in which equipment monitors its own health; reaches out to system experts to create a recovery plan; devises workarounds; sources, orders, and schedules the services experts; gets 3D-printed service and spare parts; and updates its production schedule.

HOW TO START

THE JOURNEY TO THE DIGITAL CHEMICAL INDUSTRY BEGINS WITH A CAPABILITY ANALYSIS THAT RESULTS IN THE TRANSFORMATION AGENDA

HOW TO START

THE JOURNEY TO THE DIGITAL CHEMICAL NETWORK

The journey to define future business models for chemical manufacturers in all industry segments requires a systematic approach to identify and capture business opportunities.

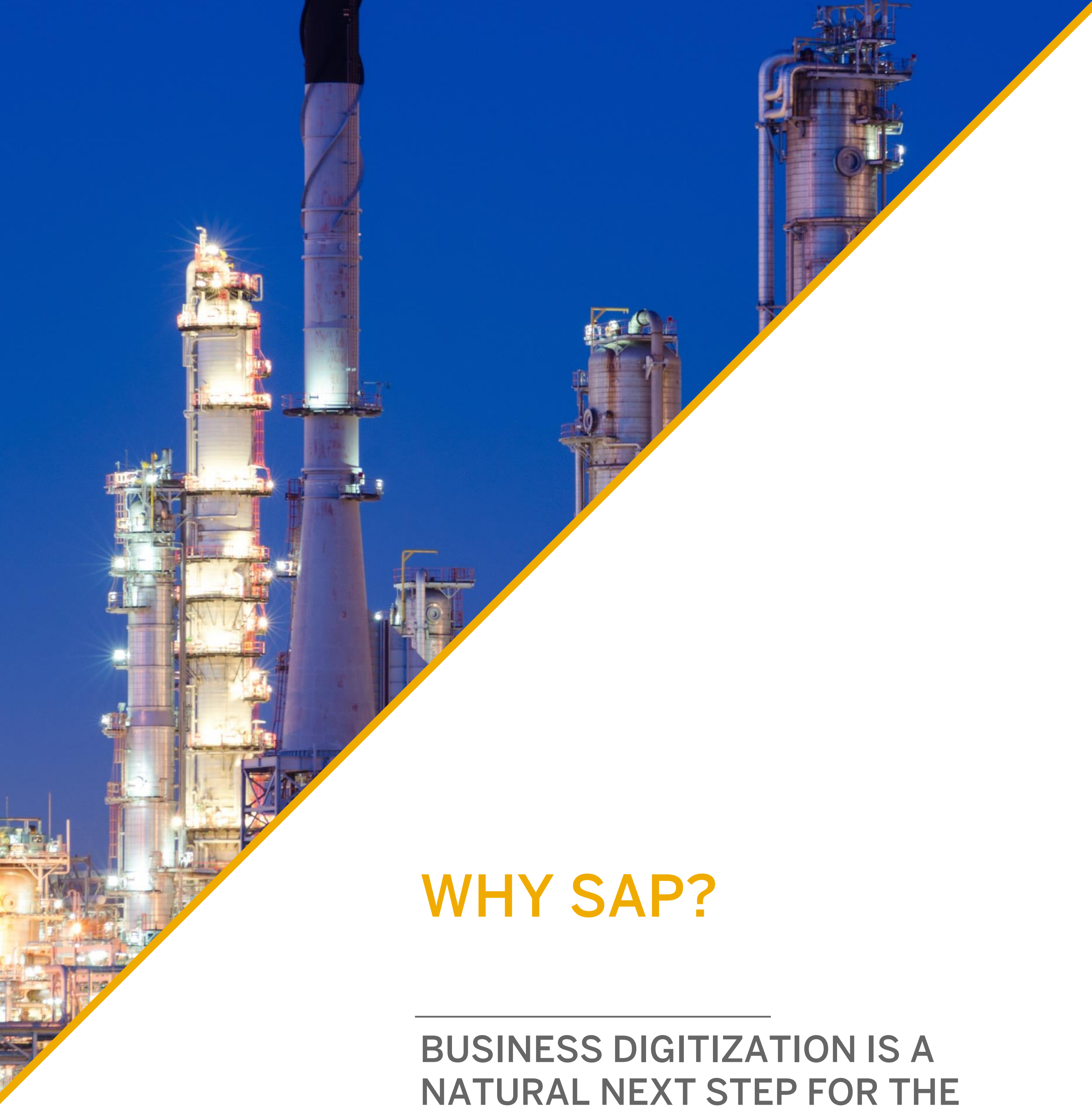
THE COLLABORATIVE VALUE AND INNOVATION FRAMEWORK

Chemical companies embarking on the transformation journey to the digital business typically start to reimagine their business with a focus on business outcomes and customers.

Answering the key questions, “What role will we play in the extended value chain?” and, “How will we make money?” will provide direction for reimagining your business processes and operational model.

For innovation today, a new level of collaboration is required. As a result, we have developed a framework that will be a continuous and holistic partnership model designed to drive true collaboration and engagement. Outlined below are the five steps of SAP’s collaborative value and innovation framework:

1. Strategy alignment: Understand company and SAP strategic direction and identify initiatives
2. Opportunity assessment: Opportunity deep-dive based on strategic initiatives and prioritization based on value
3. Solution road map and ROI: Document end-state solution and business case including benefits, TCO, ROI, and strategic road map
4. Value realization: Deliver transformation on time, on budget, and on value
5. Governance: Maximize investments and accelerate value creation with governance based on executive engagement, value delivery, and continuous innovation



WHY SAP?

BUSINESS DIGITIZATION IS A NATURAL NEXT STEP FOR THE #1 BUSINESS APPLICATION COMPANY

It took years of innovation, strategic investment, and the forging of new strategic relationships to build the end-to-end digital business platform.

SAP IS COMMITTED TO INNOVATION

Vision Help the world run better and improve people's lives

Mission Help our customers run at their best

Strategy Become the cloud company powered by SAP HANA

GLOBAL PRESENCE AND RELEVANCE

- **75K employees** representing 120 nationalities
- **295K customers**
- SAP operates in **190 countries**

INDUSTRY AND LOB FOCUS

- Solutions for **25 industries and 12 LoBs**
- **98% of top valued brands** are our customers
- **74% of the world's transactions** managed on SAP

DIGITAL ECONOMY-READY

- **80 million** business cloud users
- **1.9 million connected** businesses
- **$800 billion+** in B2B commerce
- **99%+ of mobile devices** connected with SAP messaging

INNOVATION LEADER

- 2011 **SAP HANA** launched
- 2012 **SAP Cloud** launched
- 2014 **SAP business networks** are the largest marketplace in the world
- 2015 **SAP HANA Cloud Platform**
- 2015 **SAP S/4HANA:** Most modern ERP system

DIGITAL CHEMICALS ENABLED BY SAP

- **97 of the top 100** global chemicals companies run SAP
- **Over 6,000 chemicals companies total** are SAP customers
- **100 pre-built scenarios** in the SAP Best Practices for Chemicals

ENABLING REAL-TIME BUSINESS

- Speed up performance of SAP CRM and empower users with real-time insights
- Analyze performance of core business processes to save time, reduce costs, and keep solutions running optimally
- 49% complaint processing performance improvement[29]

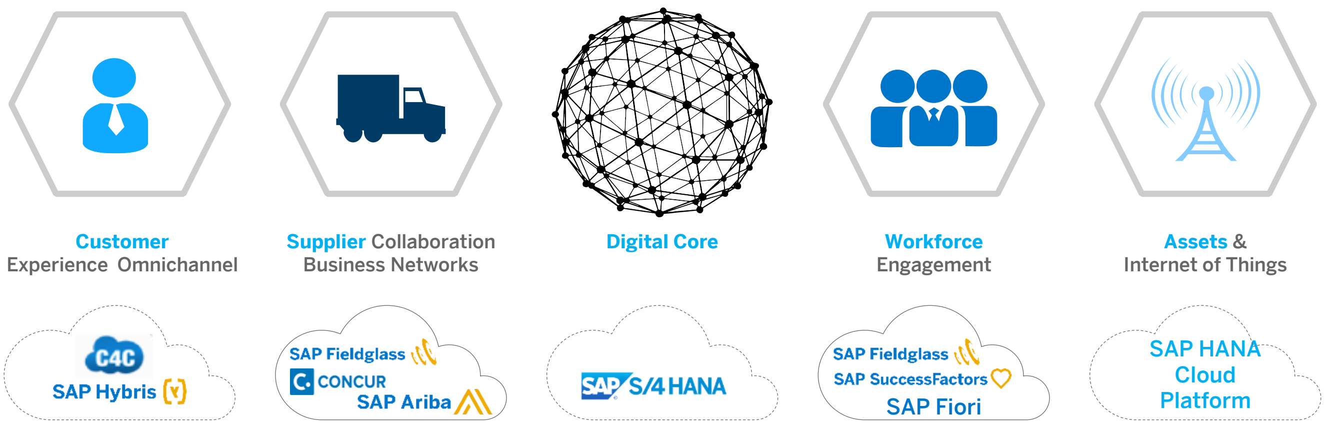
INCREASING BUSINESS TRANSPARENCY

- Harmonized business processes and key performance indicators group-wide
- 6x faster data loading
- 4x data volume compression

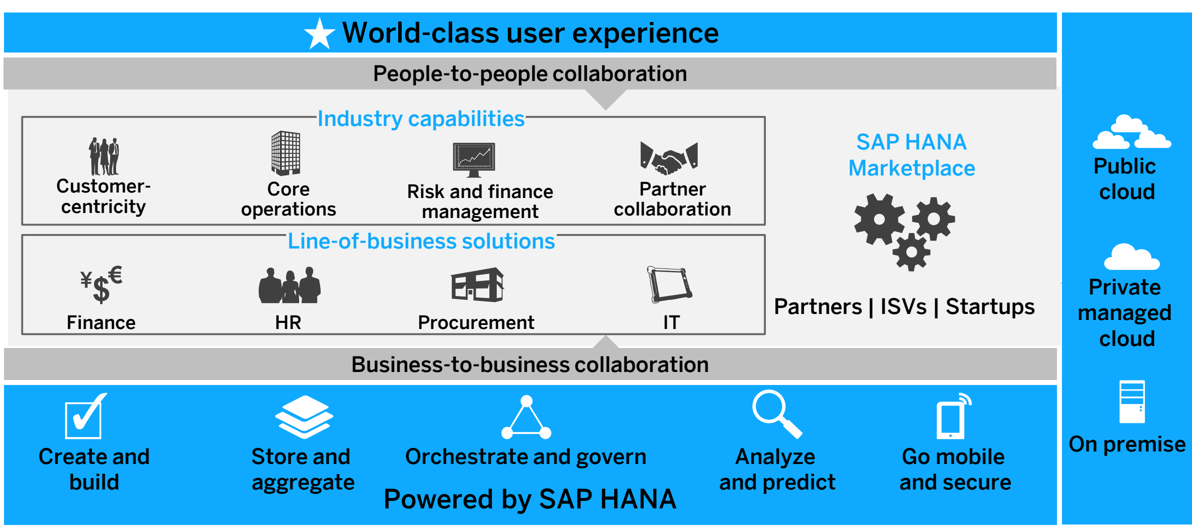
ACCELERATING REAL-TIME DECISION MAKING

- Integrate systems, information, and business strategies for enhanced enterprise business process management and control
- Improve financial management, report analysis, and decision making
- Achieve faster reporting and data compression

CREATE COMPETITIVE ADVANTAGE THROUGH INNOVATION



SAP will bring simplification, innovation, and acceleration required to support the development of your digital business strategy. These capabilities will be leveraged throughout SAP's collaborative value and innovation framework.



Simplify transaction processing, account management, and customer service while enhancing chemicals operations.

- Deliver superior customer service and connect to customers via a single view enabled by the SAP HANA platform
- Give customers a smooth experience across all channels such as direct sales, internet, distributors, and telephone
- Provide agility with SAP HANA Enterprise Cloud. Get fast access to the latest SAP innovations, allowing for faster response to business needs

Use SAP HANA Cloud Platform to enable chemical companies, suppliers, and customers to connect and collaborate.

- Connect mobile users to enterprise data on customers, accounts, and services, giving access to the information they need to better engage customers
- Process and optimize data on customers and assets across all operating units and legal entities with SAP HANA in the cloud
- Adopt and apply analytics solutions through the cloud to enhance visibility into supply and demand

Predict and respond to opportunities and risks with predictive analytics solutions powered by SAP HANA.

- Address unplanned asset downtime more quickly
- Take new products and services to market more quickly and respond to customers on the platforms they prefer
- Balance demand and supply with predictive modeling and accurate and timely analytics using SAP HANA; also detect fraud more quickly
- Accelerate initial deployment of your SAP HANA and SAP S/4HANA projects with SAP HANA Enterprise Cloud

SAP GLOBAL SERVICES AND SUPPORT TO DRIVE YOUR SUCCESS

In the digital economy, speed, simplification, and business innovation matter more than ever. SAP has a broad range of services focused on the chemical industry to cover the end-to-end digital transformation journey. These services take into account the latest technology and industry trends, such as the Internet of Things and Big Data, global orchestration, process mastery, and delivering customer outcomes. SAP experts can provide services ranging from advising on a digital innovation road map to implementing with proven best practices, providing the ability to run across all deployment models and optimizing for continuous innovation across your digital journey.

As innovation is key to maintain a competitive advantage, the SAP chemicals practice helps you identify and bring innovations to life quickly. Customers, teaming up with SAP chemicals innovation experts, start with innovation discovery workshops, followed by a joint evaluation and prioritization session. Next, the prioritized cases are realized in a prototype. Following an iterative approach, the prototype is then transferred into a real-life scenario, ready to be rolled out across your organization.

To simplify deployment and minimize time to benefit, SAP offers a number of accelerators (rapid-deployment solutions, SAP Best Practices for Chemicals, and the chemicals model company), supporting quick deployment and an agile implementation approach, resulting in time and effort savings. Tailored to chemical industry segments (e.g., specialty chemicals, plastics and bulk chemicals, agrochemicals, and industrial gases) and key industry processes (e.g., R&D, manufacturing, plant maintenance), these solutions can be deployed in a matter of days.

Furthermore, the chemical model company accelerates delivery of your digital strategy: a state-of-the-art chemical reference landscape combining the latest SAP applications with related SAP Best Practices for Chemicals made available over the cloud. Rounding out a simplified consumption experience, SAP Activate was recently introduced for SAP S/4HANA and cloud adoption. It provides a combination of SAP Best Practices, methodology, and guided configuration. We provide learning and drive value realization and a solid engagement with SAP MaxAttention, SAP ActiveEmbedded and SAP Value Partnership across the customer lifecycle.

With over 1,000 chemical industry consultants and support professionals, Global Service & Support (GSS) provides the industry expertise, assets, and the proven methodologies required to define and deliver your digital strategy, accelerate business innovation and time to benefit, reduce TCO, and run a stable platform (on premise, in the cloud, or hybrid). By teaming up with GSS, you benefit from the lessons learned from chemical implementations and operations across the globe, and from the latest insight into industry and technology trends.

SAP HANA Enterprise Cloud is the optimal springboard to the cloud. It offers an attractive option for organizations that are eager to leverage SAP's latest innovations, such as SAP S/4HANA, with the peace of mind that SAP is in the driver's seat.

ADVISE

Simplify and innovate
- Digital innovation road map and plan
- Best-run chemical company
- Co-innovation by industry

IMPLEMENT
with proven best practices

Implement with SAP Activate
- Simplified consumption experience for SAP S/4HANA
- SAP Best Practices for Chemicals and guided configuration

RUN
all deployment models

Run with one global support
- One global, consistent experience
- End-to-end support - on premise, cloud, hybrid

OPTIMIZE
for continuous innovation

Optimize to realize value
- Continuously capture and realize benefits of chemical digital transformation

Learn | Extend / Innovate | Engagement Foundation | Support

SAP COMPREHENSIVE ECOSYSTEM

Orchestrating the world to deliver faster value

Our comprehensive ecosystem for chemicals offers:

- A wide range of business services (OEM suppliers, banks, key vendors)
- Special technology services with focus on IT/OT convergence, geospatial integration, asset health management, etc.
- Open architecture: choice of hardware and software
- Complementary and innovative third-party solutions
- Reach – partners to serve businesses of any size, anywhere in the world
- Forum for influence and knowledge
- A large pool of industry experts with broad and deep skill sets

Our partner ecosystem includes, among others:

BUSINESS NETWORK

- 1.9 million suppliers
- 200 major travel partners (air, hotel, car)
- 50K service and contingent labor providers

INFLUENCE FORUMS & EDUCATION

- 32 user groups across all regions
- 40+ industry councils
- SAP community >24 million unique visitors per year
- 1,800 SAP University Alliances

IMPLEMENTATION SERVICES

- 110+ partner companies
- 3,200 service partners
- Delivering chemical-specific solutions

PLATFORM & INFRASTRUCTURE

- 1,400 Cloud partners overall
- 1,500+ platform partners

INNOVATION

- 1,900+ OEM solution partners to extend SAP solutions
- 2,000 startups developing SAP HANA apps

CHANNEL & SME

- 400 channel partners
- 4,800 overall channel partners

ADDITIONAL RESOURCES

Outlined below is additional external research that was used as supporting material for this white paper

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Note: All sources sited as "SAP" or "SAP benchmarking" are based on our research with customers through our benchmarking program and/or other direct interactions with customers

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Run Simple