THOMAS DI GIACOMO

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DIGITAL TRANSFORMATION WITH SAP®

AN EXECUTIVE GUIDE

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by Thomas Di Giacomo

DIGITAL TRANSFORMATION WITH SAP®

AN EXECUTIVE GUIDE

From the publisher of *SAPinsider*

Digital Transformation with SAP®
An Executive Guide

by Thomas Di Giacomo

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As Chief Technology Officer, Dr. Thomas Di Giacomo drives the rapid innovation and growth of SUSE's expanding portfolio from the enterprise Linux operating system to software-defined solutions such as the OpenStack cloud infrastructure, Ceph-based storage, and software-defined networking solutions. He engages customers, partners, and open source communities to share and define SUSE's technological vision.

Di Giacomo has more than 15 years of experience in the IT industry, serving in various global leadership roles in engineering and product innovation, with expertise in open source platforms, development, and support of global information systems and technologies applied to various industries such as telecommunication, hospitality, and healthcare.

Di Giacomo holds a PhD in Computer Science from the University of Geneva where he was a senior software developer & researcher involved in both academic work and joint corporate projects with international leading enterprises.

Executive Summary

The term "digital transformation" has captured the imagination of technologists and business people alike. The question is why? As we'll explore in this book, it has everything to do with an increasingly digital economy. Today, businesses are at a new juncture. The ease with which new technologies can be combined has increased dramatically. This makes it easier to spin out new business models that use these technologies. Untested upstarts can now enter *your* market with new business ideas and take away *your* customers. This is happening right now, which explains the interest in digital transformation. The trendline doesn't lie.

Businesses, in other words, are interested in digital transformation because they understand the need for it. In this book, we'll look at the technology and business landscape in a digital economy—and chart out some of the main areas of focus. What are the technologies at play? What are companies doing with them? How serious is the threat? We look at the disrupters and the disrupted. We also look at the transformers, which are what your company should strive to be. And to help you get there, we also walk through how to think about digital transformation, because it's easy to get lost.

That's just Part 1 of the book. Parts 2 and 3 will take a deep dive into the respective roles of SAP and SUSE in the world of digital transformation.

If you're an SAP customer, you know by now that SAP is a leading thinker and doer when it comes to digital transformation. We'll explore SAP's completely re-coded portfolio through the lens of the SAP Digital Business Framework. This framework uses SAP S/4HANA to power a digital core that is helping many companies meet the challenges of the digital economy.

As for SUSE, we've been working for years with customers worldwide to enable highly agile technology infrastructures with open source technology rooted in our Linux distribution—SUSE Linux Enterprise Server. With SAP discontinuing support for Windows and UNIX, many customers are interested in exploring the SUSE world. This book will help.

SUSE and SAP have been partners for years. SAP built the first SAP HANA on SUSE, and the partnership is even closer today. To help you thrive in a digital economy, we work together as companies and with our customers to deliver a true digital transformation platform. This platform has the flexibility of open source at its core. It also has the strength of in-memory data processing to power new business models with greater insight and the ability to respond faster.

The opportunities in the digital economy are tremendous, and so are the risks. Dive into this book to learn about both, and find out what your company can do to respond.

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PART I

Digital Transformation in a Digital Economy

For all its hype—and for all the marketing agendas on which it depends—the digital economy is a very real phenomenon. While it may have started the day the first person connected to the Internet, today we've reached a critical mass where digital modes of interaction dominate enough spheres of activity—promising only to grow—that businesses choosing to ignore the digital economy do so at their own peril. Consider the following key developments in the world of digital transformation.

The Internet of Things (IoT)

Manufacturers that want to stay relevant are embedding sensors in their products—from smartphones and pacemakers to thermostats and running shoes—that communicate with one another and to the cloud. In healthcare, sensors in equipment can drive down medical costs by reducing visits to the doctor. And, in the car insurance industry, onboard sensors can send real-time driving data to insurers who then bill customers according to usage-based insurance models that attract the safest drivers. In industry after industry, the IoT is helping companies get closer to their customers by generating data that yields actionable insight that can be used to change lives, improve outcomes, and drive loyalty. According to Gartner, in fact, "By 2022, IoT will save consumers and businesses $1 trillion a year in maintenance, services and consumables."[1]

3D Printing

Also known as additive manufacturing, 3D printing has been used for years in industries like aerospace and automotive companies to generate prototypes. But today, with advances in printer technology and the

computer-aided design (CAD) software used for design blueprints, the cost of 3D printing has dropped dramatically. Now—with price tags south of $1,000—almost any motivated organization or individual can afford a 3D printer. With the right blueprints and source materials (e.g., thermoplastics, metals, ceramics, and even food items), local low-cost manufacturers can produce items on-demand as needed. This has the potential to disrupt manufacturing businesses everywhere—as well as the supply chains that have built up around them.

Autonomous Vehicles

While fully autonomous vehicles are out on the roads in only a limited capacity today, already the underlying technology for driverless cars is being used to test the environment and make navigation decisions to ensure safety. On the other hand, the fully autonomous vehicle is a current reality in the farming industry, where conditions on an open field are more predictable—and the driver's primary choice is what movie to watch while plowing the field. Moving forward, as acceptance grows on the open road, autonomous vehicles promise to reduce congestion, optimize routes, and dramatically reduce highway deaths.

The New Media Landscape

Big cable and traditional networks are under pressure today as companies such as Netflix, Amazon, Hulu, PlayStation Vue, and Sling TV use digital-economy technology to forge better consumer experiences and greater loyalty at a reduced price. New media players support customers who want to consume their media anytime, anywhere, on any device. They can also understand their customers at the point and time of content consumption, track this consumption, and use algorithms to predict what customers will like in the future—with a high level of confidence. Similarly, music-streaming services such as Pandora and Spotify are disrupting an industry which only yesterday it seems were churning out CDs and delivering them through physical retail outlets.

Robotics

By now, the role of robotics in automating manufacturing is a familiar story. What is less known is its role in business-process automation—especially

for rote work such as call-center duties and IT support. Robotic process automation (RPA) is defined as "the application of technology that allows employees in a company to configure computer software or a 'robot' to capture and interpret existing applications for processing a transaction, manipulating data, triggering responses and communicating with other digital systems."[2] Alternatively known as artificial intelligence, machine learning, or just "bots," RPA can be used to integrate or fill gaps in business processes with less coding than would be otherwise needed. It can also eliminate human error, thus helping to deliver better customer experiences.

Augmented Reality

Virtual reality and augmented reality are different. Virtual reality creates a completely computer-generated environment. Augmented reality incorporates virtual elements into the real world. Virtual reality is mostly for entertainment purposes—or training scenarios such as flight simulation. Augmented reality has broad business applicability today. Field technicians can use it for hands-free visual learning while making repairs. Offices can use it to create more lifelike remote teleconferences. And for online shopping, augmented reality can help customers evaluate products better by allowing them to see how a new piece of furniture, for example, fits in with their home décor. "By 2020," Gartner says, "100 million consumers will shop in augmented reality."[3]

Blockchain

Blockchain is the technology behind Bitcoin and other cryptocurrencies—of which there are many. These alternative currencies are increasingly accepted as a payment method in the digital economy. And, according to Gartner, "By 2022, a blockchain-based business will be worth $10 billion."[4] How will businesses react when the general ledger is replaced by the distributed ledger?

Work

In the digital economy, the nature of work itself is changing. With increased automation from robotics and artificial intelligence, jobs are becoming scarcer. This is true not only for factory jobs and other manual labor but for jobs in the legal, medical, and other professional fields. At

the same time, digital-economy technology is helping to drive the rise of independent workers. McKinsey Global Institute finds that "20 to 30 percent of the working age population in the United States and the European Union is engaged in independent work...The proportion of independent work that is conducted on digital platforms, while only about 15 percent of independent work overall, is growing rapidly, driven by the scale, efficiency, and ease of use for workers and customers that these platforms enable. Such platforms include Uber, Etsy, Didi, and others."[5] All of these new technologies, and their benefits, are outlined in **Table 1**.

IoT	Sensors connecting everything to everything
3D printing	The democratization of manufacturing
Autonomous vehicles	Less traffic, fewer accidents, and dramatically lower death rates
The new media landscape	Personalized media consumption anytime, anywhere, on any device
Robotics	Artificial intelligence reaching into every business sector
Augmented reality	From hands-free repairs to lifelike online shopping experiences
Blockchain	A new way to manage payments—without banks.
Work	A changing landscape with more independents and expectations for greater freedom

Table 1 New technologies of the digital economy

Consumer-Driven Change

While technology plays a key role in enabling the rise of the digital economy, much of the change we see today is consumer driven. The consumer demand for more of the digital economy should come as no surprise. Consumers have always craved convenience—and this is part of what the digital economy delivers. It also delivers power—mostly through choice and information. Consumers, in other words, know that they can get what they want almost anywhere—and that they can compare offerings based on quality and price with relatively little effort.

This is dramatically different from the old days when sellers (retailers and manufacturers) had a captive audience that obediently flowed through the proper channels. If you wanted something back then, you

visited a physical store within driving distance. You had perhaps two or three options, and as a result, much more control resided on the supply side of the equation.

Today, the equation has been reversed. Today, companies compete for market share on the home turf of the always-on, hyperconnected consumer. That home turf is the digital economy where price and quality are merely table stakes. More than ever, what separates companies from the competition is the ability to deliver positive experiences.

The Disrupters

Admittedly, much of the discussion about the digital economy revolves around a few common stories of companies that have come out of nowhere to seize market share. Two of the stories we hear about again and again are Airbnb and Uber.

Today, Airbnb is a huge player in the hotel industry, giving major hotel chains a run for their money. Actually, it's more precise to say that Airbnb facilitates room rentals rather renting them out itself—because, as is well known, the company owns no hotels. If growth is an indicator of consumer acceptance and embrace—then it's easy to say that consumers love the Airbnb model. According to the World Economic Forum, which collaborated in a 2016 study with Accenture, it took Airbnb just 2.8 years to reach a valuation of $1 billion. The typical Fortune 500 company, in comparison, has taken more than 20 years.[6]

Uber has done something similar—upending the taxi industry. As Airbnb owns no hotels, Uber owns no vehicles. Instead it facilitates rides through a smartphone app that consumers love and use often.

Today, Airbnb enjoys a valuation of $31 billion[7] while Uber— despite recent missteps—has a reported valuation in the area of $70 billion.[8] Each is often cited as an example of the sharing economy—a subset of the digital economy. The sharing economy is a term that is often used to describe "economic and social activity involving online transactions" on peer-to-peer networks that grow out of open-source communities seeking to enable access to goods and services.[9] Here at SUSE—the first organization to deliver an enterprise-grade Linux distribution—we know open source intimately. And while the "sharing economy" is rooted in community, as a business model it has tremendous abilities to build strong companies that capture market share.

In the sharing economy, the name of the game is matching demand with supply. Airbnb matches travelers with rooms for rent. Uber matches riders with rides. Why do consumers love this model? Because it gives them freedom, choice, and power. It turns out the old channels left a lot to be desired. These new companies have figured out a new forward, and now industries are being disrupted.

The Importance of Platforms

One topic receiving quite a bit of attention in the digital economy is the importance of platforms. A paper produced by the World Economic Forum and Accenture talks about "the platform (r)evolution":

> "Rapid advances in cloud and mobile connectivity are dismantling the technological barriers and reducing the costs associated with establishing global platforms. These platforms offer huge potential for innovation and the delivery of next-generation services. In fact, as research by the MIT Sloan School of Management shows, 14 out of the top 30 brands by market capitalization in 2013 were platform-oriented companies."[10]

Both Airbnb and Uber are platform-oriented companies—and much of the advantage they enjoy over the competition involves the power of their platforms. Here, the history of how Airbnb emerged is instructive. Famously, the company originally started as AirBed and Breakfast, linking apartment owners with mostly young people who needed a cheap place to stay while attending a conference (like the 2008 Democratic National Convention in Denver). Early on, apparently, the company required users on the supply side—hosts, in other words—to provide air mattresses. This model quickly evolved to beds, rooms, and full apartments and houses. While the original focus was on conference attendees (it would be creepy if someone wanting to crash on your floor was in town for no specific reason, right?) the community soon made its wishes known: People just wanted to travel the Airbnb way wherever they went. Today, Airbnb offers anything from vacation rentals to shared working spaces. You can rent a castle in Europe—or even a private island. Once focused on air mattresses, today Airbnb has "blossomed into an open marketplace of space."[11]

Broadening its scope to support the demands of the market proved relatively unproblematic because of Airbnb's platform approach. According to analyst and author Sangeet Paul Choudary, platforms work because "they create new sources of supply that had never existed before. No one would have imagined an inventory of travel accommodations composed of the houses of people living in the cities." What's more, the new sources of supply, at first, "tend to be inferior and less sophisticated compared to the existing ones." But over time, "the supply on these platforms evolves to compete directly with mainstream competitors: As the platform finds greater adoption among consumers, it attracts mainstream producers as well."[12]

Airbnb and Uber are only two examples of this platform phenomenon. Think YouTube, Wikipedia, Amazon, Quora, and Kickstarter—to name just a few. What the platform approach provides is a new way to tap otherwise unseen markets and grow communities of customers and suppliers that help drive business growth.

The Disrupted

For traditional companies, stories about how digitally-native companies are disrupting industries and taking over the world can be somewhat dispiriting. As much as Airbnb and Uber represent the disrupters in such stories, companies like Eastman Kodak and Blockbuster represent the disrupted.

Eastman Kodak

In 2012, Eastman Kodak rather famously filed for bankruptcy, only to resurface later as a shell of the company it once was. Common explanations that Kodak was "disrupted" shed only so much light on the topic. The question is, what really happened? For such a well-known business case, it turns out that there's quite a bit of confusion on this matter. Scott Anthony, writing in *Harvard Business Review*,[13] runs through some of the more common explanations.

- **Myopia.** Did Eastman Kodak fail to see the rise of digital technology because it was so focused on its own way of doing things? Not really. Consider the fact that in 1975, Kodak engineer Steve Sasson produced the first digital camera prototype. It was big, clunky, and

complicated—but as Anthony writes, "it clearly had massive disruptive potential."

- **Lack of investment.** While Kodak may have been on top of the new technology, did it fail to invest in it seriously? Did the company fail to realize the importance of what it had? No. To the contrary, the company invested billions in digital imaging.
- **Mismanagement.** Did the company focus on camera performance, failing to embrace what appealed most to the market: simplicity? Maybe early on, but "Kodak ultimately embraced simplicity, carving out a strong market position with technologies that made it easy to move pictures from cameras to computers."
- **Smartphones and social media.** Did Kodak miss it when cameras moved to mobile phones and people started posting images to social media? Again, not really. As Anthony notes, in 2001 Kodak bought the photo-sharing site Ofoto. The company saw this development as well.

Ultimately, however, it was Kodak's approach to Ofoto—trying to get customers to print digital images—that put the nail in coffin. "Kodak created a digital camera, invested in the technology, and even understood that photos would be shared online," Anthony says. "Where they failed was in realizing that online photo sharing *was* the new business, not just a way to expand the printing business."

In the digital economy, in other word, things can change quickly. The business you were in yesterday may not be the business you need to be in today. Fortunately, your customers will lead the way. The best bet is to always pay close attention to what they want, and then find new ways of delivering it.

Blockbuster

Like Kodak, Blockbuster has a reputation for having missed some changes as well. In 2000, in fact, Blockbuster reportedly passed up the opportunity to buy Netflix for just $50 million. The proposal was a partnership of sorts in which Netflix would manage Blockbuster online while Blockbuster would promote Netflix in its stores. Netflix, reportedly, "just about" got laughed out of the room.[14]

Today Netflix is worth close to $33 billion, according to some sources, and Blockbuster is out of business. What Blockbuster failed to see, it is often said, is that it wasn't in the retail business but the distribution business. A Deloitte report[15] shows that Blockbuster was disrupted by three trends:

- **E-commerce.** Netflix grew up online and followed the classic disruption model of catering to underserved customers with what at first seemed like inferior products. While Blockbuster rented sought-after new releases in stores, Netflix put up a website that allowed movie buffs to rent older movie online and receive a DVD by mail. Crucially, Netflix had no late fees—something that Blockbuster customers disliked quite a bit. Eventually, Blockbuster replicated the Netflix model somewhat—blending it with its store model by allowing customers to return DVDs in the store even if they ordered them online and received them by mail. Not a bad model for the time—but by then, it was too late.
- **Grocery-store kiosks**: Blockbuster also faced a challenge from Redbox which distributed DVDs via vending-like machines in grocery stores, requiring fewer employees, much less overhead, no brick-and-mortar stores, and greater convenience. Today Redbox is still going strong.
- **Streaming video.** By the time broadband service became widely available, Netflix was in a much better position to move quickly and claim market share because of the online subscribers it had cultivated for years. This closed the loop on the classic disruption model mentioned above: Serve customers early on that the big guys won't defend, then move up the value chain. This, by the way, is what Airbnb did as well.

The Transformers

While the digital economy has certainly put the pressure on traditional companies, all is not lost—not by a long shot. The truth is that traditional companies have tremendous potential in the digital economy. This is particularly true for large established players:

> "[Traditional companies] have significant resources such as hard assets, brands, global distribution, customer relationships, data and decades of institutional know-how to harness for their digital transformation. In a sense, they are too big to fail . . . Digital disruption is not (yet) bankrupting Forbes Global 2000 companies.[16]

But even for those companies who do not make the list of top companies by valuation, the digital economy hardly means the end of the road. For many, in fact, it has meant a new beginning. Take, for example, Encyclopedia Britannica.

Encyclopedia Britannica

It would be difficult to think of a more traditional company than Encyclopedia Britannica. The company, after all, first started publishing its iconic, multi-volume encyclopedia sets before the United States even existed as a country. But in 2012, Britannica announced—to much fanfare and consternation—that it would cease publishing the print version of the encyclopedia. According to company president Jorge Cauz, writing in *Harvard Business Review*, this announcement "sent ripples through the media world . . . But in our Chicago offices this wasn't an occasion to mourn. In fact, our employees held a party the day of the announcement, celebrating the fact that Britannica was still a growing and viable company."[17]

How did such an old-school and venerable company make the transition to viability in the digital economy? As Cauz explains:

> "We had known for some time that this day was coming. Given how little revenue the print set generated, and given that we had long ago shifted to a digital-first editorial process, the bound volumes had become a distraction and a chore to put together. They could no longer hold the vast amount of information our customers demanded or be kept as up-to-date as today's users expect."

Britannica may be unusual in that its disrupter—potential disrupter, that is—was not the Internet. It was the CD-ROM. Back in the 1970s, the company had already loaded its contents onto a mainframe to streamline the process of making editorial changes and updates for the print edition. But even then, the company knew that the final product itself would eventually go digital. Yet even as it prepared for the digital future, print sales grew throughout the 1980s, peaking in 1990. "Our 2,000-plus salespeople," Cauz writes, "sold more than 100,000 units of the iconic bound set in the United States. Then the business collapsed."

The market was changing, people were busier, and the traditional door-to-door sales models was floundering. What's more, home computers were starting to ship with CD-ROM drives—and it was clear to Encyclopedia Britannica that it needed to move its print version to CD—which it did in 1994. Through a series of bold decisions and moves, Britannica bounced back. The company succeeded by taking the following actions:

Changing the Sales Model

The venerated door-to-door approach became obsolete. The company adopted other, newer methods of direct sales. It also tested different price points for its CD-ROM version. These ranged from less than $100 to $1,200.

Moving Online

Part of changing sales models involved tapping nascent online opportunities. It may seem obvious now, but in 1996, the early days of the Internet, moving online was not the obvious choice. Today, the equivalent might be moving to the IoT or 3D printing. As part of its online strategy, it sought revenues from subscriptions and advertising. It also worked with AOL to tap into new channels.

Persevering

As Cauz puts it: "One or two more years fighting in this market would have further debilitated Encyclopedia Britannica ... But Internet access exploded, as we had expected (and hoped), and the biggest threat to our company, the CD-ROM, was itself disrupted by online access, just when we needed it to be. Britannica was able to reestablish a strong direct relationship with consumers, and our digital subscription business took off."

Experimenting

On the road to success, Britannica tried several new ventures—not all of which succeeded. One was "a free, ad-supported consumer encyclopedia," says Cauz. The other, was a learning portal for primary education. Both failed. But valuable lessons were learned—namely, says Cauz, that "the Internet was a far more favorable place to do business than CD-ROM had been."

Listening to Customers

Another thing Britannica learned from its experimentation was that its customers were telling the company what they wanted—particularly in the K–12 space. According to Cauz, customers wanted "affordable lessons and learning materials, linked to the curriculum, that could be used in classrooms and at home. These educators wanted products that included assessment tools and that supported individualized or 'differentiated' learning for various grade and reading levels." Britannica had the brand customers trusted—all that was left was finding a way to deliver the product.

Focusing on Value

A big part of the Britannica brand is expertise. It has always delivered the highest quality knowledge produced by the most well-respected scholars in their fields. In addition, it has always worked with top-notch editors. So, despite some tough years of "whisper-thin margins," as it struggled against Microsoft Encarta, "there was one thing we didn't do: reduce our editorial investment," Cauz writes. "With our business declining, we could easily have justified eliminating long-tenured editors from a cost perspective. But editorial quality has always been intrinsic to our value proposition, and we knew that it would continue to differentiate us in a growing sea of questionable information."

Differentiating

The "growing sea of questionable information" that Cauz refers to may be a refence to the Internet itself—where information can be suspect indeed. But likely, it's a reference more specifically to Wikipedia—which

he refers to as the "disruption that wasn't." As Wikipedia took off, Britannica responded by settling into its core strategy:

> "So instead of getting mired in a competition with Wikipedia, we focused on editorial quality with Britannica Online and used Wikipedia's quantity-over-quality approach and its chronic unreliability as differentiators in our favor. We knew that Britannica's long-standing mission to bring expert, fact-based knowledge to the general public met an enduring need for society. This resonated deeply in the education market (it's now standard practice for teachers to instruct students not to rely on Wikipedia as a reference source), and it helped boost sales there. Today more than half of U.S. students and teachers have access to some Britannica content, and globally we're growing even more rapidly."

Many of these themes, as we shall see, are also common to the process of digital transformation.

The Experts Speak

Digital Transformation: Operational Efficiency in List Form

It's highly likely that you employ a team of operational-effectiveness professionals who review, in detail, the person hour/minute/second of effort it takes to perform the thousands of operational activities executed by thousands of business operators on a daily, weekly, monthly, quarterly and annual basis. All that quality data is summarized, graphically presented, and Six-Sigma/lean-processed into saving 1.67 person minutes per task. Combining thousands of tasks, the net results are significant savings and faster time to market. But, is it good enough?

Tightening operational effectiveness, especially under continuous review, is necessary and highly valuable, but it likely doesn't appreciably help with competitiveness in the marketplace. A marketplace increasingly impacted by digital disrupters.

These disruptors don't play the same operational game. They grew up digital and they operate and survive exclusively in the cloud.

Most businesses today are built on well-defined and institutionalized processes and policies. They have large—often dispersed—teams with varying skillsets. And they have a mix of legacy technology and systems that are deeply integrated into their business. To succeed, business and technology leaders must completely re-think traditional approaches as their existing and new customers are deciding what service is best for them. With the rapid pace of change in today's business landscape, business must transform ahead of the competition (those digital disrupters).

The new business strategy of digital transformation focuses on three pillars of change. Rethinking operations and processes is the first step, and involves many of the following.:

- **Start with your business model.** Decompose, document, and detail the elements of your cost structure and revenue model, your partnerships, your key activities, and customer relationships and segments.
- **Draw on your core value proposition.** It may be your heritage, your experience, your diversity, or your culture. How, at your core, are you a differentiating factor for your customers? Keep that factor in place, and allow every other part of your business model to change.
- **Break out of your logistics.** Re-evaluate your current partnerships and go-to-market philosophy, as follows:
  - Instead of designing, manufacturing, and delivering your product to stores, find and evaluate supply-chain partnerships that can deliver faster and cheaper.
  - Outsource or out-task non-essential activities; do what you do best and leave the rest to other professionals.
  - Buy assets that would be more valuable, and divest assets that do not deliver your core value.
  - Invest in sales channels not currently used to reach a customer market not currently served.

- **Create independence between how you make money, and how you spend money.** Don't tie your service offering directly to the costs associated to deliver the service. This tie reduces your freedom to make holistic and dramatic changes to delivery and cost models. Create an overall direction on profitability, and let the operations team determine the best way to spend the cost portion—both Opex and Capex, and short-term expense and long-term investments.
- **Find operational effectiveness throughout the organization, in every department,** for the entire value chain. When competing for fractions of percentages of market share, every dollar counts:
  - In marketing, increasing the lead-to-deal ratios through a thorough understanding of customer behavior and segmentation; this requires a detailed appreciation of data analytics.
  - In risk management, decrease slippage/loss/failures by implementing strong but flexible operational governance; this requires a detailed appreciation of data governance.
  - In supply chain and procurement, increase the value of total partnerships and decrease the cost of those partnerships over time; this requires a detailed appreciation of data mobility.
  - In IT, eliminate the knots in software, infrastructure, and data by creating environments focused on a high-level replaceability and line of business-cost effectiveness; this requires a detailed appreciation of data management.
  - Implement complex business agility by differentiating between what to buy, where to put it, who manages it, and how to pay for it; this requires a detailed appreciation of IT agility.

As enterprises look for ways to enable greater operational efficiencies, they usually turn to technology—most start at the application and infrastructure layers. The combination of cloud computing, digital business, analytics, and mobility is creating new technology requirements and enabling operational efficiencies.

Enterprises across industries need to improve processes and automation, especially within their supply chain. Of course, one of the first places they look is at their SAP applications. Moving from legacy SAP apps to SAP HANA or SAP's latest S/4HANA can help reduce complexity, total cost of ownership (TCO), and perhaps even more importantly, enable the business to transform processes and gain greater efficiencies. SAP HANA's core capabilities of making data and insight available in real time work great for things like:

- Collecting data from IoT devices to optimize operations.
- Analyzing supply-chain and inventory data to identify gaps and provide a seamless customer experience.
- Using predictive analytics to automate business processes and free up resources for more strategic and value activities.

It's also important to note that whether considering a cloud or on-premise solution, companies who want to leverage SAP S/4HANA as part of their digital core must transition to a Linux distribution. Moving away from proprietary UNIX technology to a more open Linux platform can help with your relationship with your CFO because savings can be significant.

The reality is, most enterprises can't implement these refocused operations and processes by themselves. Trusted partners are also needed. That's why Hitachi partners with SUSE. Both Hitachi and SUSE maintain strong relationships with SAP to not only ensure the performance and reliability of your SAP solutions, but, more importantly, to provide the foundation and building blocks you need to implement your process and operational efficiencies.

By Paul Lewis

A Deeper Dive: The Categories of Digital Transformation

Clearly, the challenges today are different for companies born before the digital economy than for those who have grown up during its rise—or *because* of its rise. For digital-native companies, the digital economy is the air they breathe. For the rest, there's digital transformation.

Intelligence

Being a smarter organization has much to do with driving insight from data—something most companies have little problem accumulating today. The problem, in fact, is more likely to be one of data overload. How much data are you dealing with? Experts "predict a 4,300 percent increase in annual data production by 2020."[18] Or to get a just bit more granular, consider the following from Domo, a business-intelligence and data-visualization firm. Every minute, Domo says: [19]

- **Facebook** users like 4,166,667 posts
- **Twitter** users send 347,222 tweets
- **YouTube** users upload 300 hours of new video
- **Instagram** users like 1,736,111 photos
- **Pinterest** users pin 9,722 images
- **Apple** users download 51,000 apps
- **Netflix** subscribers stream 77,160 hours of video
- **Reddit** users cast 18,327 votes
- **Amazon** receives 4,310 unique visitors
- **Tinder** users swipe 590,278 times
- **Snapchat** users share 284,722 snaps
- **BuzzFeed** users view 34,150 videos
- **Skype** users make 110,040 calls
- **Uber** passengers take 694 rides

Driven largely by mobile usage, social media, and video streaming, the global growth in data has now put us in zettabyte territory. In the

Cisco Visual Networking Index,[20] in a forecast for 2016–2021, here's what Cisco says about data from mobile usage alone:

- **Global mobile data traffic grew 63% in 2016.** Global mobile data traffic reached 7.2 exabytes per month at the end of 2016, up from 4.4 exabytes per month at the end of 2015. (One exabyte is equivalent to one billion gigabytes, and one thousand petabytes.)
- **Mobile data traffic has grown 18-fold over the past 5 years.** Mobile networks carried 400 petabytes per month in 2011.
- **Almost half a billion (429 million) mobile devices and connections were added in 2016.** Smartphones accounted for most of that growth, followed by M2M modules. Global mobile devices and connections in 2016 grew to 8.0 billion, up from 7.6 billion in 2015.
- **Mobile video traffic accounted for 60% of total mobile data traffic in 2016.** Mobile video traffic now accounts for more than half of all mobile data traffic.
- **Average smartphone usage grew 38% in 2016.** The average amount of traffic per smartphone in 2016 was 1,614 MB per month, up from 1,169 MB per month in 2015.
- **Smartphones (including phablets) represented only 45% of total mobile devices and connections in 2016, but represented 81% of total mobile traffic.** In 2016, the typical smartphone generated 48 times more mobile data traffic (1,614 MB per month) than the typical basic-feature cell phone (which generated only 33 MB per month of mobile data traffic).

That's a lot of data generation. But look at Cisco's forecasts for what's ahead:

- Monthly global mobile data traffic will be 49 exabytes by 2021, and annual traffic will exceed half a zettabyte.
- Mobile will represent 20 percent of total IP traffic by 2021.
- The average global mobile connection speed will surpass 20 Mbps by 2021.
- The total number of smartphones (including phablets) will be more than 50 percent of global devices and connections by 2021.

- Smartphones will surpass four-fifths of mobile data traffic (86 percent) by 2021.
- 4G connections will have the highest share (53 percent) of total mobile connections by 2021.
- 4G traffic will be more than three-quarters of the total mobile traffic by 2021.
- More traffic was offloaded from cellular networks (on to Wi-Fi) than remained on cellular networks in 2016.
- Over three-fourths (78 percent) of the world's mobile data traffic will be video by 2021.

The Data Challenge

To turn data into intelligence, you need a platform. Not just a data platform; ideally, your company should be the platform itself—as much as possible. Leading companies of the digital economy like Facebook, Netflix, and Amazon are all platform companies where customer interactions and network-based activity take place—generating an enormous amount of data. But, critically, these companies *do* something with the data—and they do it with sophistication. The point is that for these companies—the ones celebrated as leading the way in the digital economy—it would be difficult to separate their *business* platforms from their *data* platforms.

What these companies are after "is intelligence—about what customers or prospects want to buy, where they want to travel, where they want to invest their money, what they like and what they dislike."[21] To get this information from your customers, you need to be intimately engaged with them. It's not a mistake that so much IT spend is now generated by marketing departments. Using tools such as social-media-sentiment analysis and IoT devices to track customer metrics, marketing is often leading the charge in digital transformation.

With the IoT generating so much more data, the question is, where do you put it all? Enterprise-grade cloud-storage options—from companies like Amazon Web Services and Microsoft Azure—are increasingly attractive to companies who seek the flexibility and capacity offered by the public cloud. Many other companies operate in mixed-cloud/on-premise environments and will pursue a range of storage options. One option from

the open-source community is Ceph, "a free-software storage platform [that] implements object storage on a single distributed computer cluster, and provides interfaces for object-, block- and file-level storage." Ceph is designed as a "distributed operation without a single point of failure," and is "scalable to the exabyte level, and freely available. Ceph replicates data and makes it fault-tolerant, using commodity hardware and requiring no specific hardware support. As a result of its design, the system is both self-healing and self-managing, aiming to minimize administration time and other costs."[22]

But regardless of how you store the data—or whether it comes from IoT sensors, from social media interactions executed with mobile devices, or from any other source—at some point the data needs to be managed and processed to yield insight.

Insight from Big Data

How do you transform Big Data into insight? An important place to start is by aggregating data for a single version of the truth. In most organizations, physical consolidation of data—finding it and putting it all in one database on one server—is impractical. Instead, companies logically aggregate their data and reference it all to a single, searchable, and accessible point—whether it's in the cloud or on-premise.

Proper data governance is critical. To pull off a single source of truth, companies need to standardize how data is created and managed. Here, the well-known data-management adage is appropriate: Garbage in, garbage out. To ensure clean, reliable, and accurate data, governance needs to be reinforced enterprise-wide and supported from the top down.

Speed is important, too. Increasingly, it's critical to act on live data. Not only does information need to be processed in real time, it often needs to be analyzed and acted on in real time so that companies can deliver better customer experiences. To achieve the speed needed, many companies are moving to modern database architectures based on in-memory models or on distributed processing such as Hadoop.

In-memory databases—like SAP HANA—run in random access memory (RAM). Thanks to the ever-dropping cost of memory, it's now feasible for organizations to run multi-terabyte workloads or more in RAM. Without the need to pull data from disks and put it back, the in-memory approach can dramatically speed up data-processing tasks.

Hadoop is an open-source technology that uses a distributed computing approach for processing Big Data. It is highly scalable—breaking workloads into small chunks, marshalling compute space from whatever commodity hardware is available, and then distributing the workload across them. This allows for processing speeds that traditional relational databases working on their own simply can't achieve.

Google co-founder Avinash Kaushik, in fact, pushes a 10/90 rule that says that for every $10 a company spends in tools for data management and analytics, it should spend $90 on data experts, scientists, etc. "The rule works quite simply," Kaushik says. "If you are paying your web analytics vendor . . . $25,000 for an annual contract, you need to invest $225,000 in people to extract value from that data."[23]

Experts are important, but so is culture. In a digital economy where acting on data is critical, companies need to foster a culture of data insight—using it to drive business-process improvement and to enhance customer experience. Data literacy should be emphasized from the top down to help workers of all stripes to make better-informed decisions that lead to better business performance.

What specific analytic capabilities need to be cultivated? Think about the categories of descriptive, predictive, and prescriptive analytics. Descriptive analytics is commonly the starting point. Dr. Michael Wu, chief scientist at Lithium Technologies, says that most analytics fall into this category—more than 80 percent, in fact. "The purpose of descriptive analytics is simply to summarize and tell you what happened," Wu writes. "For example, number of post, mentions, fans, followers, page views, kudos, +1s, check-ins, pins, etc."[24]

Next comes predictive analytics—which is commonly understood as "a variety of statistical techniques from predictive modeling, machine learning, and data mining that analyze current and historical facts to make predictions about future or otherwise unknown events."[25] Wu, however, quibbles with this characterization: "The purpose of predictive analytics is NOT to tell you what *will* happen in the future. It cannot do that. In fact, no analytics can do that. Predictive analytics can only forecast what *might* happen in the future, because all predictive analytics are probabilistic in nature."[26]

Finally, comes prescriptive analytics. Wu explains:

> "A prescriptive model can be viewed as a combination of multiple predictive models running in parallel, one for each possible input action. Since a prescriptive model is able to predict the possible consequences based on different choice of action, it can also recommend the best course of action for any pre-specified outcome. The goal of most prescriptive analytics is to guide the decision maker so the decisions he makes will ultimately lead to the target outcome."[27]

When companies talk about "actionable data," this is what they're talking about.

A common way of weaving data into the decision-making process is to use dashboards that put data in front of executives and front-line workers as part of their daily routines. Many dashboards—admittedly of the descriptive nature—can be configured by users to track whatever key performance indicators (KPIs) are important to the jobs they hold. Dashboards can be analytical or operational. Analytical dashboards are typically used by executives and managers to track progress with established business goals, while operational dashboards monitor KPIs, gauge performance, and alert users to critical situations. In either case, users should be able to drill down into the data presented to investigate further and drive insight.

Many dashboards can be extended for mobile use—which is common for salesforce enablement as well as many other scenarios. Dashboards also tend to use powerful data visualization techniques that support quick understanding of sometimes complex data by depicting information in a dynamic format using various colors and presentation techniques. But for organizations to derive real benefit from dashboards and reporting tools in general, the data itself needs to be based on a single a version of the truth. Otherwise, confusion will prevail and different lines of business will work at cross purposes. With a good groundwork laid, however, companies should be able to derive greater value from their data—making faster decisions supported by the facts, highlighting problem areas for continuous improvement efforts, and achieving a unified view of performance that helps everyone in the organization work better together toward a common goal.

Agility

In the digital economy, agility is ability. If you can't change in response to circumstances—whether it's to meet customer needs or to seize new opportunities as they arise—you'll have trouble even staying afloat. According to a study from the John M. Olin School of Business at Washington University, 40 percent of Fortune-500 companies existing today will be gone in the next 10 years.[28] Or as Richard Branson has been quoted: "Every success story is a tale of constant adaption, revision and change. A company that stands still will soon be forgotten."[29] As we've seen from our case study about Encyclopedia Britannica, such claims have some validity.

For IT types, the issue of agility is often at the top of their minds because, as 451 Research says, much of a company's agility "is enabled by the underlying software-defined infrastructure." The issue, again, is one of disruption—or avoiding it. 451 Research returns to the example of Uber, which has disrupted the transportation industry by delivering an exceptionally easy customer experience. A customer simply needs to "install the app, add a credit card and request a driver—all accomplished digitally." The traditional experience, on the other hand, leaves a lot to be desired. "Before Uber," says 451 Research, "travelers often resorted to waving their arms to flag a taxi, or if they called for a taxi, they were usually unfamiliar with local taxi services so were unaware which ones were reliable." What's more, the "payment process in taxies can be frustrating, and there's little way for passengers to ensure they obtain a good driver." As 451 Research concludes: "Digital transformation improves the customer experience, which, in turn, improves customer-retention rates and draws in new customers as well."[30]

Airbnb has a similar story—particularly vis-à-vis payment processes. Early on, when the company was merely a platform that connected supply and demand, the company left payment up to the community members themselves—the host and the guest. Speaking at a PSFK conference in New York in 2011, Airbnb co-founder Joe Gebbia talked about an early experience the company had when it launched a new version of the service for the 2008 South-by-Southwest conference in Austin, TX. Only two

people used the service—and one of them was one of the other co-founders, Brian Chesky. As Gebbia says:

> "We learned two invaluable things that forever changed the company. The first is that it's extremely awkward to exchange money in person. We were having a great experience with our hosts, and suddenly the conversation turned to 'where's my money?'—and we're like, ah gosh, this just feels so wrong. So we started to wonder: What if you could book a room with the simplicity of using your credit card. Just like a hotel, you could book an average person's room?"[31]

The next relaunch of the service then included support for online transactions. In both cases—Uber and Airbnb—the integrated simplicity of payment processing is a big part of the appeal of the service. No haggling, tips included—a seamless experience with no awkward exchanges.

In Airbnb's case, this is just a small example of the agility needed to change quickly in response to what customers need. As a young, digitally native company, this change may not have been all that difficult for Airbnb. For traditional companies, who operate on entirely different scales, it's more difficult. In this regard, 451 Research looks at the case of growing pains at Facebook:

> "Facebook's motto used to be 'Move fast and break things.' But as it grew, it discovered this approach didn't scale, and didn't work out so well for its customers (ad buyers tend to like when their ads are displayed). Instead, two years ago, it announced a new motto with a very different take and one that meshes with our research—'Move fast with stable infrastructure.' This is exactly where the agility in digital transformation can make the difference that enables enterprises to keep up with their own competitive disruption without falling apart in the process."[32]

DevOps

One development aimed at helping IT to increase agility is DevOps. Notoriously hard to define, it isn't something you can buy or something you do. Neither is it a set of specs or a specific job role. Rather, it can

be described best, perhaps, as a grassroots movement of IT professionals seeking ways to make IT work better—a movement that by now has evolved into a culture.

DevOps has roots in the agile-development community—and in fact is commonly referred to as agile on steroids. Agile development—with flavors such as Scrum and Extreme Programming—is an approach to software development that emphasizes quick-, incremental-, and iterative-coding cycles in contrast to waterfall or traditional sequential approaches. The idea is that not all requirements for a software solution can be known up front; that users are better served by seeing and reacting to early functional mockups. From there, developers and users can go back and forth in iterative cycles to move toward the final goal.

DevOps takes this idea of close collaboration and puts it on steroids for two important groups in IT: development and operations. Interestingly, the idea for DevOps can be said to have emerged out of a third group: testing. In 2007, Patrick Debois—widely credited with coining the term DevOps—was consulting as a software tester on a large data-center-migration project for the Belgium government. Annoyed by having to navigate conflict between system administrators and developers, he sought a solution. Thus, long story slightly less long, DevOps—eventually—was born.[33]

Gartner defines DevOps as:

> ". . . [A] change in IT culture, focusing on rapid IT service delivery through the adoption of agile, lean practices in the context of a system-oriented approach. DevOps emphasizes people (and culture), and seeks to improve collaboration between operations and development teams. DevOps implementations utilize technology—especially automation tools that can leverage an increasingly programmable and dynamic infrastructure from a life cycle perspective."[34]

To be sure, other models of IT operational collaboration exist—namely ITIL (formerly the IT Infrastructure Library) and IT service management (ITSM). While it may be tempting to add DevOps to this list, it's more appropriate to say—at least in many cases—that DevOps works *with* these models. Classic ITIL categories—such as Service Transition, Service Operation, and Continual Service Improvement—all play a critical role in DevOps. Take, for example, the issue of configuration management

(CM) within ITIL's Service Transition. "Good CM techniques are something that DevOps advocates," one blogger notes. "Quite simply, if code or configuration can change, version control it." In fact, as the blogger notes, "DevOps has seen the introduction of tools that extend the area of CM beyond developers' code and into server or application configuration, something often titled 'Infrastructure-as-Code.'"[35] Such tools include Vagrant, Ansible, Docker, Chef, and Puppet.

While ITIL can seem to be overly structured and prescriptive with its specific process recommendations, DevOps might appear more amorphous with its emphasis on culture. In the real world, fortunately, most organizations take a practical approach, borrowing liberally from the best practices of all different sort of approaches—Lean, DevOps, ITIL, Agile, Kanban, or whatever. The important thing is to measure success by monitoring processes, adjusting wherever necessary based on what works best.

Software-Defined Infrastructure (SDI)

Another important development on the IT/business agility front is SDI (software-defined infrastructure) or the software-defined data center (SDDC). The rise of SDI can be seen both as a response to and an extension of the idea of virtualization—and virtualization itself can be thought of as an answer to the problem of excess or unused data-center capacity.

Back in the old days, IT organizations would often add a new server for every new solution it added to its portfolio. One for email, one for the employee portal, one for ERP, customer relationship management (CRM), payment processing, etc. Soon you would end up with a lot of servers—many of them dedicated to a single application or service. The time and energy it took to procure, rack, stack, configure, network, and maintain these servers was immense. What's more, many of these applications and services would not always be running—and even if they were running, they didn't necessarily need all the capacity available on the server. What you were left with was a lot of dormant capacity. Think of virtualization as a way to put that excess capacity to work—and as a way to scale up operations quickly.

This is accomplished by creating a "virtual machine" (VM) on top of an existing physical machine. The idea is that the new VM—the guest—uses the underlying operating system resources of the host, even though the guest acts and appears to the rest of the infrastructure as its own, separate machine.

Each guest VM is managed by a hypervisor. A hypervisor acts as the virtual-machine monitor (VMM). One hypervisor can manage several VMs running on a single server. But if the original problem was server proliferation, the new problem became hypervisor proliferation as more VMs were added to the data center.

On top of this, only the operating system was being virtualized—at least at first. What did this mean? It meant that IT could quickly provision a VM—in just minutes, actually—but administrators would still have to wait for other teams to perform all the associated tasks back in the old physical world required to bring a machine online. These included configuring network services or adding the VM to the active directory or the configuration management database.

If you look at infrastructure in terms of compute, network, and storage resources, early virtualization focused only on compute—leaving network and storage high and dry. This is the problem that SDI helps solve.

SDI virtualizes *all* elements of the infrastructure. "Network virtualization," as defined by TechTarget, "combines network resources by splitting the available bandwidth into independent channels that can each be assigned—or reassigned—to a particular server or device in real time." Storage virtualization, meanwhile, "pools physical storage from multiple network storage devices into what appears to be a single storage device managed from a central console."[36]

The vision for SDI is one in which all data-center resources—on-site, in the cloud, or in mixed hybrid scenarios—function as a single, fully integrated system that treats networks, storage, and servers as secure, infinitely scalable computing resource pools. In this vision, rapid delivery and management of business solutions will be ordinary everyday events in which workload infrastructure provision levels are precisely determined by each application's requirements for performance, reliability, and scalability. IT and business, in other words, will have the agility it needs to respond to change.

Open Source for SDI

Open-source technologies for provisioning and managing compute, storage, and networking resources are playing a key role in making SDI a reality for companies everywhere. This makes sense when you consider the widespread adoption of Linux-based operating systems in data centers

worldwide. According to a report from the Linux Foundation,[37] Linux leads the enterprise shift to the cloud, with 75 percent of enterprises reporting that they use Linux as their primary cloud platform.

Linux is an open-source operating system—and part of the ethos of open source is agility. Consider it a natural outgrowth of unrestricted access to open technologies that encourages their use and adoption by large communities of technologists. Clearly, the sharing of and collaboration on code inherent in the open-source-development model lends itself well to technical advancement and rapid innovation.

Today's open-source innovations can help measurably improve service agility. Companies can build an internal infrastructure that has the flexibility to quickly provision resources based on the unique requirements for performance, availability, and capacity that each application and every work group may have. Ideally this enables companies to do the following:

- Leverage existing investments in physical and virtualized systems.
- Select solutions from multiple suppliers.
- Take a pragmatic approach that fits the way you implement and manage the lifecycle of your services.

There are several open-source projects that have formed around core-data-center areas—projects that are hot today and clearly gaining momentum. These include the following:

OpenStack

OpenStack is a cloud-operating system and set of software tools that control large pools of compute, storage, and networking resources throughout a data center, all managed through a dashboard that gives administrators control while empowering their users to provision resources through a web interface. OpenStack is backed by a community of thousands of individual members, as well as leading software-development and hosting companies. According to Gartner analysts, by 2019, OpenStack-enterprise deployments will grow tenfold, up from just hundreds of production deployments today, due to increased maturity and growing ecosystem support.[38]

Ceph

Ceph is one of the leading open-source distributed software storage platforms. Ceph stores data on a single distributed computer cluster and provides interfaces for object-, block-, and file-level storage. It delivers excellent performance, reliability and scalability—all while providing maximum compatibility with legacy applications.

Docker

Docker is Linux-container technology that can support development and operations requirements for fast, consistent application implementations. Docker is open-source technology that automates the deployment of applications inside software containers. It provides an additional layer of abstraction and automation of operating-system-level virtualization on Linux. Organizations are increasingly seeing Docker and Linux containers as ways to more quickly build, deploy, and manage applications. In fact, when 451 Research began tracking Docker in 2015, it saw usage "double over the course of six months, going from 6.3% to 14.1% of IT decision-makers saying their organizations had a containerized application in production by Q3 2015."[39]

All three of these technologies—OpenStack, Ceph, and Docker—are ongoing open-source projects that will continue to benefit from an active community of technologists working collaboratively to make improvements so that companies can increase their agility and succeed in the digital economy.

Cloud Technology

No discussion of agility and digital transformation is complete without a focus on cloud technology. But as a term, "cloud" can a bit misleading. While from a user perspective, we may now be comfortable with the notion that the apps on our smartphones access data from far off, formless places that we can't see or touch, businesses engaged in digital transformation should understand cloud technology in much more concrete terms. Ultimately, the cloud is simply a kind of computing model that remains rooted in physical-computing hardware linked to a network. Think of words like server, router, infrastructure, and data center. While many of these technical resources are "virtualized," dynamically provisioned, and

shared across multiple data centers, we have not yet figured out how to do away with the physical components that make up the cloud.

If you're a business moving to cloud computing, you'll either be outsourcing your cloud capabilities—through offerings such a AWS, Azure, and Google—or you'll be using your own data-center resources. Which brings us to the three common models used in cloud computing: public, private, and hybrid.

Public Cloud

When most of us think cloud, we think public cloud. This model is big data centers selling cloud capabilities—folks like AWS and Azure, but also IBM, Google, and SAP. Think of public cloud as a service—three services to be exact.

1. **Infrastructure as a service (IaaS)**: Provides access to infrastructure in the cloud. Treat it like your own data center—adding components and deploying applications as you wish. Public-cloud providers give you access to a logical cluster of computing power (servers)—with hypervisors that virtualize the assets you use. But as the consumer of these resources, you don't really have to take that into account. Just access the resources and get to work.
2. **Software as a Service (SaaS)**: Provides access to specific applications or software packages in the cloud. Sometimes they're browser-based, like Gmail, QuickBooks, or LinkedIn. Other times you access them through a thin client, as with Microsoft Office 365, Saleforce.com, or Concur (now owned by SAP). For end users—or for lines of business looking for a quick way to get up and running quickly with new capabilities—SaaS is the easiest way to go.
3. **Platform as a Service (PaaS)**: Provides access to a cloud platform to build, deploy, and innovate with greater ease for the digital economy. PaaS gives you a full solution stack—including servers, an operating system, a run-time environment, storage, networking, middleware, libraries, services, and tools. You also get a development environment to build and deploy seamlessly. And while you don't necessarily control the lower layers of the stack, you do control the applications you deploy.

Private Cloud

Think of the private cloud as your own cloud that you control. Most enterprise-grade cloud solutions deployed by companies fall into this category. This is particularly true for SAP deployments—though this may be changing as the market grows more comfortable with the cloud as a computing model in general.

The idea of a private cloud is that it operates exclusively for you and your company—with hypervisors that virtualize technical resources to optimize use. Some companies use their own data center resources. Others outsource to a third party that maintains strict security standards and, in a sense, walls off the cloud for their own exclusive use. This is referred to as single-tenancy, which can be thought of as servers and other compute, network, and storage assets that only you can use.

Security is often cited as the primary reason for maintaining a private cloud. The thought is that the public cloud is just too exposed to ensure the safety of sensitive corporate data—though the issue of which is *actually* more secure is fiercely contested.

Whatever position you take on security, there are indisputable tradeoffs. Two commonly cited benefits of public cloud are cost and scalability. Large public-cloud service providers operate large data centers—the sheer size of which helps to drive down the cost of compute resources. These resources are—at least theoretically—infinitely available. If you need more, you can get it on demand—which makes you highly scalable.

On the private-cloud side, the benefits are not only security, but compliance and control as well. Many companies operate within industries that need to comply with regulations such as the Health Insurance Portability and Accountability Act of 1996 (HIPAA), Sarbanes–Oxley (SOX), or the Payment Card Industry Data Security Standard (PCI DSS). These companies are likely to shy away from public cloud due to its multi-tenancy model—where data from different companies resides on the same server. This is seen as just too risky. The private-cloud approach also gives companies more control—allowing IT to customize resources to achieve target performance levels as needed.

Hybrid

The hybrid approach isn't necessarily a blending of public- and private-cloud approaches—though it can be. More commonly, it's a blending of on-premise and cloud approaches—whether the cloud approach is

private or cloud. As you can see, it gets complicated. But the truth is, this blended approach—whatever the exact mix—is increasingly common. According to a report released by Markets and Markets, in fact, the "hybrid cloud market is estimated to grow from USD 33.28 Billion in 2016 to USD 91.74 Billion by 2021."[40]

A classic hybrid-cloud use case is elastic scalability without the security risks of going 100% cloud. Another use case is to keep live-production systems on premise, while moving to the cloud for other purposes. For example, some companies use cloud solutions only for backup and recovery, testing, or development. This can help drive down costs and increase agility on the margins—while at the same time giving the IT organization a starting point to familiarize itself with the cloud model.

Still another use case is something that happens almost organically in many businesses—namely, line-of-business solutions to meet specialized needs. When approached in a haphazard manner—rogue business units deploying nimble cloud solutions on their own without coordination from IT—you have the problem of "shadow IT." This can lead to security issues, a fragmented IT environment, and disjointed experiences that lead to poor customer outcomes. But when coordinated with IT in the context of a hybrid-cloud strategy where cloud solutions are integrated with the on-premise environment, line-of-business cloud solutions give organizations the agility they need to succeed in the digital economy.

Some commentators take pains to distinguish hybrid cloud from hybrid IT—emphasizing that the first is focused on enterprise architecture while the second is more focused on how the IT organization operates. Hybrid IT, it is said, "is a technique in which an enterprise uses both in-house and cloud-based services to complete their entire pool of IT resources." [41]

Closely related, but with different points of emphasis, is Gartner's model of Bimodal IT. Gartner defines Bimodal IT as:

> ". . . [T]he practice of managing two separate but coherent styles of work: one focused on predictability; the other on exploration. *Mode 1* is optimized for areas that are more predictable and well-understood. It focuses on exploiting what is known, while renovating the legacy environment into a state that is fit for a digital world. *Mode 2* is exploratory, experimenting to solve new problems and optimized for areas of uncertainty."[42]

Detractors suggest that the Bimodal IT approach may lead to a two-tiered workforce, pointing to hybrid IT as more singular—with a vision of one organization managing both approaches.[43] Whatever your personal position, the idea of maintaining fast and slow lanes in IT is an old one. It's behind Facebook's motto change—mentioned earlier—from "Move fast and break things" to "Move fast with stable infrastructure." It's behind the idea of increasing IT operational efficiency so that organizations can keep the lights on through greater automation and parlay the cost savings for more value-added work. And it's also behind the impulses for DevOps and Agile development—where the goal is to break through rigidity in IT and create space for companies to respond to change with greater agility through faster, more frequent innovation.

Customer Centricity

In many ways, customer centricity is where the rubber hits the road with digital transformation. If intelligence focuses on Big Data analytics and agility focuses on IT-related themes of software-defined infrastructure and cloud, then customer centricity focuses on both of these areas—and a whole lot more. Customer centricity, in other words, involves the entire business. It's where you hear terms like holistic, enterprise-wide, and cultural change.

If you want to deliver better experiences and outcomes, you need insight on which to act and the flexibility to keep pace with what customers expect. In addition, you also need a responsive supply chains, a workforce focused on the customer experience, business processes that meet customer expectations for convenience, integration across customer touchpoints, service organizations that understand the customer journey, and much more. Traditional siloes that put product development, for example, in one bucket and sales and marketing in another simply don't work anymore. In a digital economy, customers don't care about how you're organized because in a digital economy it's all about *them* not *you*.

The Empowered Customer

Think about how one-sided the old store-based model is. It basically says: "Here's something that you may want at such and such a location. Come here and we'll let you buy it—for the price we set." Back in the day,

customers went for this deal because they had no choice. Now they do. They have tremendous choice, in fact. With the ability to shop online and in-store, they can compare you and your products against other products and services for price, quality, and availability. This has greatly empowered the customer.

Take, for example, the issue of showrooming. This is when customers use your store just to look at and evaluate products—and then buy it online for less money. At one time, showrooming scared the pants off traditional retailers. And most certainly it has done its part—in conjunction with other factors—in leading to retail outlet closures over the past few years. On the other hand, some companies are responding in interesting ways.

Here's a take from Joel Anderson, Walmart.com President and CEO, as quoted in *Wired* magazine: "You've got to go where the customer wants you to go. We live in the age of the customer. We're embracing showrooming."[44]

According to David Rogers, author of *The Digital Transformation Playbook* and co-author of an influential study on showrooming, there are many ways in which shoppers use their phones in the store. Some of these reasons, like showrooming, may be a competitive threat—but others may not. Customers might do research: What are the ingredients in the frozen dinner I'm planning to buy from Walmart's grocery section? Others send pictures to a spouse or friend for a second opinion on how a piece of clothing looks. Rather than threats, these behaviors can actually be part of the customer's buying journey—behaviors, that if facilitated in the proper fashion, can lead to more sales and stronger relationships.[45]

But how do you facilitate the buying journey? Walmart started by studying how its customers use its mobile app—and soon found that they use it in very different ways at home than they do in the store. At home, they would be scanning multiple offerings—maybe making a purchase based on what they see. In the store, the activity was more research-based. In response, Walmart created a second version of the app that can be offered to customers when it detects, through geolocation, that the customer is visiting a physical store. This store-mode version presents different features more fitting to the experience customers want. "Once in store mode," says an article in *Wired*, "you have access to an interactive version of the weekly on-sale circular for that store. You can see what's new in the store. You can scan bar codes with the phone's camera for prices and keep a running list of everything you're buying so you'll know the

total cost when you get to the register." This helps enhance the customer's in-store buying experience—and numbers show this approach has paid off. Today, "more than 12 percent of online sales made through Walmart's smartphone app happen while customers are in the store, or at least while they're in the app's in-store mode."[46]

Customer Networks

The Walmart story touches on several themes important for achieving customer centricity. One is the importance of understanding the customer experience. While companies facing the downside of showrooming might complain about the phenomenon, what are they going to do? Ban smartphones? Not likely—they'd be better off learning about the customer and how they're using the tools at their disposal.

One key to gaining this understanding is to know something about the nature of the new customer/company relationship dynamic in the digital age. As we have pointed out already, the old dynamic was rather one-sided. David Rogers calls this the mass-market model—where customers were essentially seen as passive targets, and the road to success was to identify what would most likely appeal to the most people (**Figure 1**). If you found this sweet spot, you would mass produce your product, gaining competitive advantage through efficiencies and economies of scale that minimized marginal costs. To ensure sales, you would use mass communication—broadcasting your message on the most popular TV shows, newspapers, magazines, radio shows, etc., to get your message out.

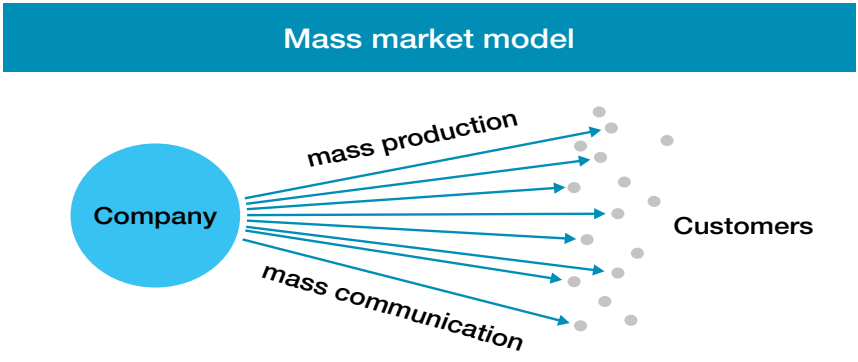

Figure 1 Mass market model

Today's model is very different, Rogers says—giving customers more of an active role in their relationships with companies. With access to social media and a wide variety of other technologies and tools, today's customers can communicate and interact with companies and others in ways that shape your brand reputation and even inspire competitive challenges. The proper analogy here is one of a network—with companies, customers, and other third parties all interacting. In such customer networks, your company still needs to communicate, innovate, and provide what customers want—but now the model is more interactive and collaborative (**Figure 2**). You need to listen constantly to what your customers are saying and respond to it effectively. You also must look for opportunities to channel the inherent dynamism of this network model by engaging customers more effectively and encouraging them to take a more active role in the promotion of your brand.[47]

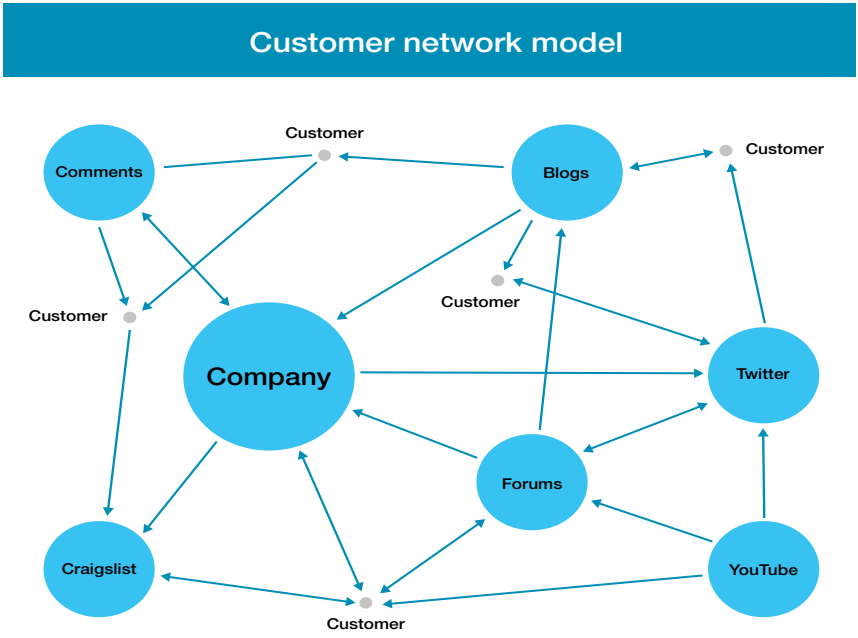

Figure 2 Customer network model

To thrive under such a model, you need intelligence and agility: Insight to understand your customers better in the moment, and the flexibility to respond in ways that keep customers coming back. These two areas come together to play a significant role in the customer journey.

The Omnichannel Objective

Today, customers can interact with you online, over the phone, or in person. Online, they can interact from multiple devices—desktop, laptop, tablet, smartphone, etc.—all of which impact supporting technologies in different ways. And in a world of customer networks, interaction points are not limited to scenarios that ultimately lead to transactions. Companies need to interact with customers increasingly through social media as well—whether it's to promote the brand, respond to issues, or merely to track opinion and sentiment.

Thus, much of the work involving customer journeys and customer centricity has to do with delivering a consistent customer experience across all of these interaction points—despite an increasingly fragmented and multi-channel environment. Around such efforts has arisen the idea of the omnichannel.

Omnichannel is simply the idea of maintaining a consistent experience across all customer interaction points. These could include email, social media, web and mobile. Others extend it to include "things like in-store displays, kiosks, interactive television and set-top boxes."[48] The idea is a holistic approach to managing the customer experience where companies need a 360-degree understanding of the customer at all times—in real time.

Some examples of omnichannel marketing in action:

Crate & Barrel "provides a seamless customer experience to shoppers using its wedding and gift registry. People can still create and monitor their registries online and in the store, but to make things more convenient, the Crate & Barrel app lets them manage their registry right from their mobile device."[49]

Starbucks gives out a "free rewards card that you can use whenever you make a purchase. But unlike traditional customer loyalty programs, Starbucks has made it possible to check and reload your card via phone, website, in-store, or on the app. Any change to the card or your profile gets updated across all channels, in real-time."[50]

Macy's allows customers to buy online but it doesn't maintain a separate warehouse for online orders. Instead it uses good data management and RFID tracking to support ship-from-store and pick-up-in-store models. "RFID allows the company to precisely track the location of a product within a store or within its supply chain." Thanks to moves like these, "Macy's profit margin grew by 257% in 2014 (versus 3% for Walmart and -14% for Target)."[51]

Digitizing the Customer Journey

One of the most concrete ways to think about digital transformation—and the steps you need to take to make progress moving forward—is the process of digitizing the customer journey. As Forrester puts it, the customer journey involves the "variety of touchpoints by which the customer moves from awareness to engagement and purchase."[52] Digitizing this journey can be an exhausting prospect for companies, especially when you consider the fact that for the typical large company these journeys can number in the hundreds.

Identify your Story

Fortunately, it's not entirely necessary to focus on every customer journey under the sun—at least not according to a report published by McKinsey & Company. McKinsey advises starting with your story:

> "From the very earliest stages, the organization needs a consistent way to describe what customers should experience across all of the journeys that they may undertake with the company. This "enterprise customer experience story" will be unique to the company and will distill its strategy, brand, and positioning into practical guidelines that together support the rest of the transformation."[53]

While these journeys differ from industry to industry, certain similarities exist. Customer onboarding and integrated service on the backend, for example, are common scenarios to most service providers whether they're in telecommunications, insurance, or finance. Whatever the case for your company, a process of formal analysis should take place to identify these journeys. During this process, it is useful to identify top priorities

and how they correspond to certain aspects of the journey. Branding may be the foremost concern for an initial new customer-engagement scenario, but as the journey progresses, the priorities might change to speed-of-process execution.

It is also important to assess each journey according to criteria such as its value to the overall customer experience, organizational commitment to supporting it, and potential technical or regulatory obstacles. The final output of the process, says the McKinsey report, is a roadmap for digitizing the customer journey.

Sequence the Technology

Based on this roadmap, the next step is to sequence out the technology transformation required to support the new digitized-customer-journey process. Here you can make dramatic improvements in the customer experience. Are there steps that can be skipped or consolidated? Are there different ways of guiding customers through their journeys? The goal is not to simply digitize an existing manual process but to reimagine it.

It is also important to resist the temptation of a one-off approach that will only lead to more siloes and exacerbate the challenges you may face in delivering a consistent customer experience across channels. The challenge, McKinsey says, is to link the journey "to all of the other channels customers use and to integrate it into back-end systems for everything from authentication to credit scoring and post-sale servicing." A company "should choose its IT components and its sequencing so that the IT architecture changes naturally as the journeys build on one another. For example, one way to accelerate digitization and reduce overall costs is to identify horizontal components, such as business-process management (BPM) layers, central administration platforms, or externally facing channels, that can be shared across all the journeys."[54]

A modular approach to the underlying technology architecture is important from the earliest stages. With "standard components such as eSignature, authentication, or document scanning and data-extraction, systems are easily reused across many different journeys and product types." With proper design, replacing these standard components with updated technology should be relatively easy. For example, eSignature could be swapped out with retinal-scanning or full-facial recognition technology—with all changes propagating back up to whatever customer

journey services that rely on them. As you repeat the process of digitizing customer journeys, the library of services inevitably grows—promoting reuse. This can play a substantial role in giving your organization the agility it needs in a digital economy.

Organize Your Workforce for Change

Because change occurs on an accelerated level in a digital economy, proper change management is also required. At the process level, you'll need a governance model that is calibrated "to an environment demanding rapid iteration, learning, testing, and reacting."[55] But a governance model is not enough on its own. You also need to build a culture of change where the people in your organization not only expect change, but embrace it.

Resistance to change, however, seems so deeply ingrained in our DNA that fighting against it often seems pointless. Keep in mind that resistance to change is exacerbated by siloes—which, by their nature, limit visibility. And change, after all, requires vision. Siloed workers—with little visibility into the organization as a whole—might not understand why a change is needed. This is why McKinsey touts "the lean-management concept of the 'work cell.'"

As with the technical architecture, workforce organization need to break down siloes in service of agility. Workers who can see outside of their narrow disciplines can more readily understand the need for change and, thus, give companies the agility they need.

Test and Measure

Ultimately, you need to launch the new digitized process that supports the customer journey. Starting out, it's useful to go with a pilot program to gather information and evaluate performance. According to the McKinsey report, one organization it worked with launched its customer journey in two different business units. This enabled the organization to compare experiences.[56] Whatever path you choose, setting the right metrics will make all the difference in the world—giving your organization the intelligence it needs to understand its customers better.

Customer insights stem from a combination of attitudinal and behavioral data, which can come from surveys, online tracking, and

transactional analysis. Some common metrics include KPIs, such as the following:[57]

- **Net Promoter Score (NPS).** A measure of loyalty that focuses on the percentage of customers who would promote your company (drawn from customer surveys)
- **Customer satisfaction (CSAT).** A measure focused on satisfaction with particular experiences, such as signing up for a service or post-purchase support (drawn from customer surveys)
- **Customer effort score (CES).** A measure of the effort required for a customer to complete a task (drawn from customer surveys)
- **Customer churn rate.** A measure of the number of customers who cease doing business with you by not purchasing again or by cancelling subscriptions
- **First response and average handling time.** A measure of how long it takes you to respond to service and support requests and the amount of time it takes to resolve an issue from beginning to end.

These KPIs, of course, are only a start. Creative organizations are constantly finding new ways to capture information and evaluate customer experience. Some organizations, for example, do sentiment analysis to measure the pulse of their customers on social media. Others are looking to the IoT, an incredible source of real-time data and insight. Indeed, as Gartner says:

> ". . . [T]he promise of new data sources such as wearable devices and broader mobile tracking strategies have the potential to open up a whole new level of customer insight. By combining behavioral data alongside attitudinal data, companies can discover patterns and correlations that have the potential to make predictive models much more powerful. Though early in their lifecycle, now is the time to monitor the progress of wearable technology and predictive algorithms to yield a complete picture of attitude and behavior."[58]

Rinse and Repeat

Digital transformation never ends. In many ways, it borrows deeply from the idea of continuous improvement or Keizen—where the idea is to stay on top of developments and continuously seek ways to streamline work and reduce waste. For digital transformation, the idea of continuous improvement is focused more on a continuously evolving understanding of the customer journey and what customers expect from your company—all gleaned from insights you cull on an ongoing basis from data analysis, social media exchanges, and face-to-face interactions with customers.

In a digital economy, digital transformation is less a one-off initiative than a way of continually refocusing the way you work and organize. While the initial phases of your digital transformation result in significant improvements in the areas of digitizing customer journeys, by implementing an agile architecture and instilling a new culture a data-driven insight, the process of digital transformation will continue. Why? Because your competition will never rest. The game moving forward is focused on how companies best use the tools at their disposal to drive better customer outcomes. Differentiation is now based on new business models that attract new customers and keep existing customers loyal.

In the next section of this book, we'll look at how SAP sees digital transformation, followed by a section on how SUSE supports SAP customers pursuing digital transformation on the ground.

Dé·Jà Vu All Over Again?

People who have been around IT for some time often may have a feeling of dé·jà vu when approaching the topic of digital transformation. After all, IT does tend to recycle preexisting ideas. But this is not necessarily a bad thing. Despite an emphasis on practical engineering skills and what works on the ground, IT as a discipline thrives on creativity. And so much of creativity involves reusing existing ideas in new contexts. Take a look at **Table 2** for a quick review of trends over the years.

Technologies/ Trends	Then	Now
Business process re-engineering	Emerged in the context of early digital disruption (1990s)	Today, an integral part of supporting new business models and digitizing customer journeys
Modularity/Reuse	Emerged with object-oriented programming and service-oriented architecture, paving the way for the digital economy	Today, the code reuse encouraged by these approaches have led us to microservices and containers that support modularized plug-in services for agile architectures
Change management	Emerged to standardize IT change according to strict models such ITIL and ITSM	Today, change management is culturally entrenched—and needed more than ever for highly regulated industries
In-memory computing	Emerged in the 1990s when RAM was expensive	Today, RAM is much more affordable. It's also available on-demand via the cloud, making in-memory viable as an enterprise-grade technology that can marry processing and analytical speed for real-time sense and respond capabilities

Table 2 Digital transformation technology and trends, then and now

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PART II

Driving Digital Transformation with SAP

If you're a traditional company encountering the demands of the digital economy for the first time, the biggest challenge you face is the issue of complexity—both in the way your business is organized and the way the technology environment that supports it is structured. With its now-familiar slogan, "Run Simple," SAP has put complexity squarely in its cross hairs. As a company, SAP has proven itself to be a thought leader on the issue of complexity, and it has revamped its portfolio of offerings to help SAP customers simplify their landscapes and drive innovation at the levels of business models, business processes, and work.

In "Value Creation in a Digital Economy," an influential paper on the digital transformation, SAP CEO Bill McDermott puts a price tag on complexity: $237 billion for the 200 biggest businesses in the world. SAP, of course, may have some insight into this issue. After all, "SAP customers represent 98% of the world's most valuable brands," while "74% of the world's transactions touch" SAP systems and almost "$1 trillion in commerce runs through [its] digital business networks."[59]

What has SAP been doing to address the complexity issue? According to McDermott, SAP has spent billions in acquisitions and R&D to build an "agile platform and solution for the digital economy." In this section, we will dive into this platform, explore how SAP thinks about digital transformation, and, along the way, look at some use cases and customer stories to demonstrate how SAP technology is being put to use.

The SAP Digital Business Framework

SAP's digital business framework is the way SAP sees many of its new innovative technologies coming together to support digital transformation. Central to the digital-business framework is SAP Business Suite 4 SAP HANA (SAP S/4HANA) as the digital core—with SAP HANA and SAP Cloud Platform serving as the foundation.

The Digital Core: SAP S/4HANA

At the center of the digital-business framework is the digital core—otherwise known as the SAP S/4HANA suite. Available in cloud or on premise, SAP S/4HANA is built on top of the SAP HANA platform, which combines advanced in-memory capabilities that bring together lightning-fast transaction processing speeds with equally fast analytics. SAP S/4HANA also uses SAP Fiori on the front end to deliver highly personalized user experiences for standard laptop/desktop and mobile scenarios.

With SAP S/4HANA, SAP has undergone its own digital transformation of sorts—digitizing the popular SAP Business Suite, which includes teh following:

- **SAP ERP** as the enterprise resource planning foundation for operations, financials, and HR
- **SAP Customer Relationship Management (CRM)** to support the sales, marketing, commerce, and service
- **SAP Supplier Relationship Management (SRM)** for e-procurement, source- and purchase-to-pay processes, spend management, and supplier performance evaluation
- **SAP Product Lifecycle Management (PLM)** to support product-related processes from the first idea to manufacturing and product service
- **SAP Supply Chain Management (SCM)** for production planning, business forecasting, and demand planning

At this point, your investment is safe and your path to digital transformation can be helped along by SAP S/4HANA, the digital core for the digital economy. But what exactly is a digital core? Sven Denecken, SVP

Product Management and Co-Innovation S/4HANA at SAP, calls it "an enabling platform for transformation and innovation." He goes on to list the following five essential characteristics of the digital core:

1. It provides the enterprise with the capability to drive and anticipate business outcomes in real time.
2. It integrates the business seamlessly across all value-chain processes such as client interaction, administration, production, and research and development.
3. Efficiency is increased by automating processes and distributing responsibility for customer insights across an intelligent business network.
4. Effectiveness increases by converting signals in business data into tangible actions, essentially bringing Big Data to the size and scale needed to turn insight into action for the everyday user.
5. It increases enterprise agility by elevating each employee's view of the organization.[60]

Outcomes, integration, efficiency, effectiveness, and agility are the vocabulary of digital transformation. A digital core, in other words, is the nerve center of the digital business—it's what makes fast innovation possible.

SAP S/4HANA can also be seen, in part, as a mash-up of business suite capabilities—where core processes once supported by SAP NetWeaver are now supported by the SAP HANA platform with greater flexibility and other enhancements. In addition, it is natively integrated with the cloud solutions such as SAP Ariba, SAP SuccessFactors, and more.

The innovations in SAP S/4HANA make many new things possible. Take, for example, any industry that produces and ships products—industries where the pressure to transform digitally is dramatically impacting e-commerce, transportation, and logistics. If you're in such an industry, you can use SAP S/4HANA to optimize your working capital with powerful cockpits for accounts payable and receivables. You can minimize stock buffers with real-time inventory management supported by a simplified data model—while increasing visibility into real-time stock-and-material flow. You can also minimize procurement costs by using Ariba Network

and improve "customer service with a new sales order fulfillment cockpit for instantly identifying bottlenecks and issues." [61]

Next-Generation ERP

SAP touts SAP S/4HANA as the next-generation ERP business suite for running a truly live business—one that operates in real-time and can respond to conditions and opportunities in the moment. This is accomplished with "massive simplifications in areas such as customer adoption, data model, user experience, decision making, business processes, and models." It also "offers innovations for the Internet of Things (IoT), Big Data, business networks, and mobile-first to help businesses Run Simple in the digital economy."[62]

From a business perspective, SAP S/4HANA allows you to connect, simplify, and gain insight by doing the following:

- **Connecting** with greater ease to people, devices (IoT), and business networks (SAP Ariba). This enables you "to deliver new value to [your] customers on any channel."
- **Simplifying** business processes, running them in real time and modifying them to increase efficiencies and meet customer needs.
- **Gaining insight** from "any data from anywhere in real time for planning, execution, prediction, and simulation." This enables you to make decisions "on the fly with the finest level of granularity for faster business impact."[63]

From an IT perspective, SAP S/4HANA allows you to simplify your IT landscape, innovate more effectively, improve the user experience, and deploy as you wish, as follows:

- **Simplify your IT landscape** and reduce your total cost of ownership (TCO) by eliminating redundant data and, thus, reducing your data footprint. "This helps you reduce hardware costs, operational costs, and complexity, and to save time."
- **Innovate more effectively** "by leveraging an open platform (SAP HANA Cloud Platform) to drive advanced applications—for example, for predicting, recommending, and simulating—while protecting existing investments."

- **Improve the user experience** with a simple role-based approach that "combines information from various sources at the point where decisions are made" to minimize the need for training and increase productivity.
- **Deploy as you wish** with cloud, on-premise, and hybrid options that fit in with your business preferences and the reality of your current solution landscape.[64]

Legacy Processes vs. SAP S/4HANA[106]

How much faster and better can you run on SAP S/4HANA compared to traditional systems? Take a look at **Table 3** for an overview.

Application	Legacy	SAP S/4HANA
Supply chain	Inventory data is distributed across multiple databases, and transactions need to be aggregated and posted following the Post-Goods Issue (PGI) process, which is run as a batch update. Meanwhile, truck drivers wait.	Inventory data is processed in real time and truckers can get on the road faster.
Sales & marketing	Add-on solutions for social monitoring don't integrate effectively with legacy ERP—and marketing teams can't monitor customers in real time.	With the ability to pull social data from feeds in real time, teams can spot trends and respond immediately to customer needs.
Forecasting	Forecasting takes days. And by the time reports are produced, the assumptions are based on out-of-date data.	Simulations can be run in real time based on timely data—helping you to better capitalize on opportunities and mitigate risk.
Finance	The quarterly and year-end financial close processes take weeks of data aggregation and are prone to errors.	Financial data across business units is consolidated in real time, supporting a soft-close process that frees up accounting for more value-added activities.

Table 3 Old and new processes with SAP

The Experts Speak

Working Smarter with SAP Environments

Connections are continuously on the rise, and therefore, digital transformation becomes a must-have for all types of businesses. Now, the crucial question becomes, how to turn this digitization into a competitive edge. This sidebar deals with essential findings based on Fujitsu/SAP references and use cases across a variety of geographies and industries.

According to Ovum's *2017 Trends to Watch* publication, "the Big Data will grow from $1.7 billion in 2016 to $9.4 billion by 2020, comprising 10% of the overall market for information-management tooling."[65] Since the Big Data value proposition of improved competitiveness, cost reduction, and risk mitigation is more than appealing, affordable and innovative architectures are the right step towards a digital advantage.

The Changing Profile of the Data Center

Dynamic business continuity requires platform solutions that support consistent and uniform management of the entire SAP software landscape. This includes using SAP HANA for every kind of IT provisioning model to ensure real-time management of productive SAP environments and transparency through operations. Based on access to data, speed, agility, and availability, a cross-functional operational concept is needed to bring information closer to the digital-transformation business and to turn the data center into a center of business advantage.

Fujitsu's KISS (Keeping IT Simplified and Streamlined) Report II about maximizing the business value of SAP Applications and SAP HANA told us that 60% of interviewed parties desire faster analytics.[66]

Furthermore, in a study conducted by Pierre Audoin Consultants (PAC) about the relevance of SAP S/4HANA for German enterprises, 90 percent of companies surveyed have been observing improved performance in data analysis and SAP-supported processes.[67]

Data Analytics: Data Quality Matters

In a hyper-connected world, data is a very valuable asset. Consequently, the process of collecting, processing, accessing, and acting on it becomes mission-critical. Due to continuously rising data streams, organizations have access to multiple sources of information. Therefore, the era of digital transformation requires the ability to capture a variety of data from which insights to drive organizational change can be obtained. Organizations need to ensure that they have the right dynamic infrastructures in place to manage and analyze data volumes in a cost effective and efficient manner; data insights are worthless without the mechanisms to use them across the business.

Developed for managing relational databases, data warehouses are better suited to reporting transactions than to overcoming the diverse analytical challenges posed by Big Data. A smarter way is to create an open-source data analytics architecture based on the Apache Hadoop open-source framework, which is coded to manage data in any format, whether it is structured, unstructured, semi-structured, or poly-structured.

SAP Vora is the perfect connector for transactional data from Business Intelligence (BI) and data from a data lake by acquiring and combining total data insight with real-time access. The integrated solution helps organizations access information anywhere, anytime, and from any device. Converting to the new infrastructure uses the latest generation of technology and concepts for flexible expansion and provisioning of new services.

Conclusion

Given that increasing digitization is opening opportunities for new business models and new players, shifting to digital is essential, even in light of its technological complexity and challenges to execute. Real-time data analysis and systems integration allow companies obtain faster, more accurate results, shorten the time it takes to manage data, and provides a more direct route to smarter decision-making.

By Wolfgang Hopfes, Hans-Joachim Heier, and Susanne Brügelmann (Fujitsu)

The Foundation—SAP HANA and SAP Cloud Platform

Little of what SAP S/4HANA does would be possible without the underlying capabilities of the SAP HANA platform and SAP Cloud Platform. Together they form the foundation of the digital-business framework, enabling the ability to gain insight at phenomenally fast speeds and offering the agility required to respond quickly to customer demands and new market opportunities.

SAP HANA

SAP HANA is the in-memory database from SAP, which first shipped in 2010. Because it runs in active memory, SAP HANA doesn't need to make time- and resource-consuming calls to disk. This means that SAP HANA runs much faster than traditional relational database management systems (RDBMS)—such as those offered by Oracle, IBM, and Microsoft. SAP, in fact, claims analysis speeds up to 10,000 times faster than traditional RDBMS.[68]

SAP HANA boasts a unique design. Traditional database approaches require the separation of online transaction processing (OLTP) from online analytical processing (OLAP)—where transactional data is typically moved to a separate data warehouse on a dedicated business intelligence (BI) server for the purpose of analysis and reporting. This is far too cumbersome a process for the real-time digital economy. Instead, SAP HANA brings transaction processing and analytics together on a single, compressed, columnar data set. Gone are complicated sums, indexes, data aggregates, and materialized views—as well as "data redundancy, disk latency, and data movement among applications and analytical tools."[69] It also supports "advanced integration capabilities such as data virtualization, replication, bulk loading, transformation, cleansing, and remote data synchronization in the same architecture."[70] This enables you to process Big Data workloads while at the same time reducing your data footprint by as much as 95 percent.[71]

When SAP urges companies to Run Simple and Run Live, much of this can be traced back to the power of SAP HANA, which removes a lot of now-unnecessary data infrastructure from the IT equation. And with transactions and analysis on a single instance, you can achieve a single version of the truth that helps to break down siloes—enabling otherwise disparate business units to act in concert on the same data almost instantaneously.

While SAP HANA is commonly thought of as a database, it is much more—which is another unique aspect of its design. When it was originally conceived, designers at SAP understood the need for a more integrated approach where applications live much closer to the data they use. Therefore, SAP HANA is also an "in-memory application development platform" that "includes a wide range of tools, including a Web-based developer workbench and IDE."[72]

Ultimately, it's the business case for SAP HANA that will win the day—or not—for companies gauging its value. This business case goes something like this:

- **Less complexity.** Part of the idea behind SAP HANA is to provide a single source of truth for transactions and analysis. This can help your organization simplify.
- **Greater speed and responsiveness.** SAP HANA is fast when it comes to data processing, but it also makes it possible for your organization to identify trends quickly. This means you can respond faster and more effectively.
- **Improved insight.** By combining transactions and analytics on a single instance, SAP HANA can yield real-time insight into customer behavior. This can help you meet customer demand more effectively.
- **Lower TCO.** SAP HANA can require less maintenance and less hardware for storage, leading to cost savings.

On a company-by-company basis, these points are only the start for building a possible business case for SAP HANA. As your company reflects on specific use cases—faster period closes, better forecasting, and improved customer service levels, for example—the business case will become much more granular. And let's not forget, SAP HANA is only one part of the SAP digital-business framework. Let's look at SAP Cloud Platform next.

SAP Cloud Platform

As much as SAP S/4HANA and SAP HANA are critical to the way SAP supports digital transformation, it's possible that SAP Cloud Platform is

even *more* critical. While none of the pieces in the SAP digital-business framework exists in isolation (which is part of the point), an argument could be made that when it comes to agility and innovation, SAP Cloud Platform is very important.

Was it always intended to be this way? It's hard to say. Previously known as the SAP HANA Cloud Platform, the offering has been renamed SAP Cloud Platform to reflect the fact that it is not merely about in-memory database services in the cloud—or, one might say, SAP HANA-as-a-service. While, indeed, SAP Cloud Platform still includes SAP HANA as a core service, today it is much more.

Returning to our discussion of the various "as-a-service" offerings for the cloud, recall that PaaS is a way to help customers "build, deploy, and innovate with greater ease for the digital economy." This, in short, is what SAP Cloud platform is all about—which is why SAP itself describes it as an "innovation platform."[73]

Based on open standards, SAP Cloud Platform provides "access to a feature-rich, easy-to-use development environment in the cloud," based on Eclipse, with a set of more than 40 services that can be used for a wide range of purposes such as integration, enterprise mobility, collaboration, analytics, IoT and much more.[74]

SAP Cloud Platform supports three basic deployment scenarios:[75]

1. **New cloud applications.** Develop new cloud applications from scratch, "with a low learning curve and small capital investment in software and hardware."
2. **On-premise extensions.** Create cloud applications for hybrid environments that integrate seamlessly with on-premise components using the Connectivity Service and Cloud Connector provided by SAP.
3. **Cloud extensions.** Build extensions to already existing cloud products such as SAP SuccessFactors, SAP Fieldglass, and SAP Hybris.

This platform approach, in part, helps your organization to succeed along the lines of the bimodal IT approach (discussed earlier) with extensions that essentially allow you to innovate and customize without

overhauling core back-end systems. In this way, you can "avoid the problem of picking up technical debt over time that results in hard-to-maintain, hard-to-upgrade backend systems as seen in the past."[76]

The openness of SAP Cloud Platform is equally important. To this end, the platform is based on OpenStack, an open-source IaaS project. SAP has invested heavily in the OpenStack Foundation, and SAP and SUSE are jointly leading the open-source development of the BOSH OpenStack Cloud Provider Interface to enable more openness on the IaaS layer. Furthermore, the standard SAP has adopted for PaaS comes from Cloud Foundry—the open-source PaaS for multi-cloud application development. With a guiding principle of enabling easy adoption through open standards and open-source components, SAP has joined the Cloud Foundry project as a platinum member.[77] This commitment to open standards is part of SAP's initiative to support developers and companies in a way that avoids vendor lock-in by supporting multi-cloud scenarios where cloud assets and resources can be co-located in a single data center.

SAP Cloud Platform: Services and Capabilities[78]

According to SAP, there are more than 40 services offered with SAP Cloud Platform to help developers quickly extend, build, and run cloud applications. Here's a run-down of the most important services available:

- **Collaboration.** Bring people together with secure access to shared business content, information, applications, and processes to drive results and increase team productivity.
- **UX.** Empower organizations to build and scale simple, personalized, and responsive UXs on any device, anywhere, to any user.
- **Integration.** Improve business agility while preventing data and application siloes by seamlessly and securely integrating cloud applications into business landscapes.

- **Analytics.** Embed advanced analytics into app solutions, empowering customers to identify, combine, and manage multiple sources of data for real-time insight.
- **The IoT.** Quickly develop, deploy, and manage real-time IoT, machine-to-machine (M2M), and remote data sync applications (see the SAP Leonardo section that follows).
- **Security.** Tightly manage and monitor security with services for authentication, SSO, on-premises integration, and self-services such as registration and password reset.
- **Mobile.** Deliver enterprise-grade native and hybrid mobile apps with support for multiple-authentication methods, secure system access, offline synchronization, and more.
- **Business services.** Access business services offered by SAP, partners, and independent software vendors (ISVs) focused on customer service and e-commerce (SAP Hybris), country-specific tax services, and more.
- **Run times and containers.** Use various run times and programming models with open standards and a cockpit that serves as the consolidated destination for all operational needs
- **Data and storage.** Run SAP HANA, spatial processing, and data virtualization on the same architecture to simplify and accelerate Big Data innovation.
- **DevOps services.** Increase developer productivity by simplifying development and improve team productivity with the ability to code and collaborate anywhere.

Customer Experience

Returning to the SAP digital-business framework, we see that the first of the four areas enabled by the digital core is customer experience. As seen repeatedly throughout this discussion, the ability to deliver positive customer experiences focused on outcomes is one of the foundational requirements for competing successfully in the digital economy. Customers today, says SAP, "demand simple personalized experiences across any channel, anytime, anywhere, and on any device."[79] With a digital economy

that increasingly emphasizes outcomes—at least from the perspective of customers, who, after all, are in the driver's seat—companies need to think about how to deliver those outcomes. This requires re-thinking business models, business processes, and the way you are organized to work.

An important new reality in the digital economy is that the customer journey—no longer linear as in the past—can take place across multiple channels. Which channel a customer chooses at any point in time is largely based on convenience—and if your company wants their business, you need to enable that convenience. Much of the customer journey, furthermore, is beyond your control. One survey finds that in a B2B context, a full 57 percent of the purchase decision making process is already completed prior to engaging a salesperson directly.[80] At least some of this pre-purchase behavior can be attributed to social media and other online communications and research. As another survey points out, online brand-related conversations happen at a rate of 2.4 billion a day.[81]

SAP Hybris[82]

To keep pace with the evolving consumer, SAP has seen the need for a single platform for engaging customers in a consistent manner with relevant information across all interaction points. Such a platform needs to support a 360-degree view of the customer and have the ability to interact in real-time—all with sophisticated predictive analytics in order to see what's coming. For SAP, this platform is SAP Hybris.

In 2013, SAP acquired SAP Hybris—then simply named hybris—as part of its own digital transformation initiative aimed at helping its customers move to the cloud and benefit from the power of digital economy technology. By helping to orchestrate business processes across customer touch points, SAP Hybris supports omnichannel initiatives with a single, harmonized experience for your customers across channels. You can also more effectively personalize those experiences—understanding the context of each interaction and responding in the moment with relevant information and services for your customers. SAP Hybris solutions also aim to simplify customer-facing systems—helping you to cut costs, time, and complexity while making it easier for customers to work with and buy from you. They also drive innovation, rapid transformation, and agility, allowing you to react and move quickly in response to change.

The SAP Hybris portfolio of offerings is vast—covering a wide range of activities and business processes for B2B and business-to-customer (B2C) scenarios in the cloud and on premise. Here, let's look at some of the offerings and supported capabilities available—grouped according to the categories of marketing, sales, commerce, and service.

Marketing[83]

SAP Hybris marketing solutions are designed for intelligent engagement with customers. With these solutions, you can gain deep insights into customers, deliver more personalized experiences, and better understand the performance of your marketing plans.

- **Dynamic customer profiling:** Gain real-time insights into customer behavior by creating dynamic customer profiles using online data and offline data.
- **Segmentation and campaign management:** Use segmentation tools and react to customer context in real-time to give relevance to your communications.
- **Commerce marketing:** Move customers to buy with an understanding of their needs and a personalized shopping experience.
- **Loyalty management:** Reward customers for their business—or for engagement activities, such as writing a review.
- **Marketing resource management:** Make sure your marketing activities are on track, on budget, and aligned with business objectives.
- **Marketing analytics:** Gain real-time insights into campaign performance and use this insight to identify new opportunities.
- **Marketing lead management:** Align sales and marketing by generating leads and delivering them to the sales teams with the insight they need to close more deals.

Sales[84]

SAP Hybris also takes a mobile-first approach to empowering sales teams in the field. Taking customer information from siloes and putting it in the hands of salespeople on the frontlines, SAP Hybris helps salespeople to target the right customers and get the most out of each opportunity.

- **Salesforce automation:** Spend less time on administrative duties and more time selling with a streamlined sales process that frees up your workers to focus on better customer engagement.
- **Sales-performance management:** Drive revenue, exceed goals and objectives, and turn strategy into action to drive higher revenues.
- **Retail execution:** Create an in-store retail experience that engages by putting the right products in front of the right customers, for the right price, at the right time.

Commerce[85]

SAP Hybris offers cloud and on-premise solutions that aim to help you engage and understand your customers across the entire commerce experience, "from content creation to merchandising to fulfillment." You can showcase your products and services, create personalized and relevant experiences, and engage and transact with your customers anywhere, at any time, and on any device.

- **B2C commerce:** Create consistent and personalized experiences for your customers online or in the real world, and gain insights from every interaction to build loyalty and increase sales.
- **B2B commerce:** Create an omnichannel experience for B2B customers with functionality to save repeat purchases, and buy in bulk as well as self-service account management tools for buyers.
- **Product content and catalog management:** Support the customer journey with product information (text, images, video, and editorial content) in one system that works across all channels.
- **Omnichannel fulfillment:** Establish a single system for customer orders across all channels, and view all order information in one place for better control over your stock.

- **Create contextual experiences:** Manage site layout and content based on historical data and current behavior to create personalized experiences that improve customer engagement.
- **Contextual merchandising:** React to customer wants and needs using real-time business metrics to fine tune your merchandising strategies.

Service[86]

More than ever, the customer experience is defined by what happens after the purchase. This is why companies need end-to-end capabilities to handle all kinds of service scenarios from community support to highly complex interactions and field service. SAP Hybris solutions for customer service can help you give your customers the right services on the right channel.

- **Comprehensive self-services:** Improve customer satisfaction and reduce support costs by giving your customers the tools they need to find the right answers.
- **Service from anywhere:** Meeting customers in whatever channel they choose, answering questions quickly, and driving purchasing decisions with expert guidance.
- **Integrated on-site services:** Deliver seamless field service—with full visibility into available resources and the ability to connect service agents to the right parts to solve onsite problems.

What is YaaS?

YaaS stands for Hybris as a Service (official name: SAP Hybris as a Service on SAP HANA Cloud Platform). Described "as the world's most advanced microservices ecosystem," YaaS enables you to "reassemble and adapt existing services to build custom experiences on the fly." On SAP Cloud Platform, YaaS serves as a business-service marketplace known as the Yaas Market. Through the YaaS Market, you can build business services as microservices (say, to extend SAP SuccessFactors), register the microservice on the YaaS registry, build new applications using the microservice (and others available on the marketplace), and then run the application in the cloud.[87]

Workforce Engagement

If complexity is the enemy of customer engagement, the same can be said for workforce engagement—where expanding global operations, changing regulations, and the proliferation of products and services are working to increase costs and impede progress.

Other forces need to be considered as well. To keep pace with change, companies are constantly reorganizing. Millennials, meanwhile, are entering the workforce in droves—and with them they bring expectations from their own consumer experiences that technology works as a facilitator of productivity rather than a hindrance. These millennials expect greater flexibility, too—which is part of the reason why, in the US at least, 83% of companies say they are increasingly using contingent, intermittent, seasonal, or consultant employees on a regular basis.[88]

Despite these challenges, the adage remains true: a company's most valuable asset is its employees. To compete, you need to attract the best workers possible and manage the workforce lifecycle from recruitment and onboarding to performance, compensation, and learning. You also need to enable this workforce with tools that help keep them productive. To help you do this, SAP puts forward two offerings: SAP SuccessFactors and SAP Fieldglass.

SAP SuccessFactors[89]

In 2013, SAP acquired SuccessFactors for $3.4 billion—which, as with the hybris purchase, demonstrates a commitment on the part of SAP to expand its portfolio of cloud offerings to help companies compete more effectively in the digital economy. With its cloud-based suite for human-capital management, SAP SuccessFactors aims to help you increase business alignment and build a competitive advantage by optimizing workforce performance. What you get is a set of "tightly integrated talent management solutions, robust workforce analytics and planning, plus a next generation core HR solution"—all of which simplifies HR processes, increases employee engagement, and improves executive insight and decision-making.

Offerings from SuccessFactors include the following modules:

- **Employee Central:** Capture employee, organizational, and talent data in one place with a self-service core HR solution that helps ensure accurate data with a user-friendly experience.

- **Recruiting:** Attract, engage, and select better candidates—and then measure the results on a continuous basis to transform recruiting into a strategic part of your talent strategy.
- **Onboarding:** Set the stage for employee success with a faster on-boarding process that increases job satisfaction, time to productivity, and first-year retention.
- **Performance & Goals:** Communicate strategy, create goals, and monitor goal progress while rewarding, measuring, and tying employee performance to business results.
- **Compensation:** Establish a pay-for-performance culture based on objective criteria that helps you increase productivity across the organization and retain top talent.
- **Succession & Development:** Anticipate staffing changes and ready your talent pool to arm your workforce for current and future needs with continuous development and career planning.
- **Learning:** Improve skills and reduce compliance risks with a learning management solution (LMS) to manage, develop, and deploy instructor-led and online trainings (formal or social).
- **Workforce Planning:** Assess readiness to execute strategies, forecast the impact of business decisions, and mitigate risk using in-depth workforce information and benchmarks.
- **Workforce Analytics & Reporting:** Empower your business leaders with actionable, quantitative insights into talent and business data.
- **SAP Jam:** Use this private social network that supports collaboration, communication and content-creation tools to improve employee productivity and teamwork (mobile enabled).

SAP Fieldglass

In 2014, SAP acquired Fieldglass, a services' procurement provider or vendor management system that runs in the cloud. In terms of workforce engagement, what SAP Fieldglass brings to the table is a focus on managing the contingent workforce (SAP Fieldglass also has capabilities for managing other vendors, such as suppliers, as discussed later).

In 2015, SAP announced the integration between SAP Success Factors and SAP Fieldglass, thus enabling "total workforce management."[90] According to an SAP press statement, this integration "bridges the gap between full-time employees and external workers by breaking down the siloes between human resources (HR) and procurement. This allows companies to manage their total workforce under a single, centralized capability."[91]

For effective workforce engagement, SAP Fieldglass offers capabilities that are broadly categorized across the areas of external workforce management and related services for managing statements of work.

External Workforce Management[92]

SAP Fieldglass automates the "process of procuring and managing flexible labor, from requisition all the way through invoice and payment." Supported steps in the process include talent requests, candidate review and selection, on boarding, time-and-material tracking, invoicing and payment processing, and offboarding. Once workers are offboarded, you can also run reports and evaluate yours processes for continuous improvement.

SAP Fieldglass also supports flexible workforce management programs—whether they're managed in-house, through one or more trusted Managed Service Provider(s) (MSPs), or with a Vendor on Premise (VOP), or any combination therein." It provides enforceable and auditable rules and tracks Service Level Agreements (SLAs) with full transparency, providing the necessary oversight to ensure the programs are as efficient and effective as possible.

Services and Statements of Work (SOW)[93]

SAP Fieldglass can automate processes for engaging service providers, ensuring compliance with safety and security policies, and measuring the quality of services delivered. It can also, "handle the management of a variety of Statement of Work (SOW) engagements including projects, offshore/offsite, independent contractors, managed programs, business services, and BPOs."

Supported processes include:

- **Sourcing**: Create and manage complex multi-bid SOWs.
- **Collaboration and contract**: Define scope of work and contract terms, including rates, roles, and requirements.
- **Management and evaluation**: Track service delivery and analyze the process for continuous improvement.
- **Invoice and approval management**: Create invoices automatically and approve deliverables with based-on requirements for a transparent audit trail.
- **Spend management**: Gain visibility across services providers and incorporate each service engagement into the overall budget.

Spend Management

Effective spend management is important for success in a digital economy where the complexity of interactions with partners, the resources dedicated to travel and expense, and the proliferation of suppliers can quickly overwhelm even the best-intentioned and well-managed organizations. Across direct- and indirect-spend categories, you need an efficient way to monitor your spend. This requires visibility into data—from inside and outside the enterprise—so that you can understand company-buying behavior and make informed decisions. To help companies like yours better manage spend across a wide variety of categories, SAP offers three solutions—all cloud-based and ready to run with SAP S/4HANA. These are SAP Ariba, SAP Fieldglass, and Concur.

In 2012, SAP acquired Ariba—a B2B procurement network—for $4.3 billion. As already mentioned, SAP added Fieldglass in 2014—the same year it acquired Concur Technologies for $8.3 billion. By adding these companies to the mix and incorporating them into the SAP digital-business framework, SAP can now claim to provide "the largest and most global network of digitally connected customers, suppliers, and other partners to help businesses collaborate more efficiently, organize and adapt resources more quickly, and innovate processes and business models."[94] And according to a press release announcing the Concur acquisition, the SAP business network—now the world's largest—"will transact more than US$600 billion annually, deliver frictionless commerce across

more than 25 different industries, and address annual corporate travel spend of US$1.2 trillion worldwide."[95]

That's starting to get big.

Certainly, each of these three offerings seem to overlap in certain areas and extend beyond the scope of spend management—which is our immediate focus here. Fieldglass, for example, does its part for workforce engagement, as already discussed, while SAP Ariba offers extensive support for financial supply chain management, e-commerce, and account management. For the purposes of our exploration of the SAP digital business framework, however, we will explore each of these offerings in light of spend management.

SAP Ariba[96]

SAP Ariba solutions for spend management integrate the entire buying process across the organization. It starts with Ariba Network, a cloud-based B2B marketplace that links buyers and suppliers on a single platform. When you connect to Ariba Network, "you connect to millions of suppliers in both direct and indirect expense categories" enabling you to "manage everything from sourcing and procurement to invoices and payments." Throughout each transaction, buyers and suppliers can collaborate—with data flowing between connected ERP systems for maximum efficiency and visibility.

While the portfolio of offerings available from SAP Ariba and Ariba Network are far too numerous to review here, below are some of the relevant offerings as they relate to spend management:

- **SAP Ariba Sourcing and SAP Ariba Collaborative Sourcing:** Negotiate better sourcing agreements by creating a sourcing environment that is connected to a powerful supplier network.
- **SAP Ariba Contracts:** Automate, standardize, and accelerate the contract lifecycle, and manage agreements for greater productivity and compliance.
- **SAP Ariba Spend Analysis:** Achieve insight into company-buying practices by aggregating spend data from anywhere and enriching it with Dun & Bradstreet market intelligence.
- **SAP Ariba Supplier Lifecycle and Performance:** Onboard, qualify, segment, and manage supplier performance quickly and efficiently.

- **SAP Ariba Supplier Information and Performance Management:** Identify, assess, and measure supplier performance to minimize risks.
- **SAP Ariba Buying and Invoicing:** Provide your users with a fast, consumer-like shopping experience with the leading procure-to-pay software solution.
- **SAP Ariba Buying:** Integrate invoice and payment processing with your ERP system to optimize the procure-to-order process.
- **SAP Ariba Catalog:** Minimize rogue buying with a procurement content solution that drives spend to approved suppliers.
- **SAP Ariba Strategic Sourcing Suite:** Supports a closed-loop, digital, source-to-contract process for direct and indirect materials sourcing.
- **SAP Ariba Supply Chain Collaboration:** Work with your partners across the entire supply chain and manage all direct materials procurement activities in one place.

SAP Fieldglass

Earlier, we reviewed some of the SAP Fieldglass capabilities regarding workforce engagement. Many of these same capabilities also play a role in spend management—such as automated processes for engaging service providers or measuring the quality of services delivered. In addition, SOW-related processes for vendor sourcing, collaboration, management, and invoicing help to minimize costs through greater control over service-provider engagements. And with the ability to "roll up all aspects of a service engagement into an overall budget," you can better "control the budget from both the project and individual level" for better spend management.[97]

Concur[98]

Concur offers expense management solutions that help companies track and control spend. By automating the expense management process, your company can save time and money while making things easier for employees, with the added bonus of getting them reimbursed faster. With

Concur, travel and expense reporting are connected, giving you new levels of visibility into both. And with smartphone apps, expenses can be captured without saving receipts.

Concur Expense: Expense reporting with Concur is supported with a mobile-first strategy. Employees take pictures of receipts and submit reports on their phones for management review. Whether it's for airline, hotel, restaurant, or transport costs, these photos are automatically inserted into expense reports as e-receipts. A wide range of credit card types are supported, and financial connectors help integrate travel, expense, and ERP data while a single, accurate view of this data supports better reporting—with dashboards and analytics—to help control spend.

Concur Travel: Concur Travel streamlines business travel with mobile support that allows your people to manage their itineraries on the go. A pre-trip planning process helps to enforce company policies by giving managers the opportunity to approve, reject, or request changes. During the booking process, you can choose which content to offer from multiple global distribution systems that shows negotiated and published prices, direct connects, or web-only fares. When travel is booked, several travel suppliers automatically send e-receipts into Concur Expense for faster and easier report creation and submission so that managers have broad insight into travel spend.

Concur Invoice: Concur Invoice streamlines the invoice management process from authorization to supplier payment for all sources of spend—including purchase orders (POs), e-invoices, paper and e-mailed invoices, and supplier networks. Automatically comparing invoices to POs and records of received goods and services, the solution helps save time and minimize compliance risk. Automation also speeds up vendor payments—including automated clearing house (ACH), checks, and credit cards—while a supplier portal allows your partners to track payment progress without calling in to your AP and procurement teams. You can also customize the workflow for invoices and purchase requisitions and run reports for greater visibility into spend.

IoT and Supply Chain

IoT is one of the more dramatic, promising—and some may say scary—developments to emerge out of the digital economy. Sensors embedded in things—from everyday items such as refrigerators and thermostats, to new offerings like the Apple Watch or connected clothing—make for a future out of science fiction. But in truth, that future is already here. While there is still a long way to go, many companies are already making huge investments and delivering IoT products to an eager market. These companies include big players such as Siemens, Samsung, Bosch, and GE, but also nimble start-ups flying under the radar—for now, at least. The space is wide open, and SAP has its eye on the prize as well—not as a device manufacturer, but as a player in the data and services layers. Its offering in this sphere, only recently introduced, is SAP Leonardo.

SAP Leonardo[99]

IoT, and the data it generates, are helping to change business forever, says SAP. With SAP Leonardo, the company says, "our endeavor is to provide an innovative solution portfolio that enables companies to not only realize the digital transformation of existing end-to-end business processes, but also to evolve new business models to run digitally."

SAP conceives of SAP Leonardo in four essential parts, all supported by SAP HANA and SAP Cloud Platform. These include the following:

- **SAP Leonardo Bridge:** Connect things from products to people by combining IoT data with business processes in real time.
- **Packaged solutions:** Use proven solutions from SAP for connected things to make the IoT work for businesses and their customers.
- **SAP Leonardo Foundation:** Build IoT applications using business services for development and technical services for processing Big Data, streaming analytics, and running predictive scenarios.
- **SAP Leonardo Edge Services:** Take in data from any device—regardless of connectivity, latency, or device protocol concerns—and deliver intelligent edge computing applications.

The key takeaway? SAP Leonardo connects things with business processes and people. Critical to SAP Leonardo is the packaged solution layer—which, in the end, is what transforms the IoT from a technologist's

vision into a reality for businesses and their customers. Let's take a quick look at these packaged solutions:

Connected Products

- **Product Insights:** Leverage sensor data to improve product design.
- **Goods and Equipment:** Connect devices and products with business processes to deliver better customer experiences.
- **Supply Networks:** Extend the supply chain to business networks to reduce planning-cycle times, minimize inventory levels, and increase service quality.

Connected Assets

- **Fixed Asset Insights:** Leverage insights from fixed assets to drive predictive maintenance.
- **Manufacturing Execution:** Optimize manufacturing with real-time visibility across multiple plants, vendors, and machine types.
- **Manufacturing Networks:** Meet customer demand with a manufacturing network that connects the supply chain with 3D printing, IoT capabilities, machine learning, and real-time operational insight.

Connected Fleet

- **Mobile Asset Insights:** Improve ordering, collection, and delivery processes by analyzing vehicle sensor data in real time.
- **Logistics Safety:** Improve logistics safety by analyzing vehicle and environmental conditions and driver health and behavior.
- **Logistics Networks:** Track inventory with enhanced supply chain logistics to increase visibility and improve compliance.

Connected Infrastructure

- **Building Insights:** Use sensor data from buildings to manage properties and optimize energy consumption.
- **Construction:** Confirm materials delivery and manage assets at constructions sites.

- **Energy Grids:** Build an energy grid that uses predictive maintenance to improve uptime.

Connected Markets

- **Market Insights:** Provide personalized experiences to consumers in certain markets.
- **Rural Areas:** Use data from agricultural equipment to increase farming efficiency and predictability in rural areas.
- **Urban Areas:** Optimize energy, vehicles, and assets to improve life across the urban landscape.

Connected People

- **People and Work:** Collect and process data for insights that can increase safety.
- **People and Health:** Build a connected healthcare network that improves patient outcomes and lowers healthcare costs.
- **People and Homes:** Empower people to control the home environment with smart home devices that make life safer and more comfortable.

What about SAP Clea?

Like SAP Leonardo, SAP Clea is a portfolio of services—not for IoT, but for machine learning and artificial intelligence (AI). "Our goal," says SAP, "is to build machine learning technology into all our software, across every line of business and industry we serve. And we're doing it with SAP Clea—machine learning intelligence embedded into our cloud platform and applications. This will make it easier to become an algorithm-driven business that lets you discover unprecedented insights, make more accurate predictions, and automate routine tasks so that employees can focus on higher-value work."[100]

Reimagine Everything

A digital business framework is one thing. But how can it be applied to support digital transformation? After all, we hear again and again that digital transformation is not so much about technology as it is about business strategy. To this end, SAP challenges its customers to go beyond technology to reimagine everything. Specifically, SAP encourages you to:

- Reimagine business models
- Reimagine business processes
- Reimagine work

Reimagining Business Models[101]

Dr. Chakib Bouhdary serves as SAP's Digital Transformation Officer. In a recent paper about reimagining business models, he writes that "CEOs, boards, and their management teams have a duty to reimagine their business model and identify ways to adjust or diversify their revenue streams and start their digital transformation journey."

But what exactly is a business model? Is it an operational concern—just the way you run your business? Is it how you make money? Or maybe the way you interact with customers? The paper helps answer these questions by identifying some key characteristics of a business model. These include the following:

- Value proposition and how it is delivered to the target customers
- Innovative ways to make money and maximize shareholder value
- Core competencies and assets needed to create competitive advantage
- Strategic suppliers and partnerships critical to a successful business
- External market forces and regulations that could impact the business

What, then, are some examples of innovative business models that can work for the digital economy? Let's take a look.

Outcome-Based Models[102]

With outcome-based models, the goal is to "re-engineer products and services for a final measurable outcome." A classic example is usage-based scenarios where the customer pays for the overall experience rather than for a specific product or service. This is not necessarily a new model. One could say that fractional ownership of private jets—which has been around for years—qualifies as an early example of this model. Here the customer does not want to own the jet, but merely wants access to it on demand.

But an outcome-based model is more than just renting. Take for example an appliance—say a washing machine. In an outcome-based model, the customer might get the machine nicely installed at her or his convenience—with all detergent included and replenished, and all repairs made without any extra charge. And when the machine reaches the end of its lifecycle, the customer gets a new machine to ensure uninterrupted service. Ease, convenience, and an emphasis on the experience rather than the product.

Outcome-based models are also known as as-a-service models—so, IaaS and PaaS models in IT both qualify. Rather than owning and maintaining the infrastructure or building the software or platform, customers get access without headaches.

A critical supporting technology for outcome-based models is the IoT. Sensors in the washing machine tell the service provider when the machine needs repairs or maintenance. They could also detect detergent levels. Or, as with Amazon Dash Replenishment, the customer could simply re-order detergent by clicking a button on the sensor that places the order.

To succeed with such models, SAP says, companies need to "collect, share, and analyze product and sensor data to monitor and optimize outcomes." They also need to think about the impact of the new model on business processes that support pricing, order-to-cash, financial accounting, and risk management. As we have seen, SAP offers a range of offerings to help customers succeed with such outcome-based models—such as SAP Leonardo.

Expansion into New Industries and Markets[103]

Another enticing business model boils down to this: Disrupt them before they disrupt you. According to SAP, "It is much easier to enter and disrupt other industries and markets than to change your own. Any value chain with significant inefficiency offers opportunity for new players to enter and disrupt."

Examples of disruption, of course, abound in the digital economy. We've already discussed Airbnb and Uber, but let's not forget Apple and Google, who have both upturned media sectors with iTunes and Google Play, respectively. Or how about banking companies in Africa that have leapfrogged the traditional branch model using mobile phones and blockchain technology to expand into previously untapped markets?

This type of expansion is not for the faint of heart. In a digital economy, traditional boundaries are often violated—not only by digital natives, but by older companies seeing new possibilities. Take, for example, the channel conflict between consumer products manufacturers and retailers—both of whom are fighting for a share of the consumer/customer. In a retail world led by Amazon, what's stopping manufacturers from buying some drones and delivering direct?

This reality may be some time in the future, but already manufacturers want closer relationships with consumers. And now with embedded sensors, the IoT, and pervasive data collection that leads to consumer insight, they can do it. Does this steal the relationship away from the retail outlet? Certainly, as disruptions of this sort continue, there will be issues that need to be resolved.

In the meantime, expect companies to do what they always do: Look for opportunities to expand. To do this effectively, SAP suggests that you first evaluate "core competencies that can be leveraged to change market dynamics." Do you have a technology, product/service, or mode of delivery that can compete against entrenched players? Do you have a talent edge or a more dynamic business process? Also consider inventive—or maybe more traditional—ways to make the expansion possible. More innovative approaches would include unit incubation—where you essentially fund a start-up (either in-house or spun off) to tackle new challenges in new ways. On the traditional side, perhaps consider M&A activity or joint ventures.

Digitization of Products and Services[104]

What if we could close the "gap between those using . . . products and services and those engineering and designing them?" This, says SAP, could dramatically disrupt traditional value chains, "where products are designed, produced, moved, and maintained" by different players, "which adds cost and increases cycle time between innovation and consumption."

By closing the gap between producers and consumers, companies can personalize their offerings more effectively to meet customer expectations. But it's important to distinguish personalization from options. The idea of personalization in a digital economy is not so much that you can offer and manage a dizzying array of different styles, colors, models, etc. That's the old model of configurability—and with such busy digital lives, the last thing consumers want to do is spend time choosing from endless options. Today, personalization is more about delivering the right product and experience at the right time based on what you know about the consumer.

Take, for example, a medical device manufacturer who tracks a patient's data over time and then makes design and engineering adjustments to tailor the device to the patient's needs. Or what about a seed and fertilizer company that helps farmers grow more crops by changing the make-up of its product based on farm data from weather, soil conditions, and more.

Of course, one technology with the greatest potential for personalization is 3D printing. "With 3D printing," SAP says, "wholesale distributors can store an 'infinite' catalog and deliver products and services much faster and at lower cost." Think, for example, of your teeth—so personalized and individualistic that dental records form the basis of a branch of science known as forensic dentistry. Not too long ago, one enterprising college student 3D printed his own braces for less than $60.[105] With such capabilities, 3D printing is bound to disrupt.

The SAP Customer Experience: UPS[106]

UPS is working with SAP "to enable companies large and small to access on-demand manufacturing with the touch of button" using 3D printing technology. According to an SAP press release, this collaboration between SAP and UPS will enable the following capabilities:

- Digitization and simplification of the production part approval process through SAP. By accelerating and standardizing the process, both companies believe a significantly greater number of industrial 3D print-ready production parts can be approved and certified and can be ordered through UPS On-Demand Manufacturing with full integration into SAP manufacturing and procurement processes.
- Automatic quantification of the financial viability of 3D printing vs. traditional procurement or manufacturing options on a host of real-time manufacturing and batch-specific parameters (such as tax calculations, shipping costs, bills of materials, and so forth). SAP and UPS intend to enable real-time decisions on the optimal supply-chain path for every parts order.
- Seamless routing of the order to UPS for production and delivery. UPS end-of-runway manufacturing can get most orders that are sent by 6:00 p.m. manufactured and delivered anywhere in the United States by the next morning. The agreement seeks to enable companies to track their orders right from their SAP software system.

Competing as an Ecosystem[107]

Today's empowered consumer demands value, and, often, that value is greater than any single company can deliver. Thus, according to SAP, companies "are finding that the most effective way to succeed is to complement their core competencies with those of other partners, jointly build new products and services, and leverage their combined go-to-market forces."

Ecosystem success requires new competencies with collaboration. First, you need to identify the value proposition that resonates with customers as well as the partners capable of helping you deliver it. Importantly, these partners need to complement your skills, offerings, and value to the market—not overlap with them. But in an ecosystem, boundaries will blur, and so-called "coopetition" with "frenemies" can only be expected.

As SAP recommends, integrating "products and services" to "ensure high quality" is of the upmost importance. So is moving at the right pace. "Develop a proof of concept," SAP says, and "refine and deploy in a select market before scaling."

Where is this ecosystem model succeeding? Look to companies talking about the "Internet of Value." Banks, for example, are using blockchain—working with tech companies to deliver greater value to customers underserved by the traditional bank model. And even as some predict that outsourcing is leveling off as a business trend, many manufacturers will continue to benefit, "especially when partners digitally connect business processes such as design, manufacturing, and supply chain," achieving "agility and scale to execute with a much lower cost structure."

Shared Economy[108]

Almost all shared economy models involve a platform that connects buyers with sellers. And as we know, many companies play the role of facilitators and experience-shapers. Of course, consumers are fickle and can switch platforms quickly where options exist. Take Uber, for example. Facing unfavorable press due to recent missteps, the company has reason to fear that alternative providers such as Lyft might sweep in and take market share. With vocabulary that includes "sharing," "peer-to-peer," and "community," the shared economy may have overtones of altruism, but it's still a business.

Admiration for the shared economy model runs high. This stems from its ability to scale almost effortlessly—and the economy with which it operates: global reach, millions of customers, few employees, no inventory. To succeed with such a model, SAP recommends a robust "cloud and app infrastructure to support the acquisition of new providers and users." Because there's always someplace else to turn, onboarding new customers or community members needs to be quick and painless.

In your role as facilitator, you also need the ability to process transactions instantly—and you'll be judged on this basis. Such transactions will likely be incorporated into inventive business processes. Think order-to-cash, automated billing, and revenue sharing.

All these transactions yield data. SAP recommends leveraging this "user data to refine the model and differentiate on services." Not only does this require fast and sophisticated capabilities for data management and analytics, it also requires leadership, collaboration, and vision. Differentiating on service, after all, comes from the business and IT innovating together to move the business forward.

Finally, when you operate on a global scale, it's important to "enforce a compliance framework to address local regulations." The benefits of new markets are immeasurable—so you want to hold onto them by following the law wherever you operate.

The SAP Customer Experience: EasyPark[109]

EasyPark is a parking marketplace that helps cities and other businesses optimize parking spaces and garages. The company is also an SAP customer. "EasyPark uses SAP Vehicles Network solution to improve customer experience and utilization of parking slots," says SAP. "The solution enables convenient end-to-end vehicle and mobility-centric services such as parking and fueling."[110]

Importantly, payment is integrated into the experience and the technology supporting it. After helping find the space and navigating you to the spot, the technology accounts for time parked—a bit like an automatic parking meter. According to one source, "Parking automatically ends when the car drives away, taking payment only for time used."[111]

In this shared-economy scenario, the buyer is the driver and the seller is either the city or a private parking space provider. EasyPark connects the two, acting as the facilitator, responsible for creating a convenient customer experience with positive outcomes.

Digital Platform[112]

Build it and they will come. This is the hope of companies that pursue the digital platform business model. And there are reasons to believe that people will indeed come. After all, says Accenture, the market capitalization of the top 15 public platform companies now stands at $2.6 trillion.[113]

With the digital platform model, the business goal is to develop communities of users and customers on a single platform—and then find ways to monetize that platform. Invariably this involves pursuing a "freemium" model to accelerate user adoption and community build-out," says SAP. Once you have the traffic and the eyeballs, the move to an advertising model is always enticing—but you can also open the platform to marketers beyond advertising. Other options include monetizing any data collected, offering research services based on this data, direct charge-for-access, and charging minimal fees per transaction.

High-tech companies, says SAP, are especially innovative when it comes to the digital platform model. "They offer free, innovative services to attract and retain a large, loyal customer base and then find smart ways to monetize and further grow that base." Take, for example, Skype, Snapchat, Tinder, Etsy, eBay, and PayPal—though the list goes on. Certainly, many of these companies are not necessarily high-tech in the classic sense. Etsy is retail and PayPal is finance. True enough. But remember, in the digital economy, every successful company is a technology company at its core.

Reimagining Business Processes[114]

The digital economy has revived business process re-engineering. In many ways, this is what's behind the idea of mapping customer journeys, as discussed earlier. Even though re-engineering processes can be hard work, there's no easy way around it. To survive in the digital economy, simply digitizing existing processes won't cut it. Customers want new ways of doing things. This is why SAP urges companies to not simply digitize business processes, but to reimagine them.

With thousands of customers all over the world and more than 40 years of experience working with them, SAP has taken some time to study how value is created. What the company has realized is that to create value in the digital economy, companies need to establish a core set of

capabilities as they relate to business processes. Let's explore these five areas in more detail.

Focusing on Customer Experience[115]

If customer experience is everything in the digital economy, then business processes need to be designed to optimize those experiences. This, says SAP, is why "companies are rethinking their customer experience across four key dimensions, all of which are highly dependent on new digital technologies."

- **Personalization.** Achieve an "integrated view of the customer's personal data." Then use analytics, agile and additive manufacturing, and AI to deliver tailored products and services.
- **Convenience.** Bring "goods and services closer to the customer" with technologies that support greater mobility, more comprehensive omnichannel capabilities, and 3D printing. If it can be done quickly, easily, and online, make it happen. Customers will pay for convenience.
- **Customer Journey.** Look for ways to optimize customer touchpoints—"from product search, to placing an order, to delivery, to post-sale service." Use "smart analytics, predictive capabilities, and real-time business" to streamline the supply chain, speed manufacturing, optimize the back office, and achieve a 360-degree view of the customer.
- **Pay for value.** Use IoT, hyperconnectivity, and Big Data to reimagine processes based on the value customers receive—and charge for that value. By moving beyond selling just products and services, you move up the value chain with your customers—where relationships are more intimate, and loyalty is longer-lasting.

Enabling Real-Time Business[116]

Sense-and-respond capabilities can help you deliver experiences that keep customers coming back. But to develop such capabilities, companies need processes that support real-time business—where transaction speeds are counted by the millisecond and analytics are incorporated into every transaction as they're executed. For enabling real-time business, SAP focuses on the following four areas:

- **Cycle-time reduction.** Use technologies, "such as AI, virtual reality, and 3D printing" to automate or eliminate process steps and reduce cycle times. This gives you greater responsiveness, allowing you to meet customer needs more effectively and serve them better.
- **Making businesses smarter.** Leverage the in-memory computing capabilities of SAP HANA to "bring analytics and transactions together on the same platform." Run simulations using real-time data for insights that support better decision making. When people talk about "smart business," this is what they're talking about.
- **Optimizing businesses.** Deploy digital dashboards to achieve "full visibility into the business." Executives and line-of-business managers should be able to "identify key issues and potential risks and take appropriate actions." They should also be able to "drill down into the data at any level of the organization and enable employees to collaborate more efficiently."
- **Speeding up and making business more innovative and agile.** Develop flexible microservices in the cloud using open APIs, and quickly develop innovative products and services. Leverage the power of structured and unstructured data on a single platform to speed time to market.

Generating Predictive Insights[117]

The combination of supercomputing, AI and machine learning, and low cost compute and storage costs is democratizing insight, making it possible for a wider range of organizations to not only see what's happened, but to see what's *going to* happen as well. SAP believes that, "predictive technologies will impact every facet of the business" and offers the following examples where predictive analytics plays a substantial role in the way companies can reimagine their business processes.

- **Asset management.** Use sensors and Big Data analytics to move from scheduled maintenance to predictive maintenance. This can increase asset availability for customers who need their equipment running 24/7. And according to SAP benchmarks, it can also "reduce cost by 10–40 percent and reduce unplanned machine downtime by 30 to 50 percent," while cutting capital expenditures and improving cash flows.

- **Customer behavior.** Use predictive tools to "analyze and anticipate the market situation" and "to optimize supply and improve price elasticity." By better understanding customer behavior, you can not only grow your market share, but also minimize customer churn by proactively reengaging at-risk customers before they go elsewhere.
- **Supply chain optimization.** Minimize supply chain disruptions and optimize your demand forecast and production planning processes by "analyzing the enormous amount of transactional and non-transactional data (e.g., weather) and finding trends using sophisticated mathematical models." SAP says this "can dramatically reduce waste and unnecessary cost in inventory, production, and logistics."
- **Disaster management.** Deploy sensors, cloud technologies, and advanced analytics for "flood monitoring, fraud detection, and smart traffic control," just to cite a few examples. With predictive insights into natural or man-made events, you can have the advantage of taking actions before the event takes place. This can dramatically minimize company risk.

McLaren[118]

McLaren telemetry systems track and compare real-time analysis of car sensor data against both historical data and predictive models. This helps the team to make immediate, proactive corrections, avoid costly and dangerous incidents, and, ultimately, win races.

Fostering Cross-Enterprise Collaboration[119]

If customers demand value above all else in the digital economy, and—as already stated—it is often impossible for any single company to deliver all of that value, then a proficiency for collaborating with outside partners can act in your favor as a key differentiator in the market. According to SAP, companies can achieve higher customer satisfaction and improved profitability with cross-enterprise collaboration if they focus on the following dimensions.

- **Supply chain execution.** Focus on core competencies and outsource the rest—including back-office functions, logistics, and manufacturing. To make outsourcing work, however, companies need "multi-tier collaboration to take action on significant changes in customer demand, supply chain disruptions, or any competitive moves that could impact the business environment."
- **Cost management.** Tap business networks to optimize spend across multiple categories, such as direct, indirect, services, contingent labor, and travel spend. Business networks also "provide real-time visibility into enterprise requirements and allow for an efficient source-to-pay process."
- **Financial supply chain innovation.** Look for blockchain to "completely innovate the financial supply chain in the near future." In the meantime, increase financial supply chain collaboration so that, "physical movement of goods is promptly followed by the digital movement of money." This can especially help smaller suppliers with their cash flow.
- **Data sharing.** Share pervasive data with ecosystem partners to deliver greater value to customers and achieve common goals. Retailers, for example, can share point-of-sale data with manufacturers to fine-tune pricing and collaborate on promotion strategy.

Exploiting AI and Automation[120]

With the rise of technologies such as AI, robotics, augmented reality, and voice recognition, it is now possible for companies to combine data-driven insight and continuous feedback with old-fashioned human decision making and analysis to make business processes smarter over time. SAP focuses on the following core areas:

- **Smart automation.** Focus on the interface between machines and people to get the most out of both. With robotics and AI becoming more affordable, more companies can put them to use for competitive advantage and innovative business processes. "Human and robot collaboration on the shop floor," for example, "is helping drive higher throughput while ensuring safe operations."

- **Business without bias.** Approach situations with greater objectivity. "Self-learning machines are capable of mimicking human actions, identifying patterns and exceptions, and providing contextualized responses," says SAP. This can help remove bias from scenarios like hiring and talent management.
- **Augmented intelligence.** Optimize tasks and decision making by using machines as knowledge partners that provide contextual information, run simulations, and make recommendations. With "advances in augmented reality, smart wearables, and voice- and gesture-controlled systems," companies can improve safety and productivity.
- **Automated shared services.** Use machine learning and AI to automate back-office functions, thus changing the value equation for shared services and business process outsourcing (BPO)—driving down cost and increasing efficiency.

Reimagining Work[121]

The way we work is changing—rapidly. Consider the following:

- 75 percent of the workforce will be made up of tech-savvy, hyperconnected millennials by 2030.[122]
- More than a third of the skills desired for most occupations by 2020 will be skills *not* considered crucial today.[123]
- 20 to 30 percent of today's workers in the United States and the EU are freelancers or independent workers.[124]
- 30 to 50 percent of outsourced and shared services jobs will be lost to smart machines.[125]

These dramatic statistics, all reported in the SAP whitepaper, "Reimagine Work,"[126] are driven by factors such as demographic shifts, technological change, and globalization. In the next few years, says SAP, innovative, revolutionary technologies from the consumer side of the

equation will be moving into the workplace. How do companies manage this coming change to maintain competitiveness? SAP suggests focusing on the following core areas:

- Real-time business with automated reporting
- Team collaboration
- Consumer-grade technology for the workplace
- Automation through machine learning

Real-Time Business with Automated Reporting[127]

Speed of action—and the organizational agility it requires—are core requirements for success in the digital economy. But many companies are held back by inadequate reporting. Executives find it difficult to customize reports, access to relevant data is often limited, and cross-functional analysis with siloed data stores takes too much time.

SAP envisions a more immediate approach for delivering data and insight to executives and workers alike. For example, with in-memory technology you can create "a single view of the truth with transactions and analytics running in real time on one platform." To test new ways forward, you can use gamification strategies and lively simulations. Machine learning, moreover, can be used to "identify cross-functional correlations to resolve issues." All of this can dramatically speed time to action—based on accurate data that you can trust.

SAP offers two examples of how it is helping to make real-time business with automated reporting a reality today:

- **Boardroom of the future.** C-level executives can use highly interactive dashboards to make decisions quickly. With readily available operational data, they can analyze revenue growth trends throughout the global enterprise and assess underperforming regions. For one such region, say, the problems are linked to inadequate product training for a relatively new sales force—information that is readily available by drilling down into the details. After identifying the root cause, the board knows what actions to take.
- **CxO dashboards.** Dashboards can be personalized so that executives can receive alerts and notifications, gain insights into real-time business conditions, and run simulations to determine the

best course of action out of multiple options. Imagine, for example, that a CFO is alerted to a cash-flow issue. With an effective dashboard, she can then drill down into accounts receivables, where she finds that the issue is caused by overdue payments from a few large customers disputing invoices. With the root cause identified, the CFO can then take action.

SAP technologies that support these scenarios include:

- SAP HANA platform for transaction processing and analytics
- SAP Digital Boardroom for real-time reporting

Team Collaboration[128]

SAP uses the term "corporate cholesterol" to suggest the kind of blockages that can create formidable obstacles to workforce productivity. Typical inhibitors, SAP says, include siloed work streams, fragmented data sharing, and restricted collaboration across the firewall where working in real time with teams—either inside or outside of the organization—is impeded by system limitations and security concerns.

To remedy corporate cholesterol, SAP suggests keeping a firm focus on cross-enterprise team collaboration that enables experts from far-flung teams can collaborate seamlessly and quickly. This harkens back to the earlier discussion about work cells—an admittedly old idea, but one made more important than ever by the increased complexity and pace of the digital economy. To support such flexible collaboration, you need to deliver intelligent data from all sources in real time—and "create workflows, assign tasks, and track progress from the same platform."

How does this all come together? Here are some examples from SAP:

- **Product recalls.** Let's say you're an auto company with a predictive maintenance solution that foresees the failure of air-conditioning in certain models. The foresight is great, but to respond quickly, you need a collaborative workspace that allows teams from engineering, corporate communications, and the supply chain to access data from various sources, analyze that data, and identify the root cause. From there, you can make the call to recall—and use your collaboration capabilities to manage the logistics efficiently for the best possible outcomes for your customers.

- **New product launch.** Today, you can use cloud platforms and crowdsourcing to engage your customers directly in product development—such as designing and producing a new a pair of sneakers. Plug into business networks to find suppliers and use cloud workspaces to allow R&D teams to collaborate on the latest designs.

SAP technologies supporting these scenarios include:

- SAP Knowledge Workspace
- SAP Jam collaboration platform
- SAP Cloud Platform
- SAP Ariba/Ariba Network

Consumer-Grade Technology for the Workplace[129]

Today's employees demand a consumer-grade user experience at work. And why not? In our consumer lives we just download apps designed for usability, then use them to interact with people and execute transactions. But at work? Not so much. Standing in the way are some common culprits: siloes that serve up multiple versions of the truth, disjointed tools that require manual data entry and aggregation, and a lack of context that makes data irrelevant.

What capabilities are needed to achieve a consumer-grade user experience in the workplace? SAP emphasizes "intelligent analytics to run simulations and make recommendations and decisions in real time." Also important: AR and the delivery of "relevant information through voice-enabled tools and smart wearables."

Some examples include the following:

- **Warehouse operations.** With "smart glasses" that augment reality by adding information alongside what the viewer sees in the real world, your warehouse workers can have their hands free to pick and pack while receiving information on order details directly in their line of sight. "The technology," SAP says, "is even capable of providing instructions or coordinating with the supervisor or other workers through voice-enabled features."
- **Asset maintenance.** Three-dimensional visualizations of machines can help technicians in the field identify issues and diagnose

problems. And with technician mobile devices integrated into the back office, you can automate notifications, approval workflows, and work order updates.

SAP technologies supporting these scenarios include:

- SAP Fiori (offers better user experiences for workers)
- SAP Ariba (offers guided buying experiences)
- Concur (offers consumer-grade travel and expense reporting)

Automation Through Machine Learning[130]

Since its inception, a primary promise of business IT has been the potential to automate repetitive tasks and drive down operational costs. Standardization, shared services, and outsourcing have brought us partway there, but growing complexity and aging technology landscapes stand in the way of further progress.

However, with recent advances in cloud technology and machine learning, says SAP, companies can "leverage intelligent enterprise applications to perform tasks faster," thus optimizing human capital and continually improving the way decisions are made. Indeed, in recent years, "machines have started demonstrating skills they never had before, such as sensing, understanding, and communicating—and they're still acquiring new skills." What's more, "machine learning combined with behavioral analysis can not only automate tasks, but also help identify and eliminate business risks."

Take, for example, the following scenarios:

- **Shared services.** With machine learning capabilities, you can automate tasks across functions—from CV matching in the hiring process to a wide range of compliance management activities. Or how about the labor-intensive process of matching payments to invoices. With machine learning, you can automate this task to such an extent that your finance people only have to focus on the exceptions.
- **Warehouse automation.** With the IoT integrated into warehouse processes, you can automate repetitive tasks. From a centralized location, you can control robots and drones to meet demand by

filling orders much faster. You can also keep operations running on a 24/7 basis, using predictive analytics to anticipate machine failure and take action before operations are impacted.

SAP technologies supporting these scenarios include:

- SAP Clea (for machine learning)
- SAP Leonardo (for the IoT)

Part 2 Endnotes

[59] *https://www.sap.com/documents/2015/08/ea13c2a6-3a7c-0010-82c7-eda71af511fa.html*

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PART III

SUSE and The Future of SAP Data Centers

SAP's vision for helping its customers succeed with digital transformation is comprehensive. It's a vision that is supported by a digital core—with SAP S/4HANA at the center—and the power, speed, and agility of the SAP HANA database and SAP Cloud Platform for ongoing innovation. But in a digital economy, no single company is an island. To deliver the full value customers expect, companies need to collaborate across the value chain. It's for this reason that SAP has partnered with SUSE for SAP HANA-based deployments.

SUSE is a pioneer in open-source software—providing reliable, interoperable Linux operating system distributions along with cloud infrastructure and storage solutions. Why is this important to SAP customers pursuing digital transformation? The title of a recent International Data Corporation (IDC) paper sums it up: "A Move to HANA Means a Move to Linux—But Not All Linux Is Created Equal."

SAP has announced that by 2025 it will end support for Oracle, IBM DB2, and Microsoft SQL. From that point forward it will require the SAP HANA database for all SAP applications—including SAP S/4HANA. At the same time, SAP requires Linux to run SAP HANA—and it has certified only two Linux vendors to date, one of them being SUSE. So, if you want to run SAP S/4HANA, you need to run SAP HANA—and if you run SAP HANA, you need to run Linux. This means that all SAP customers on Unix or Windows operating systems will have to move to Linux before 2025.

Why the requirement for Linux? It has a lot to do with standardizing on a single operating system—one that is up to the tasks of digital transformation. According to IDC, "The operating system (OS) layer in an SAP HANA environment can contribute significantly to the system's

performance, availability, security, and other key aspects." And because Linux is rooted in open source, it can benefit from the community's rapid innovation and enhancements. For customers used to Windows, moreover, "the good news is that today, Linux is a mainstream OS with 31% of worldwide server revenue attributable to servers that ship with Linux." (See **Figure 4**)

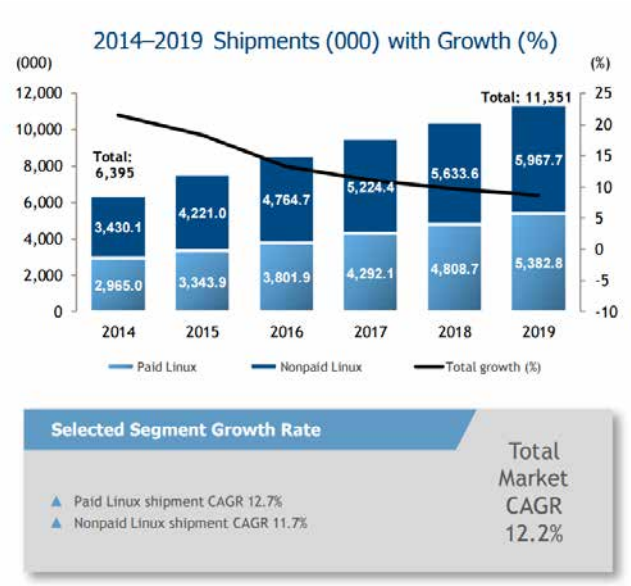

Figure 4 Worldwide Linux server operating environment shipment snapshot

All of this leads to a choice for SAP customers regarding which Linux distribution to choose. But as IDC says, "Even though Linux is an open-source OS, the adage that 'Linux is Linux is Linux' isn't necessarily true." For SAP customers, what's needed is a Linux solution that can be trusted to support SAP workloads—and that can help companies increase agility, minimize cost, and manage complexity in dynamic data center environments that need to live up to the demands of a digital economy.

SAP and SUSE: Collaboration, Integration and Years of Partnership

The partnership between SAP and SUSE is based on almost two decades of collaboration. For more than 17 years, SUSE has worked with SAP on joint testing and development at the SAP Linux Lab—and the integration between the two companies is so deep that SAP originally built the first SAP HANA solution on the SUSE platform (See **Figure 5**). As already mentioned, SUSE and SAP are collaborating on Cloud Foundry and Bosh OpenStack for the SAP Cloud Platform. And for its own data centers, SAP runs on SUSE.

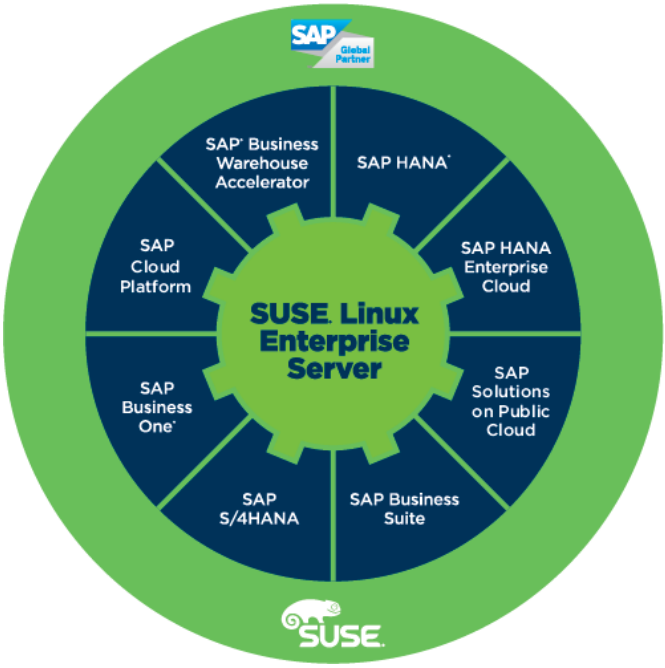

Figure 5 SAP and SUSE integration

SAP Runs SUSE

Challenges:

- Expand SAP HANA Enterprise Cloud
- Meet enterprise requirements

Solutions:

- 6,600 servers
- 12,000+ CPUs
- 16,000 VMs
- SUSE Linux Enterprise Server
- SUSE Linux Enterprise Server for SAP Applications (SLES for SAP)

Results:

- 99.999% availability
- Reduced total cost of ownership
- Streamlined operations

More relevant for your digital transformation efforts is the fact that SUSE is the leading platform for SAP workloads running on Linux worldwide—with more than 70 percent of SAP customers who use Linux choosing SUSE. SUSE solutions for SAP are not merely re-naming exercises with SAP added to the offering. They are designed and built from the ground up based on actual customer needs.

When it comes to digital transformation, SAP and SUSE work together. SAP S/4HANA provides the agility and adaptability customers need to realign their business processes to take advantage of key technologies such as the IoT, Big Data, and mobile applications to compete in today's digital economy. SUSE, in turn, supports this agility and adaptability with the right mix of traditional and new IT infrastructure. Businesses around the world and across industries rely on SUSE's experience

and innovation with SAP environments to help guide them in achieving their digital transformation initiatives.

With SUSE, the starting point is your business priorities—as it should always be with digital transformation. What, exactly, do you want to do? Maybe your starting point is a better customer experience, or a more responsive supply chain, or predictive insight into customer data. Whatever the launch point, we start at the place that's right for your company and then align your IT resources accordingly. But we don't push companies to move exclusively to the SUSE platform. Rip and replace can be disruptive—and you need to focus on disputing your *industry* rather than your internal operations. With this in mind, we help manage and support your existing infrastructure alongside the SUSE platform.

To help make the transition as smooth as possible, we've worked hard to improve user experience with installation wizards that accelerate the ramp-up. We've also added simple and intuitive single pane-of-glass management tools that make administration easier. And to support innovation, SUSE is part of a design ecosystem made up of the world's largest technology companies—including SAP, as well as Microsoft, Hewlett Packard Enterprise (HPE), Dell, and many others. This means that if you're running SAP S/4HANA, for example, and you need to build innovative solutions that extend or add to the core, we have the know-how and experience to help you.

Integrated Support

When you run SAP solutions on SUSE, your support experience is seamless. Whatever the issue, simply initiate a support request using the regular SAP escalation channels (telephone, web front-end, or SAP Solution Manager), and the request is assigned to the SAP support request system. This is just one of the benefits of the tight integration between SUSE and SAP.

SUSE Linux Enterprise Server for SAP Applications (SLES for SAP)

SLES for SAP is the premier operating environment for SAP solutions and the only solution that supports both x86-64 and IBM Power Systems servers.

As a reference development platform for SAP applications, including SAP HANA, this offering ensures the greatest level of scrutiny on patches and fixes, guaranteeing robustness and reducing the possibility of incompatibilities when patches are applied. In addition to being formally certified and recommended by SAP, it also has a proven history of customer success. Some reasons for moving to SLES for SAP include the following:

- **More scale-up and scale-out options.** Better scale-out options with storage, file system and networking enhancements. Support for the latest industry-standard, scale-up hardware and increased virtual CPU and memory limits.
- **Unparalleled enterprise support.** Seamless and integrated priority support and maintenance through SAP Solution Manager from both SUSE and SAP.
- **Performance.** Consistently outstanding uptime and performance—even under full CPU loads and high-memory stress. Built-in joint validation and certification eliminate software incompatibilities.
- **Business continuity.** The SUSE Linux Enterprise High Availability Extension is built in. This is an integrated clustering solution for both physical and virtual Linux deployments (read more about this in the "Availability" section later).
- **Fast deployment.** Installation and deployment of SAP applications in hours, not days.

Key Features of SLES for SAP

- Built-in high-availability clustering and automated failover for SAP HANA that reduces downtime
- An installation wizard that fully automates SAP HANA and SAP NetWeaver installations and integrates with SUSE Manager
- Tools for transitioning SAP landscapes on Microsoft Windows to SAP S/4HANA on Linux
- A page-cache limit that sustains SAP application performance
- Seamless priority support from SAP and SUSE

The Five Pillars of Trust

SAP puts tremendous trust in SUSE to enable digital transformation for our mutual customers. This trust, however, is not based on wishful thinking. It is based on the fact that SUSE solutions consistently deliver enterprise-level reliability, availability, scalability, manageability, and security.

Reliability

Reliability is the measure of how long a system performs its intended function—and in enterprise data centers, reliability is a must-have. SLES for SAP was designed to run complex processes quickly without crashing. It runs critical functions in a way that prevents "buggy" programs from causing systems to become unstable and crash. In addition, unlike Windows, which typically gives applications and users access to the Windows kernel, SLES for SAP creates a strong wall of separation between the kernel and users. Each layer has limited access to the others, which reduces the risk of unauthorized access to your system and data—thus increasing reliability (and security).

Another option for greater reliability is SUSE Linux Enterprise Live Patching. With this offering, you can apply kernel fixes on the fly—without interruption, without reboot, and without downtime. Critical to this approach are the following principles:

- Limited-scope fixes to the kernel to ensure security and stability while preventing memory corruption
- Minimal changes to the source code to minimize complexity
- No run-time performance impact to ensure full-speed execution for the operating system and all applications on top
- No application interruptions while patching
- Full review of patch source code for accountability and security purposes

Availability

Often confused with reliability, availability is a measure of how much time equipment is up and running and in an operable state. Since 2011, SUSE and SAP have been working together to improve the availability of SAP HANA so that customers can grow their deployments to include multiple nodes and true Big Data environments. To ensure high availability and disaster recovery for SAP HANA, SAP offers SAP HANA System Replication. SUSE enhances this feature with the SUSE Linux Enterprise High Availability Extension This extension, included with SLES for SAP, supports failover automation for scale-up and scale-out scenarios and is certified to work with AWS and Azure. The following two resource agents play a critical role in how the SUSE Linux Enterprise High Availability Extension helps improve the disaster tolerance of SAP HANA systems.

Disaster Recovery for SAP HANA Scale-Up and Scale-out Environments

This scenario is single-box replication. It allows you to replicate your SAP HANA data from one computer to another to compensate for system failures. SLES for SAP uses the new SAP HANA resource agent to check the SAP database replication. The master node assumes responsibility for the SAP HANA databases running in primary mode, and the slave is responsible for instances operated in synchronous (secondary) status. This helps reduce risk due to hardware failure and optimize takeover time due to SAP HANA memory preload.

Simplified Cluster Configuration

Also available is the SAP HANA Topology resource agent, which simplifies cluster configuration. This resource agent runs on all nodes of a SUSE Linux Enterprise High Availability cluster and gathers information about the status and configuration of SAP HANA system replications.

Together, these approaches work to ensure high availability for your critical applications and make sure that if disaster strikes, you're able to recover quickly.

Scalability

The sheer volume of transactions and data in the digital economy demands computational and data-processing performance and scalability like never before. One answer to this challenge comes from Linux High Performance Computing (HCP) clusters. HPC technologies are extensively used in scientific, academic, and governmental research, but as demand for processing power and speed grows, HPC is beginning to interest other businesses of all sizes and has become increasingly popular in the mainstream data centers across industries. Commercial HPC usage now encompasses the following industries:

- Automotive engineering
- Pharmaceutical design
- Oil and gas exploration
- Renewable energy research
- Entertainment and media
- Financial analytics
- Consumer products manufacturing
- Super-scalable business computing

With advanced memory management, new processor support, and unmatched performance on systems with multicore processors, SLES for SAP is an operating system that is uniquely capable of meeting high-performance requirements. Key features include a native POSIX thread library and advanced multi-pathing and I/O capabilities, along with live patching for increased service availability, wizards that automate installation, and a page-cache limit that optimizes Linux paging behavior.

Storage Scalability

Another important aspect of scalability involves data storage—as in, where do you put the constantly growing volumes of data that are overwhelming your organization? To address this challenge, SUSE takes a software-defined approach. If this approach seems new, it needs to be noted that the logic within enterprise storage devices has always been written in software. Yet, while software-defined storage is hardly a new concept, it's only recently that hardware has progressed enough so that enterprise storage software and hardware can now be separated. Today, it's the ability to separate storage software from storage hardware that delivers the real value.

At SUSE, we base our approach to software-defined storage on open-source Ceph technology, which is designed as a distributed storage cluster to provide virtually unlimited scalability from terabytes to petabytes. Ceph is a unified block, object, and file solution that is ideal for bulk, large-data, and active-archive applications. Using SUSE and Ceph for software-defined storage, your organization can run a highly scalable solution that radically reduces storage costs both in terms of capital and operational expenditures.

Manageability

A persistent challenge of the digital economy is finding ways to manage your IT environment so that just keeping the lights on doesn't steal time and resources away from innovation. SUSE Manager can help. Built for Linux, SUSE Manager delivers open-source infrastructure management capabilities that help reduce complexity and regain control of IT assets by enabling you to comprehensively manage Linux systems with a single, centralized solution.

SUSE Manager provides automated and cost-effective software, asset, patch, and configuration management, as well as system provisioning and monitoring capabilities. These capabilities enable you to easily manage your enterprise Linux system deployments across physical, virtual, and cloud environments. As a result, your organization can decrease total cost

of ownership while securing enterprise systems and improving compliance and service quality. With SUSE Manager, you can do the following:

- Manage multiple Linux distributions (SUSE and Red Hat) from a single, centralized console
- Administer a wide variety of hardware across physical, virtual, and cloud environments
- Maintain and demonstrate compliance to internal security policies and external regulations
- Implement and enforce a standard approach to maintain Linux security
- Track hardware and software inventory with simple, automated advanced reporting

Security

While SAP pays a lot of attention to the security of the SAP HANA database, your company also needs to be concerned with connecting layers that are separate from SAP HANA, such as the operating system and the network and storage layers. Many hackers, in fact, deliberately target operating systems rather than databases. Once they have access and privileges, getting to the database application may be as simple as signing in.

SUSE has a long history in IT security for Linux operating systems and offers a comprehensive security package for SLES for SAP to protect systems from all kinds of security incidents. This package consists of the following components:

- **Security certifications.** These include Carrier Grade Linux (CGL) Registration, FIPS (Federal Information Processing Standard) 140-2 validation for OpenSSL, and Common Criteria Security certification EAL4+.
- **Security updates and patches.** SUSE constantly provides security updates and patches for the SLES for SAP operating system and guarantees the highest security standards over the entire product lifecycle.

- **Documentation.** SUSE publishes a security hardening guide that describes the security concepts and features of the SUSE Linux Enterprise Server 11 operating system. This guide provides generic security information that is valid for all workloads, not just for SAP HANA. Also available is another guide focused specifically on SAP HANA.

The SAP HANA guide provides detailed descriptions on the following topics:

- **Security-hardening settings for SAP HANA systems.** Learn how to tweak SLES for SAP security settings to further improve operating system security and security for hosted applications, specifically in the context of SAP HANA. Also learn about possible impacts of each setting, on areas such as system administration and how settings are prioritized.
- **Local firewall for SAP HANA.** Dive into the dedicated local firewall that SUSE has developed to improve network security for SAP HANA databases. This firewall selectively opens network ports on external network interfaces that are needed by SAP HANA and any other services. It is available for download from SUSE servers.
- **Minimal package selection.** To reduce the number of operating system packages on your SAP HANA system to help minimize potential security holes, learn which packages are necessary and which can be safely discarded. Reducing the number of packages also reduces the number of updates and patches that must be applied.
- **Security updates and patches.** Find out which update and patch strategies are the best, and how to configure SLES for SAP to frequently receive all relevant security updates.

The Software-Defined Data Center with SUSE

At SUSE, we see software-defined infrastructure (SDI) as a critical enabler for digital transformation (**Figure 6**). Key to the concept of SDI is that virtualized workloads can be automated, configured, consumed, migrated, scaled, and replicated independent of the underlying infrastructure

(compute/server and storage and network). SDI, in other words, leverages your existing investment in physical and virtualized systems so that you can optimize resource usage and flexibly respond to demand.

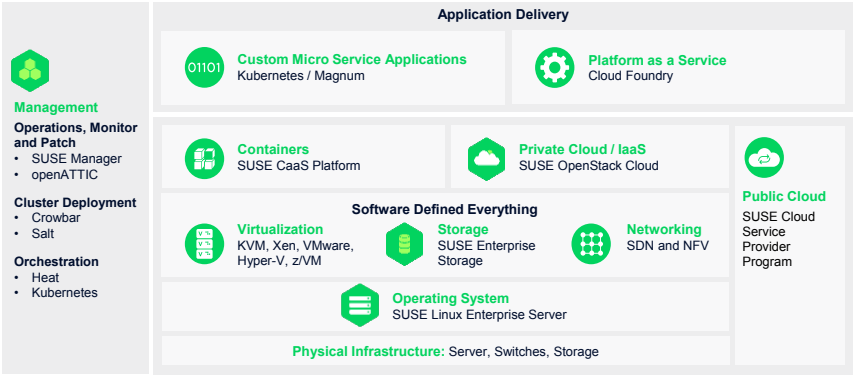

Figure 6 SUSE SDI

The potential is tremendous. With SDI, you can run a hybrid cloud environment in which infrastructure is decoupled from hardware dependencies, providing the agility and scalability needed to meet business needs while keeping control in the hands of internal IT teams. When this happens, the data center becomes a strategic asset and a source of competitive advantage. Long deployment times and the rigidity and inefficiencies of hardware-defined infrastructure are relics of the past.

In SUSE's vision for SDI, organizations can maximize the value and control of both cloud services and legacy systems, while automation frees IT staff from routine deployment and management tasks to focus more energy on strategic initiatives. On-site and public-cloud resources function as a single, fully integrated system that treats networks, storage, and servers as secure, infinitely scalable computing-resource pools. Rapid delivery and management of business solutions is an ordinary everyday event in which infrastructure provision levels for a given workload are precisely determined by application requirements for performance, reliability, and scalability.

This is a vision that's pragmatic at its core—giving you the flexibility to choose the innovative technologies that meet your requirements for increasing efficiency and managing costs, without vendor lock-in. It is also

a vision that can be made reality with open-source technology. Indeed, data centers have been built with open-source technology for decades. Open source, therefore, plays an integral role in enabling SDI implementations, leading the evolution toward more agile service delivery. And as an open-source company, SUSE has invested heavily in solutions that enable organizations to build and operate an SDI that help companies compete more effectively in a digital economy.

SUSE OpenStack Cloud

A key aspect of SDI is cross-platform deployment of system resources for applications that lines of business depend on to drive revenue and gain a competitive advantage. OpenStack provides the means to control system resource pools and automate provisioning of those resources. Although OpenStack is designed largely for facilitating private and public clouds, SUSE uses it to deliver software-defined data center orchestration in its private cloud infrastructure solution, SUSE OpenStack Cloud. In addition to delivering exceptional agility, scalability, and efficiency in mixed hypervisor (Xen, KVM, Microsoft Hyper-V, and VMware ESXi) environments, SUSE OpenStack Cloud is the easiest and fastest OpenStack-based private cloud solution to deploy.

SUSE and Docker

For IT teams, delivering services across multiple platforms in a timely manner is a constant struggle. Docker provides a standard for simplicity and agility when deploying applications in Linux containers. The low overhead and layered image system of Docker containers increases the density of application deployment. By eliminating the need for a guest operating system, Docker containers can have two-to-three times the number of virtual environments than a regular VM. This benefits building an SDI because you can reduce costs by running more virtual environments on your existing hardware platforms. Docker is fully supported with SLES for SAP for production environments and is the only Linux distribution to support Docker containers on AMD's x86-64, IBM Power Systems, and IBM

z Systems hardware. SUSE's implementation includes a secure private registry with a graphic user interface to manage application containers.

SUSE Enterprise Storage and Ceph

Another challenge for IT teams is the exploding data volumes that are making storage costs difficult to contain. Ceph is the foundation for SUSE Enterprise Storage—the resilient, highly-scalable software-based storage solution that enables organizations to build cost-efficient storage using commodity, off-the-shelf servers and disk drives. For many SUSE customers, this software-defined approach, which emphasizes hardware choice, openness, and flexibility, is a welcome departure from the more rigid systems that have defined the storage market thus far. These attributes, combined with the self-managing and self-healing of storage-server clusters, make SUSE Enterprise Storage ideal for software-defined data centers. SUSE Enterprise Storage is fully integrated with SUSE OpenStack Cloud orchestration.

SUSE Manager

Already discussed above, SUSE Manager is a critical component for enabling SDI, especially when it comes to managing hybrid environments that mix public and private cloud approaches with on premise.

This is because SUSE Manager supports Linux server management no matter where that server is deployed—in your data center or in the cloud. SUSE Manager is also available as Bring Your Own Subscription (BYOS) on Amazon Web Services, Windows Azure, and Google Compute Cloud. BYOS allows enterprise customers to transfer existing SUSE product subscriptions to select SUSE cloud service providers for use within their public cloud.

SUSE Containers as a Service Platform

SUSE Containers as a Service Platform is a solution that puts together SUSE Linux Enterprise MicroOS, the operating system optimized for running the next generation of applications with Linux containers, and the container-orchestration solution for container cluster management based on Kubernetes (an open-source application containerization technology).

This MicroOS technology is a modern Linux operating system, designed for containers and optimized for large deployments. MicroOS inherits the SUSE Linux Enterprise Server knowledge while redefining the operating system into a small, efficient, and reliable distribution. For building and maintaining container infrastructure, SUSE Containers as a Service Platform supports the following:

- Transactional updates and rollback based on btrfs technology (a copy-on-write file system)
- Container images in Docker format for fast deployment and ready-to-run application containers
- Container orchestration at scale through Kubernetes for creating large-scale business applications

In addition, SUSE Containers as a Service Platform makes it easy to install the entire cluster with complete and automatic installation and configuration of components using Salt technology (configuration management). SUSE Containers as a Service Platform empowers developers to run cloud-native container applications and operational departments to quickly set up and administrate a cluster.

Whether you're building private clouds within your own firewall, leasing IT resources from public cloud service providers, or using a combination of both, SDI is better suited for bringing about a shared,

on-demand IT services environment than traditional hardware-defined infrastructure.

Today's private clouds, public clouds, virtualized services, and bare-metal resources are all stepping stones on the path to the software-defined data center. The challenge is to make smart choices given the available options—choices that fit into your existing operations with little or no disruption while efficiently and cost-effectively leading you to a fully software-defined future.

Enabling DevOps

For agility and speed of development, many organizations are eagerly embracing the principles of DevOps. One key to success with DevOps is culture. What's needed is a group of passionate professionals who are committed to good habits and the continual improvement of these habits. The goal is to deliver a working product quickly, provide incremental changes to feedback faster, and solve the problems at hand.

Another key is automation. As things change and evolve, plan to review what can be automated periodically, using metrics to see where improvements can be made. Continuously deliver, review, and repeat. Having a smooth delivery process allows you to fix almost any problem in a timely manner. Providing more frequent deliveries gives you more confidence in your infrastructure, with more features and bug fixes. Ideally, your development and quality assurance environments should be as close to production as possible, making it easier to make changes to both, thus reducing deployment issues. Keep development resources to a minimum and solve what is on the table now. The more that teams are committed to these DevOps approaches and the more they work to improve on them, the more success they will have.

To support these aims, SUSE offers flexible, open-source solutions for each phase of the DevOps cycle. We believe in using open-source technologies, processes, and tools to enable the effectiveness of the DevOps model. We also publish our tools via open-source projects that we use for DevOps (for example, OBS and OpenQA) and that are integrated with other standard DevOps tools (for example, Jenkins). SUSE provides a full-reference framework of solutions and tools for all stages of the process, and we share our own DevOps experiences. In addition, we provide

the open-source infrastructure technologies you need to succeed in your digital transformation.

Customers: SAP and SUSE

All over the world, customers work jointly with SAP and SUSE to move forward on their digital transformation initiatives. Here are just some of their stories.

Ctac

As a managed services provider, Ctac needs to find the optimal combination of hardware and operating systems to run their clients' applications efficiently and cost-effectively. To make its managed SAP HANA service stand out from the competition in terms of performance and availability, Ctac chose IBM Power Systems servers running SLES for SAP.

The Challenge

As a long-time Gold partner of SAP, Ctac has a deep understanding of ERP solutions and their practical applications across multiple industries. When SAP introduced its SAP HANA in-memory database technology, Ctac realized that SAP HANA would ultimately forever change the way companies run their businesses.

"The pace of business is always accelerating, and the introduction of SAP HANA in-memory technology provides a huge boost in speed and responsiveness, helping companies to handle both analytics and transactions faster," says Rob van Acquoy, Operations Manager at Ctac. "As the requirement for real-time information spreads across industries, and in particular, as leading companies in each industry embrace new technology, all other companies will ultimately need the same capabilities in order to stay competitive."

Initially, Ctac implemented its SAP HANA service on Intel-based hardware, using appliances from Lenovo to handle SAP BW workloads. To extend the service, and to support customers looking to run their SAP ERP workloads on SAP HANA, Ctac recognized that it required a more powerful platform.

"IBM Power Systems offered great flexibility around running virtualized instances of SAP HANA, which suited our requirements as a

provider of hosted SAP landscapes. And with SLES for SAP specifically tuned to the demands of SAP HANA, and able to take advantage of all the hardware features of IBM Power Systems, this was the ideal combination for our requirements," says van Acquoy.

SUSE Solution

Ctac selected SLES for SAP as its preferred operating system for SAP HANA (including the SAP S/4HANA business suite). "Although IBM AIX is the 'standard' operating system for IBM Power Systems servers, we felt that SUSE Linux Enterprise Server offered compelling advantages for SAP HANA," says van Acquoy. "We made our decision for SUSE Linux Enterprise Server for SAP Applications primarily because of the close relationship between SAP and SUSE, which means that they offer the best and easiest support path. Better support means that we can keep our customers' SAP landscapes in optimum condition at all times, and also minimize our own support costs, passing on the savings in the form of extremely competitive pricing for our services. In addition, SAP develops its Linux builds on SUSE Linux Enterprise Server, so new functionalities are available sooner and the quality and stability are generally better on this distribution of Linux."

Using the SAP-certified SUSE Linux Enterprise High Availability Extension helps Ctac to achieve extremely high availability for its clients at much lower cost than competing solutions. This is because it incorporates clustering technologies for application servers, storage, and network components in a single solution. By contrast, the other leading distribution of Linux requires companies to license and deploy three separate products to achieve equivalent results.

Furthermore, using SLES for SAP enables Ctac to take advantage of a page cache limit option that optimizes performance for SAP workloads. Conventionally, the Linux kernel will follow a process of swapping out infrequently accessed application memory pages and use these as a cache to accelerate standard file system operations. In an SAP landscape, this process can have a negative impact on performance because certain SAP applications need large amounts of memory, some of which is only rarely accessed. The SLES for SAP page cache limit option instructs the kernel to give priority to application memory when the page cache is filled to the configured limit, rather than paging it out. By removing the potential

conflict between application memory and system page cache, the issue of degraded performance is eliminated.

On the hardware side, SLES takes full advantage of the unique capabilities of the IBM Power architecture, including those enabled by the PowerVM hypervisor. SAP HANA workloads are designed to work best on systems that maximize memory bandwidth, multi-threaded instructions, and CPU caching, precisely what IBM Power offers.

For SAP HANA systems, SUSE Linux Enterprise Server is the only operating system able to take advantage of the latest IBM Power 8 processors. This means that Ctac's clients can access features such as simultaneous multi-threading with eight threads per core (SMT-8). This enables more instructions to be executed at the same time than on Intel-architecture systems, where the CPU is limited to two hardware threads per core. Critically, the IBM Power architecture also supports more memory per system and offers significantly larger L2 and L3 caches. With much lower memory latency, the Power architecture running SUSE Linux Enterprise Server minimizes the time CPUs spend waiting for data. Ctac has also deployed SUSE Manager to help manage software licenses and deploy patches across its 80 SUSE Linux Enterprise Server instances.

The Results

With SLES for SAP on IBM Power supporting its customers' SAP landscapes—including conventional SAP ERP—Ctac has the optimal combination of performance, availability, flexibility, scalability, and easy management. The latter two advantages translate into lower costs for Ctac, helping it to provide exceptional service levels at a lower price than its customers could achieve if they were running their SAP landscapes in-house.

Choosing the SUSE Linux Enterprise platform rather than AIX for its IBM Power Systems environment has given Ctac more flexibility, because it can also run the same platform on its Intel servers. As van Acquoy explains: "One of the best things about SUSE Linux Enterprise Server is that it gives us a great deal of flexibility for our SAP HANA service. For example, there are some SAP features that are supported on Intel architectures, but have not yet been released for Power. If one of our customers wishes to use these features, we can support them on SUSE Linux Enterprise Server on VMware until they become available on IBM Power Systems. And because the operating system is the same on both platforms,

it's much easier to manage, not least because we have SUSE Manager controlling the whole infrastructure."

The combination of SLES for SAP and SUSE Manager makes it easy for Ctac to keep track of all its Linux instances, no matter what platform they run on. SUSE Manager automatically fetches the patches and updates the patching journal for each system, minimizing the risk of security or stability problems.

Finally, tight integration between SUSE Linux Enterprise Server and the IBM Power Systems' hardware also makes it easy to spin up a new Linux instance whenever an existing or new customer requires it—by using IBM PowerVC, Ctac can get a new instance up and running in just 10 minutes.

Emmelibri

To provide impeccable services to help its clients in the publishing industry thrive, Emmelibri wanted to become more agile and cost-efficient. To take advantage of its mature virtualized environment, eliminate superfluous costs, and boost processing power for critical SAP applications, the company needed a leaner, more sustainable operating system. After attending SUSECON, Emmelibri realized that SLES for SAP was the ideal solution to increase processing capacity, generate cost savings, and deliver unprecedented scalability.

The Challenge

Providing services that enable brick-and-mortar publishing companies to succeed and web-only resellers to surpass their online rivals, Emmelibri continually needs to keep pace with evolving industry trends. This translates into the requirement for faster, more cost-effective, and more scalable service delivery to ensure that their publishing customers continue to prosper regardless of their business model. Luca Paleari, CIO at Emmelibri, says, "We identified the proprietary UNIX operating system and hardware platform for our SAP landscape as one of the elements that hindered the innovation strategy that we were pursuing. First of all, the existing platform was too expensive to manage, maintain, and upgrade, particularly if we wanted to fully virtualize the SAP landscape. Second, enabling full business continuity and disaster recovery functions was prohibitive in terms of costs and complexity."

High availability and disaster recovery are essential to the companies Emmelibri serves because 75% of them use SAP applications for their core business processes. That means any unexpected downtime could potentially translate into financial or reputational damage.

SUSE Solution

Emmelibri identified the SUSECON event as instrumental in choosing its new operating system. As Luca Paleari says: "By attending SUSECON, we came in closer, more in-depth contact with the SUSE world and appreciated the company's dynamic, skilled and professional approach. This helped us to better evaluate SUSE's offering and realize that SUSE Linux Enterprise Server for SAP Applications was the solution that best suited our long-term strategy."

During the first phase of the implementation project, the joint Emmelibri and SUSE team migrated most of the company's SAP world—including SAP ERP with modules for financials, control, and materials management; SAP Enterprise Portal; SAP BW; and SAP BusinessObjects—to the SUSE platform. The remaining applications, running third-party operating systems, will soon be migrated to SUSE Linux Enterprise Server, fully virtualized on VMware and running on Cisco UCS servers. By moving SAP to its preferred virtualization platform (Emmelibri has more than 500 virtual servers on VMware), the company now benefits from new abilities to concentrate skills and investment on a single platform.

The Results

Migrating its SAP landscape from IBM's Advanced Interactive eXecutive (AIX) to SLES for SAP has already delivered significant benefits to Emmelibri, with more to come.

Emmelibri also benefits from the fact that SLES for SAP is specifically tuned to meet the demands of SAP ERP software and includes a separate update channel for certified and pre-tested software packages. SUSE provides integrated priority support, working with SAP to support the whole stack from a single point of contact.

dm-drogerie markt

To innovate faster than its rivals, German retail store chain dm-drogerie markt migrated its SAP environment to SLES for SAP—a huge advantage, as SLES for SAP is typically a preferred platform for new SAP offerings. With support from SUSE Consulting, the company completed the migration three months earlier than planned. With the new SUSE platform in place, dm-drogerie markt has cut SAP response times by 40% on average.

The Challenge

dm-drogerie markt is a leader in its industry, achieving year-on-year revenue growth of around 10 percent. Even as the fight for market share in the notoriously competitive retail market has become more intense, dm-drogerie markt has held on to its leading position and continues to achieve significant growth. To accomplish such remarkable success, the company has retained a clear focus on boosting agility and providing excellent customer service.

Now, the company is looking to expand even more by winning market share. To hit its ambitious growth targets, dm-drogerie markt needed to sharpen its ability to deliver even better customer service. That didn't just mean improving the quality of the services it already offers; the company also wanted to come up with new ways to delight shoppers.

To further improve the shopping experience, dm-drogerie markt wanted to ensure that customers can purchase their desired products anywhere—in store and online. Taking its approach to inventory management to the next level, the company deployed the innovative SAP Customer Activity Repository application. This offering combines data from real-time inventory, on-shelf availability, customer purchasing habits, and ERP systems to create unified demand forecasts. These forecasts enable dm-drogerie markt to figure out precisely which products customers are likely to buy, purchase appropriate stock levels of these products, and offer them at the right locations. The new SAP application takes advantage of the cutting-edge SAP HANA database, which features in-memory data processing and a columnar structure, making it easy to report on massive quantities of data at lightning speed. As business users across dm-drogerie markt become increasingly accustomed to the speed of SAP HANA, they

are requesting more and more services on the platform, which gives them rapid insight to support smart business decision making.

Separately, dm-drogerie markt is consolidating its ERP systems on the SAP ERP platform. By replacing existing home-grown solutions with standard applications, the company will be able to take advantage of pre-packaged functionality. This will enable the IT team to cut down on development work, release new functionality in days rather than weeks, and save money.

Because of these new deployments, dm-drogerie markt's SAP systems are becoming even more central to the business. As such, it has become increasingly important for the company to be able to take advantage of new offerings from SAP as soon as they are released. Since SAP typically launches new solutions for Linux before making them available on other platforms, the company recognized that it would be much easier to stay one step ahead of competitors if it migrated the SAP applications to a Linux-based solution.

SUSE Solution

After evaluating offerings from a range of vendors, dm-drogerie markt decided to migrate its business-critical SAP ERP applications from the IBM z/OS and AIX operating systems to the SLES for SAP platform. Replacing its existing IBM mainframe and IBM Power Systems servers, the company deployed an x86 infrastructure based on VMware virtualization technology.

After deciding to move to Linux, dm-drogerie markt examined different distributions and found that SLES for SAP was a perfect fit. First off, SLES for SAP has a strong track record of providing exceptional performance and excellent reliability. Secondly, a dedicated SUSE team was able to provide local support during the migration process, taking a lot of the anxiety out of such a critical project. On top of that, SUSE has an extremely close relationship with SAP, and new SAP offerings are typically available first on SLES for SAP, so the company would not have to wait for the latest functionality.

An expert team from SUSE Consulting provided extensive support to help dm-drogerie markt deploy the new solution seamlessly. The SUSE consultants listened carefully to the company's needs and worked closely together with dm-drogerie markt's in-house IT team. Together, the teams

designed an entire Linux infrastructure and processes tailored to suit dm-drogerie markt's business.

Throughout the migration project, dm-drogerie markt worked hand-in-hand with the SUSE experts. Whenever dm-drogerie markt hit obstacles, the SUSE team helped solve them quickly, ensuring that the mission-critical SAP applications could continue running smoothly throughout the project.

Today, dm-drogerie markt relies on SUSE Linux Enterprise Server to support its mission-critical SAP applications. These include SAP for Retail, a sophisticated ERP solution tailored to meet the needs of companies in this industry, and SAP E-Recruiting, which is part of the SAP Human Capital Management solution. In addition, dm-drogerie markt relies on the SAP Solution Manager tool, which acts as a central lifecycle management hub for SAP systems.

Because dm-drogerie markt's SAP applications rely on the SUSE Enterprise Linux Server operating system, the company can take advantage of new SAP solutions extremely quickly. For example, the company recently deployed its first SAP Fiori app, an advanced mobile solution that enables staff to complete tasks such as claiming travel expenses on the go. Ultimately, by providing business users with the latest technological innovations, the IT team helps them work more productively.

For years, dm-drogerie markt relied on the IBM DB2 for z database running on an IBM z Systems server to support its SAP systems. The SAP applications were operated in a three-tier setup, where the database and applications were running on different servers with different operating systems and management processes.

To streamline and standardize its SAP application landscape, the company recently migrated its SAP ERP databases to IBM DB2 for Linux, Unix, and Windows running on SUSE Linux Enterprise Server. Now, the company has implemented a two-tier architecture, operating the database and the SAP application on a single system. This not only reduces networking latency and overhead, it also simplifies system maintenance and management because applications and their relevant data are better separated from each other. As a result, the SAP system configuration is simpler, and dm-drogerie markt avoids the problem of maintenance on a central database instance affecting all applications.

To optimize performance for its large SAP workloads, dm-drogerie markt is taking advantage of a kernel-tune option in SLES for SAP. As standard, the Linux kernel swaps out any application memory pages that are rarely accessed and uses the freed-up memory pages as a cache to speed up file system operations. But some SAP systems require large amounts of memory to ensure rapid access to business data, and some of this memory is rarely accessed. If a new request submitted by a business user requires the application to access memory that has been paged out by the kernel, the user would typically experience sluggish response times. However, the kernel-tune option in SLES for SAP tells the kernel that once the page cache has been filled to a pre-defined limit, application memory takes priority and should not be paged out. Using this feature, dm-drogerie markt can limit the amount of page-cache used by the Linux kernel whenever applications and the system page-cache compete for memory. As a result, business users can enjoy rapid response times for their queries around the clock.

As part of its consulting service, the SUSE team deployed SUSE Manager and provided training for dm-drogerie markt's IT staff, showing them how to use the solution to automate patch and configuration management.

The Results

Although dm-drogerie markt did not encounter any problems with the availability and performance of its SAP applications on the previous platform, migrating to SLES for SAP has enabled the company to achieve a superior price performance ratio, without compromising system reliability.

Moving to SLES for SAP cut response times for the company's mission-critical SAP applications by around 40 percent on average. In fact, some reports that used to take 3.5 hours now complete in under an hour, a remarkable improvement. In addition, the IT team can deploy SAP support packages around 30 percent faster than before.

Additionally, taking advantage of the cutting-edge SUSE Manager solution enables dm-drogerie markt to manage its SAP environment more efficiently. As a result, the company successfully expanded its SAP footprint without increasing the burden of system management on IT staff.

Conclusion

As we've seen throughout this book, most companies have little choice but to transform. Digital natives and nimble players of all sorts are attempting to take market share wherever possible. Consumers demand more, and boundaries aren't what they used to be. Manufacturers are going direct and cutting out the retailer. Technology companies are entering the banking industry with new ways of managing financial transactions that leapfrog traditional models. The commonly repeated adage for the digital age is true: Today every company is a technology company, and if you're not, you need to embrace digital transformation in order to survive and thrive.

SAP is a leading enterprise software company with a comprehensive approach to digital transformation, from the way the company thinks about the challenges of the digital economy to the way it has revamped its portfolio for the cloud to help its customers succeed. With the in-memory processing made possible by SAP HANA, your company can generate insight faster. With the agility enabled by SAP Cloud Platform, you can respond to change with confidence. And with a re-coded business suite in the form of SAP S/4HANA, you can deliver better customer experiences, engage the workforce more effectively, manage your spend with greater control, and achieve new levels of supply chain efficiency by leveraging the IoT.

Supporting your SAP environment with an equally resolute focus on digital transformation is SUSE.

Our vision of software-defined infrastructure based on open standards gives you the power to optimize your technical resources—compute, network, and storage—so that you can realize the performance needed to operate effectively in the digital economy. And with a relationship with SAP that spans almost two decades, we've integrated our technology into SAP's at a level that helps you meet—with confidence—almost any challenge you face on your digital transformation journey.

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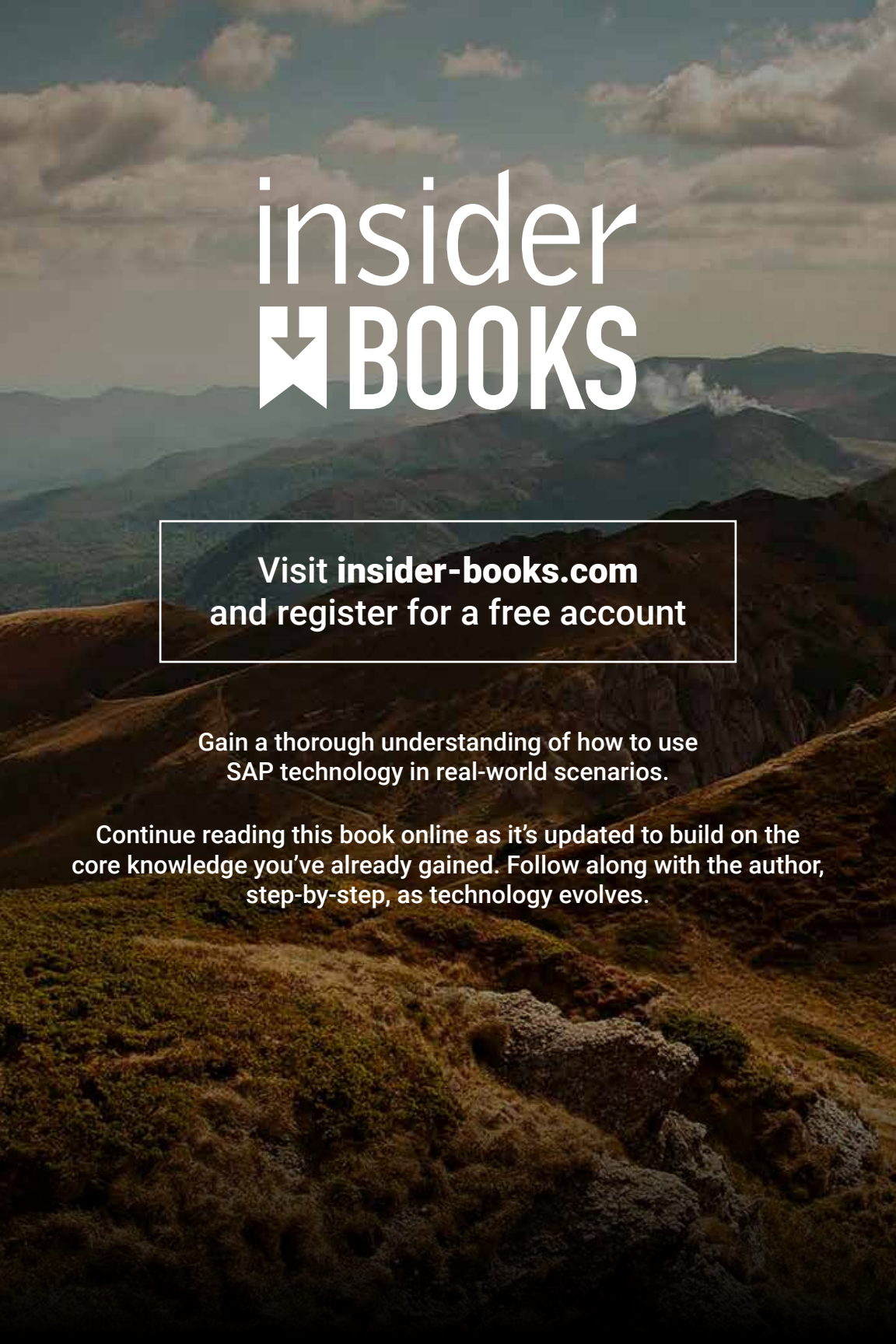
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