Distilling Data: Machine Learning and the Promise of AI in Consumer Products
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Turning Data Challenges into Opportunity

Every year, the volume of world data doubles, and 75% of it is in unstructured formats such as text, voice, and video. Never have consumer products (CP) companies held so much information on consumers, suppliers, and internal processes. The big question is, how can CP companies harness this flood of data to achieve better business outcomes and compete more effectively?

Much of this data is coming from customers and Internet-connected devices, which are quickly permeating every aspect of modern life, both at home and at work. Analysts expect, “In five years, 1 million new devices will come online every hour, creating billions of new interconnections and relationships, and producing more and more data.” The challenge is figuring out how to turn this gold mine of data into tangible competitive advantage – ahead of competitors.

At the same time, consumers have fully embraced mobile devices that provide anytime, anywhere access to information and countless buying choices. But as information volumes and choices continue to grow, the customer experience is becoming overwhelmingly complex. The challenge for CP and retail companies is to find ways to simplify and improve the customer experience, rather than contribute to the information overload.

For CP and retail companies, the business backdrop to this emerging data story is multifaceted and complex – and driving the need to harness this data more quickly, more effectively, and in novel ways. Specifically:

- Most CP companies are facing persistent and extreme pressure on margins, ever-heightening customer expectations, and demands for greater agility – both internally and in dealings with customers – across the value chain.
- Digital disruption is raising the competitive stakes as smaller, more specialized CP companies are bypassing traditional distribution models in favor of a straight-to-consumer, e-commerce-first strategy.
- CP and retail customers increasingly want personalized products and experiences, and companies that are able to deliver them can build lasting customer relationships. The challenge is scaling personalization even as customer data volumes and the variety of formats explode.

In this paper, we posit that artificial intelligence (AI) is the missing link among three variables: massive data stores, mass personalization of products and customer experiences, and the ability to navigate and win in today’s complex business environment. AI is defined as the ability of computers to mimic human logic and thinking, for example, learning to play a strategy game, such as chess. AI can also be used to perform natural language processing (to interpret what people really mean in a text), speech recognition (think Siri from Apple Inc. and Echo and Alexa developed by Amazon.com Inc.), and visual recognition (to conduct quality inspection of goods). These AI methods are collectively described as “cognitive computing.”

AI technologies have been named “the next industrial revolution” by the World Economic Forum, as these technologies can dramatically transform everything from the total customer experience to internal business processes across the enterprise. This paper focuses on the potential of machine learning, a subset of AI that refers to the ability of computers to learn from data without being programmed. Machine learning algorithms adapt to change by learning continuously as data accumulates, making them a powerful tool for CP companies seeking to make accurate predictions or take the next best action automatically.

Machine Learning: No Longer Hype

Machine learning has the potential to understand, personalize, and influence consumer behavior in-store and online, resulting in higher revenue and profitability simultaneously. Because machine learning algorithms can adapt to change by learning continuously, they can:

• Find patterns and predictions across the large, highly complex data sets that are common in today’s CP landscape
• Predict, with remarkable accuracy, next-best-action outcomes and embed these predictions in real-time transactions at massive scale
• Filter out and recognize bias from data-based facts

These capabilities make machine learning and artificial intelligence absolutely essential to responding to digital disruption and new market and business demands, such as scalable personalization. For example, when a shopper goes to a Web site in search of a product, the Web site must be able to push out personalized offers and views that are highly tailored based on the shopper’s search history. So it’s no surprise that, according to Demis Hassabis, CEO of DeepMind Technologies, personalization cannot be scaled without machine learning algorithms and artificial intelligence embedded within all aspects of the customer experience. 5

5. www.youtube.com/watch?v=rbsqaJwpu6A
Harnessing the Speed and Accuracy of Modern Machine Learning

In the early days of deep learning, the technology was plagued by a lack of speed and accuracy. But given recent technological advancements, there’s never been a better time for CP companies to adopt machine learning technology. Doing so will be critical to their success, as CP businesses tend to have large consumption and faster cycles, creating massive amounts of data and variables. They need analytical solutions with massive computing power to process this data and deliver fast, accurate results.

The latest machine learning solutions use in-memory computing technology, which provides the fastest data-retrieval and processing speeds available today. This allows them to crunch massive data volumes in near-real time, and with great accuracy. (For example, in pilots with SAP customers, in-memory-computing analytic solutions from SAP have produced results that are more than 98% accurate.) This processing power – combined with embedded AI and machine learning technologies across the whole value chain – can transform how companies run and service customers (see Figure 1).

WHY MACHINE LEARNING FOR CP NOW?

While use cases for machine learning have been around for decades, it’s only recently that consumer products (CP) companies have been able to harness it, thanks to:

- Affordable massive computing power to process massive amounts of data quickly
- Ability to embed sophisticated algorithms within transaction processing to make and automate decisions in real time
- Availability of massive, historical data sets – structured and unstructured
- Analytics that are more than 98% accurate at predicting outcomes when processing the right data
- Pervasive mobile devices that can be used to inform and influence consumers in real time
- New scientific advances in deep learning
DELIvERING THE WHAT, NOT THE WHY

One thing hasn’t changed, even with the most advanced machine learning solutions: while these technologies can predict accurately what will happen and what will yield the best outcome, no computer can answer the question, “Why?”

However, this does not detract from the huge potential value of machine learning for CP companies. As noted earlier, more than anything, customers today want simplicity, convenience, and trust. And by harnessing their data using machine learning, CP companies can meet these customer needs by creating simpler, seamless, and personalized customer experiences.

EARLY ADOPTErS ArE SEEING BIG rESuLTS

Those CP companies that adopted machine learning early are seeing significant positive results, such as dramatically improved sales, profitability, customer engagement, and productivity. According to McKinsey, CP companies outperforming their peers typically use far more advanced analytics (including machine learning) than their competitors to set shelf pricing, determine product assortment and mix, and optimize trade promotions.6

For instance, consider the success of eBay Inc., one of the world’s largest online marketplaces. This company is strongly dependent on understanding the buying and selling patterns hidden among its millions of daily transactions. eBay needed a faster, more efficient way to sift through its massive 50 petabytes of data to separate accurate market signals from noise. Through a partnership with the innovation center at SAP Labs LLC in Palo Alto, it is now using a machine learning solution to analyze over 500 metrics.

As a result, management can know with 97% confidence that a signal from a shopper is a true positive, and then respond by offering the next right action for exactly that customer. In this way, machine learning allows eBay to scale personalization across every customer, simultaneously.

The benefits of machine learning and AI have been proven in other industries as well. Most notably, financial services and media companies have already embraced AI in response to recent waves of digital disruption. For example, in Europe, more than a dozen banks have replaced older, statistical-modeling approaches with machine learning techniques. These new recommendation engines are delivering undeniable results, including:

• 10% increases in sales of new products
• 20% savings in capital expenditures
• 20% increases in cash collections
• 20% declines in churn 7


Applying Machine Learning Across the CP Enterprise

Given the strategic role of AI and machine learning – and how it is transforming core business areas – these technologies can dramatically change everything from the total customer experience to internal business processes. Let’s take a closer look at the business value of machine learning and AI across core business processes, with a focus on how it can revolutionize the total customer experience.

This closer examination is critical, because consumers don’t want things done to them, but rather for them in a way that’s faster, easier, and more personalized. Apps, for example, that advise consumers when to buy flights, or where to purchase diapers, are perceived as high value because they free up consumers from the countless searching-and-matching exercises that take time and effort. In short, the apps can make the lives of consumers simpler.

By 2018, 20 percent of business content will be authored by machines.  

The following table summarizes recent examples of how companies are harnessing machine learning to solve problems and increase efficiency across the CP enterprise in a way that directly touches consumers.

<table>
<thead>
<tr>
<th>Company</th>
<th>Business Goal or Need</th>
<th>Machine Learning Application</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>A large communications company</td>
<td>Improve customer service and bring more people’s digital lives to life</td>
<td>Uses predictive algorithms within SAP® software to personalize offers for more than 6 million subscribers across 28 regions</td>
<td>Goals realized include: • 14% more products per customer household • 28% reduction in customer churn rate • 80% reduction in effort through the use of precise, accurate, fast polling of 10 million observations and 800 variables to identify propensity to purchase, churn, and credit risk</td>
</tr>
<tr>
<td>Various SAP customers</td>
<td>Gather statistics on the brand’s visual exposure, estimate ROI in ad contracts, and optimize logo placement for maximum exposure</td>
<td>Employ an innovation center at SAP Labs LLC to create a machine learning app that detects the visual exposure of specific brands and statistics in videos and images</td>
<td>Now customers can: • Estimate ROI in advertising contracts and optimize logo placement for maximum exposure • Use image recognition technology to detect consumer emotions in real time</td>
</tr>
</tbody>
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## Personalizing product development
Scaling personalization of products to meet unique customer needs and preferences

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>Flavorprint from McCormick &amp; Company Inc.</td>
<td>Provide better nutritional choices for the healthy, consistent outcomes demanded by consumers</td>
<td>Use advanced machine algorithms to mix thousands of flavors to make products that consistently meet consumer preferences, even as weather patterns, crop yields, and cost pressures change</td>
<td>Food companies can constantly tweak their recipes to keep them faster and easier for high customer satisfaction.</td>
</tr>
<tr>
<td>A large bank</td>
<td>Reduce churn and retain existing customers</td>
<td>Uses SAP HANA® Cloud Platform and machine learning to monitor and predict triggers that create churn risk and deliver a highly customized experience whenever customers trigger a churn indicator, which helps retain customers</td>
<td>By combining real-time data across various channels (phone, branch, Internet) and processing over 7 TB of data, the algorithm predicts churners with 88.8% accuracy. This enables the bank to take proactive action to retain customers.</td>
</tr>
<tr>
<td>WeissBeerger</td>
<td>Give beer brewers and bars true, consumption-related insight into their products to help them optimize promotions, sales, and operations</td>
<td>Applies analytics to the beer tap with the SAP HANA platform to generate insights into consumption patterns</td>
<td>By delivering consumption-related insights about their products, WeissBeerger helped clients: • Optimize promotions and adjust pricing for each bar using promotional algorithms • Improve sales, operations, and consumption while reducing waste</td>
</tr>
</tbody>
</table>
Company Business Goal or Need Machine Learning Application Results

**Supporting customer service**
Improving customer service and responsiveness while reducing costs

Various SAP customers  Help customers navigate their products, find what’s best for them, and learn about new product functionality  Use Concur® solutions and SAP Ariba® solutions and their voice recognition functions to help users select trips or find the right spare part to purchase; employ chatbots – which use voice recognition and machine learning algorithms – to provide customer support in any language  Solutions are being piloted.

**MAXIMIZING PRODUCTIVITY ACROSS THE INTERNAL VALUE CHAIN**
The business impact of AI and machine learning can dramatically improve operational productivity across supply chain, accounting, and human resource operations – not just the customer experience. Companies are using these technologies to connect their front and back offices to increase efficiency and reliability, support new business models, increase competitiveness, and even introduce device processes that eliminate the need for human intervention.

For example, many large, online retailers are seeing their fulfillment costs rise more quickly than sales. Market winners will be those companies that find and apply just the right shipping permutation for each order to reduce costs without frustrating customers. Companies are innovating by shipping orders for multiple items in fewer boxes from different warehouses or stores, or directly from suppliers. They may hold shipments until all items are aggregated from various warehouses and suppliers, or group shipments so that items currently in stock go out immediately, with others sent directly by manufacturers. Other retailers – such as Amazon – give customers options for free shipping and prepaid, expedited shipping, and the option to ship items as they are ready in multiple boxes.
Similarly, marketing processes are being disrupted in positive ways by machine learning technologies. For example, machine learning is increasingly the engine behind in-store apps that can tell how long a customer has been in a certain aisle and then provide that customer with targeted offers and recommendations based on data about the customer’s personal consumption and preferences.

Consider how KAESER KOMPRESSOREN SE, one of the world’s largest suppliers of air systems, is using AI to simplify the sales lifecycle and streamline its supply chain to meet customer needs while generating healthy margins. Using SAP® solutions, it can proactively monitor customer assets and address maintenance needs – all while increasing service levels of customers. For example, its customers are benefiting from improved equipment uptime, decreased time to resolution, reduced operational risk, and accelerated innovation cycles.

More important, the company has been able to align products and services more closely with customer needs, strengthening its market position as a thought leader and innovator – for example, by selling “air as a service.” By innovating new business models – and becoming a value-added service provider, not just a commodity business – KAESER KOMPRESSOREN can increase profitability and stock pricing for stockholders.

The following table provides examples where machine learning algorithms are being used to crunch data that would have been impossible for humans (and machines) in the past, helping create more profitable ecosystems and effective supply chains. It illustrates how companies are extending machine learning with robotics and solutions for the Internet of Things everywhere – from manufacturing to retail stores.
<table>
<thead>
<tr>
<th>Company</th>
<th>Business Goal or Need</th>
<th>Machine Learning Application</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Various customers of Semantic Visions</td>
<td>Mitigate risk across the delivery of products</td>
<td>Use VEGA to analyze 90% of the world’s news content to detect millions of signals in the world’s top 10 languages, distinguishing critical signals from noise and giving customers the situational intelligence needed to respond</td>
<td>Over 1 million companies use VEGA to track their supplier networks worldwide and to detect supply chain threats – in real time – before they disrupt production lines and impact costs.</td>
</tr>
<tr>
<td>Various customers of SAP S/4HANA®</td>
<td>Achieve a range of goals</td>
<td>Work with predictive algorithms embedded within SAP S/4HANA to adjust safety stocks; use software to integrate the information of corporate finance, operations, manufacturing, warehousing, and transportation systems</td>
<td>SAP benchmark results show reduced inventory by five days per SKU and order fill rate improved by 7%.</td>
</tr>
<tr>
<td>A large home improvement giant</td>
<td>Maintain accurate inventory in real time, reduce inventory management costs, and improve service in stores</td>
<td>Uses an inventory-checking robot that glides through the aisles, scans bar codes with “computer vision,” and uses a laser to detect items that are out of stock</td>
<td>The robot keeps inventory records up-to-date. It moves out of the way of shoppers, and interacts with them to help them find products, even with people who speak different languages.</td>
</tr>
</tbody>
</table>

Continued
### Streamlining the supply chain and back office
Using machine learning to make services and operations more efficient

<table>
<thead>
<tr>
<th>Company</th>
<th>Business Goal or Need</th>
<th>Machine Learning Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>A luxury car manufacturer</td>
<td>Diagnose, correct, and prevent faults</td>
<td>Uses advanced data algorithms to diagnose, correct, and prevent faults</td>
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<tr>
<td></td>
<td></td>
<td>By reducing the instance of faults, the company is reducing costs. It has enabled a new</td>
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<td></td>
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<td>business model – a new total care service where customers are charged per hour for the use</td>
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<tr>
<td></td>
<td></td>
<td>of its engines, with all servicing costs underwritten by the company.</td>
</tr>
<tr>
<td>Port of Hamburg (Germany)</td>
<td>Ensure that cargo from millions of containers each year finds the fastest route to the world</td>
<td>Uses SAP HANA® Cloud Platform, embedded predictive algorithms, and the Internet of Things to enable every component in the harbor to communicate, including ships, trucks, people, cranes, bridges, and traffic control systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Real-time information and predictive algorithms let shipping agents view the availability of containers at the docks and work with terminal operators on collection schedules to reduce waiting times. As a result, the port saves 5,000 truck-hours each day.</td>
</tr>
<tr>
<td>Google Inc.</td>
<td>Reduce energy usage</td>
<td>Employs self-learning algorithms to reduce its energy consumption</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The company reduced energy consumption by up to 40%, equivalent to the amount used in a year by 350,000 U.S. households, a savings of hundreds of millions of dollars per year.</td>
</tr>
</tbody>
</table>

The Technical Limitations of Machine Learning

As these examples suggest, machine learning has come a long way, delivering the incredible levels of speed and accuracy needed to support enterprise-class applications. Looking ahead, the main barrier to widespread adoption of machine learning is creating AI that actually “acts like a person.” Humans often do not act in rational ways. Our emotions guide our decisions, and hence the most logical action — the action current AI solutions would take — may not be what a consumer or employee would choose. Machines can learn from historical data on actual human behaviors and improve responses and user experiences over time. But if someone introduces a new behavior, the machine won’t have any basis to determine how to respond properly.

Research indicates that machine learning algorithms may learn and inadvertently incorporate bias into decision-making processes. Each transaction provides a portion of a historical map from which better, future decisions can be made. But past decisions are not always the best map to inform future decisions and outcomes.10

These issues are being addressed, however. And we can see this in today’s state-of-the-art solutions. Consider SAP SuccessFactors’ HCM Suite, which includes a complete set of tightly integrated talent management solutions, robust workforce analytics and planning support, and a next-generation core HR solution. This suite uses a machine learning algorithm to parse information and provide a very simple visual interface to help companies rank the best candidates. The software identifies and tracks CVs, eliminates unconscious biases by supporting the down-selection of candidates, and can narrow down candidate lists. Narrowing down to a short list of candidates typically takes up to 80% of the time HR professionals spend in the hiring process. Machine learning powered by the right solutions vastly accelerates this process while eliminating bias.

Getting Started with AI and Machine Learning

As these real-world examples illustrate, the opportunities afforded by AI – and machine learning in particular – are huge. And we are just at the beginning of the AI journey. But as with any disruptive technology, there are barriers to adoption and questions to answer. Will machine learning eliminate jobs? What will people do after their jobs have been eliminated? Will machines optimize results or “bake in” prejudice based on historical data and human behavior? And how do we safely manage and protect customer data?

Some of the brightest minds in the world are working to answer these questions (see the sidebar). At the same time, companies are moving ahead – investing strategically, learning and sharing their experiences, and reaping the rewards of innovation. They are using machine learning, for example, to complete repeatable, onerous tasks – many of which couldn’t be scaled in the past – in an efficient, automated way. This allows them to reduce costs by increasing efficiency while freeing up valuable human resources to do work that only people can do, such as empathizing with a customer or creating an appealing marketing campaign.

TACKLING THE BIG QUESTIONS AROUND ARTIFICIAL INTELLIGENCE

Cambridge University, in collaboration with Oxford University and University of California, Berkeley, just launched a new research center that will explore the opportunities and challenges to humanity posed by the development of AI. The multidisciplinary center brings together philosophers, psychologists, lawyers, and computer scientists to research the ethics and responsibilities of AI.

Stanford University has invited leading thinkers to begin a 100-year effort to study and anticipate economic and social implications in the design and use of AI systems.11

11. https://ai100.stanford.edu/about.
LEARNING FROM SUCCESSFUL EARLY ADOPTERS

So how can CP organizations get started with AI – and in particular, machine learning? A first step is to take a look at how other companies are harnessing AI and machine learning for competitive advantage. This can help leaders break out of what’s familiar and envision what’s possible.

They can also learn from the mistakes and best practices of firms that have already entered the world of AI – and partner with the right solution provider to help them realize their vision. In the work carried out with customers implementing AI solutions, SAP has identified the following 10 best practices to consider:

1. Don’t try to start from scratch. Machine learning technologies are sophisticated data stores with faster computing power, requiring data scientists and advanced statistical methods and platforms. None of this can be easily learned on the job. Companies achieving quick results partner to make use of the latest available software that has human-like intelligence embedded into its core functionality.

2. Have good master data – and master the data. Data must be managed to be useful, meaningful, and actionable. This means knowing what data is required to solve a given problem. Without the right data, even the world’s most sophisticated machine can’t find a pattern.

3. Seek to solve a specific question or problem. If the question hasn’t been framed, employ design thinking.

4. Use internal and external data sources – and hyperpersonalize to understand individual customer behavior and the market as a whole. This might mean importing data from other e-commerce platforms, retail partners, social data, and proprietary Web sites to enhance existing data sets in order to find patterns of shoppers and consumers.

5. Facilitate people and machine collaboration. Although insight can be best extracted from data through advanced machine learning algorithms, certain tasks – such as creative campaign building – are better suited to marketing teams.

6. Empower frontline staff to make real-time decisions. Frontline managers armed with deeper insights must learn to make more decisions on their own. Top management sets the overall direction but only intervenes when exceptions surface.

7. Pay strict attention to privacy and ethical concerns. This means having a legally vetted, transparent, human framework for delimiting what data can and can’t be used, and in what ways. It ensures that the AI-driven decisions are ethical and socially responsible, and that companies are accountable for them.

8. Protect no sacred cows. Use A/B testing and employ experiments to render the most optimal results over time. Learn and improve from mistakes.

9. Ensure privacy by design. Have a framework (legally and transparently validated by consumers) around what data can be used and how it can be used with opt-in features.

10. Be aware of the ethical and social implications of AI and machine learning. In a field as new as this, it’s hard to foresee where the technology may take us. But it’s certain there will be very real impacts on CP companies, their employees, their customers, and their partners. It’s a fragile ecosystem, so it’s important to act with deliberation and care.
CHOOSE THE RIGHT PARTNER
As CP companies move forward, it’s important that they choose the right ecosystem of AI solution providers to help them identify and implement AI opportunities with the greatest rate of return – now and in the future. This means investing in solutions that can be embedded across the entire enterprise with minimal effort. Doing so is critical, as the power of machine learning comes from combining massive transactional data sets with algorithms that learn by themselves.

Over the past 43 years, SAP has led the market in standardizing and optimizing software supporting business processes across 25 industries. Today, 74% of the world’s transactions run on SAP software and technology. Armed with deep knowledge, a strong customer base, and technologies that can process Big Data in real time, SAP is uniquely positioned to embed AI and machine learning in all business software across the enterprise to unlock significant value.

Since 2010, SAP has spent over US$30 billion in acquisitions and innovation, resulting in in-memory computing with the SAP HANA® platform, a wide range of advanced analytics solutions, AI and machine learning functionality, and mobile and cloud solutions. With these new technologies, SAP is enabling the five digital capabilities and platforms that save CP companies months of development and scarce resource time as well as resources (see Figure 2).

Figure 2: SAP Enables Five Digital Pillars for Business Process Innovation
LEARN MORE

AI is no longer just hype. AI technologies such as machine learning have evolved in recent years to support transformative business solutions with huge potential benefits. CP companies can ignore it at their peril because, make no mistake, other firms are moving ahead, investing in solutions that will put them at the head of the pack.

To learn more about CP applications that include machine learning and artificial intelligence at SAP, visit www.sap.com/ml and explore the following resources:

- The Consumer-Driven Digital Economy
- Retail in a Digital World
- Enterprise Digital Readiness Assessment
- Digital Consumer Products Readiness Assessment
- Digital Retail Readiness Assessment

Or visit SAP at www.sap.com.