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AMPLIFY

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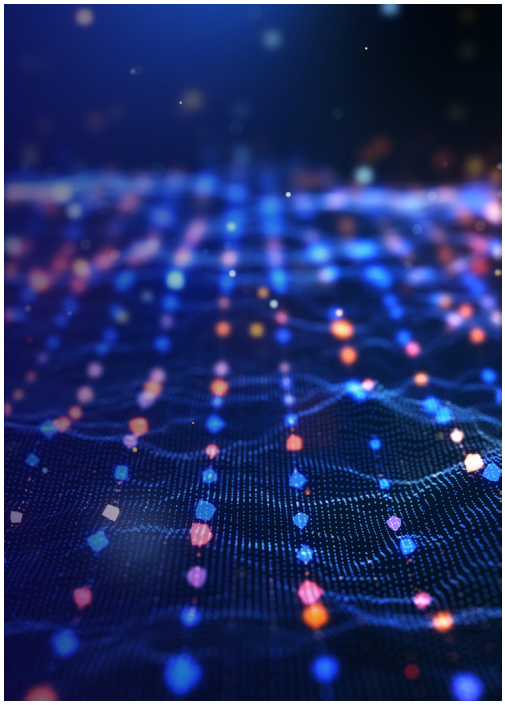
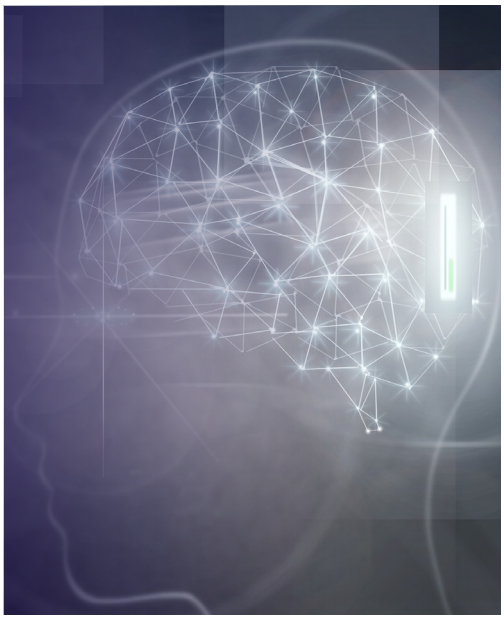
Anticipate, Innovate, Transform

Maximizing Business Value with Analytics

CONTENT





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MAXIMIZING BUSINESS VALUE WITH ANALYTICS

BY DENIS DENNEHY, GUEST EDITOR

The phrase "data is the new oil" has been bandied about for several years to convey the potential value of data. Not surprisingly, the global business analytics market rose to more than US $89 billion in 2023. Looking forward, the International Market Analysis Research and Consulting Group (IMARC) forecasts that the market will exceed $180 billion by 2032.[1]

Of course, what the British mathematician and data scientist Clive Humby meant when using this phrase is that data, like oil, isn't useful in its raw state.[2] Data must be sourced, extracted, refined, and processed in order to be turned into something of value for organizations. Business analytics is the systematic process of collecting, analyzing, and interpreting critical business data using a range of advanced statistical techniques, technologies like AI and big data analytics (BDA), and industry-specific software applications.

As organizations move further into the digital era, decision makers, data scientists, strategists, and C-suite teams seek analytical innovations to help their organizations extract and create value (both economic and social) from large, complex data sets to augment decision-making, improve efficiencies, enhance business performance, and enable digital strategizing and implementation.

Creating business value, however, requires organizations to learn from the insights generated by their data to make data-driven decisions.[3] Such learning is challenging as, historically, the attention of decision makers was largely on understanding "what" happened using descriptive analytics and "why" it is happening using diagnostic analytics (see Figure 1).[4]

The real economic value of advanced analytics (e.g., AI, BDA) is in sensing and predicting more accurately what *will* happen and acting to seize opportunities (e.g., changing customer sentiment) or mitigate threats (e.g., supply chain interruptions).

In this issue of *Amplify*, we explore several ways organizations leverage business analytics to create business value. As we delve into this dynamic business environment, it becomes evident that leaders who understand their business and data and can strategically align their analytical capabilities are best positioned to derive business value.

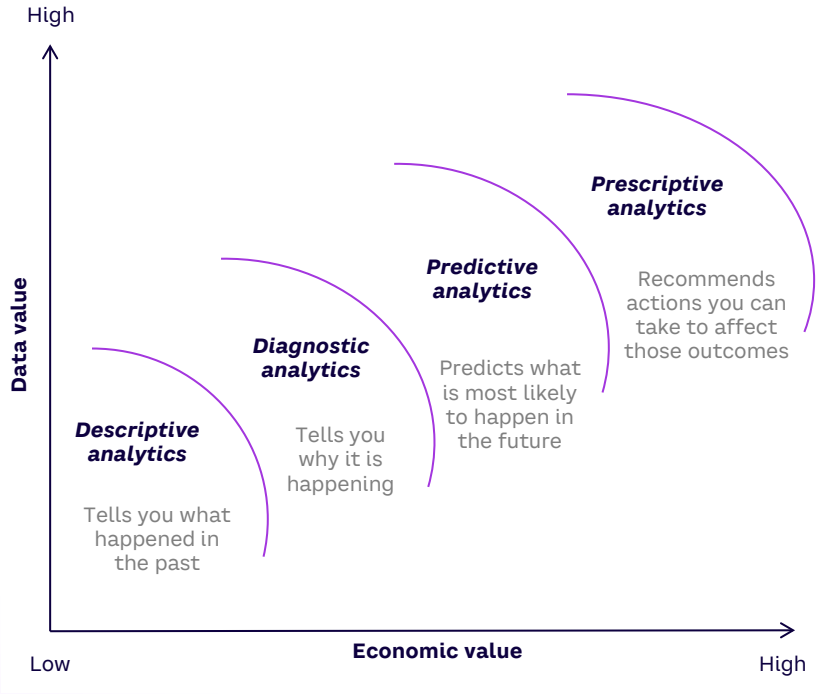

Figure 1. Business value of data innovation

IN THIS ISSUE

This issue showcases the relationship between business analytics and business value and provides real-world examples of how analytical technologies can be successfully adopted and adapted to create business and social value in a variety of sectors and industries.

First, Pamela McCloskey and Byron Graham explain "why" and "how" organizations in the banking industry are developing and using big data analytics capabilities (BDAC) to derive business value. Their article highlights the importance of a socio-technical approach to analytics: technical resources (e.g., data, technical infrastructure, software tools) and human capital with the skills to use these resources combined with the right social elements to nurture a data-driven culture that ensures the correct use of data for insight and decision-making. McCloskey and Graham present examples of how organizations have drawn on BDACs to successfully respond to recent shocks in the external environment, including the pandemic and regulatory changes in the financial services industry. The authors' proposed framework for assessing and developing the resource base for BDAC helps organizations understand their level of analytics maturity to maximize operational efficiencies and performance. The framework outlines how (1) process integration (creating a "single source of truth"), (2) process assimilation (restructuring to embed data skills,) and (3) diffusion (creating a data-driven culture) can enable organizations to develop BDACs to increase business value and gain strategic benefit.

Next, Conn Smyth, Samuel Fosso Wamba, Murray Scott, Sean Coffey, and I take a look at the important topic of resilient agri-food supply chains, an issue that affects us all. We report on the challenges facing the industry and explain how agri-food supply chain organizations are leveraging AI-based systems to plan for, respond to, and recover from supply chain disruptions efficiently and cost-effectively. The results show that AI-enabled information processing can build resilience in agri-food supply chains while reducing food waste and improving supply chain performance. The article is part of a wider doctoral research project and is informed by 147 survey responses from practitioners in the global agri-food industry. We propose a framework that maps six benefits of AI-based systems to three benefits of the agri-food supply chain and end with a call to action for a concerted effort between industry and academia to design, develop, and deploy AI solutions to make the world a better place.

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In our third piece, Oteng Ntsweng, Wallace Chipidza, and Keith Barrett Carter pose a thought-provoking question: how can organizations harmonize humanistic and financial values using generative AI (GenAI) analytics? The article includes an examination of three real-world cases (PwC, Morgan Stanley, and Ørsted), exploring how GenAI is changing the analytics value chain, how data experts are preparing for the future, and what is being done to re-skill employees to enable effective collaboration between GenAI and employees. Building on insights from these cases, the authors provide frank conversations on ethical digital transformation and AI for social good. Their recommendations include alignment between GenAI tools and need, adopting an employee-inclusive GenAI adoption approach, and promoting leadership teams that are knowledgeable in AI and analytics. The authors conclude that the incorporation of GenAI in business analytics offers the potential for significant advancements in business value, but there is a need to foster collaboration between GenAI and data experts to enhance value without losing humanistic outcomes.

In our final article, Maria P. Diaz Campo, Arman Ghafoori, and Manjul Gupta explain the growing trend of AI hallucinations (when GenAI generates unreasonable or inaccurate output) and how it can have detrimental consequences for organizations and individuals. The authors suggest that the degree to which such hallucinations are tolerated depends heavily on context and argue that individuals have lower tolerance levels for AI hallucination when the stakes are high (and vice versa when the stakes are low). They point out the importance of considering the contextual nuances surrounding the use of GenAI to help developers, decision makers, and academics establish best practices and manage potential sources of error. They also highlight the significance of understanding culture at the national level, as it can be instrumental in assessing societies' tolerance levels to AI hallucinations. The authors' suggested model provides unique insight into levels of analysis (i.e., personality, organizational culture, national culture) and how they pertain to AI hallucination. They make a compelling case that understanding context is critical for making informed decisions about strategically adopting and implementing GenAI (and emerging technologies in general). The article concludes with several key takeaways that can help balance potential value opportunities and risk tolerance.

This issue of *Amplify* clearly shows how business analytics can create business and social value and should motivate business leaders to be hypervigilant about their data because, just like oil disasters, data disasters (e.g., data breaches, cyberattacks) have increased in frequency and impact. Management teams that actively nurture a strong analytics culture and focus on the innovative use of analytical tools while growing their investments in emerging technologies will be in a stronger position to future-proof their business and mitigate potential disasters.

REFERENCES

[1] "Business Analytics Market Report by Software (Query, Reporting and Analysis Tools, Advanced and Predictive Analytics, Location Intelligence, Content Analytics, Data Warehousing Platform, and Others), Deployment Type (Cloud-Based, On-Premises), End-User (Large Enterprises, Small and Medium Size Enterprises), Vertical (BFSI, Energy and Power, Manufacturing, Healthcare, Government, Education, Media and Entertainment, Telecom and IT, and Others), and Region 2024–2032." International Market Analysis Research and Consulting (IMARC) Group, accessed May 2024.

[2] Suarez-Davis, Jon. "Data Isn't 'The New Oil' — It's Way More Valuable Than That." The Drum, 12 December 2022.

[3] Hagiu, Andrei, and Julian Wright. "When Data Creates Competitive Advantage." *Harvard Business Review*, January-February 2020.

[4] Dennehy, Denis. "Ireland Post-Pandemic: Utilizing AI to Kick-Start Economic Recovery." *Amplify*, Vol. 33, No. 11, 2020.

About the guest editor

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HARNESSING BIG DATA IN BANKING FOR STRATEGIC ADVANTAGE

Authors

Pamela McCloskey and Byron Graham

Traditional banks are facing increased competition from digital "challenger banks" and "neobanks," which offer traditional banking services online and through mobile applications, rather than high street branches. These new entrants are much further along the analytics maturity journey than traditional banks.

Banks hold large quantities of data relating to customer transactions and financial data, including income and spending activity, financial product holdings, financial history, and demographics. Increasingly, data is collected from digital sources, such as mobile applications and online banking systems, with open banking expanding this trend. This big data can be used to improve decision-making and innovation, but it requires the bank to possess or develop important resources and capabilities.

The definition of big data analytics capability (BDAC) has evolved over time, reflecting the realization that gaining value from big data is a wider organizational capability rather than something entirely reliant on data and technical resources.[1] As shown in Figure 1, the initial focus was on the characteristics of big data, including its volume, variety, velocity, veracity, and value.[2] The focus then moved to big data analytics, which also emphasizes the tools and methods used to analyze this big data.

More recent conceptualizations focus on combining these elements alongside a wider resource base, including talent, a data-driven culture, and organizational learning. These technical and non-technical resources can be combined to strategically leverage data to gain actionable insights and drive innovation, leading to a widening definition of BDAC.[3] This shift highlights that value gained from big data extends beyond the IT department and requires change across business functions.

KEY ELEMENTS OF BDAC: TECHNOLOGY, PEOPLE & CULTURE

Organizations aiming to develop a BDAC or increase the maturity of an existing BDAC can evaluate their current status across three key resource and organizational elements, as illustrated in Figure 2. The first resource type is technical and includes both data and the tools/infrastructure to build an analytics platform (i.e., a "single source of truth" for analytics purposes). The second type is the people aspect, which refers to data professionals with the requisite skills and leadership. The third resource is an organizational culture that is change-oriented and data-driven, in both data and non-data roles.

> **BANKS HOLD LARGE QUANTITIES OF DATA RELATING TO CUSTOMER TRANSACTIONS & FINANCIAL DATA**

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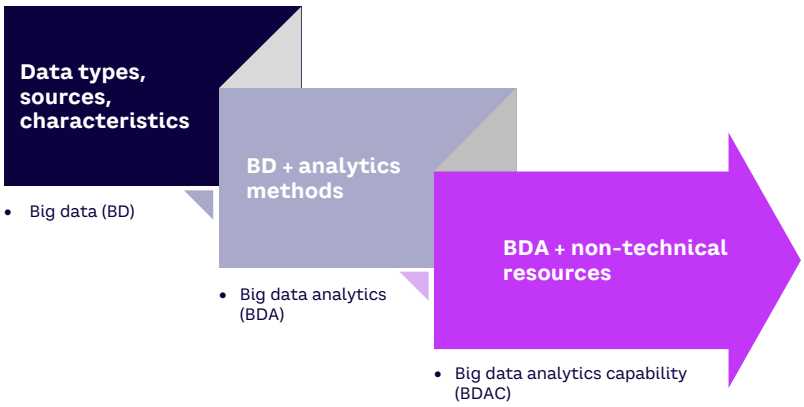

Figure 1. Moving from a focus on big data to BDAC

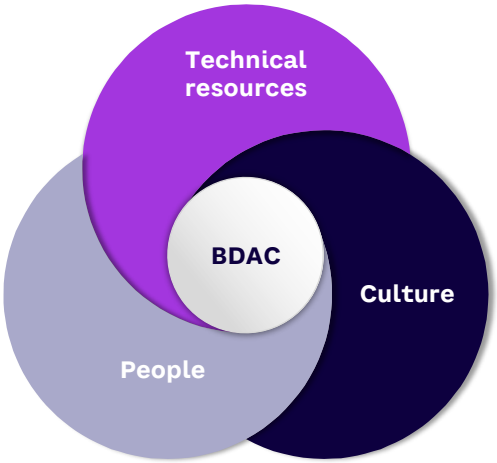

Figure 2. BDAC resources

In addition to these BDAC resources, effective resource orchestration is required via organizational processes and structures that harness these resources effectively in the development and deployment of BDACs. These are highlighted below.

TECHNICAL RESOURCES: DATA & TECHNOLOGY

Central to any analytics project are the technologies used to process, store, and analyze the data. In the case of BDAC, this data is large and complex. Digital transformation means that traditional structured data is only one of many types, and firms can now draw on more novel big data sources.

Big data is defined by the "5 Vs" mentioned earlier: volume, velocity, variety, veracity, and value.[4] *Volume* is the most intuitive V, referring to the size of the data created by digitization. *Velocity* refers to the speed at which data is created, reflecting the increased generation of streaming data from sources such as sensors, as well as high-velocity transactional data from sources like credit cards and the stock market.[5] *Variety* refers to the data being in many forms, including structured data that fits neatly into rows and columns and unstructured data from sources like text, images, and video.[6] The *veracity* (or quality) of the data is also an important consideration, as poor data quality can result in misleading outputs. Crucially, the data should result in business *value*, highlighting that the data should be viewed as a firm asset.

Technologies are needed to store, process, and analyze the data. Data is often generated from multiple internal and external sources and therefore needs to be combined in a central data warehouse or data lake to maximize value by combining various data sources, rather than operating across isolated data sets or systems.

As a first step in data analysis, reporting and visualization tools can be used to generate descriptive analyses of current and past key performance indicators (KPIs) and trends. Modern business intelligence solutions typically enable reporting automation and self-service dashboards, reflecting the democratization of analytics across the organization. More advanced predictive and prescriptive analytics tools have traditionally focused on coding languages, such as Python and R. Alongside coding languages, a range of more user-friendly, drag-and-drop tools have been developed to democratize and increase the efficiency of the analytics process.

PEOPLE RESOURCES: DATA PROFESSIONALS

Data professionals with the right skills and mindset are required to generate value from big data. This includes data analysts, data engineers, and data scientists. Alongside the technical skills needed to work with the data and tools, there is an increasing recognition that softer skills are required, such as business domain knowledge, curiosity, and problem-solving. Finding staff with this range of skills is challenging; this type of idealized data scientist is sometimes referred to as a "unicorn."[7]

Although data professionals are essential, a broader level of data literacy and data democratization across business functions can help an organization become more data-driven. Businesses are moving toward data democratization by providing access to data and analytics tools throughout the organization. The development of no-code/low-code analytics tools and AutoML (automated machine learning) has created opportunities for a broader range of less technically orientated staff to engage in analytics, resulting in "citizen data science," in which non-data scientists are involved in tasks previously restricted to data scientists and engineers. These trends require upskilling the workforce to increase data literacy.

CULTURAL RESOURCES: DATA-DRIVEN

Vast amounts of data can be collected, but if reliance on human intuition prevails over data-led decision-making, the benefits of BDACs will not be achieved. Culture is an intangible resource, created and transmitted by people. It is a way of "thinking, feeling, believing."[8] Much like gravity, we cannot see culture, but it is there.

A data-driven culture requires decision-making based on data and analytics, rather than relying only on human judgment and intuition. This means data is viewed as an asset, with behaviors and practices based on a shared belief that data plays a key role in an organization's success.[9] The goal is for data to be embedded in the organization such that employees think in a data-first way, replacing the words "I think" or "I assume" with facts and quantitative statements based on data.

It is important to promote the use of data across a firm so that insights are not just sought after but used to get the full benefit of BDACs. Non-data roles in the firm should also understand the importance of a data-centric approach and good data quality, as well as the value of good data questions.

> **A BROADER LEVEL OF DATA LITERACY & DATA DEMOCRATIZATION ACROSS BUSINESS FUNCTIONS CAN HELP AN ORGANIZATION BECOME MORE DATA-DRIVEN**

ASSESSING & DEVELOPING RESOURCE BASE FOR BDAC

Firms are at varying levels of analytics maturity, but traditional banks have a lower level of analytics maturity than their digital, technology-driven counterparts. Regardless of maturity stage, an audit of current resources with the correct stakeholders can allow a firm to establish its resource position when planning a data strategy.

An "as is" snapshot of the firm's current position can be contrasted with a "to be" position, and the resulting gap analysis can be used to identify required resources. This can inform the second part of the task: active resource orchestration by managers via integration, assimilation, and diffusion (which will vary by firm).

The key processes that help synergize the bundling of BDAC resources are summarized in Table 1.

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INTEGRATION: CREATE SINGLE SOURCE OF TRUTH	ASSIMILATION: RESTRUCTURE TO EMBED DATA SKILLS	DIFFUSION: CREATE DATA-DRIVEN CULTURE
Identify core processes in value chain; incrementally replace manual processes with digitalization & automation	Create centralized team to maintain analytics platform	Make analytics consumable & accessible firm-wide
Implement data governance program; enforce best practices for high-quality, accessible data	Embed data skills in teams that support core areas of value chain to keep data close to decision makers	Incent data-driven initiatives
Create prioritized list of use cases for data-driven decision-making	Create cross-functional autonomous teams to support core areas of value chain	Upskill teams, including leadership, on importance of data culture
Transfer required data for use cases from multiple systems to single analytics platform	Filter for data-driven mindset in hiring practices	Link KPIs to data
Select tools with scalability & self-serve features	Hire best data skills you can afford	Sell analytics via enablement roles
Select tools that can be supported with evergreening	Empower employees to take initiative through decentralized decision-making	Create community of practice
Think: technical excellence	**Think: team autonomy**	**Think: data first**

Table 1. Processes of integration, assimilation, and diffusion for BDAC development

INTEGRATION

The goal of the integration process is to create a single source of truth for analytics. Processes of digitalization and automation are required to capture and store a variety of data sources in a timely fashion. With legacy systems in place, traditional banks typically have less digitalization and automation. An incremental, iterative approach is required in such cases to prioritize key aspects of the customer journey and replace manual data collection and storage processes with digitalization and automation. Data can then be taken from source systems, via extract, transform, load (ETL) processes, and stored in a single location for analytics, such as a data warehouse.

Data quality is an important aspect here, and firms need a robust data governance program to ensure high-quality, reliable, accessible data. Firms must also select the best tools for analytics purposes, including a visualization tool that's scalable and promotes self-serve capabilities so those in data and non-data roles can be close to data for decision-making. An "evergreening" program ensures that tools are constantly renovated so they are always fit for purpose. *Think: technical excellence.*

ASSIMILATION

The goal of the assimilation process is to introduce and distribute data skills in the firm in support of analytics development and deployment. Ideally, excellent-quality data and robust tools that bring data closer to decision makers across the firm will enable team autonomy and remove external dependencies on accessing data for decision-making.

The first step is to reorganize the teams, making sure each team has the data skills it needs and that its leaders put a strong emphasis on the importance of data. A centralized team should drive best practices and standards, including data quality and storage, governance, and tooling approaches. Outside this centralized data team, individual product or service areas should have data skills embedded, with a cross-functional, autonomous team supporting each product or service area. This way, the data team has the domain-specific knowledge needed to support team goals and an understanding of data and tooling standards from the central team. Upskilling will be required, alongside hiring practices that filter for a data-driven mindset in employees. In the early stages of BDAC development, firms should hire the best data skills they can afford and reward accordingly. *Think: team autonomy.*

DIFFUSION

The goal of the diffusion process is to develop and maintain a data-driven culture. The processes of integration and assimilation enable this state, in which analytics are available for decision-making across the firm. Data must be accessible and consumable firm-wide, and it must be achieved via tools that promote data democratization.

A data-driven culture can also be incented via data-driven strategic initiatives, with upskilling at all levels of the firm to improve data literacy, including leaders who can set an example. Team- and firm-level KPIs can be linked to data goals and measured in a data-centric way. Data-enablement roles can be introduced to champion the use of data by showcasing the benefits of a data-driven culture and talking about successful use cases both within the firm and outside. Communities of practice are a key feature of firms with a data-driven culture, enabling knowledge sharing and collaboration by drawing together a critical mass of data-driven employees. *Think: data first.*

INTERNAL & EXTERNAL DRIVERS OF BDAC DEVELOPMENT & DEPLOYMENT

Firms with developed BDACs gain strategic competitive advantage through improved decision-making and innovation. In banking, firms have developed BDACs to increase operational efficiency and performance and in response to external drivers, such as competitive pressures, regulatory requirements, and external shocks. Once developed, a BDAC can be deployed to carry out analytics at various levels, including descriptive, predictive, and prescriptive.

GAINING EFFICIENCY

In the banking sector, analytics are often used to gain operational efficiencies, such as automating the customer due diligence process, which helps save on staffing costs. Analytics can help leaders decide which branches to close, measure the success of product lines, and understand outcomes by measuring customer satisfaction. Data-driven KPIs can be used to monitor a range of targets, from employee performance to quarterly team goals.

REACTING TO COMPETITIVE PRESSURES

In many countries, retail banking is dominated by large incumbent banks with huge volumes of current and historical customer data. Despite this, they have often been slow to embrace advanced analytics. Digital disruptor banks are entering the market, offering similar banking services but through digital mobile applications. They are capturing a variety of near-real-time data, such as customer interactions, and using this for product development. To keep pace, traditional banks have been increasing their efforts to develop BDACs, including by investing in the underpinning resources discussed previously.

RESPONDING TO REGULATIONS & PROTECTING CUSTOMERS

New regulatory requirements and changes to existing ones are another important driver of analytics in the banking sector. This can include using analytics to meet standard regulatory returns, as well as advanced use cases like detecting and blocking financial crime by identifying suspicious transactions on customer accounts or optimizing transaction monitoring rules. The introduction of new regulations has also driven banks (incumbents, in particular) to develop BDACs to meet these requirements.

HANDLING EXTERNAL SHOCKS

The need for banks to roll out government support schemes quickly during the pandemic meant that projects were completed in a fraction of the time they would normally have taken. The business loan application process moved entirely online, and key tasks were broken down into user stories and simplified to create a digital customer journey. Modular elements from other processes were effectively reused and stitched together. This increase in digitalization allowed for automatic data collection and storage of key customer interactions that previously occurred in person, streamlining the process.

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CONCLUSION

BDAC development in the banking industry highlights several lessons that are broadly applicable. Regardless of analytics maturity level, BDAC requires three key resources from all firms: (1) data and technology resources, (2) people with the requisite data skills, and (3) a data-driven culture. BDAC resources can be synergized via the orchestration processes of integration, assimilation, and diffusion.

The large quantities of data in both traditional and digital banks have the potential to drive strategic value, but data quality and integration from disparate sources remain challenging. Fostering a data-driven culture is important in the development and deployment of BDACs, which require a high level of data literacy across all levels and functions in the organization. Increased data literacy across the organization facilitates data democratization and citizen data science, allowing nontechnical staff across levels and functions to gain value from data.

The banking industry, like other sectors, also has an opportunity to develop BDAC to increase value and gain strategic benefits. The nature of analytics is dynamic, and BDACs need to be continuously updated to keep pace with technological and industry developments.

REFERENCES

[1] Mikalef, Patrick, et al. "Big Data Analytics Capabilities: A Systematic Literature Review and Research Agenda." *Information Systems and e-Business Management*, Vol. 16, July 2017.

[2] White, Martin. "Digital Workplaces: Vision and Reality." *Business Information Review*, Vol. 29, No. 4, December 2012.

[3] Gupta, Manjul, and Joey F. George. "Toward the Development of a Big Data Analytics Capability." *Information and Management*, Vol. 53, No. 8, December 2016.

[4] White (see 2)

[5] Gillon, Kirstin, et al. "Business Analytics: Radical Shift or Incremental Change?" *Communications of the Association for Information Systems*, Vol. 34, 2014.

[6] Gillon et al. (see 5).

[7] Davenport, Thomas. "Beyond Unicorns: Educating, Classifying, and Certifying Business Data Scientists." *Harvard Data Science Review*, Issue 2.2, May 2020.

[8] Kluckhohn, Clyde. *Mirror for Man: The Relation of Anthropology to Modern Life*. Whittlesey House, 1949.

[9] Kiron, David, Renee Boucher Ferguson, and Pamela Kirk Prentice. "From Value to Vision: Reimagining the Possible with Data Analytics." *MIT Sloan Management Review*, 5 March 2013.

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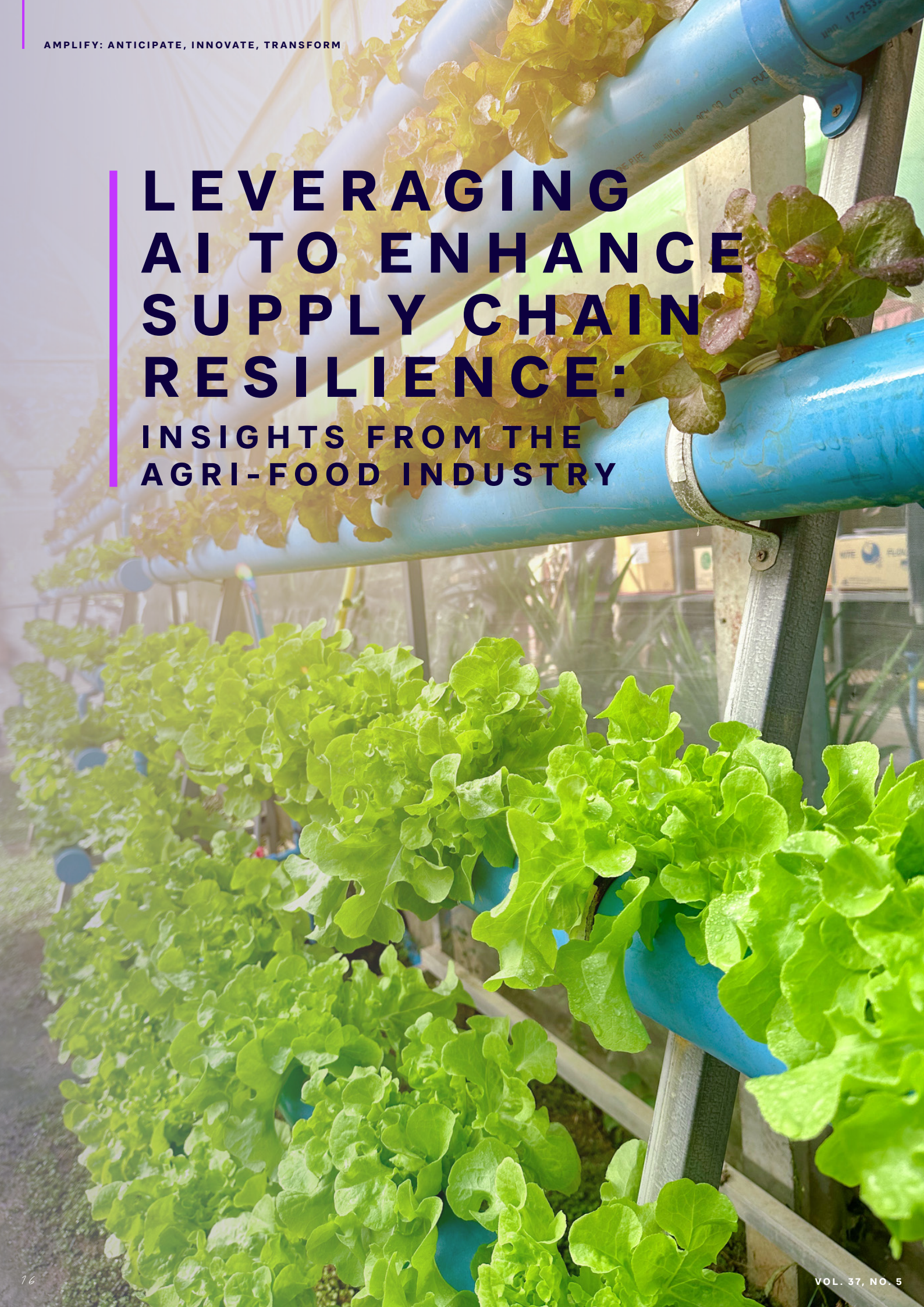
LEVERAGING AI TO ENHANCE SUPPLY CHAIN RESILIENCE:

INSIGHTS FROM THE AGRI-FOOD INDUSTRY



Authors

Conn Smyth, Denis Dennehy, Samuel Fosso Wamba, Murray Scott, and Sean Coffey

The agri-food supply chain ecosystem is complex, involving farmers, agricultural cooperatives, manufacturers, distributors, traders, wholesalers, and retailers.[1] In contrast to other food supply chains (e.g., automated canned food), the agri-food supply chain faces issues related to short shelf life; seasonality; quality and quantity variability; strict regulations; specific requirements for transport, handling, and storage; price variability; and weather dependence.[2]

The main function of the food system and its primary sector, agriculture, is to satisfy the basic human need for food, but sustainable food systems also maintain ecosystem health and contribute to social well-being.[3] Nevertheless, our ability to feed a growing global population is under threat.[4]

Recent global events highlight the vulnerability of agri-food supply chains (and supply chains in general) to exogenous shocks and the importance of developing resilient supply chains.[5] For example, the COVID-19 pandemic impacted 86% of supply chains in the UK.[6]

Supply chain resilience refers to the ability of supply chains to efficiently and cost-effectively plan for, respond to, and recover from disruptions. This includes taking actions that return the supply chain to its original state (or better than before the disruption).[7]

A resilient supply chain is characterized by four dimensions:

1. Preparedness
2. Response
3. Recovery
4. Growth or adaption

OUR ABILITY TO FEED A GROWING GLOBAL POPULATION IS UNDER THREAT

Supply chain disruptions are defined by the Food and Agriculture Organization of the United Nations (FAO) as "unforeseen events that interfere with the normal flow of goods and/or materials."[8] It has been reported that organizations experience 15 supply chain disruptions annually.[9] To mitigate disruptions, supply chain organizations need to:

- Identify and understand vulnerabilities in the business landscape and assess vulnerabilities throughout the supply chain
- Determine what part of the supply chain can best address and manage the identified vulnerabilities
- Strengthen supply chain elements to mitigate vulnerabilities by enhancing processes, systems, and practices

Against this backdrop, agri-food supply chain organizations are seeking innovative solutions such as AI-based systems to improve sustainability, transparency, and resiliency.

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AI IN A NUTSHELL

At a basic level, AI is a collection of technologies that combines large quantities of data, algorithms, and computing power to focus on a single task (i.e., face recognition). At a higher level, AI technologies aspire to replicate human behavior, referred to as "artificial general intelligence."[10] AI systems have rapidly evolved from applications like decision support systems to systems that can solve complex problems and perform specific tasks. AI is an umbrella term for the six functions listed in Table 1.[11]

Machine learning (ML), expert systems, robotics, and natural language processing (NLP) are the dominant AI functions being studied in agri-food supply chains as part of our ongoing research project.

RESEARCH METHODOLOGY

This article is informed by two types of data (secondary and primary). The secondary data is based on a recent study that synthesized and categorized the reported challenges encountered by practitioners in the agri-food industry.[12] The primary data is based on a survey of nine questions related to themes, including AI-based information processing, supply chain resilience, and performance. Each question was measured on a seven-point Likert scale, with extreme points ranging from 1 equals strongly disagree to 7 equals strongly agree. The survey was circulated to practitioners in the agri-food sector (see Table 2). 151 responses were gathered, of which four were invalid.

Participants had an average of four years' industry experience in this sector, and their roles varied from C-level executives to operations management. Data analysis was conducted using structural equation modeling, which provides statistical procedures for testing survey measurements and hypotheses.

KEY CHALLENGES IN THE AGRI-FOOD SUPPLY CHAIN INDUSTRY

The challenges described in Table 3 are based on the analysis of 76 studies that focused on the agri-food supply chain industry.[13] The impact of supply chain disruptions has an inherent cost (e.g., financial, resource, raw material).

For example, the Russia-Ukraine crisis disrupted fertilizer and animal feed throughout Europe, immediately hitting farmers involved in pork production who bore that cost for several months before it hit meat processors by way of increased livestock costs. Meat processors then bore the cost for several months while negotiations took place with customers. Production, throughput, and food chain were lost forever — an unexpected consequence of such a crisis. In Ireland, 2023 saw a nearly 10% drop in total pork production compared to the previous year, due to significant losses and high operating costs. At the national level, there are now fewer than 200 productive units.[14]

AI FUNCTION	DESCRIPTION
Machine learning	Algorithms and computational models that enable computers to learn from experience
Expert systems	Rule-based computer programs that reason with knowledge of a subject to provide advice or solve problems
Robotics	The science of extending human motor capabilities with machines
NLP	Enables machines to understand, interpret, and derive meaning from human languages
Machine vision	Uses digital input and pattern recognition to automatically inspect, analyze, and extract information from objects
Speech recognition	Converts human speech or audio to text

Table 1. Functions of AI

PARAMETERS	DETAILS	FREQUENCY	PERCENTAGE
Gender	Male	106	72%
	Female	36	24%
	Prefer not to say	5	4%
Years of agri-food supply chain industry experience	2-5	18	12%
	6-10	42	29%
	11-15	34	23%
	16-20	9	6%
	20+	44	30%
Geographic area of responding organization	Europe	116	79%
	North America	14	10%
	South America	2	1%
	Asia	9	6%
	Africa	3	2%
	Australia	3	2%
	Total	**147**	**100%**

Table 2. Profile of respondents

CHALLENGE	DESCRIPTION
Relying on traditional forecasting techniques	Forecasting can refer to either making predictions about internal operations and processes or customer-demand forecasting. Because traditional forecasting methods cannot handle the inherent complexity of modern supply chains, predictions may be inaccurate, resulting in issues like poor decision-making.
Selecting appropriate suppliers; managing supplier relationships	Supplier selection and management are increasingly important for supply chain organizations due to customers' growing need for efficient delivery and rising global competitiveness. To select an appropriate supplier and effectively manage this relationship, supply chain organizations must consider and actively monitor many tangible and intangible factors.
Managing supply chain disruptions & risk mitigation	Supply chain disruptions and risk mitigation are grouped due to shared objective: to minimize or illuminate any interruption to the supply chain. Supply chain disruption can result in increased costs, financial loss, and damage to the organization's reputation, so avoidance is vital.
Managing inventory; selecting appropriate replenishment strategies	Inventory (e.g., raw material) is central to any supply chain. Inventory and vendor management strategies must evolve to ensure the supply chain aligns with rapidly changing needs and demands of customers.
Supply chain configuration, design & planning (SCCDP)	SCCDP plays an essential role in creating competitive advantage and ensuring supply chain responsiveness. Effective SCCDP uses all available resources to ensure the supply chain can meet demand in the face of disruptions and the fluctuating demand of customers.
Managing smooth & continuous production process	Production may include sourcing raw materials, moving them to the production facility, preparing the (raw) product for production, and transporting the finished products to retail suppliers or directly to the consumer. Agri-food supply chain organizations are increasingly adopting and adapting technological solutions to ensure streamlined production while creating economic value.
Optimizing supply chain processes & procedures	The goal of process optimization is to continuously reduce waste, increase productivity, and increase economic value through a systematic approach of analyzing and improving business processes to achieve maximum efficiency and quality. Supply chain optimization is a growing concern for agri-food organizations because traditional optimization methods lack the ability to handle the nonlinearity and complexity of contemporary supply chains.

Table 3. Challenges in the agri-food supply chain industry

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HOW CAN AI ADD VALUE TO THE AGRI-FOOD INDUSTRY?

Anecdotal evidence indicates that AI offers transformational power to support executives responsible for dealing with exogenous shocks and enabling resilient supply chains.[15] Analysis of the primary data used in this study shows that AI-enabled information processing can build resilience in agri-food supply chains, reducing food waste and improving performance. The potential benefits and applications of Al in the agri-food industry are described in Table 4.

A COLLECTIVE EFFORT TO USE AI WILL PROVIDE ECONOMIC VALUE IN SEVERAL WAYS

LOOKING TOWARD THE FUTURE

Although AI holds much promise to transform agri-food supply chains (see Figure 1), considerable managerial and organizational challenges will need to be addressed.[16] These challenges will require a concerted effort between academia, the supply chain industry, and policy makers to ensure its transformative power is realized through rigorous, evidence-based research. For example, a recent study showed that security is a major concern for adopters and non-adopters in operations and supply chain management.[17]

A collective effort to use AI in this context will provide economic value in several ways. First, it could be a vehicle to achieve the EU's ambitious target to cut the unintentional loss of food mass in agri-food supply chain industry in half by 2030.[18] Almost 57 million tonnes of food waste are generated annually with an associated market value estimated at €130 billion (about US $140 billion).[19]

BENEFIT	DESCRIPTION
Enhanced market & customer insights	NLP can extract meaningful insights into customer behavior or market trends from open data sets. For example, the EU Meat Market Observatory provides statistics and current meat market trends in Europe, while social media sites contain information on customer opinions and behavior. NLP can extract data and determine actionable insights that could improve sales and identify food trends.
Increased demand forecasting accuracy	ML-powered demand forecasts perform significantly better than traditional methods. ML models can be trained to predict consumer demand and consider the effect of seasonality on consumer demand across regional and global markets. This enables organizations to align production output with demand.
Improved supplier selection & management	Al can be used to identify the most appropriate suppliers by incorporating multiple variables, such as product price, quality, and delivery satisfaction, into the decision-making process. Moreover, Al can be used to continuously evaluate supplier performance.
Optimized ingredient selection for bespoke products	Al can be used to quickly identify the most appropriate ingredients based on client specifications for a new product line.
Optimized production process & improved quality control	By creating dynamic simulations of all organizational processes, AI can be used to identify the optimal configuration that will meet or exceed KPIs. Al-powered simulations provide an excellent decision-support tool for the supply chain design and planning team. Al can use real-time monitoring to identify production anomalies, reducing waste and improving quality control. AI-powered robotics can be used to automate packaging, reducing labor costs.
Increased supply chain visibility & responsiveness	Al can significantly improve supply chain visibility, automating supply chain mapping to provide supply chain organizations with a comprehensive, detailed view of the entire supply chain. AI can predict supply chain disruptions, helping organizations become more responsive to interruptions and delays.

Table 4. Benefits of AI to the agri-food industry

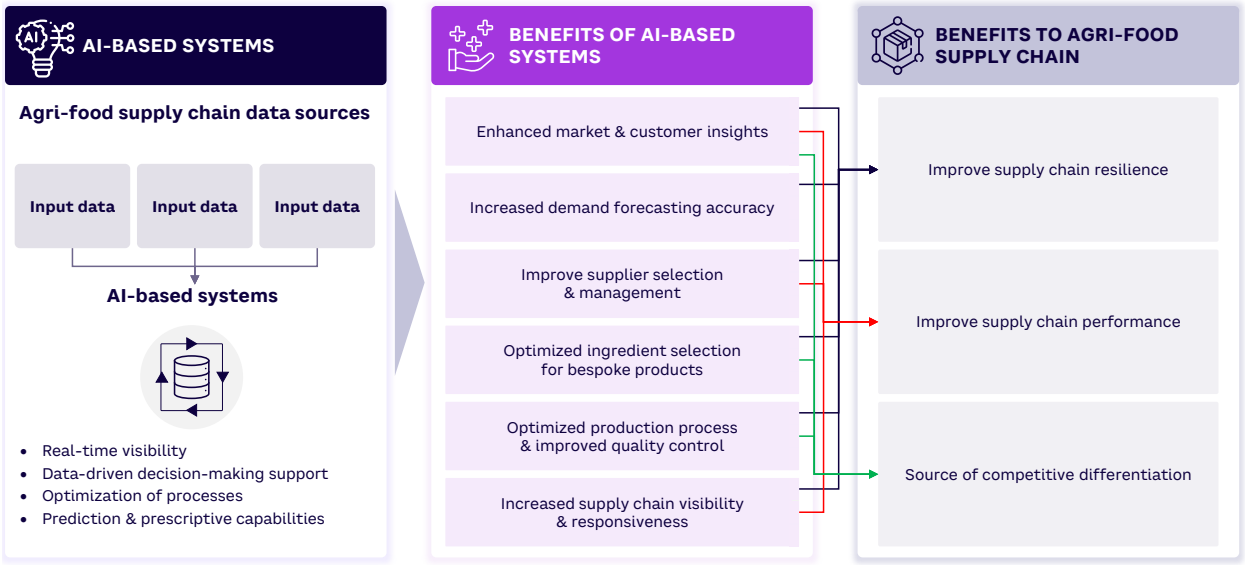

Figure 1. Benefits of AI systems

Second, it could help farmers produce more food. Supplies must increase by 70% by 2050 to meet the needs of the world's growing population, according to the FAO.[20]

Third, investing in AI and emerging technologies can contribute to sustainable livelihoods, hunger reduction, and generating income in both developed and developing countries, which is critical for the transition to a sustainable food system. A food system "gathers all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation, and consumption of food, and the outputs of these activities, including socioeconomic and environmental outcomes."[21]

Awareness without action is fantasy, so we call on industry leaders, academics, and governments to actively engage in the design, development, and deployment of AI solutions to make the world a better place for all.

REFERENCES

1 Spanaki, Konstantina, Erisa Karafili, and Stella Despoudi. "AI Applications of Data Sharing in Agriculture 4.0: A Framework for Role-Based Data Access Control." *International Journal of Information Management*, Vol. 59, August 2021.

2 Zissis, Dimitris, Emel Aktas, and Michael Bourlakis. "A New Process Model for Urban Transport of Food in the UK." *Transportation Research Procedia*, Vol. 22, 2017.

3 Zamani, Efpraxia D., et al. "Artificial Intelligence and Big Data Analytics for Supply Chain Resilience: A Systematic Literature Review." *Annals of Operations Research*, Vol. 327, September 2022.

4 "Agriculture & Food System." European Environment Agency (EEA), 4 March 2024.

5 Dennehy, Denis. "Ireland Post-Pandemic: Utilizing AI to Kick-Start Economic Recovery." *Amplify*, Vol. 33, No. 11, 2020.

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[6] "Coronavirus Impact Felt by 86% of Supply Chains." Supply Chain Movement (SCM), 20 March 2020.

[7] Vanpoucke, Evelyne, and Scott C. Ellis. "Building Supply-Side Resilience — A Behavioural View." *International Journal of Operations & Production Management*, Vol. 40, No. 1, August 2019.

[8] Scholten, Kirstin, Mark Stevenson, and Dirk Pieter van Donk. "Dealing with the Unpredictable: Supply Chain Resilience." *International Journal of Operations & Production Management*, Vol. 40, No. 1, January 2020.

[9] Vanpoucke and Ellis (see 7).

[10] Dennehy (see 5).

[11] Smyth, Conn, et al. "Artificial Intelligence and Prescriptive Analytics for Supply Chain Resilience: A Systematic Literature Review and Research Agenda." *International Journal of Production Research*, 23 April 2024.

[12] Smyth et al. (see 11).

[13] Smyth et al. (see 11).

[14] Kelly, Lorcan Roche. "The Crisis Threatening Ireland's Pig Farming Industry." *Irish Farmers Journal*, 3 January 2024.

[15] Zamani et al. (see 3).

[16] Fosso Wamba, Samuel, et al. "Industry Experiences of Artificial Intelligence (AI): Benefits and Challenges in Operations and Supply Chain Management." *Production Planning & Control*, Vol. 33, No. 16, April 2021.

[17] Fosso Wamba, Samuel, et al. "Are Both Generative AI and ChatGPT Game Changers for 21st-Century Operations and Supply Chain Excellence?" *International Journal of Production Economics*, Vol. 265, November 2023.

[18] "EU Platform on Food Losses and Food Waste." European Commission, accessed May 2024.

[19] EEA (see 4).

[20] "Achieving SDG 2 Without Breaching the 1.5 °C Threshold: A Global Roadmap, Part 1." Food and Agriculture Organization of the United Nations (FAO), 2023.

[21] "Food Losses and Waste in the Context of Sustainable Food Systems: A Report by the High Level Panel of Experts (HLPE) on Food Security and Nutrition." HLPE Report 8, FAO, 2014.

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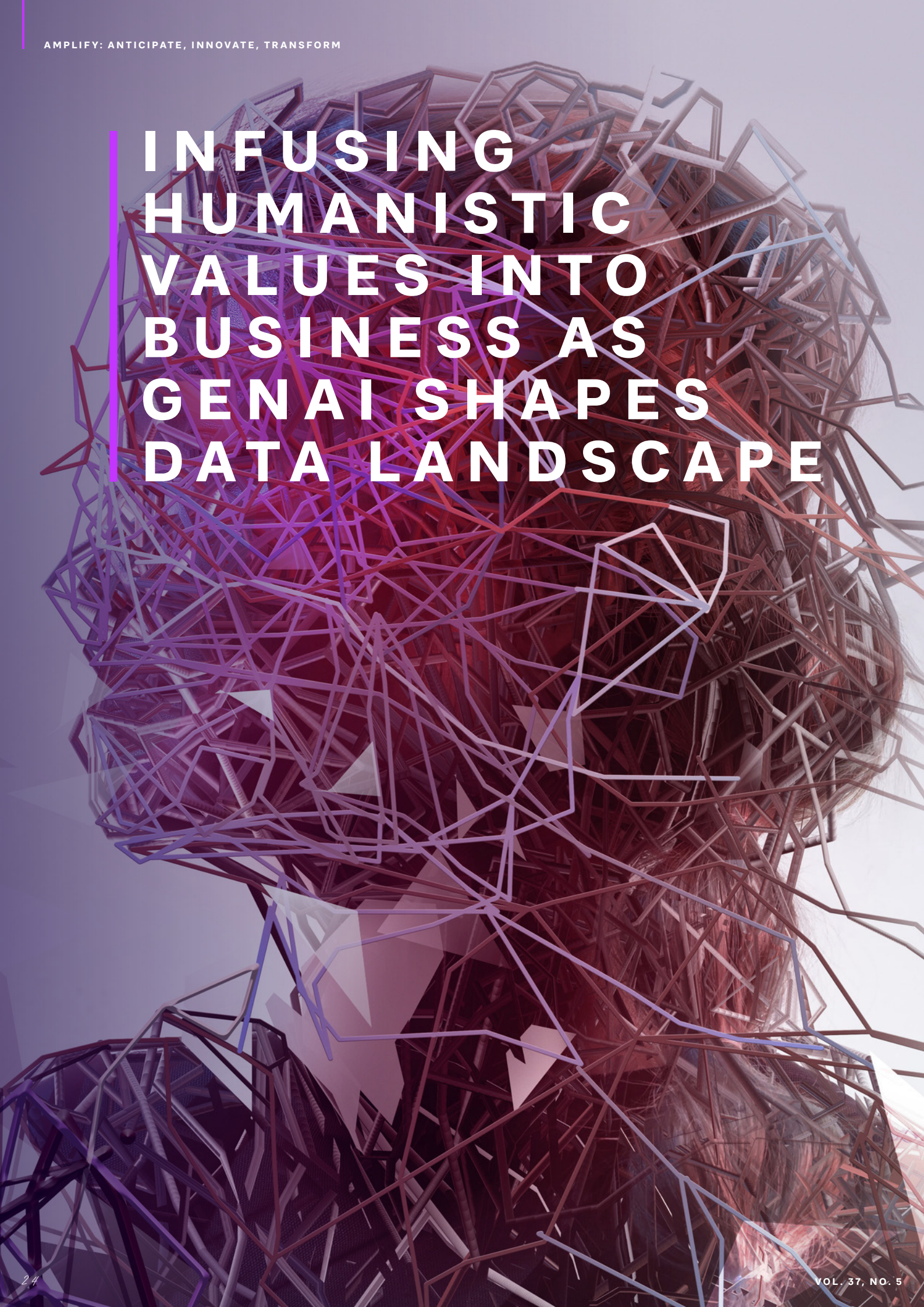
INFUSING HUMANISTIC VALUES INTO BUSINESS AS GENAI SHAPES DATA LANDSCAPE



Authors

Oteng Ntsweng, Wallace Chipidza, and Keith Barrett Carter

"You shall know a word by the company it keeps." — John Rupert Firth[1]

Eighty percent of organizations say their primary technological goal is hyper-automation (the end-to-end automation of as many business processes as possible), which promises significant leaps in business value.[2,3] It comes as no surprise, at least to us, that business analytics is considered a promising business function for generative artificial intelligence (GenAI) augmentation. Indeed, movement toward data democratization (empowering everyone within an organization to work with data) has been a long-standing goal for many organizations.[4]

Data democratization traces its roots to the early 2000s, marked by the advent of drag-and-drop data analytics tools like Tableau and Power BI. These tools simplify data access, enabling all members of an organization to engage with data without much reliance on data experts, with the ultimate goal of delivering higher business value.[5,6]

So if data democratization aimed at significant progress in business value is nothing new, why do some perceive GenAI as a threat to data-related jobs?[7,8] And why does this necessitate a rethink of our conception of business value?

Although proponents of AI draw parallels between GenAI and past innovations like ATMs and autonomous delivery systems, those advances unfolded gradually and did not drastically reduce jobs in their respective sectors. GenAI is advancing at an unprecedented pace, with large language models (LLMs) becoming easier to use and being integrated into widely used software products, including Microsoft Office and dominant data analytics tools.

GENAI'S ROLE IN BUSINESS ANALYTICS

Done right, business analytics can significantly increase business value.[9,10] But keep in mind that "value" has become a fashionable term, and such words are often repeated to the point of oversimplification. Consequently, value is frequently discussed without explicit definitions, the assumption being that everyone understands what it means. But as Firth rightly observed, you shall know a word by the company it keeps.

The metrics associated with value, including productivity and profitability, speak volumes about prevailing priorities among business leaders.[11] The dominant focus on financial metrics often eclipses crucial humanistic outcomes (particularly for employees), which are increasingly vital with the advent of GenAI.

IF DATA DEMOCRATIZATION AIMED AT SIGNIFICANT PROGRESS IN BUSINESS VALUE IS NOTHING NEW, WHY DO SOME PERCEIVE GENAI AS A THREAT

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These integrations are set to alter not just workflows but entire work ecosystems, potentially impacting humanistic outcomes, especially for frontline workers like data experts.

Indeed, although data democratization is nothing new, GenAI has taken things up a notch. Drag-and-drop analytics simplify some tasks, but they still require specialized knowledge in statistical analysis and familiarity with the analytics tool.

English is now a programming language and data analytics tool, thanks to GenAI. The ability to converse with an analytics platform by asking plain-English questions about company data implies that all employees can extract insights and ideas from data.[12] As mentioned, drag-and-drop tools such as Tableau and Power BI are now imbued with GenAI capabilities. Tableau Pulse enables the automation of data analysis and communicates insights concerning metrics of interest conversationally, aiming to let virtually everyone become data-driven. We are all programmers and data "experts" now.[13]

In that case, what becomes of data-related jobs? How should these GenAI teammates be added to the workflow? How would that impact workforce ecosystems and, in turn, employee-related outcomes? Although experts disagree about whether GenAI will wind up displacing more jobs than it will create over time,[14] some job cuts in data analytics have been linked to changes resulting from AI.[15]

We tend toward a more ambivalent stance on the issue of displacement. From any reasonable person's framework, imbuing data analytics tools with GenAI capabilities will undoubtedly enhance efficiency. Unless there is a lot of work to go around, some people may have to go. The issue with current discussions on job displacement is that it is viewed as a binary outcome — either GenAI replaces humans, or it doesn't. In reality, the extent of displacement is likely to vary across different industries and over time. Additionally, those who argue that GenAI will create new jobs often cite prompt engineering as a prime example. However, as GenAI tools become increasingly sophisticated and user-friendly, prompt engineering jobs may not be sustainable. We therefore advise caution against definitive predictions and recommend focusing on how employees can be better prepared for the future.

In this article, we (two academics in information systems [IS] and analytics and a practitioner with decades of experience in digital transformation) explore how GenAI can be integrated into the analytics value chain. We examine real-world cases to understand how GenAI is changing this value chain in various business functions, the impact on humanistic outcomes, and what is being done to re-skill employees. In this way, we lay a stone on the path toward ethical digital transformation and AI for social good.[16]

CURRENT LANDSCAPE

As mentioned, there are two prevailing perspectives about the threat GenAI poses to data analytics and related jobs. The proof of this divide is evident in industry actions. Some companies have committed to using GenAI as a tool to augment their workforce without replacing human workers; others have demonstrated its potential for job displacement by letting go of employees (though the total number of jobs directly lost to GenAI remains low).[17,18]

Some argue that we are not yet at the point of displacement, since GenAI tools still lack critical thinking, strategic planning, and complex problem-solving abilities.[19] We agree that GenAI is less likely to cause immediate displacement. The layoff we cited earlier, at EXL Service Holdings, impacted only 2% of the workforce, and it was mainly targeted at junior staff in data analytics and digital operations.

Nevertheless, we caution against predictions that displacement will not happen or that it is so far off that there's no cause for concern. Remember that GenAI was released to the public in late 2022 — these technologies are less than five years old. ChatGPT's advanced data analysis tool was introduced in June 2023.[20] Yes, it still produces inaccurate results here and there, but it can perform complicated calculations, generate charts based on uploaded data, and generate code associated with produced analysis.

In fact, the original idea for this article came after one of the authors gave ChatGPT's advanced analysis tool a tutorial question on optimization she had used in her business analytics course. Not only did the tool get the correct answer, it worked through it in less than 10 seconds. Again, these tools are still "infants." We are only beginning to

realize the impact LLMs are about to have on data analytics and cognate jobs, including software development.

Many other GenAI-powered analytics tools are available, including ChatGPT Enterprise, Tableau Pulse, and bespoke tools like the AI @ Morgan Stanley Assistant, which gives financial advisors speedy access to a database of about 100,000 research reports and documents.[21]

Given privacy and security concerns, we expect more organizations to develop proprietary AI-based analytical tools. For instance, Databricks, a company providing a unified platform for data, analytics, and AI, recently agreed to acquire GenAI start-up MosaicML in a deal valued at approximately US $1.3 billion, a strategic move targeting the rapidly expanding demand for businesses to develop or fine-tune their own ChatGPT-like tools.[22] As people who deal with data in our research and work, we agree that these tools offer profound leaps in productivity.

However, little is known about how they are integrated into actual organizations and their impact on employees. This may be because organizations are starting to jealously safeguard their most lucrative GenAI use cases.[23] We did find some real-world cases that can help us look at how GenAI can be integrated into analytics and the potential impact on data experts.

We scoured recent news articles and practitioner outlets, including the *Wall Street Journa*l, the *New York Times*, *MIT Sloan Review*, and *Harvard Business Review* for informative cases. We identified three from which we draw insights on successfully integrating GenAI into analytics. Note that data experts are not just those with "data" in the title. We consider other professions that deal with data (e.g., portfolio managers, financial advisors, and wealth managers). Data expertise is a matter of skill, not job title.

CASE 1: PWC DIGITAL ACCELERATOR PROGRAM

The digital accelerator program is not new, but we believe it offers some valuable insights. Launched in 2017, the program began with three components: data science, automation, and data management.[24] At the heart of this program is what has been labeled "citizen development." Citizen developers are recruited from among PwC's employees and voluntarily take courses in relevant technologies, including data analytics and GenAI. Following certification from these courses, graduates take some time to develop applications relevant to the company.

Employees have complete autonomy regarding what automation products they pursue, and the most promising ones are promoted by the company's centralized Products and Technology group.[25] One digital accelerator created a program that automated a workflow for extracting data from various spreadsheets, saving 40 hours of work on audits; eventually, this program was integrated into the company's internal library.[26]

We see two factors contributing to this program's success. First, it is supported by Tim Ryan, PwC's US chairman and senior partner.[27] Second, employees who develop useful products are rewarded.

With PwC planning to invest $1 billion into GenAI, we foresee that in the next few years, the accelerator program will reach new heights.[28] It is also promising to read that Mohamed Kande, PwC's vice chair, leader of US consulting solutions, and global advisory leader, shared that PwC aims not to replace workers but to optimize their jobs. "We are not going to leave anybody behind. It's going to be a team sport," he said.[29]

CASE 2: MORGAN STANLEY

Morgan Stanley is leading the charge as one of the first major Wall Street firms to develop a proprietary solution anchored on GPT-4. It designed a tool that gives financial advisors quick access to a database of about 100,000 research documents and reports.[30] As we know, financial advisors deal with both structured and unstructured data. Structured data could be in the form of stock performance; unstructured data includes business reports, client meeting notes, portfolios, and more. Before implementing AI @ Morgan Stanley Assistant, financial advisors had to scour the unstructured data using manual search. The AI assistant lets them search workplace documents using queries akin to a Google search.

Interestingly, this tool does not tell financial advisors what to do;[31] it simply searches the data and spits out what is required, giving the human advisor autonomy to serve the client. Morgan Stanley's co-president shared in a memo that

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financial advisors will always be the center of the company and that GenAI will only offer advisors some leaps in efficiency.[32] In a continued effort to move AI innovation forward, Morgan Stanley recently announced its first company-wide head of AI, Jeff McMillan, who previously headed the analytics, data, and innovation unit within the wealth management division and was instrumental in the development and implementation of AI @ Morgan Stanley Assistant.[33]

CASE 3: ØRSTED

At Danish multinational energy organization Ørsted, the data experts are the executive management team, which needs to stay abreast of industry trends. With north of 300 relevant news articles each day, it was almost impossible for each executive to read them all. Attempts at having individual folks create summaries resulted in a flow of information that wasn't fully aligned.

Ørsted integrated an LLM from Azure OpenAI into the Dataiku platform, enabling an automated daily news digest. The company's head of digital strategy and innovation, Heidi Østergaard, shared, "For us, democratization of AI is about increasing AI literacy in the organization, giving people the tools and platforms they need."[34]

RECOMMENDATIONS

Case studies drawn from news articles may not fully represent the empirical reality of how GenAI is integrated into these firms. However, they help us think about what seems to work and how it might happen. Drawing from these cases, we propose the following five recommendations (summarized in Figure 1).

1. ALIGN GENAI TOOLS WITH DATA EXPERT NEEDS

Senior management has a tendency to pursue digital transformation goals without much input or feedback from members of the organization who use and are impacted by GenAI integrations. Combining top-down and bottom-up approaches is helpful to ensure that GenAI tools align with data experts' actual workflow and needs. For instance, at Ørsted, GenAI analytics were implemented to solve a data expert problem. The literature on IS has consistently shown that individuals are inclined to continue using a technology they find beneficial. Thus, tailoring these tools to meet user needs will enhance their perceived usefulness, which is needed because the success of digital transformation depends on the active use of these technologies.

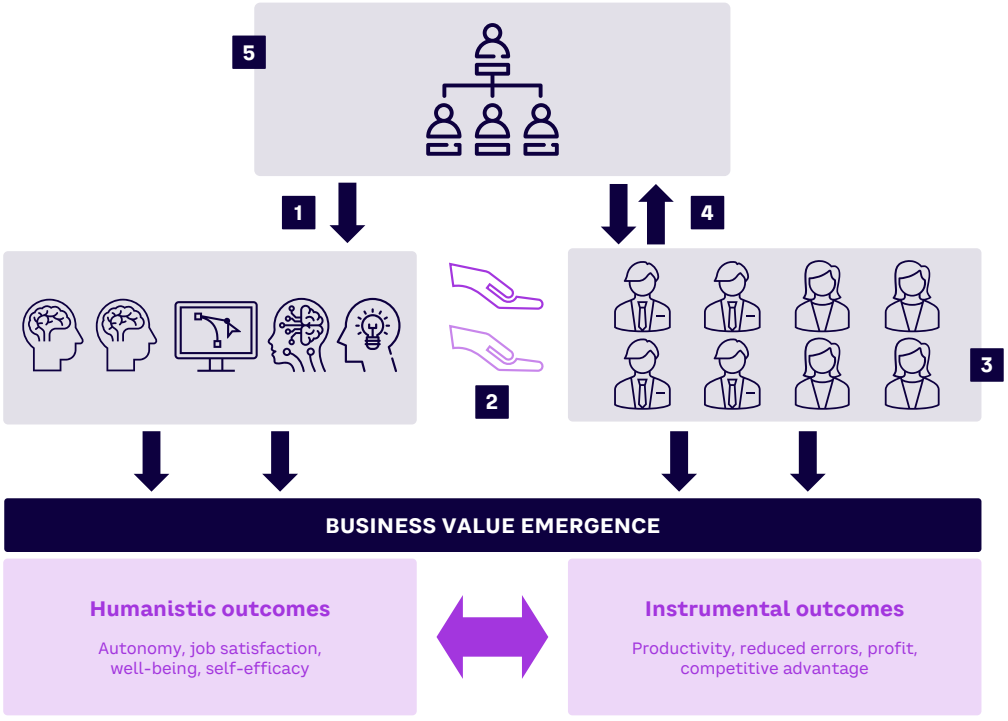

Figure 1. Summary of recommendations

2. GENAI TOOLS MUST LEND A HAND, NOT CONTROL

There is a delicate balance between helping data experts reap the benefits of GenAI integration and ensuring that GenAI does not assume supervisory control over human experts. In the three cases we discussed, GenAI's main task was data analytics, leaving the human experts to make the final call. Indeed, GenAI should not dictate employees' actions. This is not only because GenAI is not yet at satisfactory levels of emotional intelligence, but also because giving GenAI some sort of supervisory role would exacerbate fears of displacement. Additionally, it complicates compensation and reward mechanisms. Who takes the credit in the event of a big win for the company, and who takes the blame in the event of a mistake? Let data experts be experts.

There are cases, however, where GenAI may have to step in. For example, Voya employs GenAI to assist humans in selecting stocks because, unlike humans who may become emotionally attached to a stock, GenAI remains impartial.[35] However, it is critical to clarify who holds the veto power in case of a disagreement between GenAI and the data expert. One way is to set up a "devil's advocate" team comprising humans and GenAI. The capabilities of GenAI are so vast and profound that it is feasible to create a GenAI that functions as a devil's advocate, critiquing suggestions from GenAI stock advisors.

3. RE-SKILL & UPSKILL DATA EXPERTS

As organizations move toward democratizing data analytics, it is crucial to ensure that data experts maintain their expertise in data analytics, mitigating any risk of redundancy or loss of specialized skills. Data experts can also re-skill and upskill. We have seen that layoffs in data analytics are affecting employees at the junior level. Data from LinkedIn shows that jobs requiring AI skills are on the rise.[36] As non-data experts are introduced to surface-level analytics (no code/low code), there is an opportunity for junior data analytics employees to enhance their capabilities by advancing to more sophisticated analytics and AI skills.

4. PRACTICE INCLUSIVE GENAI INTEGRATION

Top management must dispel any notion that data experts using GenAI for domain-specific knowledge are at risk of being replaced by the technology. Leadership at all three organizations we studied publicly acknowledged that these tools are intended to support, not threaten, data experts. Such assurances from leadership are vital as they foster a sense of psychological safety, which is essential for effective collaboration between GenAI and data experts.

Let's put ourselves in the employees' shoes. Imagine having a colleague who can crunch numbers and produce thousands of lines of code in seconds. Wouldn't you feel threatened by them? We should not rob employees of their "somebodiness" by even implying that they are easily replaceable. One way to circumvent such thoughts is to take an employee-inclusive GenAI adoption approach. For instance, PwC makes the tools available to company citizens and allows them the autonomy to automate, ipso facto including them in GenAI initiatives. Indeed, as mentioned, products deemed promising from these employee projects are adopted firmwide, and those employees are compensated accordingly.

5. SENIOR LEADERSHIP MUST BE KNOWLEDGEABLE IN AI & ANALYTICS

We've heard many times that 90% of digital transformation projects fail. One of the critical antecedents to successful digital transformation is a realistic appreciation of what technology can and cannot do. To fully benefit from integrating GenAI into the analytics value chain, leadership must understand — at least to a basic extent — the capabilities and limitations of these LLMs.

This understanding helps prevent digital transformation strategies from becoming mere wishful thinking. For example, Morgan Stanley appointed the previous wealth management chief analytics and data officer as the companywide head of AI who reports directly to the co-presidents. This decision flattens the organizational hierarchy by positioning the head of AI at a senior level rather than under the CTO or CFO, signaling a long-term commitment to AI investment. Additionally, this positioning ensures that the firm's AI initiatives are aligned with broader strategic goals.

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CONCLUSION

The incorporation of GenAI in business analytics offers the potential for significant advancements in business value. Our article contends that prevailing views of business value tend to emphasize financial outcomes. With the apprehensions surrounding potential GenAI-induced displacement in white-collar professions (justified or not), it is crucial to thoughtfully integrate GenAI into data analytics processes to facilitate successful digital transformation.

REFERENCES

[1] Firth, J.R. *Papers in Linguistics 1934–1951*. Oxford University Press, 1964.

[2] De Cremer, David. "For Success with AI, Bring Everyone on Board." *Harvard Business Review*, May–June 2024.

[3] Piskorski, Misiek, and Amit Joshi. "What Roles Could Generative AI Play on Your Team?" *Harvard Business Review*, 22 June 2023.

[4] Lefebvre, Hippolyte, Christine Legner, and Elizabeth A. Teracino. "5 Pillars for Democratizing Data at Your Organization." *Harvard Business Review*, 24 November 2023.

[5] Petrova, Bilyana. "The Importance of Drag and Drop Analytics." Reveal, 28 June 2023.

[6] Ruzgas, Tomas, and Jurgita Bagdonavičienė. "Business Intelligence for Big Data Analytics." *International Journal of Computer Applications Technology and Research*, Vol. 6, No. 1, January 2017.

[7] Lin, Belle. "EXL Service Cutting 800 Jobs as It Shifts Focus to AI." *The Wall Street Journal*, 4 April 2024.

[8] Lin, Belle. "IT Unemployment Soars to 4.3% Amid Overall Jobs Growth." *The Wall Street Journal*, 6 October 2023.

[9] Cazier, Joseph A. *Leading in Analytics: The Seven Critical Tasks for Executives to Master in the Age of Big Data*. Wiley, 2023.

[10] Koch, Hope, Wallace Chipidza, and Timothy R. Kayworth. "Realizing Value from Shadow Analytics: A Case Study." *The Journal of Strategic Information Systems*, Vol. 30, No. 2, June 2021.

[11] Koch et al. (see 10).

[12] Lin, Belle. "Businesses Seek Out ChatGPT-Tech for Searching and Analyzing Their Own Data." *The Wall Street Journal*, 12 May 2023.

[13] Davenport, Thomas H., Ian Barkin, and Kerem Tomak. "We're All Programmers Now." *Harvard Business Review*, September–October 2023.

[14] Delaney, Kevin. "Bringing AI Tools to the Workplace Requires a Delicate Balance." *The New York Times*, 8 May 2023.

[15] Lin (see 7).

[16] Dennehy, Denis. "Ireland Post-Pandemic: Utilizing AI to Kick-Start Economic Recovery." *Amplify*, Vol. 33, No. 11, 2020.

[17] Lin (see 7).

[18] Smith, Ray A. "AI Is Starting to Threaten White-Collar Jobs. Few Industries Are Immune." *The Wall Street Journal*, 12 February 2024.

[19] Marr, Bernard. "Will ChatGPT Put Data Analysts Out of Work?" *Forbes*, 7 February 2023.

[20] Lu, Yiwen. "What to Know About ChatGPT's New Code Interpreter Feature." *The New York Times*, 11 July 2023.

[21] Son, Hugh. "Morgan Stanley Kicks Off Generative AI Era on Wall Street with Assistant for Financial Advisors." CNBC, 18 September 2023.

[22] Loten, Angus, and Belle Lin. "Databricks Strikes $1.3 Billion Deal for Generative AI Startup MosaicML." *The Wall Street Journal*, 26 June 2023.

[23] Brans, Pat. "Will Enterprises Soon Keep Their Best Gen AI Use Cases Under Wraps?" *CIO*, 17 April 2024.

[24] Davenport et al. (see 13).

[25] Barkin, Ian, and Thomas H. Davenport. "Harnessing Grassroots Automation." *MIT Sloan Management Review*, 11 September 2023.

[26] Davenport et al. (see 13).

[27] Barkin and Davenport (see 25).

[28] Loten, Angus. "PricewaterhouseCoopers to Pour $1 Billion Into Generative AI." *The Wall Street Journal*, 26 April 2023.

[29] Loten (see 28).

[30] Son (see 21).

[31] Welsch, Andrew. "How AI Will Change Wealth Management." *Barron's*, 5 July 2023.

[32] Son (see 21).

[33] Corbin, Kenneth. "Morgan Stanley Names Jeff McMillan First Firmwide Head of AI." Financial News, 18 March 2024.

[34] "Ørsted: Monitoring Market Dynamics With LLM-Driven News Digest." Dataiku, accessed May 2024.

[35] Welsch, Andrew. "How Voya Is Blending AI with Humans to Pick Stocks." *Barron's*, 31 July 2023.

[36] Laker, Benjamin. "LinkedIn Data Predicts 65% Shift in Job Skills by 2030 Due to AI." *Forbes*, 3 October 2023.

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AI HALLUCINATION IN THE WAKE OF GENAI

Authors

Maria P. Diaz Campo, Arman Ghafoori, and Manjul Gupta

Conversations about AI are unavoidable because the potential benefits of AI adoption are unprecedented, particularly for organizations. Generative AI (GenAI) allows firms to increase employee productivity, streamline internal processes, and enhance customer-facing ones. It has the potential to create new avenues for value generation by fundamentally transforming the way firms generate data and interact with it.

GenAI provides a conversational interface to query data sets and generates easily interpretable outputs, letting those without technical expertise interact with data. This creates new possibilities for leveraging data and improving decision-making. These benefits make GenAI a true game changer, helping companies derive business value from existing and emerging data.

However, these boons are not without banes. Debates over GenAI include issues common to most technology development debates, such as job displacement and ethics. But this debate also deals with issues distinctive to AI such as intellectual property, algorithmic bias, and information reliability.

With analytics now an indispensable component of value generation, the issue of information reliability has become critical. So it's no surprise that AI hallucination (when GenAI produces nonsensical or inaccurate output) has recently taken center stage. The public learned that ChatGPT erroneously claimed a law professor had sexually harassed a student in a class,[1] Google's Gemini generated images deemed to be "woke" that were historically inaccurate,[2] and Meta's Galactica was shut down because of inaccuracies and bias.[3]

Blind reliance on fabricated data from these hallucinations can have severe consequences. Blind reliance on any information source is never advisable, and ensuring data accuracy is fundamental in any analytical process. Ensuring data reliability is particularly challenging when GenAI presents fabricated information as factual, often with limited transparency about the source. AI hallucination is especially problematic for novice users who lack the technical expertise to verify such data.

Some argue that it's time to focus on GenAI's value potential, but concerns about its use continue and should not be overlooked, especially when developing adoption strategies. So we must ask: "To what extent is AI hallucination acceptable?" and "How much room for error are we willing to tolerate?" These are not easy questions, but they are essential to navigating the path forward with GenAI.

The degree to which such hallucinations are tolerated is contingent on context and the circumstances surrounding the usage. But how does context come into play? And what does it mean at various levels of analysis? Figure 1 illustrates the contextual lenses — national culture, organizational culture, and personality — in which we can evaluate tolerance to AI hallucination at different levels of analysis (i.e., societal, organizational, and individual).

WITH ANALYTICS NOW AN INDISPENSABLE COMPONENT OF VALUE GENERATION, THE ISSUE OF INFORMATION RELIABILITY HAS BECOME CRITICAL

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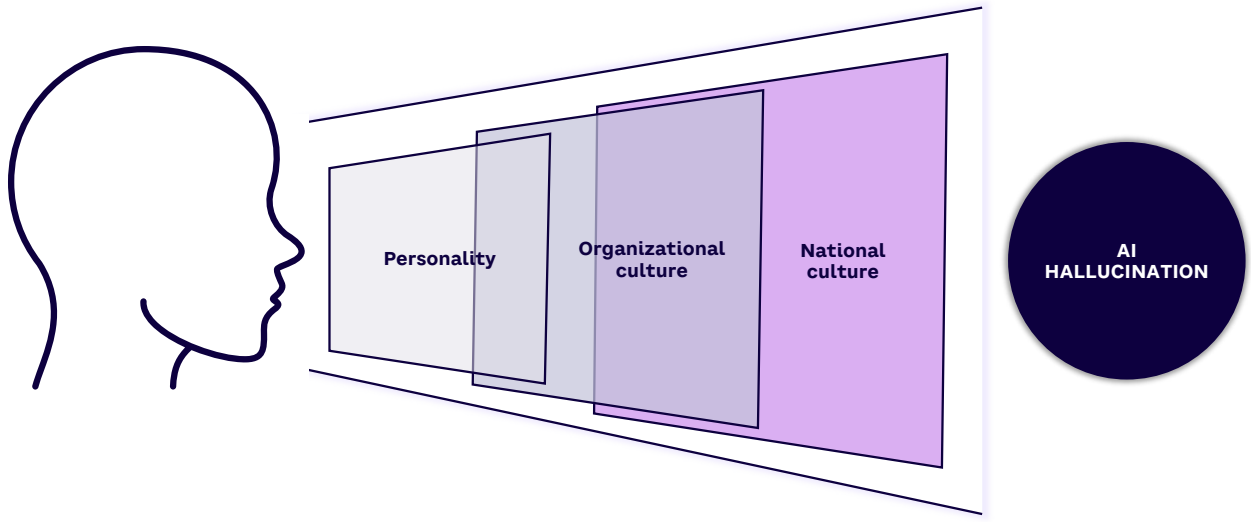

Figure 1. Context at different levels of analysis for AI hallucination

AI HALLUCINATION THROUGH THE LENS OF NATIONAL CULTURE

At a societal level, context comes from national culture. When seeking to understand tolerance for hallucinations, it is unlikely that a global consensus can be reached, making understanding national cultures instrumental in assessing societies' tolerance levels.

One cultural aspect particularly useful in understanding the differences in tolerance to AI hallucination is how comfortable individuals are with uncertainty and ambiguity. Individuals in societies that are comfortable with uncertainty in their daily lives may be more tolerant of hallucinations; those who are highly risk-averse may be less tolerant.

Another aspect that affects tolerance to hallucinations is how a society values short-term and long-term outlooks. Societies with long-term orientations are more likely to tolerate AI hallucinations by acknowledging the potential future value of embracing GenAI. Conversely, societies with short-term orientations may be hesitant to adopt GenAI tools, given the immediate negative consequences we've seen from hallucinated outcomes.

The EU Artificial Intelligence Act aims to regulate AI contingent on the risk these systems represent. Importantly, it reflects the notion of disparate perspectives on AI use among societies by regulating its use for specific applications deemed unacceptable in the EU but acceptable in countries with diverging cultural stances (e.g., social-scoring systems like those used in non-Western societies).[4]

The AI Act reinforces the idea that the circumstances encompassing the use of AI interact with national culture to determine a society's tolerance of error. It categorizes AI systems according to their risk to regulate their use, such as prohibiting systems that deceptively manipulate behavior, leading to significant harm. This suggests that although fabrications may be viewed differently due to contextual and cultural cues, the magnitude of the consequences of relying on AI-generated information drives what we consider tolerable.

AI HALLUCINATION THROUGH THE LENS OF ORGANIZATIONAL CULTURE

At the firm level, we can better understand tolerance to AI hallucination by looking at organizational culture. All firms are unique, but similarities or differences among them help define various cultures.[5] Some organizations are more open to embracing change and adopting new technologies; this may come at the price of uncertainty and newfound error sources. Accepting that markets are dynamic and constantly changing stems from a culture of flexibility and adaptability, so these organizations may be more likely to adopt GenAI and be more tolerant of hallucinations.

Other organizations are not as open to change. This may come from certain aspects of a firm's culture, such as a focus on processes. That focus helps with productivity, but it may come at the expense of adaptability. Organizations with this type of culture may not be as tolerant of hallucinations (adherence to processes could hinder flexibility in navigating GenAI's limitations).

As our reliance on data for decision support increases, so will the situations in which GenAI can be useful. However, not all situations have the same stakes in terms of errors, and companies with diverging cultural stances are likely to react very differently.

Google's Gemini "woke" responses clearly illustrate the importance of the stakes surrounding GenAI use.[6] This could have been viewed as an error in processing and output, but many found the historical inaccuracies and biases intolerable. This led to a serious hit to Google's reputation as a tech leader.

AI HALLUCINATION THROUGH THE LENS OF PERSONALITY

Societal and organizational views can give us important insights into AI hallucination tolerance, but to understand this phenomenon, we must look at the end user.

Fortunately, personality can help us assess individual beliefs about the acceptability of AI hallucinations. Individuals who are neurotic may be less tolerant of AI hallucinations, for example, given their susceptibility to anxiety. Individuals who tend to be open to new experiences may be willing to tolerate certain levels of hallucination.

We must consider the circumstances in which people engage with AI systems alongside personality. Consider the example of the law professor wrongly accused by AI of sexual harassment. This could be viewed as an error in the system, but the stakes raise our level of intolerance. That is, an output error is unacceptable when someone's career and reputation are on the line.

As organizations operate within societal dynamics and individuals engage within organizations, these contextual factors interact at a higher level of abstraction. They should not be considered in isolation; rather, we must look at them holistically to understand how we react to hallucinations and how we should interact with GenAI systems.

SHOULD YOU CARE ABOUT GENAI HALLUCINATING?

Amid the ongoing debate about the potential benefits of GenAI versus possible areas for concern, there are decisions to be made. GenAI is here to stay, and lingering on the debate stage without acting will set us back as the market moves forward.

As discussed in this article, competing factors come into play to determine our tolerance to AI hallucination, so a "Here's what you should do" statement addressing this phenomenon is not the answer. We believe that understanding the context is crucial to making informed decisions about strategically adopting and implementing emerging technologies. This understanding can help us balance the potential value of the opportunity with our risk tolerance.

Here are several key takeaways:

- **Consider the national context around your firm's operations.** What regulations are in place to guide GenAI's adoption and use? Do they align with your organization's culture, or do they require a cultural shift? Are there practices in other countries that closely resemble your own that you could adopt?
- **Consider where your firm falls within each cultural dimension** to determine how accepting your company is of new systems and its tolerance to AI errors.
- **Get to know the individuals that make up your organization;** many have probably informally adopted these technologies. Consider their experiences and personalities when devising adoption strategies that align with their current practices.
- **Establish clear regulations that encourage transparency** when AI-generated data is being leveraged for decision-making, but ensure their enforcement aligns with your organization's culture and your employee's personalities.
- **Foster education** on GenAI use and its potential pitfalls to promote a culture of responsible use.

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We must not dismiss the issues surrounding AI hallucinations. The potential benefits of GenAI are virtually endless, but the repercussions from misuse or blind reliance on its output can be highly detrimental. The good news is that a balance is possible. Key to that balance are: (1) having context at the fore of your adoption strategies, (2) accounting for tolerance levels, and (3) mitigating the risk of misuse while capitalizing on the many opportunities this technology offers.

REFERENCES

[1] Verma, Pranshu, and Will Oremus. "ChatGPT Invented a Sexual Harassment Scandal and Named a Real Law Prof as the Accused." *The Washington Post*, 5 April 2023.

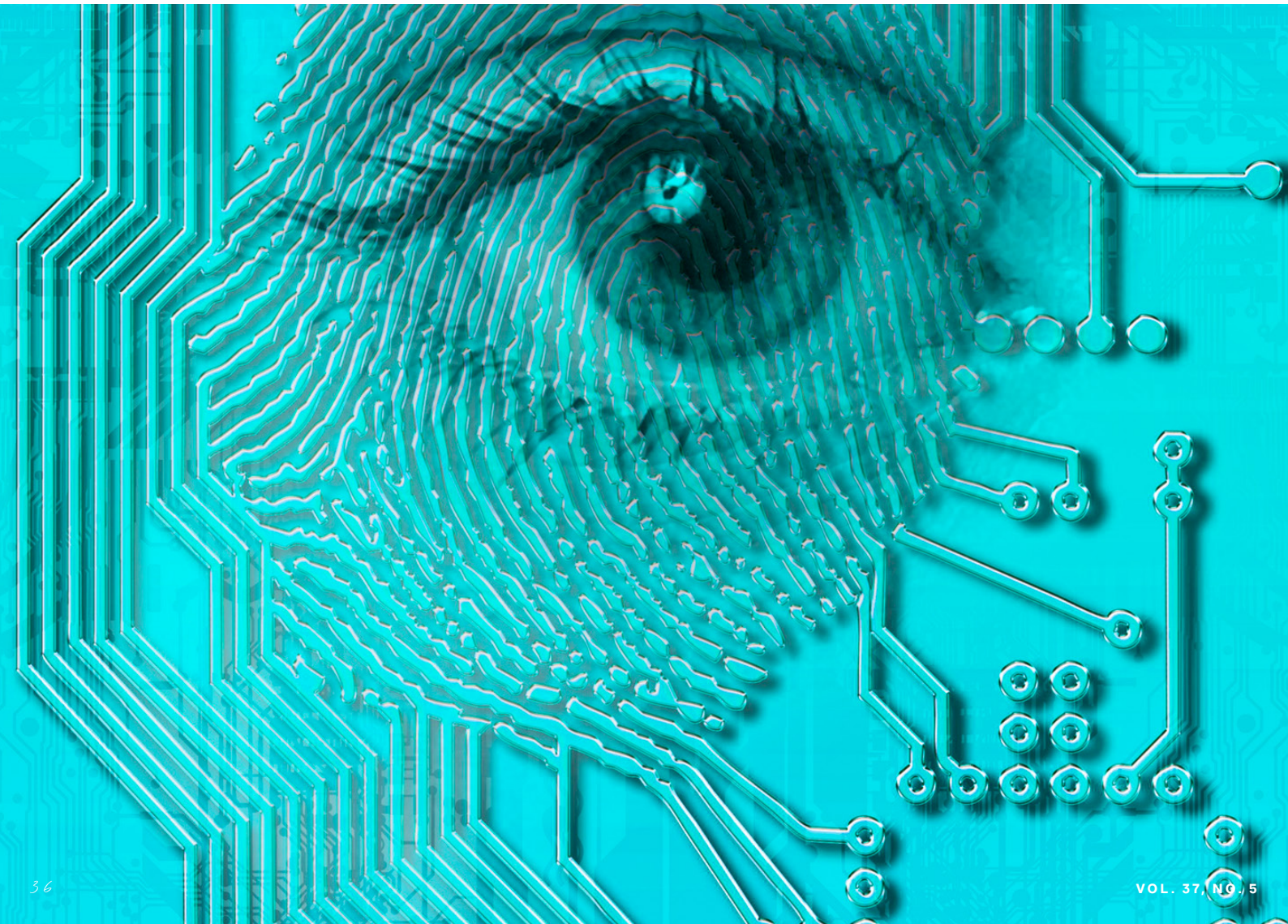
[2] Zitser, Joshua. "Google Suspends Gemini from Making AI Images of People After a Backlash Complaining It Was 'Woke.'" Business Insider, 22 February 2024.

[3] Heaven, Will Douglas. "Why Meta's Latest Large Language Model Survived Only Three Days Online." *MIT Technology Review*, 18 November 2022.

[4] "EU AI Act: First Regulation on Artificial Intelligence." European Parliament, 8 June 2023.

[5] Gupta, Manjul, Amulya Gupta, and Karlene Cousins. "Toward the Understanding of the Constituents of Organizational Culture: The Embedded Topic Modeling Analysis of Publicly Available Employee-Generated Reviews of Two Major US-Based Retailers." *Production and Operations Management*, Vol. 31, No. 10, August 2022.

[6] Zitser (see 2).



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