A FUTURE WITH PURPOSEFUL AI

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TOWARDS A FUTURE WITH PURPOSEFUL AI

While debates about job automation and ethos of artificial intelligence (AI) continue, technology stalwarts — individuals and organizations — pursue AI advancement, collectively giving it a purpose that can eventually make our lives better and solve some grand challenges facing the planet. Google just launched a massive open AI division, making available on cloud its Tensor Processing Units, which can accelerate both training and running machine-learning (ML) models, for developers. An American software firm, Cylance Inc., leverages AI, algorithmic science, and ML to prevent cyberattacks. Tesla has achieved considerable success in building capabilities to prevent collisions for automated vehicles. At Infosys, we continue to build on the capabilities of

Infosys Nia, our next-generation integrated AI platform. Besides helping our clients in faster revenue reconciliation (CPG), better forecasting (pharma), and dynamic fraud analysis (banking) among others, Infosys Nia is also bringing significant automation-led productivity improvements to delivery efficiencies across our own service lines. In the last 12 months, it has helped us eliminate the efforts of around 11,000 full-time employees, thereby helping us repurpose those people into more valuable and meaningful tasks.

Organizations across the board are acknowledging the potential of AI. In a recent study commissioned by Infosys, 'Amplifying Human Potential: Towards Purposeful Artificial Intelligence', out of the 1,600 IT and business

decision-makers interviewed, 76 percent cited AI as fundamental to the success of their organizations' strategy and 64 percent believed organizational growth is dependent on large-scale AI adoption. A majority (84 percent) plan to train employees on the benefits and use of AI, and 80 percent plan to retrain or redeploy impacted employees.

In this issue of Infosys Insights, we present various perspectives on the larger purpose of AI to help you trace meaning across massive technology-driven changes, which is beyond complete comprehension for most of us. On the cover, Abdul Razack tells you why adopting AI should not be about choosing one or two from a list of AI techniques, but using a wide range. Because, today, the true potential of AI is unfathomable.

In the Ideas and Beyond section, the spotlight is on ideas, inspirations, and pursuits that could inform the future. Kris Gopalakrishnan, cofounder of Infosys and Chairman of Axilor Ventures, elucidates the second AI wave — on why the confluence of human intelligence and AI will amplify growth and ensure sustainable progress. In the other article, Abhijit Shroff, Senior Principal, TechArch, focusing on next-gen cloud and AI platforms, knocks over the fear and paranoia surrounding AI — about robots controlling humans.

In the Tech Talk section, we get down to brass tacks across three industries. Mohit Joshi, President and Head of BFSI, Healthcare, and Life Sciences, Infosys, explains why and how ML can eliminate all regulatory compliance woes tangled in complexity for decades.

Madhu Janardhan, Head of Retail, CPG, and Logistics (Americas), Infosys, writes about the potential transformation of the logistics industry through big data and AI. Venky Ananth, Vice President, Healthcare, Infosys, captures how the industry is coming face to face with automation and AI and what could be a road map to start the journey.

In the Renew-New section, we focus on the duality of renewing the past and exploring the new in the time of being digital. Is there a safety net for 'digital refugees'? Holly Benson, VP and Managing Partner at Infosys Consulting, ponders on this question with some insightful data. In the next article, Dominique Leroy, CEO of telecom major, Proximus, converses with Rajesh Krishnamurthy, President and Head of Energy, Utilities, Telco, and Services, Infosys, explaining why the company is cautiously optimistic about adopting AI. Then, Aniket Maindarkar, tells you what constitutes 'smart' in smart retail.

In the final section, Research Unraveled, Dr. Martin Prause, Professor of Computational Economics (CE) and Business Analytics at Otto Beisheim School of Management, Germany, highlights the applications of CE in today's business landscape and how AI can improve business simulations.

I hope this issue provides you with a rich outlook on AI and helps you make informed decisions for your business.

Ravi Kumar S.
President and Deputy COO, Infosys

CRACKING THE AI CONUNDRUM

The various techniques of AI, or what Minsky calls 'agents' are by themselves of little use. But when used together, with a clear purpose, they have the potential to create great outcomes. This is what enterprises have to aim for, as they undertake the AI journey.

In his seminal book 'The Society of Mind', cognitive scientist and artificial intelligence (AI) guru Marvin Minsky constructs a model of human intelligence step by step, built up from interactions of simple parts called 'agents' that are themselves mindless. These agents are akin to the various AI techniques which have matured today, such as machine learning, deep learning, natural language processing (NLP), and artificial neural networks. But collectively, these agents hold the potential to create great outcomes, but when taken individually, they are pretty 'mindless' and not a patch on the whole. So when enterprises adopt AI, it is essential to have a sense of purpose – to use all the AI techniques needed – not just individual agents.

Let's look at a business scenario that illustrates this idea. Let's say, a manufacturing business is under pressure to increase yield. So, it has identified in its 15-step supply chain process, one step that is currently consuming four hours. The organization is excited about applying a certain AI technique to this step and improving the process significantly. Cause for celebration yet? Not really, because the company could instead, create a high-impact solution by taking a comprehensive

approach towards increasing yield – by applying a bunch of AI techniques. These could help them identify the known and the unknown problems surrounding the issue of inadequate yield, make interconnections among them, read hidden patterns, and gather insights. The true potential of AI is unfathomable. The key is to continually embrace AI by experimenting, learning, and building on successes.

Today, two important developments have precipitated an environment for AI techniques to rapidly develop and thrive, empowering organizations to adopt AI:

ABUNDANCE AND AVAILABILITY OF DATA: With IoT creating colossal amounts of structured and unstructured data, organizations have unprecedented access to data. The more the data that is fed into a machine learning algorithm, the sooner it 'stabilizes' and improves accuracy. According to Ovum Research, machine learning will be the biggest disrupter for big data analytics in 2017.

SUPERCOMPUTING POWER AT A REASONABLE COST: Neural networks have existed for decades, but it is only now that

massive computing power is available at a reasonable cost, which in turn has helped increase the number of 'layers' in these networks. Each 'layer' adds more intelligence but also consumes enormous computing power, which earlier used to be prohibitively expensive.

More layers mean better outcomes. This is what is commonly referred to as 'deep learning'.

Beyond automation: AI is about problem finding and problem solving

A piecemeal approach to AI amounts to turning the clock back by underutilizing its true power. Kvelling upon the automation-driven scale and cost efficiencies is appreciating only a fraction of the picture – being myopic really. To tap into the true potential of AI, it is important for businesses to change their approach to problem finding and problem solving.

There are essentially two kinds of problems that a business needs to solve:

Known problems – These have been known to us for years but it is only now that we have the technology to tackle them and achieve tangible results. Some examples are fighting money laundering and financial fraud, ensuring better regulatory compliance, medical diagnostics, analyzing customer sentiment, and so on.

compels us to look beyond and push the boundaries, as technology-led innovations and disruptions are upending business models and creating new paradigms. Often, going after the familiar problems may not lead to the best solutions. On the upside, AI-driven techniques such as predictive analytics and forecasting – of revenues, possible snags, behavior of suppliers, partners, and clients in a certain context, cost of products yet to be built, and so on – are enabling deeper understanding, discovering problems, and creating better solutions for them.

At Infosys, we believe that a comprehensive approach to adopting AI – spanning both the known and the unknown problems – albeit in a step-by-step manner, is the way forward. We have adopted Design Thinking across the board to address these two categories of problems and create sustainable solutions for our client ecosystem. True to the principles of Design Thinking that pivots on the end-user, our clients are integral to this journey of problem finding and problem solving.

Our next-generation AI platform, Infosys Nia, leverages open source and consolidates various AI tools and techniques to create a 'society of mind', if you will. Infosys Nia brings onto a single platform, big data / analytics, machine learning, knowledge management, cognitive automation capabilities, end-to-end RPA capabilities, optical character recognition (OCR), natural language processing (NLP) capabilities, and infrastructure management

A JOURNEY INTO THE UNKNOWN

It is important to deal with the known problems first and build credibility, especially among the skeptics in an organization, through early results.

AI is never about a piece of technology. Rather it is a new paradigm altogether that needs to be treated thus.

There should be dedicated focus and investment in problem finding, an area that is inextricably related to realizing the true potential of AI.

Unknown problems – These are problems that have not manifested themselves yet. Problems that we don't even know exist.

But these are 'problems' nevertheless. The pervasive technology revolution today

services. It enables a wide set of industry- and function-specific solutions and allows customers to build bespoke experiences to suit their business needs.

While the power of AI lies in problem solving, it will allow humans to focus on problem finding!

## Addressing larger issues, amplifying human potential

While automation and AI are transforming bottom-line-focused, data-rich industries such as retail, manufacturing, and telecom, as well as touching others such as healthcare, insurance, and financial services, these technologies are also enabling massive collaborations across organizations and industries. Some of these are the result of new business models and disruptions, and others are driven by the need for the greater good. Many technology leaders and visionaries believe that AI has the power to address some of the biggest problems facing us – as humans, on planet Earth.

Google DeepMind focuses on trailblazing work in machine learning with the aim of bringing about an 'artificial general intelligence', to harness AI for grand challenges. CEO of DeepMind, Demis Hassabis, says: "If we can solve intelligence in a general enough way, then we can apply it to all sorts of things to make the world a better place."

OpenAI, a non-profit AI research company, backed by Tesla and SpaceX founder, Elon Musk, is aimed at 'advancing digital intelligence in a way that is most likely to benefit humanity as a whole.'

Although concerns around machines overtaking humans may exist, human creativity and imagination will triumph. AI will relieve us from the mundane and the cumbersome, liberating us to focus on finding the most relevant problems to solve. To achieve our true human potential.

We live in extraordinary times, where technology empowers us to envision a future where we can sync our brains with artificial neural networks, yet at the same time ponder upon the possibility of job loss and AI systems going rogue. It is a time when all enterprises will embark upon the AI journey and learn along the way. The more we iterate and the more we learn, the better the results will be. So as we take the initial steps, it is important to acknowledge the potential of AI and build a purposeful platform for it.

It is important to deal with the known problems first and build credibility, especially among the skeptics in an organization, through early results.

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Abdul Razack

In a career that spans over two decades, Abdul has been involved in several engineering and consulting roles at Commerce One, Sybase, KPMG Peat Marwick, and SAP. Abdul holds a Master's Degree in Electrical Engineering from Southern Illinois University, and a Bachelor's Degree in Electronics and Communication Engineering from the University of Mysore, India.

If you wish to share your thoughts on this article or seek more information, write to us at **Insights@infosys.com**

IDEAS AND BEYOND
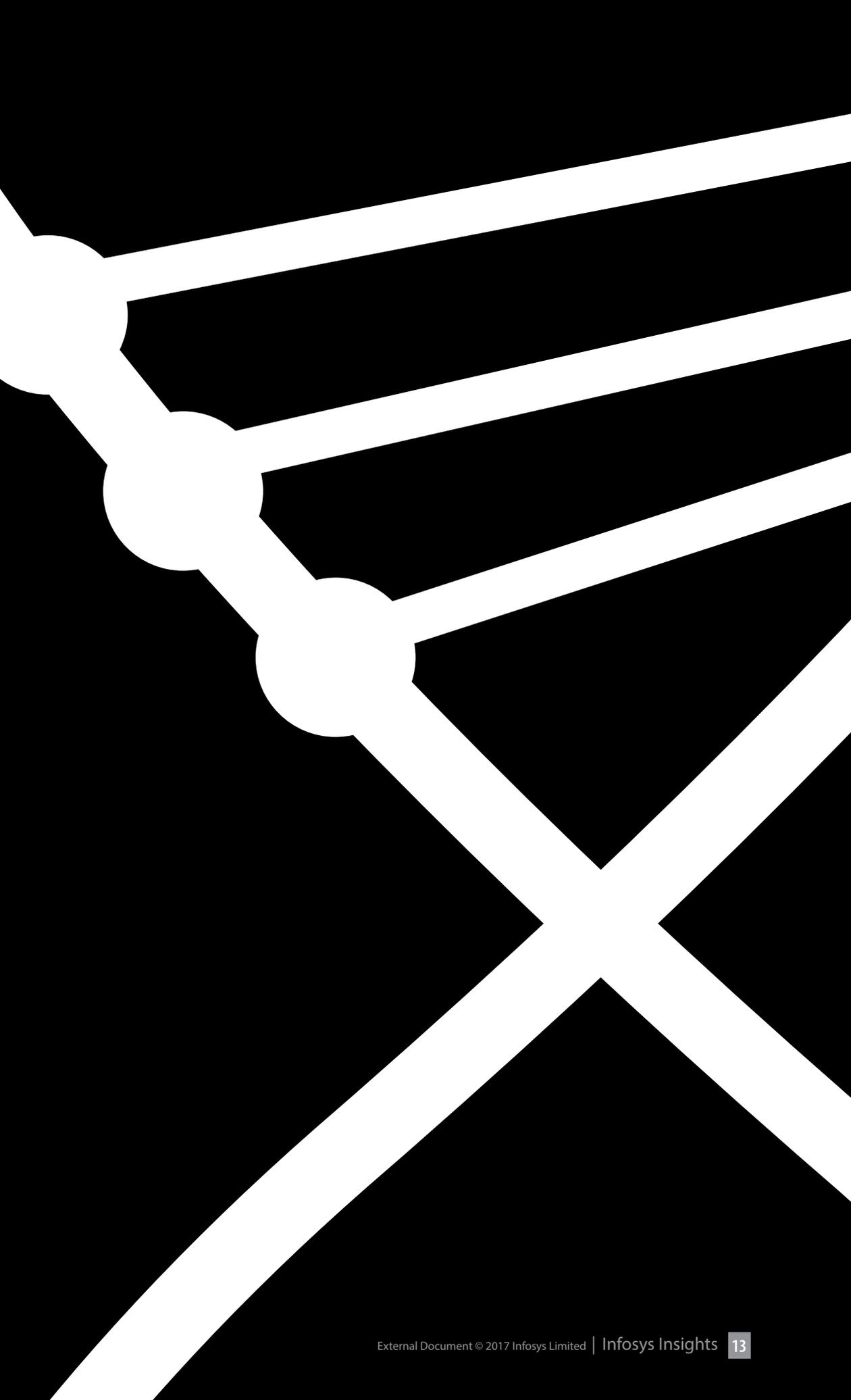
TAKING AI WHERE THE HUMAN BRAIN GOES

The human brain — intelligent and unique — is challenging scientists, who are determined to decode its complexity and unlock possibilities to enhance human lives. By harnessing artificial intelligence (AI), they have already made breakthroughs in man-machine interactions through Watson, Siri, and more. But for AI to have a truly transformational impact, artificial neural networks need to be further reinforced by human native intelligence.

The human brain has advanced over time in responding to survival instincts, harnessing intellectual curiosity, and managing demands of nature. When humans got an inkling about the dynamics of the environment, we began our quest to replicate nature.

Our success in imitating nature has been related to advances in science and technology. Take for example, our aspiration for flight. We replicated wings to achieve safe and long-haul air travel. However, we are aware that inflexible aircraft wings are not an exact replacement, and a likely solution may lie in the Self-Assembly Laboratory at the Massachusetts Institute of Technology (MIT). It is developing a 4D printing technique to create aircraft wings that adapt to aerodynamic conditions.

While the human brain finds ways to exceed our physical capabilities, the combination of mathematics, algorithms, computational methods, and statistical models is accelerating our scientific pursuit. Artificial intelligence (AI) gathered momentum after Alan Mathison Turing developed a mathematical model for biological morphogenesis, and authored a
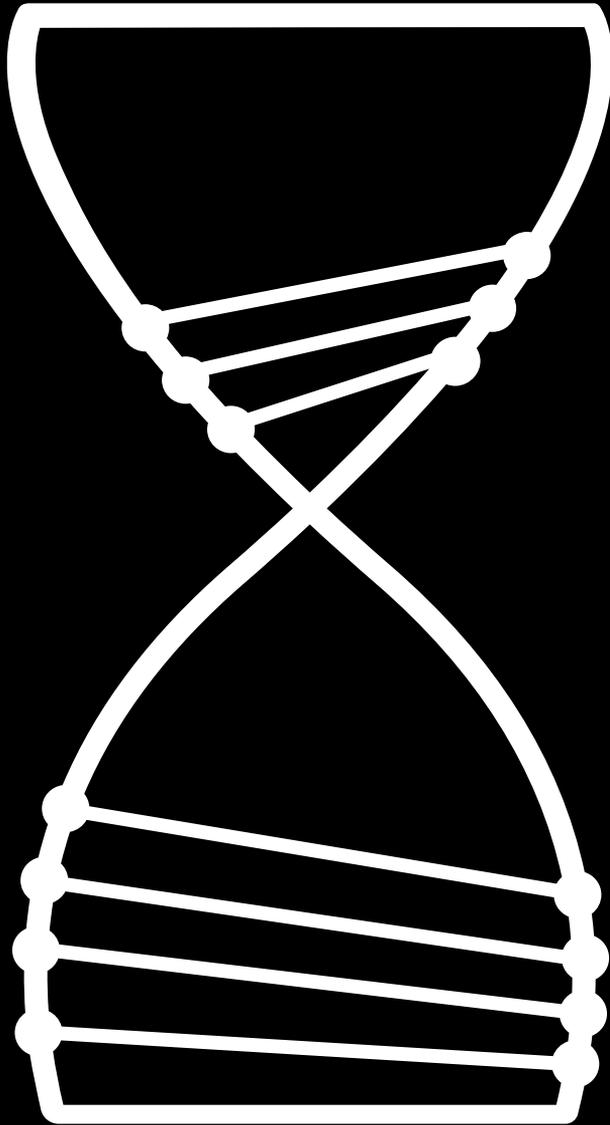
Before you know it!
It won't be long before AI mimics a human brain
to do more, with less — just like we can.

seminal paper on computing intelligence. Today, AI has grown from data models for problem solving to artificial neural networks – a computational model based on the structure and functions of human biological neural networks.

Teaching the machine

The first generation of AI created machine-learning systems. Machine learning focuses on the development of computer programs that can change, or learn, when exposed to new data. Algorithms from the first generation of AI 'taught' machines to identify images and objects, see obstructions, correlate, and discover relationships between variables. It resulted in intelligent applications that managed single tasks at a time.

Today, AI has grown from data models for problem solving to artificial neural networks based on human biology.

AI makes industrial machinery accurate, reliable, and self-healing; and paves the way for calibrated performance resembling human action. Modeling techniques locate indecisive voters, identify crops that are most suitable for a specific topography, and verify clinical diagnosis and treatment. AI integrates with robotic controls, vision-based sensing, and geospatial systems to automate advanced systems. It enhances disease prevention and treatment, boosts engineering systems, and drives self-organizing supply chains. As of today, AI provides near-human customer care at the Royal Bank of Scotland, and assesses insurance claims at Fukoku Mutual Life Insurance.

In fact, we now rely on machines for decision-making across processes — underwriting, recruitment, fraud detection, maintenance, and more. Real Core Energy uses machine-learning algorithms that evaluate production and performance parameters to guide oil-drilling operations as well as investment decisions. Gift concierge service 1800-Flowers. com uses AI to recommend gifts. It combines customer interaction with macro buying trends and consumer behavior to recommend personalized gifting ideas. Philips has developed a deep-learning-based, automatic screening solution to detect tuberculosis, a disease that affects 2.5 million people in India.

The human race conceded to artificial intelligence in move #37 of the game between Lee Sedol, the world champion of Go, and AlphaGo in Seoul, South Korea. Experts took weeks to understand the 'wisdom' of the AlphaGo machine.

The structure of artificial neural networks is inspired by the human nervous system. It helps 'train' machines to make sense of speech, images, and patterns. DeepFace, the Facebook facial recognition system, was trained to recognize human faces in digital images by using millions of uploaded images. Researchers at MIT have developed a model for facial recognition that duplicates the neurological functions of the human brain.

Machines learn to think

Computational neuroscience bridges the gap between human intelligence and AI by creating theoretical models of the human brain for inter-disciplinary studies on its functions, including vision, motion, sensory control, and learning.

Research in human cognition is revealing a deeper understanding of our nervous system and its complex processing capabilities. Models that offer rich insights into memory, information processing, and speech / object recognition are simultaneously reshaping AI.

A nuanced understanding of the structure of the human brain can help restructure hierarchical deep learning models. Deep learning, a branch of machine learning, is based on a set of algorithms that attempt to model high-level abstractions in data. It will enhance speech / image recognition programs and language processing tools by understanding facial expressions, gestures, tone of voice, and other abstracts. We are on the threshold of experiencing advances in speech technology that will lead to more practical digital assistants and accurate facial recognition that will take security systems to the next level.

However, contemporary deep-neural networks do not process information the way

the human brain does. These networks are highly data-dependent and should be trained to accomplish even simple tasks. Complex processes require large volumes of data to be annotated with rich descriptors and tagged accurately for the machine to 'learn.' Further, deep-learning systems consume far more power than the human brain (20 watts) for the same amount of work.

We need to discover less intensive machine-learning approaches to augment artificial intelligence with native intelligence. Our world is awash with data from Internet of Things (IoT) applications. Deep-neural networks capable of consuming big data for self-learning will be immensely useful. But just as children identify trees despite variations in size, shape, and orientation, augmented intelligence systems should learn with less data or independently harness knowledge from the ecosystem to accelerate learning. Such self-learning algorithms are necessary for truly personalized products and services.

The interface imperative

The merger of human intelligence and AI will turn computers into super-humans or humanoids that far exceed human abilities. However, it requires computing models that integrate visual and natural-language processing, just as the human brain does, for comprehensive communication.

Language-learning skill is one of the defining traits of human intelligence. Since the meanings of words change with context, 'learning' human language is difficult for computers. AI-embedded virtual assistants can address complex requests and engage in meaningful dialogue only when they 'think and speak' the human language. Machines should learn to understand richer context for human-like communication skills. They should be endowed with richer cognitive capabilities to interpret voice and images correctly.

AI systems such as IBM's Watson, Amazon's Alexa, Apple's Siri, and Google Assistant will become more useful, if enhancements to the quality of language and sensory processing, reasoning, and contextualization are achieved. Voice-activated devices and smart machines will create a centralized, artificial-intelligence network or 'intelligent Internet,' which will redefine man-machine and machine-machine collaboration.

In the near future, drones with built-in navigation systems will deliver goods in crowded cities, and smart home appliances
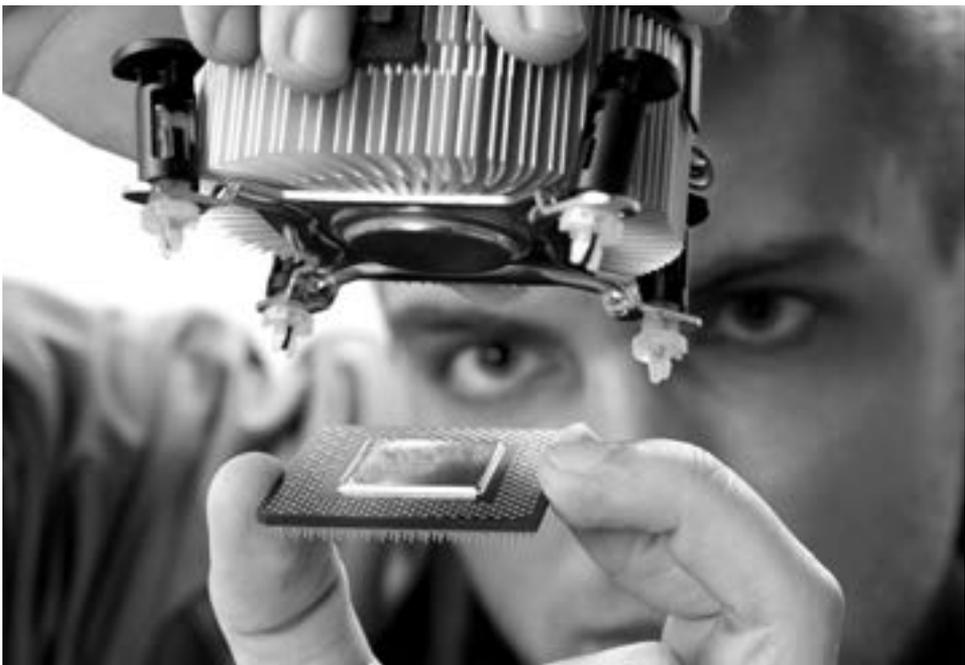
Just as children identify trees despite variations in size and shape, augmented intelligence systems should learn with less data or independently harness knowledge from the ecosystem.

will translate recipes, assemble ingredients in response to voice commands, and serve gourmet meals.

Of course, as computers become more powerful, more networked, and more human, they become capable of independent interaction with stakeholders. However, creativity and strategic thinking differentiate the human race from artificially intelligent entities. Today, we do not fully understand concepts that make our intelligence unique. We need to know more deeply how the human mind operates, as a means to incorporate emotional and social intelligence into machines. Human beings will continue to control everything until machines become self-referential systems. Till then, we must revisit our ecosystem, which spans education systems, skill-development processes, and social welfare models to make way for more efficient methods.

AI systems will be a force multiplier for every industry and human activity. AI can transform billions of lives via myriad applications, and solve fundamental issues: clean the air we breathe, purify the water we drink, enrich the food we consume, and ensure our wellness. All it needs is that the person-to-machine user interface mimics the brain-to-brain interface.

The world will be a better place for successive generations when technology works in transformative and invisible ways. While the native intelligence of the human race has produced inventions that are ubiquitous, the confluence of human intelligence and artificial intelligence will amplify growth and deliver sustainable progress.

Experts took weeks to understand the 'wisdom' of the AlphaGo machine.

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Senapathy 'Kris' Gopalakrishnan served as the Vice-Chairman of Infosys from 2011 to 2014, and the Chief Executive Officer and Managing Director of Infosys from 2007 to 2011. Kris is one of the cofounders of Infosys.

Recognized as a global business and technology thought leader, he was voted the top CEO (IT Services category) in Institutional Investor's inaugural ranking of Asia's Top Executives, and selected as one of the winners of the second Asian Corporate Director Recognition Awards by Corporate Governance Asia in 2011. He was also selected to Thinkers 50, an elite list of global business thinkers, in 2009. He was elected president of India's apex industry chamber, the Confederation of Indian Industry (CII), for 2013–14, and served as one of the co-chairs of the World Economic Forum in Davos in January 2014.

In January 2011, the Government of India awarded Kris the Padma Bhushan, the country's third-highest civilian honor.

He now serves on the Board of Governors of the Indian Institute of Technology Madras, and the Indian Institute of Management Bangalore, is the Chairman of the Board of Governors of IIIT - Bangalore, and is on the Board of Trustees of the Chennai Mathematical Institute.

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*If you wish to share your thoughts on this article or seek more information, write to us at **Insights@infosys.com***

BETTER AT BEING HUMAN, THANKS TO AI

Fear and paranoia about where AI is headed helps no one.
A positive outlook, combined with a strong foundation to make
innovation safe – through cooperative governance, will
help us amplify human potential – not destroy it with AI.

Over the past few years, a growing tribe of AI doomsayers has made several predictions on the threat of AI. The prophesies include, among others, an impending war by killer robots and the need for humans to become cyborgs to stay relevant in the age of artificial intelligence (AI). Statements such as these are not limited to technology leaders. For instance, a prominent theoretical physicist has warned that "AI could spell the end of the human race." Additionally, a British inventor publicly voiced his concerns about how the human race will be unable to survive against more intelligent machines.

This may seem far-fetched to many of us. As humans, we are all programmed to be aware and cautious as an in-built safety mechanism – but not to the point of being paranoid. Paranoia merely breeds panic and serves no purpose other than to impair the human condition. Humans are curious and positive creatures. This ability – to feel and find happiness in the simplest of things – without proven and accurate data is a human privilege. It gives us a unique advantage against any AI tool, robot or cyborg.

To be fair, some of the concerns voiced by the global community are certainly well-founded. For instance, the CEO of a high-tech automaker raised valid concerns that "AI will follow the will of the people that establish its utility function." In other words, he worries that AI can be dangerous in the wrong hands. To counter this, the industry needs
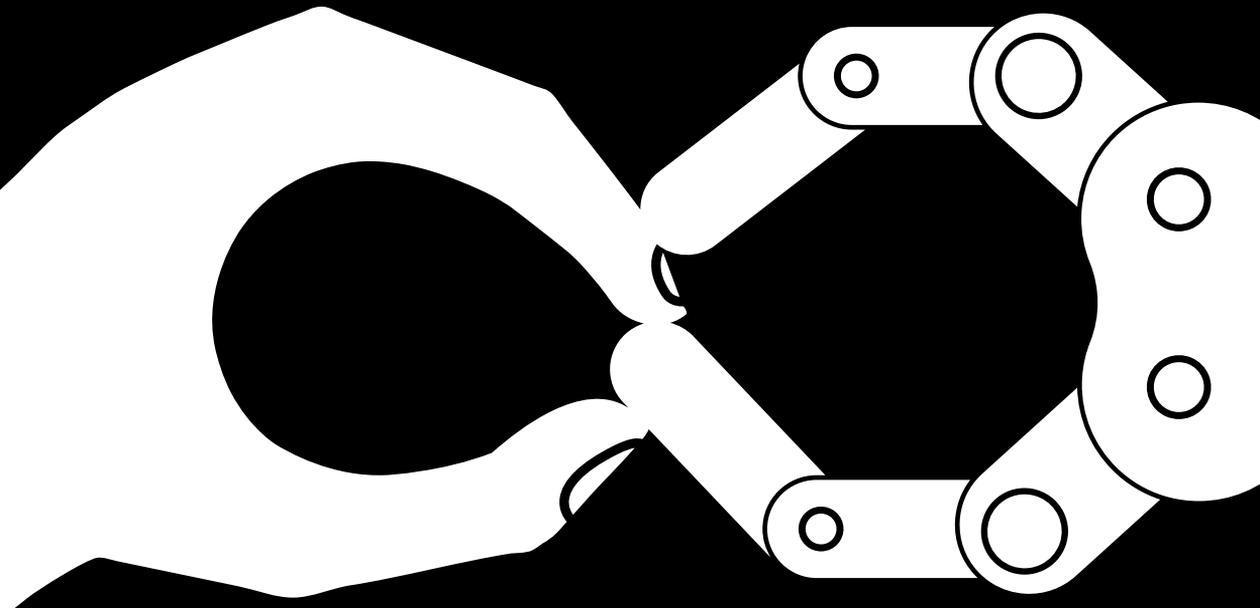
Infinite possibilities.
The future of AI is not dystopian.
It's about amplifying human potential.

robust regulatory frameworks and stringent governance that ensure innovations in AI are not hijacked for unethical or criminal purposes. Microsoft's AI bot, Tay, and its series of racist comments on Twitter is a classic example of how AI software may repeat user behavior gleaned from public data, particularly when there are no filters. Thankfully, Tay has been taken offline now and Microsoft is working on upgrades.

A Case for Stronger Controls

However, incidents such as the corruption of Tay may be giving AI an undeserved ticket to hell. All innovations have teething troubles. In the early days of cloud computing, security was the key concern. The question in everybody's mind was: Is my data safe on the cloud? Certainly, phishers and hackers were lurking in the shadows, waiting to steal sensitive data. But, this fear did not stop businesses from leveraging the transformational benefits of cloud. Very soon there were strong regulations making it mandatory for cloud service providers to adhere to certain standards. Today, security is no longer a major issue in cloud transitions.

Many organizations are making committed strides in this direction – to ensure that AI innovation is safe.

The same can be said of AI. With the right controls, why fear the power of big data and the value of deep AI? With proper regulations, big data and deep learning can only serve to amplify human potential, propel the global economy forward, and improve the overall human condition. Interestingly, many organizations are making committed strides in this direction – to ensure that AI innovation is safe. OpenAI, a non-profit AI research company, has been established to understand AI-centric governance and ensure that AI is used safely. Recently, a group called the Partnership on Artificial Intelligence to Benefit People and Society – comprising Google, Facebook, IBM, Amazon, and Microsoft has been formed to establish best practices, and conduct and publish research about all AI-related topics.

AI can Make Us More Human

When touting the benefits of technology, it is important to have a well-rounded and unbiased view. Consider for example that today, after decades of technology revolutions, 9.6% of the world's population continues to live in dire poverty. Despite all the technological advances that the world has seen in these past decades, a large proportion of the global population is still struggling to survive. Technology, largely, has thus far served the haves. AI has the potential to take the benefits of technology and learning and transform the lives of those who have been left behind – by the sheer scale, speed, and accuracy it can bring to global and large-scale initiatives. AI offers a great opportunity to provide a civilizational upgrade to the masses by allowing us to apply our innate qualities of 'empathy' and 'compassion' to improve the lives of have-nots. Freed from repetitive and mundane tasks, humans will be able to harness the power of knowledge on-demand to address daily job problems. AI can help them discover opportunities to truly advance their unique traits of imagination, creativity, and a quest for purpose. In doing so, we will be able to solve bigger problems such as hunger, disease, ignorance, and poverty. AI, in fact, holds the promise of helping us become more human.

The Power of AI

The current definition of a 'job' is a flawed one. Most of today's jobs are nothing but mundane economic tasks that need to be fulfilled. The dynamic human mind is capable of much more. If anything, it needs to feed on creative, imaginative, and innovative challenges such as the socio-philanthropic condition. This is where the power of AI comes in.

Here's an example: It's 2017. Tom and Dave are operations engineers with traditional 'jobs'. Tom is a subject matter expert (L2 function) while Dave is a dispatch / routing agent (L1). This two-person team is trained to understand insights generated through big data and ensure smooth operations. In future, this whole process can be replaced by a single person who can not only leverage analyzed data but also predict issues and recommend corrective actions. This will be enabled by a combination of cloud (for real-time actionable insights) and digital natives (to execute the recommended action). The end result: Higher operational productivity and better efficiency for the business. What about Tom and Dave then? Tom becomes a knowledge worker who finds ways to enhance the underlying

Paranoia merely breeds panic and serves no purpose other than to impair the human condition.

IT operations, optimize robotic execution, and enable intelligent decision-making using digital natives. And, instead of simply relaying and executing actions, Dave is now free to find better ways to add value to the company and realize his true potential. Dave could be creating the next 'uber' marketplace for his enterprise.

We can safely put away our fears of a dystopian world or a post-apocalyptic future where humans serve robots.

What about the robots?
With deep learning, the robots can learn to think and act based on data knowledge trees and human action knowledge trees. They can be taught to understand how human and business events influence economic activities, thereby empowering them to generate better output.

Consider how AI can deliver value to BPO employees who handle customer complaint calls, bank tellers who dispense cash, or toll booth operators who issue tickets. Imagine a future where healthcare providers leverage their digital avatars to provide trusted real-time care when required, without having to visit ERs. AI and automation will bring about significant and positive disruption in the lives of such people by encouraging them to adopt value-generating roles. In fields such

as oilfield drilling and space exploration, where calculations are massive and extreme precision is critical, AI and Deep AI can offer advanced predictions, helping engineers improve drilling processes and enabling astrophysicists to make ground-breaking discoveries. The possibilities for digital natives and AI are endless: They can positively transform banking, finance, agriculture, government operations, healthcare, drug research, and clinical trials, to name just a few areas.

Bottom Line

In conclusion, it is evident that AI can help machines serve humanity better by creating a harmony between digital and biological intelligences.

We can safely put away our fears of a dystopian world or a post-apocalyptic future where humans serve robots. As we empower robots to take on some 'jobs', we will dedicate ourselves more emphatically to improving and enhancing the human condition. That is where the true power of AI will be clearly seen.

Human and artificial intelligence have to work together, as a team, complementing their abilities to realize human potential.

About the Author

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Abhijit is an Associate Vice President and Senior Principal Technology Architect with Infosys, having around 19 years of experience in the industry. He has led emerging and niche technology business practices, built products, and led complex technology programs in the space of HPC, Big Data, Operations Autonomics, and Hybrid Cloud Computing.

He is currently focusing on building and delivering the next-generation AI platform to help clients reimagine their business and IT operations landscape. His interests include adoption of technology for impacting social and economic transformation.

TECH TALK
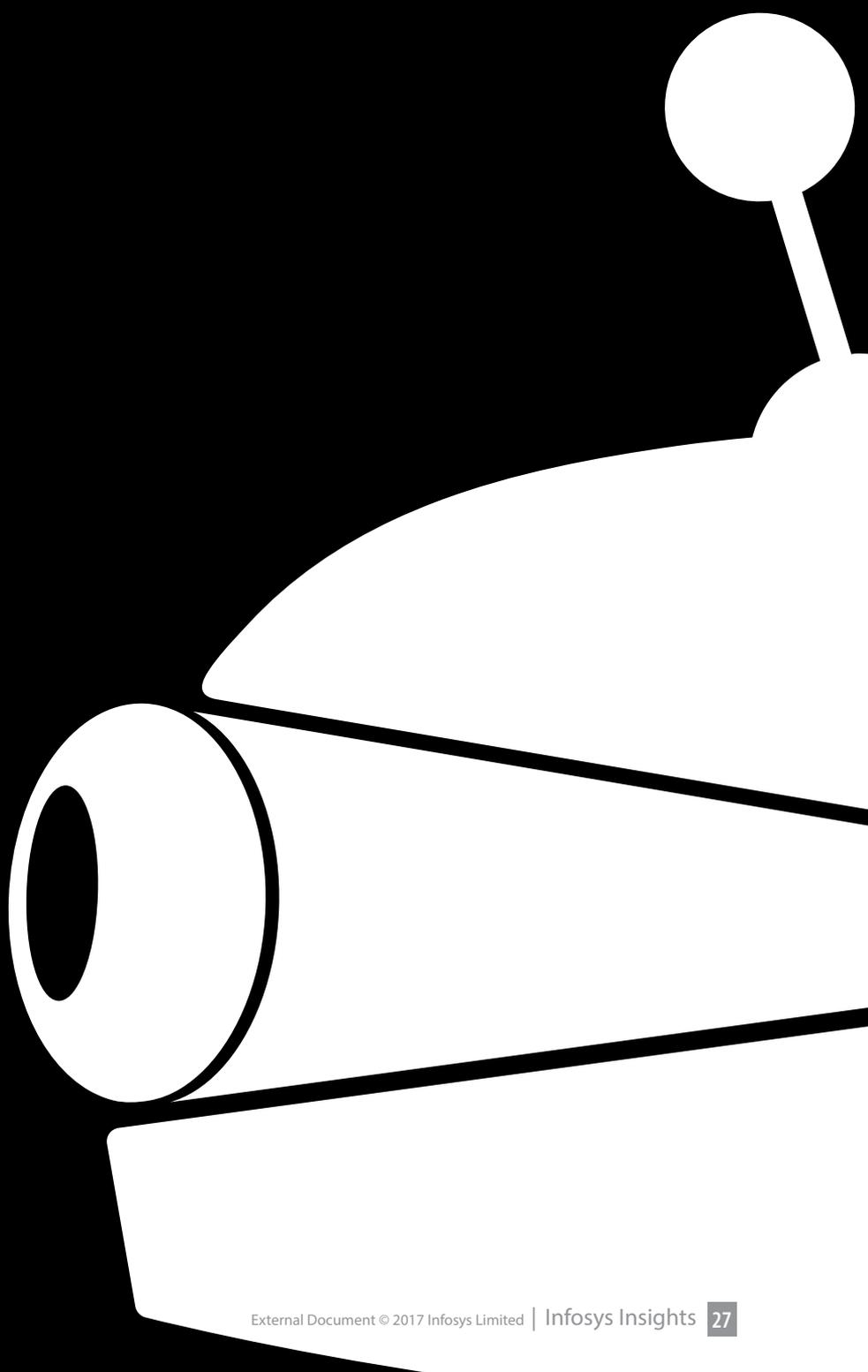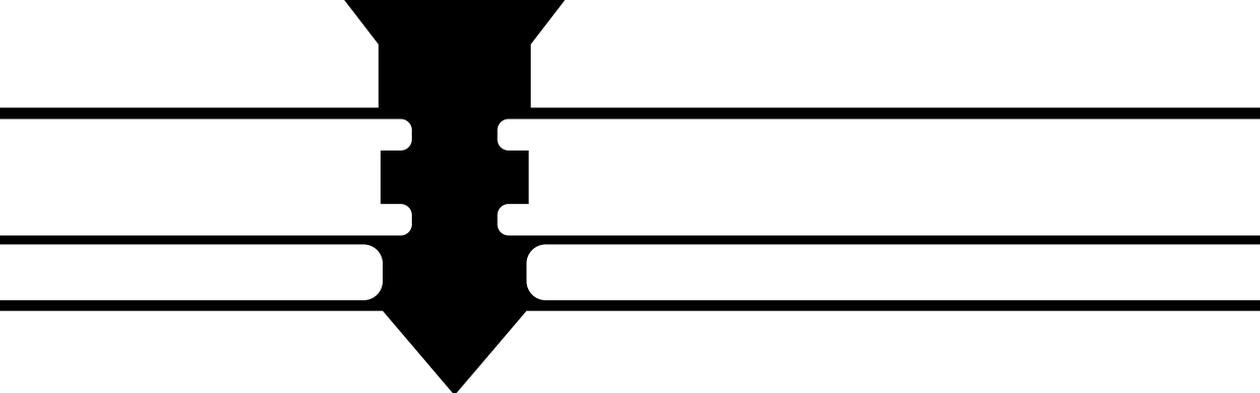
AI TAMES THE COMPLEXITY OF REGULATION IN FINANCIAL SERVICES

By 2020, financial institutions will be staring at more than 300 million pages of regulations, way beyond what employees will be able to handle. Currently, banks spend approximately US$270 billion each year – which is 10 percent of the total operational spending of big banks – on regulatory compliance. Even the average credit union spends the equivalent of one employee's time for every four employees, on meeting regulatory obligations.

This is the scale of regulatory complexity that banks face today. It arises primarily from three sources:

DATA QUALITY: Compliance teams are presented with enormous quantities of internal and external data emanating from customer records, financial transactions, phone calls, emails, and activity logs. But ironically the information doesn't always serve their purpose. When surveyed during a webinar on regulatory trade reporting, 33 percent of participating firms said their biggest compliance challenge was getting hold of the right kind of data, while 24 percent said it was the quality of data itself. Under such circumstances, the ecosystem becomes vulnerable to fraud and policy violations.

REGULATORY OVERLOAD: 2015 alone saw the addition of 20,000 new banking regulatory requirements. In an ever-tightening regulatory milieu, banks have to deal with onerous and copious legislations in all the geographies they are present in. This not only entails huge effort, but at times also creates a conflict between jurisdictions.

PRODUCT DATA SILOS: Some cases of fraud come to light only upon examining additional data outside the transaction itself or in a cross-product view. For instance, a credit card transaction that looks aboveboard might not be so when seen in conjunction with the customer's account information. Unfortunately, compliance managers rarely get the opportunity to access a cross-product view – that is, a comprehensive picture of risks

The key to simplicity.
AI is helping financial organizations deal with the complexity of cross-border, multilayered regulations.
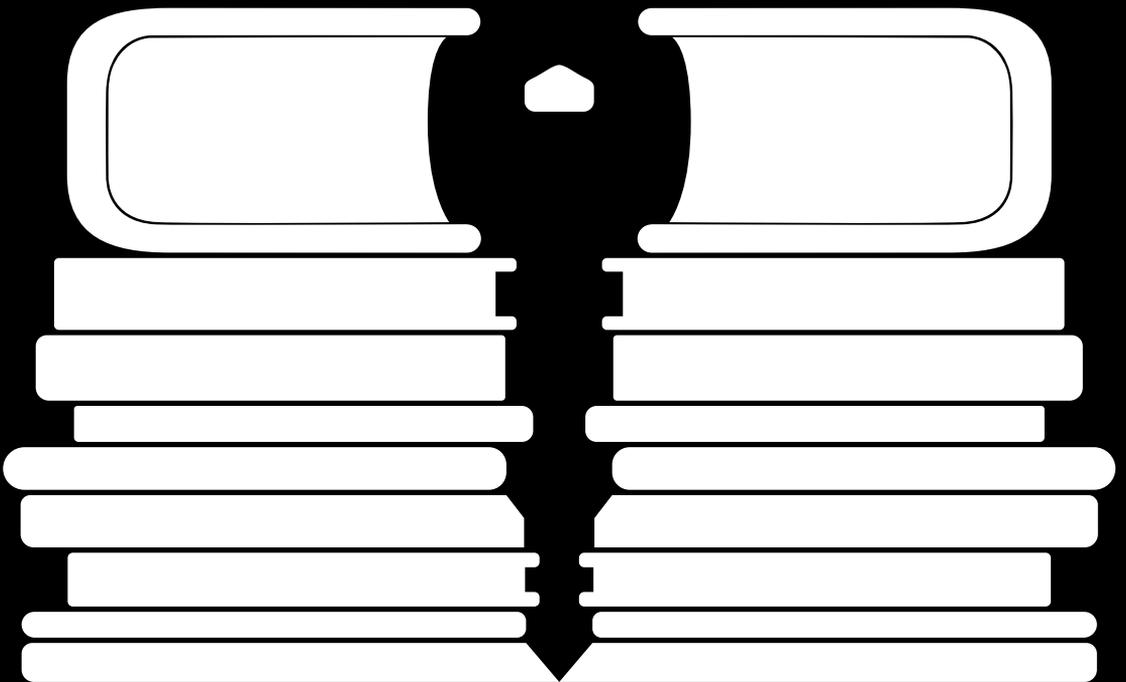
and potential violations – because product data in banks typically resides in silos.

Managing this complexity takes a fine balancing act. Set the reporting threshold too low (that is, widen the scope of documents under regulatory purview) and end up with an exponential increase in false positives; lift the threshold too high and risk a breach. Through experience, most banks seem to have settled on a workload that occupies about 15 percent of their workforce.

If that seems excessive, imagine the situation in three years, when the 300 million pages of regulations prediction comes true. With the reins slipping away from humans, the only option before banks is to leverage automation technologies, from machine learning and natural language processing to deep learning, and manage the burgeoning scale and complexity.

Of course, banking compliance is no stranger to technology. With improvement in capability and reduction in cost, biometric technology has been instrumental in fraud prevention. I expect fingerprints and retinal scans to be soon widely applied in authenticating card transactions. And although biometric technology is largely independent of artificial intelligence today, we can expect to see visual recognition systems working in the background to identify users in the near future.

Most financial institutions have also been using some levels of automation to perform reporting and compliance-related tasks for a few years now. To cite an example, banks are leveraging readymade platforms and toolsets to automate the entire life cycle, from data gathering to report submission.

Now it is the turn of Regtech to introduce some of the disruptive technologies in financial services to the realm of compliance; technologies such as big data analytics, APIs, and machine learning, which are modeling risks, tracking capital compliance, and cracking down on money laundering and other malpractices. Of these, I consider machine learning a significant marker in the progress of technology adoption from simple automation to evolved forms of artificial

intelligence. Machine learning – the ability of computers or smart devices to learn from data without being programmed – is making its way into banks, identifying deviant activity patterns from big data across products and asset classes, and developing and testing algorithms to proactively manage risk and fraud.

Machine learning is far better equipped than human beings for this role because not only can it handle massive amounts of data and a very large number of variables for analysis, it can also spot correlations that are not apparent to us. For instance, a risk manager on finding a large drawdown might investigate a few indicators such as the location or the time of transaction, and other similar parameters that are known to us. The machine, on the other hand, is not limited by the confines of human understanding – it will look further, even at hundreds of apparently unconnected variables for its analysis, and garner insights.

> *Imagine the situation in three years, where by some estimates, we may have 300 million pages of regulations.*

Machine learning, by its sheer power of speed and scale, has many everyday uses such as reviewing documents. Last year, JPMorgan Chase employed machine learning to review commercial loan agreements, which used to occupy staff for 360,000 hours every year. The bank is not only saving enormous manual effort and time, but is also reporting lower error rates. JPMorgan Chase is now planning to deploy machine learning in more complex areas, such as credit default swaps and custody agreements.

The next frontier for machine learning, in conjunction with other AI technologies, especially natural language processing and robotics, is to comprehend regulations, decide if a certain action is in violation, and answer queries. Today, two bankers in different parts of the world could interpret the same text differently based on one's individual experience and regulatory context. With natural language processing making significant strides, there is the possibility of using AI to read and codify regulatory information into a single source of truth. In such a scenario, the two bankers based in different parts of the world only need to query the AI system, through a chatbot for example, and they would both receive an identical interpretation of the text.

Today, two bankers in different parts of the world could interpret the same text differently, based on experience and context. But with a natural language processing-powered chatbot, they can soon receive an identical interpretation of the text.

While this may take three to five years to unfold into the mainstream, Infosys is already working with a client to digitize their global standards and compliance handbooks on our knowledge-based AI platform. Users can query the platform about a particular transaction in English and a chatbot will tell them if it is permitted or not.

So what will AI's impact on banks and financial institutions in the near future be?

As stated earlier, approximately 15 percent of a bank's workforce is engaged in risk and compliance activities. At the top are the policy makers, liaising with regulators and industry bodies, and working closely with the bank's top leadership. These essentially 'human' roles will be irreplaceable by machines. In the middle are those responsible for evaluating risks and managing exceptions, and so on. Most of them will continue in their jobs, but might need to upgrade some skills. The bottom tier of the compliance staff performs voluminous and repetitive day-to-day tasks, which will be automated. The average compliance workforce will shrink by half in the next three to five years.

Understandably, this will spark job security concerns. My belief is that while jobs will be lost to automation, some staff can be trained and upgraded to fill vacant middle-tier roles, instead of the organization recruiting afresh. Others can be deployed in new roles, where they can use their knowledge to solve compliance problems, train new hires, or participate in Regtech innovation.

Research corroborates this approach. When Infosys recently surveyed 1,600 senior leaders in IT and business functions for their views on AI, 84 percent said they plan to train employees on the benefits and use of AI, and 80 percent of respondents plan to retrain or redeploy impacted employees. AI is an opportunity for enterprises to conduct more purposeful pursuits, starting by amplifying the ability and achievements of their human resources.

There is a flipside to AI adoption in regulatory compliance. Banks have to be careful not to allow machine learning and other AI systems to develop biases, which could negatively impact the quality of decisions. They should also make sure that the compliance team doesn't lose its grip on things once machines start taking decisions. Last but not the least, they would have to convince regulators that their intelligent machines are doing at least as much due diligence in compliance screening, if not more, as the human beings before them.

Financial institutions should make sure that the compliance teams don't lose their grip on things once machines start taking decisions.

About the Author

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Mohit is responsible for firm-wide sales operations and reporting processes, including large deal pursuits and top account growth. He has over 18 years of professional experience working across the US, India, Mexico, and Europe. His area of expertise lies at the intersection of financial services and technology. He was also selected as a Young Global Leader (YGL) by the World Economic Forum, Davos, earlier this year.

He joined Infosys in 2000 and has since worked in various capacities. In 2007, Mohit was appointed CEO of Infosys Mexico and was instrumental in setting up the first subsidiary in Latin America. He has previously worked in India with ABN AMRO and ANZ Grindlays in their corporate and investment banks.

Mohit holds an MBA from the Faculty of Management Studies, Delhi University, and a bachelor's degree in history from St. Stephen's College, Delhi.

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MOVING THE GOALPOSTS: AI AND LOGISTICS

Artificial intelligence (AI) is going mainstream because of two parallel events – unprecedented availability of computing power and business outcomes from analyzing big data. This article explores how AI models capitalize on big data to reinvent logistics.

Logistics accelerates the movement of goods and provides a fillip to global trade. Logistics enterprises can ensure the smooth flow of commodities and finished products over land, sea, and air. These enterprises function in a borderless world, connect the dots between the central hub and spokes, streamline processes, and ensure that business users are empowered to make timely and informed decisions for logistics to function with clockwork precision. The catalyst for this synchronicity is the voluminous data harnessed during the journey of goods from origin to destination. However, enterprises face situations such as shipments that are

misdirected, stuck in transit, or that cannot be traced. Machine learning can convert this logistical challenge into an opportunity. In fact, the compounding effect of big data and AI can create hyper-efficient logistics enterprises operating in a smart ecosystem.

Remote sensing, the Internet of Things (IoT), telematics, and geospatial mapping embed information into products and the vehicles transporting them – the origin, destination, journey, and the recipients of goods. So the physical flow of materials across the supply chain leaves a trail of data – which is usually in an unstructured format and scattered
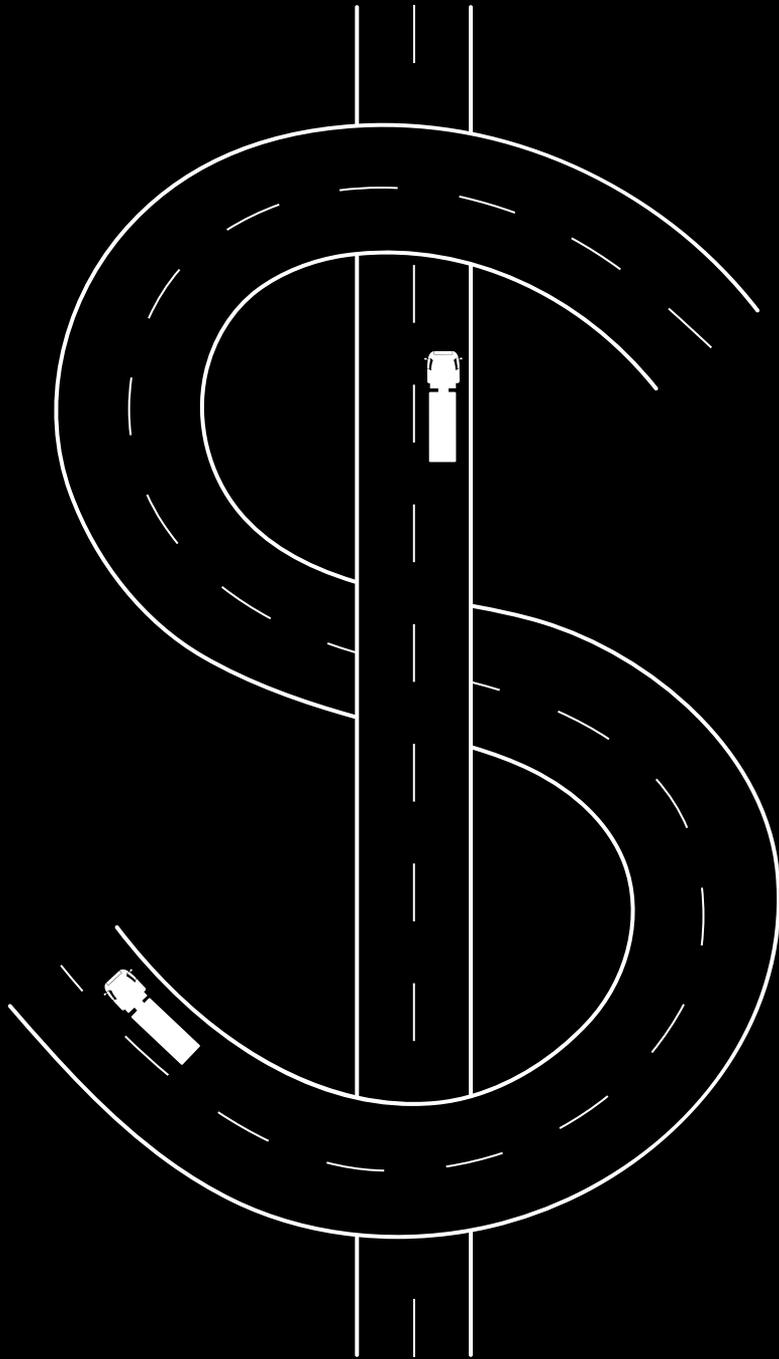
Destination delight.

AI is revolutionizing logistics by optimizing resource
utilization, increasing profit margins,
and delighting enterprises and customers.

across the ecosystem. This is a sweet spot for AI, which depends on large volumes of data to extract knowledge and learn through self-analysis.

The logistics industry can use AI tools to integrate data from diverse sources, devices, and systems, and distill business insights, letting them evaluate how road, air, rail, and ocean carriers, freight forwarders, third-party logistics (3PL) firms, and enterprises make informed decisions and operate more profitably.

Last-mile efficiency

Route optimization rationalizes the cost of last-mile delivery, which is a significant overhead in logistics expenditure. AI algorithms can leverage historical trip sheets and real-time statistics to estimate the delivery time for each shipment. Continuous analysis improves the accuracy of projected delivery. Data-driven operating models are already helping food distributors such as Sysco, retailers such as Walmart and Tesco, and logistics providers like UPS, DHL, and FedEx provide same-day delivery – the Holy Grail in B2C logistics service.

Schmitz Cargobull, a German trailer and truck body manufacturer, monitors maintenance requirements, cargo transported, and delivery routes of trailers to minimize vehicle breakdown.

AI platforms optimize the route of every delivery vehicle in real time. Streams of geographical, environmental, traffic, and shipment data are correlated with designated delivery time windows and vehicle information to sequence deliveries and generate the best route for each shipment. The next best point of delivery or a modified route can be calculated based on constraints / events, and shown on a live map. The most optimal delivery route is shared with the driver via the on-board navigation system of the vehicle – during the journey.

Data-laden dashboards help logistics facility managers take informed decisions by monitoring the performance of drivers, specific facilities, and the enterprise networks. Real-time visibility into key performance indicators such as units moved per hour for each category of product / parcel / pallet, average vehicle speed, and total travel time, help benchmark and improve service planning.

Network optimization

Since omnichannel marketing is a business imperative for enterprises, the location and layout of warehouses need to be reoriented for anytime, anywhere delivery. Big data helps enterprises, government agencies, and lending and economic development institutions determine the location of the distribution infrastructure. The World Bank is using big data optimization methods to develop a multi-modal transport network in India. Open spatial information helped create and validate a pilot model for identifying locations of multi-modal ports.

AI-driven analytical tools help logistics providers aggregate customer demand and simplify distribution networks, while managing inventory. Intuitive systems optimize the distribution network and ensure smooth warehouse operations by instantly mapping capacity and availability of equipment as well as manpower with workload, and providing visibility across warehouse and transportation processes. An analytical approach improves stow accuracy and maximizes the usage of assets, including conveyors and rack systems.

Logistics companies can improve productivity as well as resource utilization at warehouses and distribution centers by capitalizing on predictive AI algorithms and analytics. Predictive maintenance of trucks, conveyors, forklifts, and trailers rationalizes warehousing and distribution costs.

Real-time data from automated materials handling systems and equipment in the facility enhances operations of large warehouses. Optimizing the route for clamp trucks and forklifts handling inbound and outbound cargo expedites movement, saves fuel, and ensures safety.

Amazon uses big data to manage 1.5 million items sold through a complex network of fulfillment centers, redistribution centers, regional sortation centers, delivery stations, and Prime Now Hubs.

Route optimization rationalizes the cost of last mile delivery, which is a significant overhead in logistics expenditure.

Freight consolidation

AI models offer insights into products, and volume and number of shipments – by location, customer, season, mode of freight, preferred delivery time frames, and transport prerequisites such as ambient temperature or humidity. It helps logistics enterprises consolidate shipments to reduce transit time, control costs, and improve customer service. Significantly, it maximizes capacity utilization despite variability in demand for B2B and B2C shipments. Small parcels can be converted into Less-Than-Truckload (LTL) shipments, and LTL freight into minimal stop truckloads.

Advanced logistics applications integrate simulation and AI to help logistics service providers implement cost optimization strategies. Damage claims can be analyzed across delivery routes and modes of transport. It supports rate negotiations for high-risk cargo, and enhances damage mitigation approaches. Rule-based AI solutions detect fraud and errors by tracking supply chain events and documents.

Avnet, a small-parcel distributor of electronic components, leverages more than 250 million data values from 5 million annual shipping transactions to identify carriers presenting invoices with errors, and analyze spend to defer delivery and save costs.

Resource utilization

Automated systems track pickup and delivery orders, job schedules, and crew availability to assign work, manage the fleet, and streamline the logistics network. Machine learning systems deliver long-term value by predicting constraints in the ecosystem and mitigating process bottlenecks in real time.

AI rules evaluate job priority, cargo type, weather, traffic, and resource capabilities to make business decisions about movement of freight. Load pooling rationalizes pricing as well as the cost of operations. In addition, it helps air, land, and ocean logistics service providers maximize resource utilization, including manpower, cargo handling equipment, transport vehicles, and space. Self-learning systems and AI frameworks will be an integral part of logistics solutions even as autonomous vehicles and drones are adopted for last mile delivery, and alter the distribution landscape.

An AI resource allocation engine optimizes daily schedules and manages engineering as well as maintenance activities for rail lines in Hong Kong. In addition, the Hong Kong Airport Authority deploys an AI scheduling system to allocate parking slots to aircraft based on flight schedules and shifts in operational dynamics.
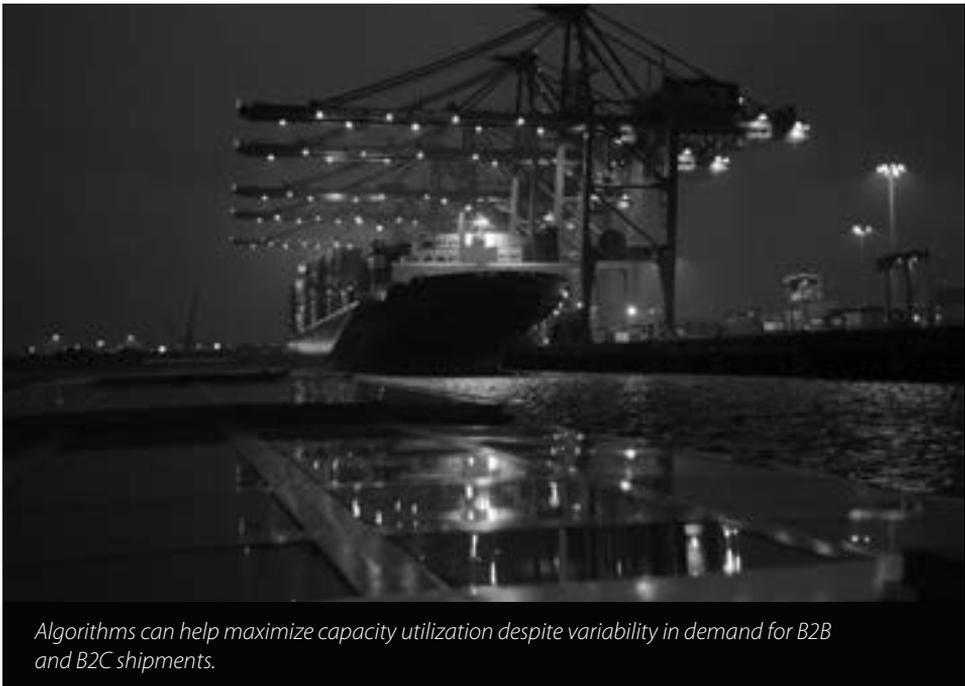
Algorithms can help maximize capacity utilization despite variability in demand for B2B and B2C shipments.

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Madhu started his career with Infosys in 1996. He has over 26 years of experience in defining strategic business solutions and IT consulting for several companies in Japan, Europe, and North America. Madhu oversees several retail and CPG accounts in the US and has expertise in developing and maintaining strong client relationships. With his collaborative approach to innovation, he has led teams to consistently deliver client delight, in challenging business–technology environments.

Madhu has a master's degree in computer applications from the Regional Engineering College, Trichy, India (now a National Institute of Technology). He enjoys cooking and hiking, and is active in the community, teaching at the local university. He also runs a private trust that focuses on education and healthcare for the underprivileged in India and some parts of Africa.

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YOU CAN FOCUS ON CARE, NOT COSTS, THANKS TO AI

▌ AI in healthcare can complement the workforce and amplify their capabilities. Human capital in healthcare needs to be diverted to care at the intersection of caregivers and patients rather than be involved in low-value, back-office operations to support front-line caregivers. AI-led automation is ushering in this great opportunity today.

Although Americans spend far more on healthcare than any other high-income country, this spend is incommensurate to the health outcomes they experience. Life expectancy is shorter than desired and chronic conditions are still widely prevalent, among other things. Analyzing this high healthcare spend reveals several underlying reasons: an ageing population, rising use of new expensive technologies in radiology, new procedures, increase in prescription drug costs (e.g., for Hepatitis C), high pharma marketing spend, and a growing number of specialties.

In addition, digital and AI-led disruption, which could bring about significant cost and process efficiencies have been relatively slow in this industry, which has also been traditionally slow to adopt new technologies owing to complexities arising out of multiple ecosystem players and intricate regulations. However, consumers are now demanding more from healthcare. As digitization sweeps across industries, consumer technologies have been growing in popularity, especially in retail and banking. These consumers are also increasingly demanding better pricing transparency, connected experience across payors, physicians, hospitals, pharmacies, and other supporting institutions, all of which play an integral role in the care continuum. And the healthcare industry is beginning to respond.
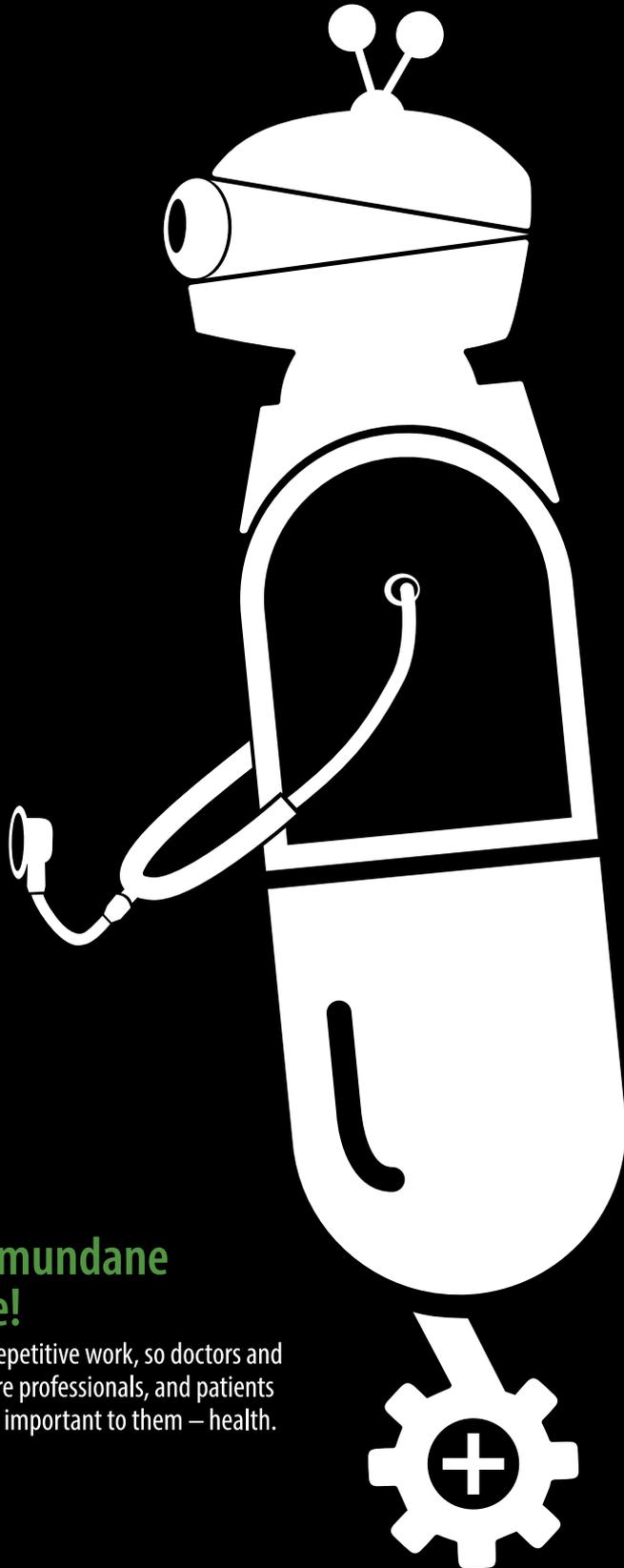
Leave the mundane stuff to me!

RPA is taking over repetitive work, so doctors and and other healthcare professionals, and patients can focus on what's important to them — health.

In 2014, the market for AI in healthcare was worth over US$600 million, and this figure is expected to rise ten times by 2021. Today, healthcare is widely believed to be one of the industries destined for AI-led transformation, which will be an antidote for the high costs, as well as an enabler for better health outcomes and experiences.

For some years now, a chatbot at Aetna named Ann has been providing round-the-clock assistance to new members in using its website, guiding them through the registration process, or helping them to recover user names and passwords. Similarly, at Credit Agricole, chatbot Marc responds to product queries in the company's health insurance space and makes relevant offers to customers after analyzing their needs. The potential of robots in superseding humans at the front office is enormous.

Deploying Robotic Process Automation (RPA) and AI in health technology can help deliver a rich and seamless experience for all participants in the care continuum. Such a model will pivot around the member, enabling her to navigate the healthcare ecosystem to derive the best possible care. In this article, we share our view on the impact of these technologies on business.

AI-led transformation will be an antidote for high costs, as well as an enabler for better health outcomes and more rewarding experiences.

Choosing wisely, but acting quickly

Enthusiasm over RPA and AI has caused a proliferation of solutions in the healthcare space. While the perfect solution might be elusive, the best way forward is to choose a solution that is most effective for the organization. This however, invariably leads to the bigger challenge – to secure support, technical and otherwise, for RPA and AI initiatives, especially at the grassroots level, and ensure robust governance around them. It is important to identify the processes best suited for automation, conduct pilots to demonstrate quick wins, and then trigger a virtuous cycle where success breeds success. Automating broken processes, however, can not only be inefficient but also dangerous. Processes must be rationalized, optimized, and simplified before automation.

The good news is that unlike traditional IT projects, which run for several years, an RPA / automation project life cycle lasts for six to ten weeks – from ideation to implementation. In our view, RPA is the right place to commence an automation journey, laying the foundation for more sophisticated AI deployment.

Doing more than just paring down costs

RPA and AI will have a far-reaching impact on healthcare, well beyond their potential to save costs or reduce labor, although these two benefits are currently paramount. By eliminating duplicate processes and automating member support processes, RPA will make it much simpler for members to avail of services of healthcare companies, even as it enables them to complete transactions faster, benefiting all stakeholders. For example, leveraging automation through a combination of RPA and AI, a healthcare company could disseminate communications on procedure authorization or claims status faster to patients and doctors. Another important benefit is improvement in quality of compliance, because with RPA, processes become fully documented, traceable, and transparent. AI can ensure accuracy of provider data, which will help healthcare companies avoid steep regulatory penalties imposed in the absence of accurate provider data.

In addition, an intelligent system can turn its vast data resources into insights and use that to propose personalized offerings to prospects, or simply offer the most relevant additional product to an existing member. Last but not the least, AI helps healthcare companies take better care of their members. In this business, it is not uncommon to encounter emotional or agitated callers. Companies can train their service staff to deal with them with empathy. There are AI software solutions, which analyze the speech of company associates during calls, and prompt them to soften their tone or slow down, whenever required.

Enabling people to accomplish purposeful goals

It is estimated that a claim processed with manual intervention costs about US$4, which when auto-adjudicated, costs about US$1 with legacy technology, and even less with automation. A single robot, which can accomplish the work of 2 to 5 claims processors, can deliver over 20X returns on labor costs alone over a 5-year term. The savings for healthcare companies, which have very large service operations with several thousand employees, is clearly enormous. Beyond this cost factor, there is an enticing opportunity to deliver a human-centered design for healthcare; by redeploying freed up staff on work of a higher order, such as member intimacy and member-care. Automating most routine tasks in service operations will make staff available to engage members in proactive, contextual, and meaningful conversations, which are also AI-enabled, and help members improve their health, or enjoy more healthy days.

An illustration might be useful here: If an AI system alerts an associate about a member who has missed renewing a prescription for diabetes medication and provides a predictive insight into the member's health disposition based on health history and related attributes, the healthcare associate can promptly arrange a review with the member's healthcare provider.

Like in several other industries, AI in healthcare can complement the workforce and amplify their capabilities. Human capital in healthcare needs to be diverted to care at the intersection of caregivers and patients rather than be involved in low-value, back-office operations to support front-line caregivers. AI-led automation is ushering in this great opportunity today.

Human capital in healthcare needs to be diverted to the intersection of caregivers and patients.

Challenges and concerns

Employees are anxious about losing their jobs to automation, and their employers about managing the change. These concerns can be addressed to a great extent by communicating plans for redeployment and retraining as early as possible. Here, it may be useful to cite the example of the banking industry, which is about a decade ahead of healthcare in terms of technology adoption. Although the teller function in banking was automated decades ago, the people who were serving in those roles continue in the industry, albeit in new roles.

An expanding technology landscape around robotics and intelligent operational systems (RIOS) gives rise to several challenges. The proliferation of solutions and vendors in healthcare complicates the decisions around AI adoption. Maintenance of AI solutions, as they scale from a single process to several thousands, is another important concern, followed by their governance and ROI.

Welcoming the Chief Robotics Officer

RIOS and AI in general will also precipitate new positions within companies and new business models in the market. The Chief Robotics Officer (CRO) will emerge in the next few years, especially in industries such as healthcare where automation is beginning to be embraced rapidly. The CRO will assume a comprehensive role with many responsibilities – from choosing the right technologies, and managing change and effective staff communications, to managing costs, governance, and ensuring ROI. She will eventually become what the CIO is today across businesses, and may even earn a place in the boardroom.

New positions like the Chief Robotics Officer (CRO) will emerge within companies, along with new business models in the market.

About the Author

Venky Ananth

Vice President, Healthcare Practice, Infosys

Venky is responsible for business profitability and growth of healthcare clients for Infosys. He manages critical relationships with senior client executives and industry analysts, and anchors talent development of key Infosys personnel. He is responsible for crafting and delivering business and technology solutions to client business problems with his deep understanding of the healthcare business and technology.

Previously, he was the global delivery head for the Infosys Digital Transformation Practice focused on the retail and consumer industries, and was responsible for Practice P&L, project / program delivery, competency development, and talent management. He has spent over 21 years with Infosys and has won many excellence and Gold standard awards for outstanding achievement ranging from thought leadership to client management.

He holds a bachelor's degree in mechanical engineering and has completed an executive leadership program at the Stanford Graduate School of Business.

RENEW NEW

WHERE'S THE SAFETY NET FOR DIGITAL REFUGEES?

The concept of a workplace refugee is not new. But the idea of 'digital refugees' takes it a step further, as it has become a global concern, and a pervasive one. Here we look at how the issue has evolved, and what we can do to tackle it.

Watching the digitization of work and life over the last couple of decades, some clever pundit coined the terms 'digital natives' for millennials who seem to have technology in their DNA, and 'digital immigrants' for the boomers and others who have had to embrace technology. These have proven apt descriptors of segments in our workforces and communities, and when we plan recruitment, training, and deployment.

Today, as technology-driven disruption renders entire companies obsolete with artificial intelligence and pervasive automation, we see the emergence of a new segment: 'digital refugees'. Like political refugees, digital refugees too are displaced and in many cases struggling and adrift. Social and governmental forces are starting to wrestle with the unique challenges they pose, leading corporations are starting to assess the impact they have on the economy, and communities are starting to wonder if – and how – this wave of disruption will reach their own doorsteps.

The concept of a workforce refugee is not new; thousands of workers have been
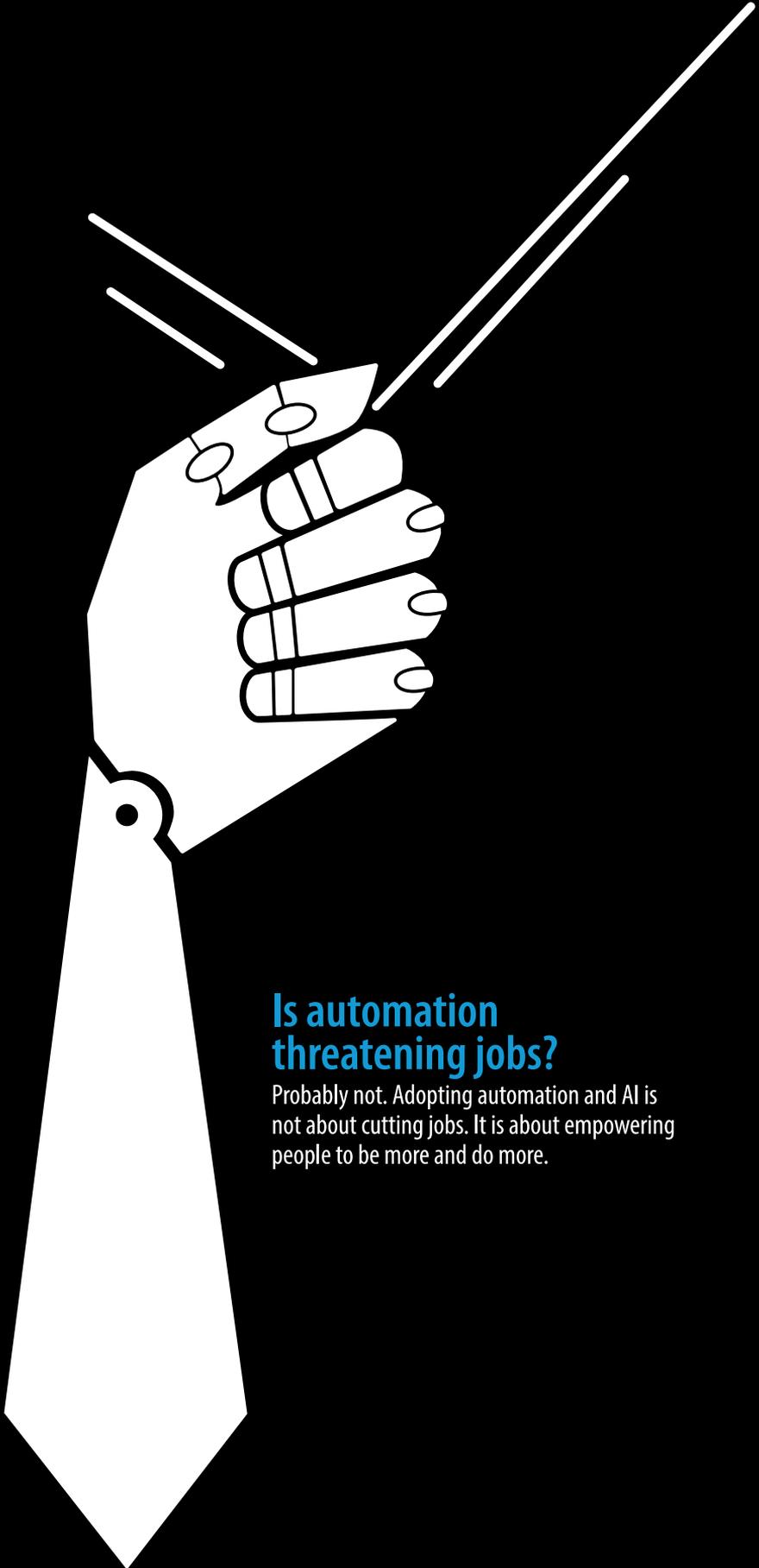
Is automation threatening jobs?

Probably not. Adopting automation and AI is not about cutting jobs. It is about empowering people to be more and do more.

displaced by automation or globalization over the past several decades, particularly in manufacturing. Some have retooled and entered other careers, largely in the service sector. But many have languished, losing hope in their nation's ability to offer them a future. The 'rust belt' is filled with stories of shattered dreams.

The case of the digital refugees may be even graver, however, for three significant reasons. First is scale; our best estimates suggest that digital refugees will not be created in isolated pockets of displacement, but rather in massive waves. The 'intellectual rust belt' is likely to be broad and borderless. Second is permanence; just as many manufacturing workers were unable to retrain themselves into knowledge-workers, many digital refugees will be unable to step up to the even higher-order technology jobs that are likely to be created as part of the digital / AI boom. Yes, jobs will be created – but they are unlikely to be jobs that displaced workers can hope to fill.

Third, and perhaps most significant, is societal and governmental readiness to take on the challenge. There is a bit of a "We have seen this before and we are not going to let it happen again" sentiment. This bodes well for workers – but it may be problematic for corporations. If we are ready to provide a social safety net, whether in terms of retraining, guaranteed wages, or economic stimuli in other sectors, the question is, "Who pays?" Some argue that corporations will need to foot the bill.

Preliminary dialogs last fall in a World Economic Forum council on the Future of Education, Gender, and Work indicated support for the idea of a global 'cap and trade' policy for AI-driven job loss, similar to current 'cap and trade' provisions for carbon generation. In other words, if a corporation leverages AI and automation to disrupt its business model, radically improve efficiency, or enhance service or operations, and if worker displacement is one outcome, then the corporation should pay to provide the safety net. This topic will be taken up at the

> *Firstly, the intellectual 'rust belt' is likely to be borderless. Secondly, it might become pervasive, as workers find it hard to retrain into knowledge workers.*

spring dialogs on the Future of Education, Gender, and Work.

In February 2017, Bill Gates took a similar position, suggesting that robots should pay taxes. While a robot tax could replace revenues previously generated by employee income taxes, the approach clearly shifts responsibility for filling the tax coffers from the individual to the corporation. On the positive side, this approach could fund the creation of a broader social safety net for displaced workers. In an interview with Quartz, Gates noted, "A tax on robots could help fund the training needed for jobs such as caring for the elderly, teaching in schools, and helping kids with special needs – roles that robots cannot fill." But it will have to be at corporations' expense.

Corporations that are politically savvy, as well as those that subscribe to compassionate capitalism, are trying to get in front of this wave. They recognize that they have to manage the inevitable disruptions. They are starting to consider ways of managing massive displacements, whether or not to proactively retrain displaced employees, and what their new, post-AI organizations need to look like. Some are finding that AI may not so much target the blue-collar layer (which is already pared to the bone) as the lower white-collar layer – lower and middle management. This creates secondary challenges – not only "What do we do with these workers?" but also "If we eliminate these positions, where is the training ground for the next generation of executives?"

Technology companies are finding the retraining challenge somewhat easier, and are aggressively moving to retrain tech workers with new digital and AI skills. Business Standard (March 7, 2017) reported that Wipro plans to reskill 10,000 employees in cloud, digital, analytics, and DevOps, among other high-demand skills. Tata is reportedly targeting another 100,000 in digital technologies. Infosys is not only reskilling employees in newer technical skills, but has also completed training over 70,000

technical employees in Design Thinking, to go along with its Zero Distance initiative, driving technology improvement and innovation.

The challenge will be greater for traditional brick-and-mortar organizations with employees who are less tech-savvy, whether at factory floor or line manager levels. Reskilling weighs heavily on executives we have been speaking to, those who are driving AI, automation, and digital disruption initiatives. Organizational redesign is also on their minds, including rethinking career paths and competency models for leadership development. Governance is top priority; how will businesses and IT govern pervasive AI and take accountability for its benefits – and risks?

As a leader in corporate learning at scale, and as a business partner deeply experienced in helping clients lead technology-driven transformations, Infosys is developing new offerings to help clients wrestle with the human side of AI, digital, and automation. We are combining human-centric design with technological innovation to find better answers – whether it is for reskilling displaced workers at a leading CPG firm, designing a more empowering culture and physical work environment for a financial services leader, or rethinking career paths for a technology leader. If firms don't want regulatory intrusion (think cap-and-trade for digital refugees), they need to find innovative solutions for human challenges on their own, and lead workers to new roles and help them accommodate into an AI-driven business environment.

Looking at this shift against a backdrop of rising nationalism, we realize that there is a lot more at stake. Many of the countries that are witnessing a rise in nationalism – including

Thousands have been displaced by automation or globalization over the past several decades.

the US – actually do not have sufficient skilled IT workers to meet domestic demand. So could a technology company, renowned for technical training at scale, provide training and development to help create a skilled domestic workforce? Instead of being merely a purveyor of AI and automation, could Infosys provide solutions for massive reskilling of digital refugees? We think the answer is yes, and we are actively pursuing this agenda, starting with our recent announcement that we will set up a new development center in Indiana and create 10,000 new jobs in the US.

Responsible employers need to think not only about reskilling digital refugees, but also about developing the skills of future generations. If basic technical proficiency increasingly divides the haves from the have-nots, one answer may be making digital literacy as much a part of primary and secondary education as reading, writing, and 'rithmetic'.

Leading technology companies are collaborating with the Code.org Advocacy Coalition to reshape education and make computer science an integral part of the K-12 curriculum. Supporters of the coalition are working toward fundamental changes in classroom content as well as professional development of educators. It is heartening to see academic transformation taking place ahead of government intervention.

While some detractors argue that early exposure to programming might make children more machine-like, research says otherwise. Introducing children to the fundamentals of computation actually enables them to better understand patterns, recognize underlying relationships, and solve problems. It teaches them to deconstruct complex problems into smaller parts and to address issues with logic – skills which will help them both professionally and personally, throughout life.

"Computational thinking is thinking in terms of prevention, protection, and recovery from worst-case scenarios through redundancy, damage containment, and error correction," says Jeannette M. Wing, Corporate Vice President at Microsoft Research and former

The intellectual 'rust belt' which can leave people behind is likely to be pervasive and borderless.

President's Professor of Computer Science at Carnegie Mellon University. She sees it as a fundamental skill. "We should add computational thinking to every child's analytical ability," she recommended in an article published in the Communications of the ACM.

At the Eliot-Pearson Children's School in the Tufts University Department of Child Study and Human Development, children program robots using building blocks with barcodes. When kindergarteners adopt the learning style of machines as they play with toys, they cultivate a habit of lifelong learning. This will create a wealth of talent for the workplace and help insulate tomorrow's workers against whatever displacements characterize the next generation.

At the end of the day, the challenge for business leaders is not only how to help displaced workers support themselves, but also how to help them maintain their dignity. When AI and automation take away not only their ability to provide for themselves and their families, but also their productive self-worth, the answer needs to address both the financial and the emotional aftermath. Our solutions to these problems need to address emotional needs as well as physical – which may in the end be the harder problem to solve. Mitigating this risk for future generations, by embedding computational skills and computer literacy at all levels of education, may be one of the greatest gifts we can offer our children and grandchildren.

About the Author

Holly Benson

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Holly brings the scientist's curiosity and observational skills to the world around her. As founder and head of Infosys Consulting's Enterprise Talent and Change Practice, she uses her interactions with some of the world's leading corporations — and their workforces — to form fresh and intriguing insights on education, skills, and the future of work.

After 25 years of work in the consulting domain, she remains a hands-on practitioner who helps clients deal with people and organizational implications of agile enterprises, intelligent automation, and changing business models. Holly is now bringing this perspective to the World Economic Forum, as a steering committee member of their Global Future Council System Initiative on Education, Gender, and Work.

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CAUTIOUS OPTIMISM MARKS THE ADOPTION OF AI AT PROXIMUS

Dominique Leroy, CEO and Member of the Board, Proximus, in conversation with Rajesh Krishnamurthy, President and Head of Energy, Utilities, Telecommunications, and Services, Infosys.

Q Rajesh Krishnamurthy

A Dominique Leroy

Q: *Automation and artificial intelligence are seen as the next game-changers for organizations. They are already reshaping industries such as manufacturing, healthcare, and transportation, among others. How do you envision AI transforming telecom – an industry that is already in the midst of transformation?*

A: Automation, both of processes and decision-making, has always been a way to optimize our operations. Whether we are talking about the correlation of incident-tickets to detect general outages, the automation of our provisioning flow, or the zero-touch configuration of a modem at the moment it is connected to our network.

So automation is not a new topic. However, we see today that the ecosystem enabling artificial intelligence is evolving rapidly based on the availability of cheap and massive computing power, IoT gathering massive amounts of data, often real-time, and new possibilities in analytics.

Like with all new technologies, it is important to keep the objective in mind. We don't
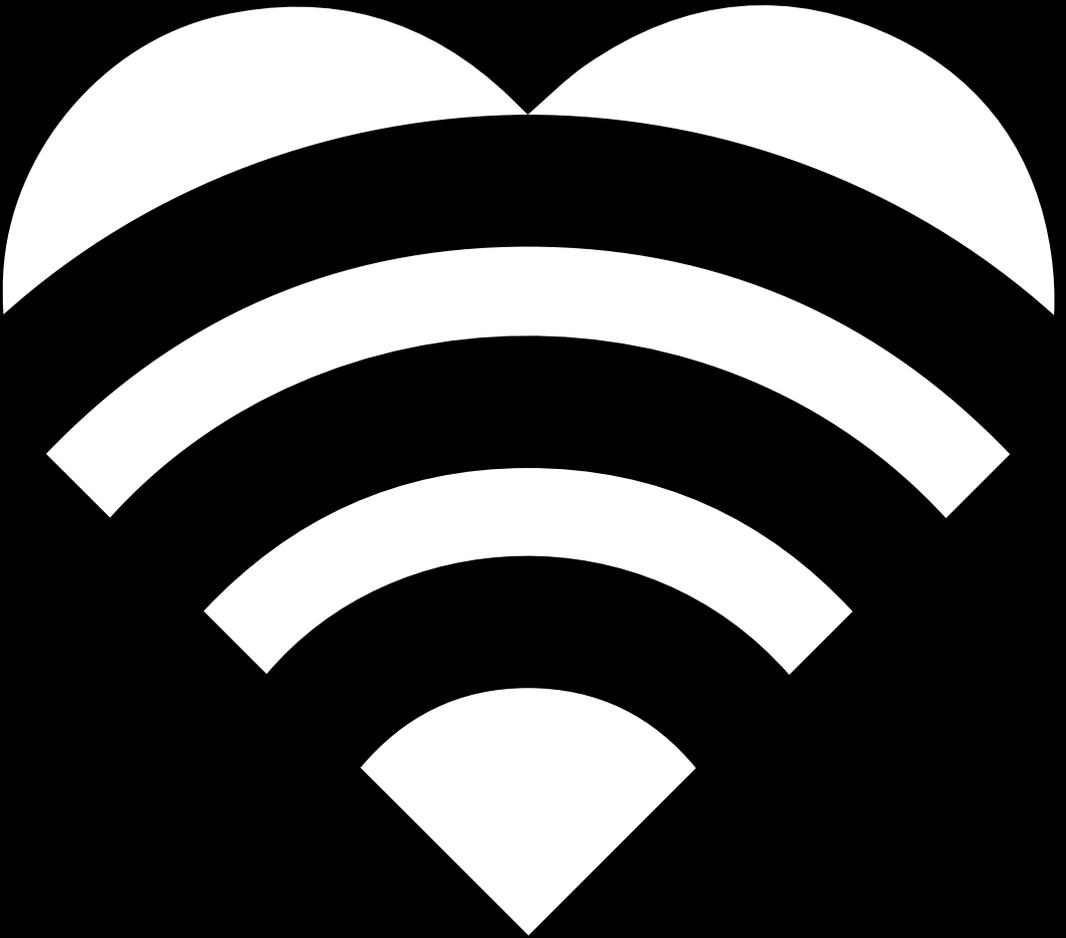
Being More Human.

AI-driven experiences will pivot on building strong emotional connects with consumers.

have the ambition to implement artificial intelligence in all of our processes, just for the sake of doing so. Nonetheless, I'm convinced that we will need the capabilities of automation and AI to further increase our efficiency and agility, as well as to offer a very high degree of personalized customer interaction. Next to that, AI will need to help us deal with the growing complexity coming from exactly the transformations you mentioned.

So, I look at technological innovation in general as an opportunity. The telecommunications industry should embrace the future, and by being early, we could play an important role. Proximus is well placed to be a key enabler of AI itself for other industries as well – offering virtualized infrastructure with our LoRa IoT network, and anonymized data sets through our brokering platform, EnCo (Enabling Company).

Automation is not just for repetitive tasks but for customer-facing roles too, like sales and customer service.

Q: *Accuracy, speed, process and cost efficiencies, and scalability are some of the immediate benefits of AI (automation, RPA, machine-learning techniques) that industries are beginning to experience. What are the new kinds of AI-driven services in telecom that you see emerging?*

A: There are three major application areas where we believe artificial intelligence could play a beneficial role.

First, AI can help solve business challenges by reducing complexity and giving people better information and insights to take better decisions faster. We see a lot of opportunities on internal optimization and operational efficiency, like you mention. This concerns the maintenance and optimization of our networks and platforms or IT help desk automation. In our customer operations division, we're evaluating ML and prescriptive analytics for field interventions with a 'First Time Right' objective.

Secondly, we also look at AI as an enabler of a better and more personalized customer experience. Concepts like voice-driven IVR and virtual customer assistants are being analyzed for simple customer interactions. It's essential here that AI is fully integrated into enterprise systems, such as CRM tools, knowledge management, and billing and ordering systems, in order to offer a single customer experience through all channels.

And finally, we look at AI as an enabler for new revenue streams. As said before, we want to build on our assets, such as our EnCo platform, to support our corporate customers in their own transformation and to leverage new business.

Q: *One principle of Proximus' Fit for Growth (Good to Gold) strategy is "simplifying at all levels." What has been the role of automation and AI in this organizational renewal?*

A: One of the pillars of our Fit for Growth strategy is to become a fitter organization and bring down our operating costs while increasing customer and employee satisfaction. To this end, we are driving simplification and efficiency at all levels in the organization. We have been simplifying our network and platforms through virtualization; our product offerings for our customers and our internal processes. AI can support us in all these domains.

Typically we have been automating simple, repetitive tasks, freeing up time for people to invest in more value-added interactions. We will certainly continue to do so, now that AI expands the scope of what is 'simple' for a computer.

This is not only done in the typical domain of operations or back-offices, but also in customer-facing departments such as sales, marketing, customer services, and supporting functions where we are investigating various use-cases.

Besides reviewing our existing processes, we will also introduce new processes, technologies, or infrastructure. We must then consider automation and AI from the start. For example, making sure that the architecture allows the extraction of the needed data, as well as challenging the

needed human intervention present in new processes versus the cost of automation.

But simplification through AI is certainly not a given, as the technology behind AI is quite advanced. We must be cautious that AI does not become a complexity layer on top of all the other ongoing technology evolutions. There is a careful trade-off to be made – on the one hand, we want to remove complexity facing our employees by means of AI, but on the other hand, we want to remain in control and not blindly depend on a chain of black boxes. This trade-off will vary depending on the application, and we will have to learn the optimal balance on the go.

Q: *Proximus is looking to transform itself into a 'digital services provider'. AI will be obviously playing a significant role in every phase of this journey. Could you share some developments, insights, and even learning around this?*

A: The journey of becoming a Digital Service Provider is threefold.

First, it is about digitizing our current business and delivering a superior digital-first customer experience. Secondly, we are transforming our core networks and IT systems to deliver more and more services from the cloud through virtual network functions and automating what can be. Lastly, we will develop new digital services, for both our residential and professional customers. In particular, for our enterprise customers, we want to create a new digital ecosystem, open to partnerships and collaboration with new emerging players, and offer our customers new application-led and service-oriented solutions, like a smart home, smart cities, smart mobility, new ways of working, and smart retail.

This transformation to become a digital services provider brings about a number of challenges. I'd like to highlight just two major ones.

At the technological level, we are investing in strict data-architecture and governance throughout the company in order to become a data-driven organization. But the biggest challenge is adoption. Adoption of new digital tools by our customers, where it is our job to ensure superior customer experience through intuitive design, as well as adoption by our employees – they must be convinced about the capabilities of AI and how it will improve the quality of their work.

We should definitely not underestimate the change management journey, involving

We want to create a new digital ecosystem, open to partnerships and collaboration.

changes in our ways of working, thinking, and doing. The success of becoming a data-driven company will depend on change managers just as much as it will on data scientists.

Q: *There is widespread angst about loss of jobs due to automation. Adoption of robotics and AI itself will create new kinds of roles, especially in the area of robotic maintenance. On the other hand, with resources freed up from mundane jobs, there will be opportunities to enhance human talent, to improve services. What is your view on repurposing talent through retraining and upskilling vis-à-vis the telecom industry?*

A: Automation and AI will mainly impact people that today do repetitive jobs that are typically prone to automation. Just remember that a little more than 20 years ago, most of our revenues came from fixed voice. In a sector that is evolving so fast, retraining and upskilling is a constant.

On the other hand, AI will augment what humans are doing. Machines excel in speed, cost, and consistency. But humans have capabilities that machines do not have: to handle complex tasks in a very broad area, and superior social ability. Embracing the full capabilities of working with AI will certainly bring a competitive advantage as it will allow all our employees to focus on human interactions.

I strongly believe that human-to-human interactions are key in our lives and it will remain so – and no robot or machine can compete with human creativity, social ability, and empathy. This means we need to keep building strong emotional links with our customers – enabling great human interactions that bring value to them – if we want Proximus to remain a strong and relevant brand in people's lives.

Rajesh Krishnamurthy: *Thank you, Dominique, for your insights. Automation and AI are reshaping the telecommunications industry, as organizations look to achieve greater efficiency, even as they deliver new services. It is also helping companies like Proximus lead the way with innovative, insights-driven offerings, and personalized experiences.*
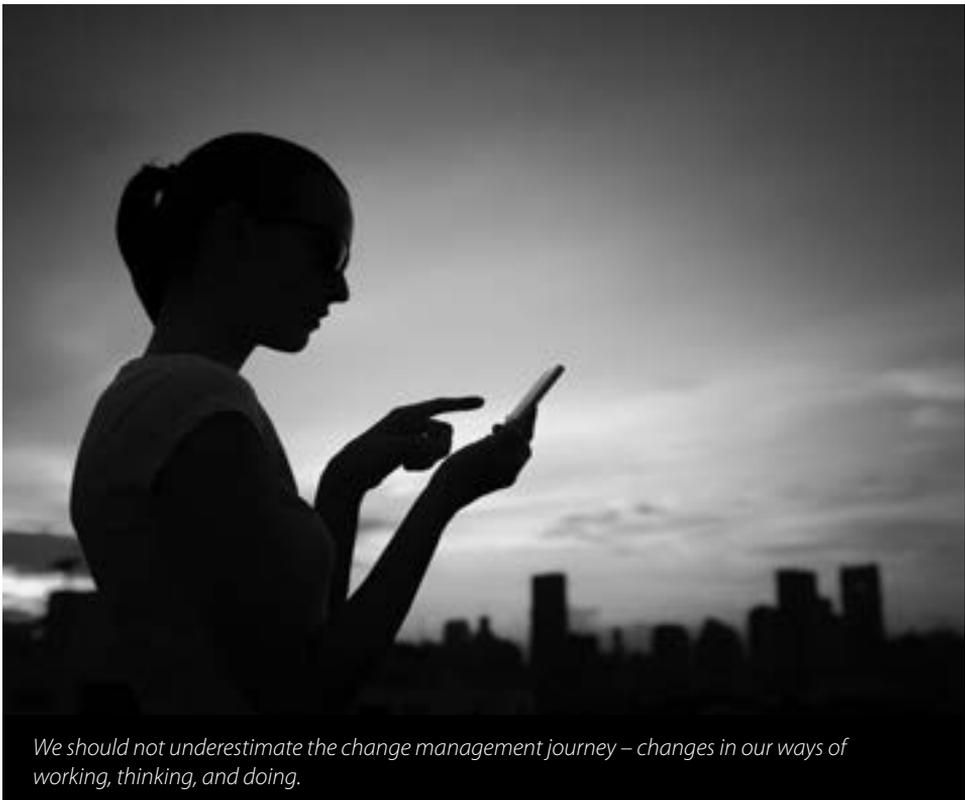
We should not underestimate the change management journey – changes in our ways of working, thinking, and doing.

About the Participants

Dominique Leroy
CEO and Member of the Board, Proximus

Dominique Leroy has been CEO of Proximus since January 2014. She joined Proximus (formerly Belgacom) as Vice President of Sales for the Consumer Business Unit in 2011 and was appointed Executive Vice President of the Consumer Business Unit in 2012.

Prior to Proximus, Dominique worked for 24 years at Unilever. She was Managing Director of Unilever Belux and member of Unilever's Benelux Management Committee.

She is also Chairwoman of the Boards of BICS and Be-Mobile, Chairwoman of the International Advisory Board of the Solvay Business School, and an independent board member at Lotus Bakeries and Ahold Delhaize.

Rajesh Krishnamurthy
President, Head – Energy, Utilities, Telecommunications, and Services, Head – Infosys Consulting, Head – Infosys Europe

Rajesh Krishnamurthy is responsible for the global Energy, Utilities, Telecommunications, and Services business unit, and also works with Infosys Consulting, the global advisory division. He also leads the Infosys operations in Europe, and in a career spanning more than 24 years with the company, he has held senior leadership positions across the business and in all major markets. He is also the Global SAP Practice leader for Infosys across industry groups spanning 20,000+ employees.

Previously, Rajesh was the Head of the Financial Services and Insurance business in Europe. He managed the global Consulting & Systems Integration (C&SI) Practice for the Retail, CPG, and Life Sciences (RCL) industry group, spanning management consulting services, packaged application services (SAP, Oracle), and advanced technologies. He is based in Paris.

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PREDICTION PUTS THE SMART IN SMART RETAIL

The outlook for Retail is sobering. The industry is facing some of its toughest challenges. What was just a means to increase margins or revenues has become a matter of life or death – innovation through digital disruption.

This need hinges on three basic capabilities delivered by technology:

IMMEDIACY: If a truck route is closed, we need to know now! In real time, so we can deliver the required inventory using another truck, via an alternative route. If a plant has to shut down, we need to know immediately, so we can plan accordingly. Data that is even a few days old is worthless.

INSIGHTS: The adoption of smart devices has generated large volumes of unstructured data. Using this data to generate insights and drive business decisions is imperative. On top of this, the convergence of retail and consumer packaged goods (CPG) industries demands the reorientation of processes and business models.

INNOVATION: AI models are reinventing retail across product cataloging, merchandising, customer service, replenishment, demand forecasting, pricing, and logistics. 'Fast fashion' retailers such as Zara and Mango integrate AI, machine learning, and personalization technologies to better understand consumer behavior. It helps recommend products intuitively, empowering them to influence demand and better manage pricing as well as inventory.
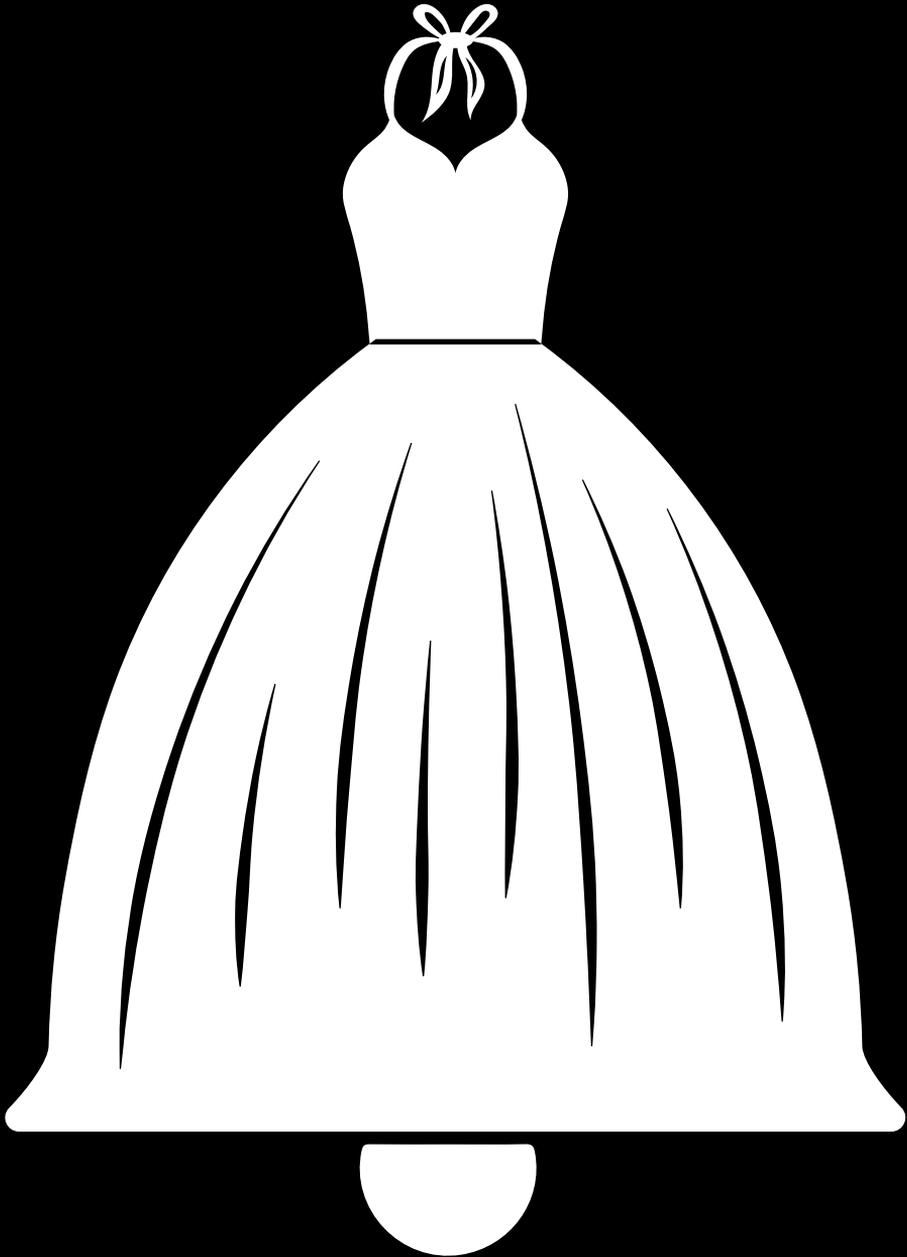
Looking for this?

Powerful predictive analytics can delight shoppers by showing them things even before they realize they are looking for it.

The science behind predictive commerce

An AI ecosystem helps brick-and-mortar and e-commerce companies realize compelling value before, during, and after a purchase. Retailers can capitalize on the widespread adoption of smartphones and the potential of AI to improve the supply chain and create value for their customers. They can shift from responsive to predictive commerce, and from micro-segmentation to personalization. Besides, an AI backbone connects stakeholders and devices in the ecosystem to blur the line between online and offline shopping experiences.

Real-life example 1: Shoppers swipe interactive windows at the Westfield San Francisco Centre (a shopping mall) to learn about various premium brands and order the products on mobile devices.

Real-life example 2:
The 'store mode' of cosmetics brand Sephora's mobile app integrates the online shopping cart with their Beauty Insider loyalty program, simplifying notifications, real-time updates, and redemption of reward points.

It is common knowledge that personalized content engages shoppers at a deeper level. AI-powered retailing creates immersive shopping experiences by connecting data from diverse sources and matching potential demand with product availability in real time. AI models integrate the browsing histories, Facebook conversations, Pinterest searches, and Instagram followers to provide granular insights into shopping behavior. It creates user profiles, assesses requirements, understands consumers, all of which help recommend complementary products and drive impulse purchases. This is the secret sauce of contextual commerce for retailers.

Influencing purchase

Recommendation systems powered by machine-learning algorithms generate substantial revenue for Amazon and Netflix. The success of recommended purchases has encouraged Amazon to pilot an AI-based 'predictive delivery' program. Delivery trucks are stocked with items that are likely to be ordered by shoppers while the trucks are en route for delivery in the neighborhood!

The Sears Auto Center has launched Digital Tire Journey, a service to enhance auto tire shopping. The AI-enabled app uses a set of questions to create a driver profile based on preferences and driving behavior. It recommends tires that match the vehicle and driver's performance as well as the most appropriate marketing channel for purchase.

Cognitive technologies provide computing devices with the ability to recognize handwriting and symbols, extract text from images and files, transcribe human speech, identify objects and faces, and understand user intent. An AI ecosystem processes queries in natural language, generates content from partial data, and sequences actions based on set parameters. Further, deep learning systems automatically validate machine-generated action, which ensures accuracy.

AI is not just for e-commerce. It can help brick-and-mortar companies by allowing them to shift from micro-segmentation to personalization.

AI-based processes predict transaction opportunities by getting to know shoppers and recommending personalized offers along the purchase path, without programmed instructions. It prompts shoppers to search for products even before they perceive the need for it.

Driving product discovery

Technologies that make sense of visual environments and engage consumers with two-way conversations elevate the shopping experience. The Pinterest Lens helps shoppers who are undecided about their shopping needs or have a limited vocabulary of a product to find it online. Pinterest's visual search algorithms evaluate similarity scores tagged with images to facilitate a user's search for home décor or fashion wear.

Machine-to-machine interfaces can be combined with simulation, augmented reality, and other virtual tools to automate complex tasks such as product design, selection of sizes for clothing and footwear, and consultations for skin care. Consumer interactions via the L'Oreal Diagnose My Hair app mimic in-store hair consultations. Adobe's AI image-editing tool adopts

photorealism to help handbag manufacturers convert rudimentary sketches into images.

A detailed taxonomy of products is critical for online discovery since product imagery alone cannot define the content, promotions, and marketing in retail. Inconsistent product tags, incorrect metadata, or incomplete attributes adversely affect product recommendations. Deep learning algorithms create a product catalog by extracting attributes, and classify products for intuitive search. Accurate classification of products enables AI entities to transform retail operations.

Providing personal assistance

Speech and facial recognition capabilities provide virtual shopping assistants with a personal touch. It converts apps into experienced concierge teams that can interact with shoppers, take orders, and share product information. Virtual assistants incorporate insights from diverse sources to make relevant recommendations, and deliver an omnichannel experience.

The Macy's On Call app combines cognitive computing and natural language processing with location-based software to guide shoppers at stores. The AI system responds to queries such as the location of products within the store and details of a product.

AI is being embedded into products to minimize human intervention. While Amazon's Dash button automates purchases, Sharp is incorporating AI into home appliances for hands-free operations. Sharp's vacuum cleaners and microwave ovens can be controlled through voice commands. Nestlé SA has deployed robots as sales assistants at retail stores in Japan. The fleet of humanoids engages customers with product information and sells Nescafé products and vending machines.

Cognitive computing and automated systems enhance retail operations – from stock management and pricing to planogramming and promotions. They provide insights to optimize marketing spend and boost productivity at the store. However, technological progress must deliver compelling benefits to all stakeholders. Each retail enterprise should replace or augment human effort with AI to transform business processes. The success of AI-driven retailing lies in navigating a personalized shopping journey for every shopper.

AI systems understand consumers and their real-time requirements, which helps recommend complementary products and drive impulse purchases.

RPA: Velocity meets acc

Robotic Process Automation (RPA) provides retailers with opportunities to optimize costs and enhance efficiency across in-store systems and the supply chain. It eliminates human intervention in the retail-specific as well as administrative and generic back-office processes. Rule-based systems for order processing, inventory planning, customer service, merchandising, product returns, and refunds can be processed faster and with better accuracy by RPA solutions.

Software robots integrate with enterprise systems such as finance and human resources to transform execution. It unifies data sources to simplify reconciliation. In the absence of manual data entry or repetition, databases are always auditable. Moreover, automated processes support reporting and compliance. Most importantly, RPA streamlines workflows and establishes a robust foundation for advanced analytics.

Retail enterprises should replace or augment human effort with AI to transform business processes.

About the Author

Aniket Maindarkar

Aniket has extensive expertise in Retail and CPG industries. He also has a deep understanding of the shared services and global business services (GBS) industry, and over the last 22 years has assisted several Fortune 1000 organizations architect and execute their GBS strategy.

He has a bachelor's degree in computer science and an MBA in marketing.

His interests include sailing, running, triathlons, and adventure sports.

RESEARCH UNRAVELED

ON THE TRAIL OF MACHINA ECONOMICUS

Dr. Martin Prause on how Computational Economics and Artificial Intelligence are changing business.

Computational Economics (CE) is a discipline that uses computer-based models to solve analytical and statistical problems. In this insightful interview, Dr. Prause uses real-world examples to explain how CE and AI are finding practical application in business landscapes. He also reveals how AI can play an important role in improving business simulations.

Q Infosys

A Martin Prause

Q: *Could you connect the dots for us – artificial intelligence (AI), computational economics (CE), and building 'machina economicus'?*

A: The quick and dirty answer is: CE is the application of AI methods to economics.

Computational economics (CE) resides at the intersection of economics and computation.

To understand how CE and AI connect with machina economicus, we must first know that the present economic theory is based on a set of assumptions, which are:

- People have rational preferences among outcomes

- Individuals maximize utility while firms maximize profits

- People act independently on full and relevant information

These assumptions about human behavior create the construct of a species known as *homo economicus*, the *'economic man'*. While these assumptions do not accurately represent how humans behave in the real world, they are necessary to define an analytical model to work with.

AI researchers aim to construct a synthetic homo economicus known as machina economicus (also described as the perfectly rational machine). A recent article by Parkes and Wellman explains how such an AI approach can mimic homo economicus if it can align perceptions, outcome preferences, and actions to come to a decision under uncertainty.

Predicting the next move.

Computational economics can enable more powerful
business simulations and better strategic decisions.

Now, computational economics has two primary economic applications for businesses today:

Example: You wouldn't care if the GPS navigation system in your car calculates a route that takes just one minute longer than the optimal one.

SOFT COMPUTING TO SOLVE ECONOMIC PROBLEMS: Soft computing refers to a set of nature-inspired computational methodologies such as evolutionary algorithms, swarm algorithms, and artificial neural networks that solve real-world problems where traditional approaches are not efficient. This is because in many cases, it takes an exponentially long time to compute an optimal solution and the margin of benefit between the second and the optimal solution is, quite often, minor. Therefore, we can safely make do with approximations. In the business world, soft computing is used in the iterative process for high-frequency trading markets where trades are done within milliseconds. Here, an optimal solution to determine the best portfolio or to forecast the financial markets cannot be calculated efficiently, hence, an approximation is the next best option.

COMPLEX SYSTEM MODELING TO UNDERSTAND BEHAVIOR:
A complex adaptive system (CAS) is a system where 'agents' autonomously interact with each other. Simply put, an agent is a unit that senses its environment, follows process rules to react to the environment and its internal state, and propagates its result to other agents for interaction. The main advantage of CAS over traditional analytical systems is the study of how specific phenomena emerge. As CAS is self-organizing, it allows non-linear behavior to emerge depending upon internal system changes as well as environmental changes.

Agent-based modeling (ABM) is a specific CAS model to study the economic dynamics, i.e., how agents behave, providing a better understanding of the system. It does not focus only on outcomes – rather it focuses on how the outcome materializes. In other words, it is a methodology to study behavior. ABM can be used in social networks to simulate interactions, consumer behavior, word-of-mouth advertising, innovation diffusion, etc. Generally, ABM is used to generate what-if scenarios for companies and governments seeking to establish policies, regulations, and forecasts.

In the words of Arthur Samuel (1959), AI is the "field of study that gives computers the ability to learn without being explicitly programmed." Taking a helicopter perspective, AI consists broadly of three fields: knowledge representation and optimization, automated analysis of data, and learning (i.e., machine learning).

What is the link between CE and AI? First, from a theoretical view, CE and AI use the same methods to solve problems. While one is tailored to economic applications (CE), the other is not tailored to any application (AI). Second, from an application perspective, AI can enrich agents in complex adaptive system modeling. Thus, agents gain cognitive abilities to match or increase real-world representation.

A recent article by Parkes and Wellman explains how AI can mimic homo economicus if it can align perceptions, outcome preferences, and actions to come to a decision under uncertainty.

In summary, thanks to CAS, we can study not only equilibriums or specific outcomes, but also how they are formed. Additionally, if the agent's behavior mimics human behavior closely, the micro and macro dynamics can be better understood.

Example: There were many publications that tried to assess the impact of Brexit and the recently discontinued Transatlantic Trade and Investment Partnership (TTIP) on foreign direct investment (FDI).

Q: *How can AI be incorporated in business simulations and how can this help companies deal with complexity and uncertainty?*

A: Business simulations are computational simulations that mimic companies and their strategic environments such as internal views,

competitors, customers, suppliers, and PEST – political, economic, social, and technology aspects. In education, such simulations are used to teach how all business elements are connected. In industry, they are used to conduct what-if analyses using appropriate assumptions and simplified models of the real world. There are many systems in place that give companies different views: ERP systems give an internal view, CRM and digital marketing offer an external view, and competitive intelligence systems provide perspectives on the strategic environment.

If the information provided by these three systems is aggregated and fed into an appropriate model, it can be used for scenario analyses and market forecasts to align strategies across all business units.

So the key question for business leaders is: Can my company define and execute a strategy consistently and coherently in this environment?

A book called 'The Second Machine Age' (2014) by Andrew McAfee and

The cognitive and heuristic shortcuts humans use to cope with constraints that are prone to discrepancies with objective reality:

- *Myopic problem representation – Where a problem is oversimplified and important variables are overlooked*

- *Group think – A cognitive bias that occurs when the demand for harmony within the group outweighs the need for critical thinking*

- *Conjunction fallacy – Based on misjudgment, where the more detailed information an individual has on a specific event, the more plausible this event is perceived to be, although it might be less probable*

- *Confirmation bias – Information that confirms existing beliefs and mental models, leading one to neglect contradictory evidence*

ABM modeling focuses not on outcomes, but on how it materializes.

Erik Brynjolfsson talks about how data generation and usage will increase exponentially in the near future, particularly if machines can train themselves to get better instead of just learning from the past. Digital systems move at a faster pace than other systems in society, adding to the complexity and uncertainty.

Here, AI comes into play when it leverages the agents of the *machina economicus* paradigm in a business simulation. First, one can study the dynamics based on more advanced models. For example, instead of using the analytical supply and demand model, consumers and suppliers can be represented as agents with desires, objectives, and cognitive capabilities. This could help to demystify the complexity and uncertainty of the company's environment. Second, to conduct a sound what-if study, hundreds of assumptions have to be tested. Therefore, thousands of simulations have to be tested. We must then identify patterns and study the outcomes. This is where machine learning comes in to identify patterns of dynamics and correlate them with outcomes.

The next step is to relax some of our earlier assumptions in the *homo economicus* model, thereby making the outcomes closer to reality, where human beings are subject to cognitive biases. Human decision making in daily life or professional business is subject to lack of information, processing time, and limited resources.

Once models can also account for this systematical error, businesses can achieve a better understanding on how they should approach their suppliers or how they should plan their marketing campaigns, etc.

Example: Daniel Kahneman and Amos Tversky (1973) demonstrated that humans use shortcuts to cope with these constraints and that these cognitive representations and heuristics are prone to a systematical discrepancy to objective reality.

Q: *What are the ways in which AI can be used for a company's business model and decision-making process?*

A: Let's move away, at least temporarily, from the idea that AI is a cognitive,

super-intelligent, artificial processing unit and instead focus on the AI methods, i.e., knowledge representation, learning, and optimization. Today, the market for AI applications is very fragmented and there is a lot of buzz around this approach. However, in most cases, AI refers to some form of machine learning or soft computing tailored to a particular application. In fact, many companies / start-ups in the European market are promoting AI methods across the value chain, and they primarily use either optimization techniques or machine learning.

In contrast to the tailored use of AI methods, there are also leading players who are already working on a machine with the capacity to learn 'the way a baby or an animal does'. This is interesting because this machine is actually learning by 'observing the world', not by being trained. This approach closes the loop and aggregates the elements of knowledge representation, learning, and optimization to support a wider range of applications.

Some examples:

- **Marketing:** Wunder.ai is matching people and products using algorithms.

- **Inventory:** Cargonexx has optimized the utility of cargo space on its trucks, thereby matching demand with supply.

- **Operations:** MicroPsi uses AI to control industrial processes and systems.

- **Development:** EyeQuant uses AI to provide automatic A/B testing for mobile app / website design.

For each element, there are multiple solutions.

Q: *AI has also precipitated concerns for businesses such as job automation, fooled AI, etc. What are the pitfalls and how can businesses avoid these?*

A: Let me elaborate on some of the basic concerns that hinder the acceptance of AI:

FEAR OF LOSING CONTROL ON DECISION-MAKING: Humans are subject to many cognitive biases and machines can easily exploit these. Do you think that we have free will when we navigate a website? No; the components in a well-designed website are placed to achieve a certain goal.

Computational economics is about identifying patterns and studying the outcomes. This is where machine learning can play a huge role.

There are other fears: Machines can easily use framing or anchoring techniques to influence our behavior, or machine-learning systems may use people's digital trails and incorporate undisclosed traits into their own decision-making.

NON-TRANSPARENT USE OF DATA: Eric Horvitz and Deirdre Mulligan highlight that social network posts can be used to determine if a person has depression. While this is good to help us initiate treatment for that person, groups with vested interest can secretly use such data against this person.

UNCERTAINTY OF THE DECISION-MAKING PROCESS: The use of machine learning is increasing, yet organizations lack understanding of how computers arrive at decisions. Is the machine programmed to be biased towards a specific company goal? How does the machine resolve ethical dilemmas such as the much debated 'trolley problem'?

UNANSWERED LEGAL QUESTIONS: Who becomes responsible when the outcome of a machine is not aligned with the law or cultural standards? What if an AI-controlled traffic signal learns that it is more efficient to change the light one second earlier than was previously done? While this may be more efficient, perhaps it can lead to more accidents.

OPENNESS TO MISLEADING INPUT: AI methods can be fooled. It took less than 24 hours for Twitter users to corrupt Microsoft's AI chatbot, Tay, into making racist comments. Nguyen, Yosinski, and Clune demonstrated how an artificial neural network (ANN) for image recognition was fooled into believing that images which were unrecognizable to human eyes were actually familiar objects.

Q: *How do we avoid those pitfalls?*

A: One approach is to establish standards that are accepted by society. Just as car manufacturers have to adhere to specific norms to sell their cars, AI designers and developers should also adhere to specifications and follow norms on how decisions are taken, although this is a difficult approach as there is no one definition of AI. Nevertheless, some organizations such as OpenAI, are already heading in this direction. Even the legal and governmental system should adapt to the rise of AI in daily private and business life to purposefully regulate the use of data.

Soon, machines may be able to learn by observing the world, and not simply by being trained.

About the Author

Dr. Martin Prause

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*Martin received his Ph.D. in economics from WHU in 2014 and
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*Before he started his doctoral studies, he received his MBA degree,
worked as the Head of IT for three years in a small- and medium-
size company, and graduated from the Technische Universität at
Dortmund with a diploma in computer science.*

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