INFOSYS INSIGHTS

TRENDS. PERSPECTIVES. IDEAS.

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AGE OF POSSIBILITIES

Digital Revolution and Problems Worth Solving

Cover image: The Thinker (French: Le Penseur) is an early 20th century bronze statue by French sculptor Auguste Rodin. This celebrated sculpture depicts a man lost in thought, representing philosophy. At the same time, the emotional tension in his body and his posture suggest a great capacity for action.

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IMAGINE IT DONE!

Ravi Kumar S.
President and Chief Delivery Officer,
Infosys

When we look around us today, we see that everything is going through a massive transformation based on the power of digital technologies - the power of computing, cloud, and artificial intelligence. Bits are beginning to infuse digital life into more and more structures of atoms. Things are beginning to both sense and respond, in real time, to the world around. Cars can tell anxious parents if their teens are driving safely, machinery on the shop floor can alert technicians to when they might break down and how to prevent that from happening, and even that innocuous toothbrush on your bathroom shelf can now tattle to dental insurers should you forget to brush before bed. Clearly, technology is making everything around us smarter.

This deep-rooted digitization – the intermingling of bits and atoms – is opening up a whole new world of possibilities, one where the future is only limited by what our imagination can grasp. Because, now it is entirely up to us to look for something that is worth having but unavailable, then imagine – to the last little detail – a world with this unavailable or missing aspect plugged in. This is the act of problem-framing, the beginning of all innovation and a uniquely human capability that no machine has as yet mastered. There on, of course, technology has greatly amplified our ability to bring these innovations to life.

So then, the great task before us enterprise leaders is to acquire a deep understanding of all that our business, our industry, and the community that we live and work in, need. Then, to hone our ability to clearly articulate these needs, so we might then use that clarity to imagine the things that fulfill these needs purposefully.

In this issue of *Infosys Insights*, we examine a range of problems and challenges that are staring at us, at humankind, and present innovative and some untrodden ways to develop the approach to solving them.

The cover story by our COO, Pravin Rao, illuminates why today's existing patterns and paradigms may not be enough to realize the potential of what digital technologies have to offer. In the pages ahead, you'll find out why the next car might be closer to a computer on four wheels, and not an internal combustion engine enclosed in a metal cage. This perspective is brought alive in an article *Technology and Connectivity Set to Transform the Auto Industry* through keen insights from Nitesh Bansal, Regional Head – Manufacturing, Americas and Europe, at Infosys. In another article, *Digital's Next Stop – Farming*, we examine how farming – an occupation that has changed very little in the past 5,000 years – is now as dependent on digital technology as any other industry. And this transition has the potential to address food shortages globally, says the author, Jeff Kavanaugh, Senior Partner, High-Tech and Manufacturing.

Leading scientist Srivari Chandrasekhar's article, *Nature is Life – With Green Chemistry You Can Choose Life*, discusses how an enterprise can produce environment-friendly pharmaceuticals that are also affordable. But isn't there an economic trade-off in the attempt to lower carbon footprint? You should read on for the answers. On a related note the essay, *From Darkness to Light: The Five Ds can Lead the Way*, talks about equitable power distribution across the world, especially by adopting green energy. This has been written by Ashiss Dash, Regional Head – Utilities, Americas, at Infosys.

Does preventive medicine, including precision medicine and individualized care, have the potential to address some of the issues facing Big Pharma today? Subhro Mallik, Head of Life Sciences, Americas, at Infosys, believes so and elaborates upon the reasons in his article. In another discerning take, SVP, IT and Digital Media at the Association of Tennis Professionals, Murray Swartzberg, discusses how analytics and insights are elevating the tennis experience for players and fans alike. His verdict is *Game, Set, and Match – Data.*

I'll leave it to you to discover the rest of the perspectives. Each exploring ways to be more than what we are today.

I do hope you enjoy reading this edition, find reasons to keep coming back to it, garner ideas and thoughts – some to mull over and some to execute.

Ravi Kumar S.
President and Chief Delivery Officer,
Infosys

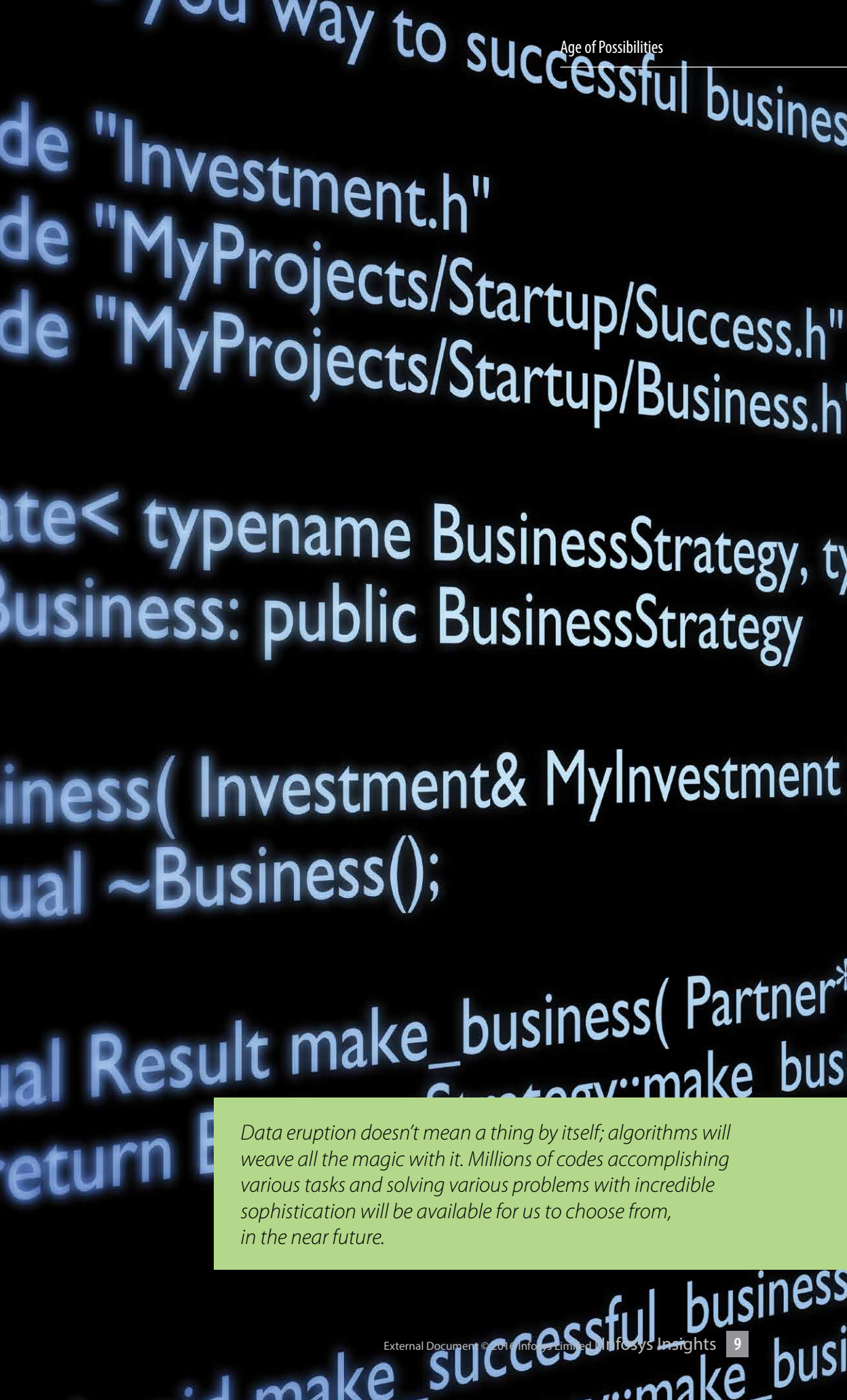
AGE OF POSSIBILITIES

The digital revolution and problems worth solving

For centuries, humankind has been following existing paradigms, solving problems using known and tested methods, and building upon past successes to create new milestones. There have been pockets of innovation, sanctums of academia, scientific experiments, and lives of sheer genius, across fields, which have propelled our race forward. However, something else is happening today – several revolutionary technologies have reached their tipping points, and some have converged, promising to pan out at a scale so phenomenal and pervasive, touching the lives of billions, that existing patterns and paradigms will not suffice to maximize the benefits these have to offer.

Consequent upon this, several phenomena are creating dramatic shifts:

- **Connectedness:** Estimates say that by 2020, there will be 50 billion sensors and devices connected to the Internet. The number of mobile phone users is expected to reach 4.7 billion in 2017 and the amount of mobile data downloaded is likely to double yearly for the next few years. What makes these vast numbers important is that they indicate unprecedented sharing of knowledge, unprecedented creation of value, and emergence of new economic paradigms. *How long before we stop owning assets that we don't use to full potential – such as vehicles and power drills?*



Data eruption doesn't mean a thing by itself; algorithms will weave all the magic with it. Millions of codes accomplishing various tasks and solving various problems with incredible sophistication will be available for us to choose from, in the near future.

- **Algorithms:** Data in the digital universe will grow by a factor of ten – from 4.4 trillion gigabytes in 2013 to 44 trillion gigabytes in 2020. But such data eruption doesn't mean a thing by itself; algorithms will weave all the magic with it. Millions of codes accomplishing various tasks and solving various problems with incredible sophistication will be available for us to choose from in the near future.
How long before algorithms will adapt to a moral code of conduct similar to that of humans?

- **The amplified human:** While we are watching Siri grow into an intelligent young lady, there have been other noteworthy artificial intelligence (AI) developments. Recently, a Japanese literary competition received 11 entries from books written by AI with human inputs, and one of them even passed the first round. Earlier this year, Google's AlphaGo beat the human European Go champion five games to zero. The ancient Chinese game of Go is considered tougher than chess and requires an incredibly complex mind to solve.
How long before we have AI-powered alter ego mentors?

Limited only by our imagination

In scale and reach, the Digital Revolution we are currently experiencing can be compared to the Neolithic Revolution, which taught us agriculture; and the Industrial Revolution, which taught us to create and use machines – transforming humanity's way of life. However, the lightning pace of technology today and the rapid blending of atoms and bits distinguish this epoch. Unlike the previous epochs, the Digital Revolution calls for reorienting our thinking, to observe and participate in a future that is being created by the day, yet mentally out of bounds to most of us. Can you wrap your head around combining mobility, AI, life sciences, and robotics, focused on creating computer-hybrid human beings? If you can, then you may be starting the company yourself!

This is an era of exploring possibilities. Possibilities that we cannot even imagine. This April, Stephen Hawking, one of the greatest theoretical physicists ever, and Yuri Milner, a Russian billionaire, announced a US$100 million investigative project to work on making travel between stars possible. They will build nanocrafts, which are small spacecrafts attached to light sails which use the power from gigawatt-scale laser arrays to reach speeds of more than 20 percent the speed of light. In this way, astronauts will be able to reach Alpha Centauri, our solar system's nearest star (four light-years away), in only 20 years. Using even the fastest spacecraft today, this journey would have taken 30,000 years!

Discovering such possibilities requires a new way of thinking. Uncreating existing reference points and examining the problem itself, rather than rushing to find solutions. In the case of the 'Breakthrough Starshot' project, considering that reaching the speed of light or close to it has been a daunting factor for interstellar travel, the question to ask was: Is the speed of light the 'problem', or the spacecraft size, tools, and methods used, to traverse the vastness of space?

This example from space travel symbolizes the zeitgeist today. Technology-driven possibilities abound. Gone are the days when technology only transformed a company, or an industry. While you may be still applauding retail's virtual stores or mobile-first banking – both digital early adopters – the traditionally conservative insurance sector is adopting AI-driven automation to drive efficiencies; life sciences is digitizing parts of clinical trials to address some of the inherent challenges; and healthcare is embracing universal accessibility as a priority, and moving towards personalized and preventive care.

The Digital Revolution has two important dimensions – the disintermediation of the supply chain (economics), and the hardware revolution (engineering) that is packing more processing power in computers, and which is doubling every two years (Moore's Law). The disintermediation is minimizing the distance between producer and consumer, and in turn ushering in new kinds of business models. Think crowdsourcing platforms, online marketplaces, branchless digital banks, publishing platforms like Smashwords, and accommodation platforms like Airbnb. The second dimension of diminishing chips and transistors is practically enabling all the disruption. Powerful, embedded computing is making the pervasively digital experiences possible, and raising our expectations irrevocably.

Being Digital. Being More.

At Infosys, we find ourselves in the midst of all this excitement as a significant participant. We have been working with global majors, through the decades, to help them transform themselves and their client experiences, with software. Today, we are partnering with them for some of the greatest transformations cutting across industries. Recently, we collaborated with GE, the digital industrial company, to embark on a journey of creating a 'digital twins' universe, where we will digitally recreate the entire life cycle of any product, from conceptualization and development, to marketing, sales, and maintenance. This way, stakeholders can better understand and manage the underlying structure, design, and functional issues, at any point in time. As the next step, microservices can be built on top of any digital twin.

We are working at the intersection of material science and engineering to help create lighter aircraft fuselages, and applying artificial neural networks to enhance the efficiency of aircraft engines. We are using our open-source analytics platform to glean near-real-time insights for ATP to amplify the experience for tennis fans and players. Until now, the highest governing body of men's professional tennis had decades of rich data stored up in silos. Today, we are able to process 12 million data points, and growing, in near-real-time for them to generate insights. Our digital oilfield solution is helping companies in the oil and gas industry collect and analyze oil well data in real time, predict field equipment failures, reduce unplanned downtimes, enable remote monitoring and faster control of field equipment, and so on.

As an organization, we have reoriented our thinking to the new reality. By using tools and methods, primarily Design Thinking, which teaches an empathetic approach to problem finding and problem solving, we have been able to make a cultural shift. Today, all our client projects undergo the filter of how close we are to the client's need (desirability), engineering possibility of the solution (feasability), and the economic value it can bring (viability). More than one-third of our 190,000-plus employees have already undergone Design Thinking training, and we have conducted more than 250 Design Thinking workshops for our clients.
Why are we solving what we are solving? What more can we do, beyond the stated requirements? How can we make it even better? How can we bring the learnings from other similar projects?

These are some of the mandatory probes in our Zero Distance framework, inspired by Design Thinking, and which dictate the approach to currently 95 percent of all our client engagements.

Endnote

Like the previous epoch-making junctures in human history, the Digital Revolution will amplify the potential of humankind. This is actually a human revolution, where epitomic technology will help us to unleash our creativity, unfetter our imagination, and awaken our problem-finding instincts, both individually and collectively. The mundane, repetitive jobs will be left for the machines to do, rather for the less-intelligent machines, giving us a new space to explore possibilities.

In this issue of *Infosys Insights*, we bring you snapshots of such possibilities – of some of the larger problems worth solving.

About the Author

Pravin Rao
Chief Operating Officer, Infosys

As the Chief Operating Officer, Pravin Rao is responsible for driving growth and differentiation across portfolios at Infosys. Additionally, he oversees global delivery, quality, and productivity, the supply chain and business enabler functions. He is also the Chairperson of Infosys BPO.

Pravin has over 28 years of experience. Since joining Infosys in 1986, he has held a number of senior leadership roles such as Head of Infrastructure Management Services, Delivery Head for Europe, and Head of Retail, Consumer Packaged Goods, Logistics, and Life Sciences. Pravin holds a degree in electrical engineering from Bangalore University, India.

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TECHNOLOGY AND CONNECTIVITY SET TO TRANSFORM THE AUTO INDUSTRY

As the automobile industry continues to evolve, we look at its journey till now and the elements that continue to drive its evolution, all directed towards achieving the ultimate frontier of digitization – the autonomous car.

These are exciting times for the auto industry. Before we delve into emerging trends and what to expect in the future, let us take a quick ride through the history of the automobile industry.

Late 1800s to 1950

Auto manufacturers in Germany, France, and the US deliver 'easy mobility' by making lightweight, affordable cars. Growth of the auto industry spurs demand for steel and petroleum. Ancillary industries and feeder services emerge and thrive.

1950 to 2000

Japan becomes an auto leader and exports vehicles. But the proliferation of automobiles results in bumper-to-bumper traffic in cities. The socio-economic impact of easy access to personal motor vehicles comes into focus. Governments respond with standards for safety, emission control, and fuel efficiency

The shape, form, and purpose of the car are rapidly changing, with machine-to-machine communication and artificial intelligence embedded in every component. But planned obsolescence and incremental tweaking of product / production technology are not sustainable to achieving the ultimate frontier of digitization – the autonomous car.

as well as regulations to restrict usage, and even purchase. In Japan, motorists require a 'parking space certificate' to register the purchase of a new or used car. While some countries introduced curbs on movement and parking of vehicles in urban areas, others integrated bicycles in the public transit system.

Post-2000

Shifts in technology and demographics, and psychographic changes driven by the ubiquitous internet create a 'sharing economy.' Auto sales stagnate or decline in some regions – either due to an aging population or the popularity of apps such as Uber and Turo. Governments and consumers seek 'inclusive mobility.'

Digital convergence blurs the lines between industries, disrupts business models, and in extreme cases, upends businesses (a notable example being film-based photography). Retail, pharmaceutical, financial services, and oil and gas enterprises leverage digital technologies and social platforms to renew their business and explore new revenue streams. Similarly, new avenues open up for automakers as they can now combine technologies to create value and offer convenient choices to meet the aspirations of diverse customer segments.

Adaptive cruise control, automatic parking, and collision warning systems transform the driving experience. Real-time data from vehicle-to-vehicle and vehicle-to-infrastructure communication systems helps minimize accidents.

The business approach to every phase of the auto value chain is being redefined by collaboration as well as advanced technologies. Fashion designer Zachary E. Posen and Thom Browne, created exterior and interior designs for Nissan's 2014 Infiniti Q50 luxury sedan. Robots work alongside humans at assembly lines in Ford and BMW. Tesla sells directly to consumers. Most important, the car itself has become a Veblen commodity, a functional necessity, and a shareable asset, all at the same time.

The shape, form, and purpose of the car are rapidly changing, with machine-to-machine communication and artificial intelligence embedded in every component. But planned obsolescence and incremental tweaking of product / production technology are not sustainable to achieving the ultimate frontier of digitization – the autonomous car. Auto manufacturers need to focus on critical aspects that define demand for automobiles, while ensuring a safer, more intuitive travel experience.

Utility, no longer limited

Cars are set to become an integral component of multi-modal, on-demand transportation systems. Leading auto brands embed connectivity systems for seamless mobility. Daimler launched 'car2go' in partnership with Europcar Autovermietung GmbH in 2011. Daimler's 'car2go' edition models incorporate advanced telematics, and serve more than one million users across 60 cities in eight countries. The BMW DriveNow car-sharing service is based on the 'pick up anywhere, drop off anywhere' principle. Electric cars are included in the DriveNow fleet. Passengers in San Francisco and select cities of Europe can locate cars using an app or find one on the road, use a chip in the driving license as the key, and leave the car anywhere. Users are billed based on the duration of travel, which includes fuel and parking charges.

The average number of miles driven by Americans has been declining since 2004, according to 'Millennials in Motion,' a report by U.S. PIRG, an independent consumer group. Industry research also indicates that millennials in America and Germany prefer alternatives to car ownership. Traffic logjam, environmental concerns, and the high average car idle time (almost 80%) may explain the emergence of pay-per-use models such as car-sharing, e-hailing, and peer-to-peer car rentals.

It is not yet known whether travelers in developing countries will follow suit. In these countries, regulators are implementing policies to restrict private vehicles even as car sales is robust, and rising income levels allow

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first-time as well as multiple car ownership. Automobile companies will need to better understand micro consumer segments and their attitudes toward car ownership and mobility to customize models for these markets.

Companies can collaborate with various stakeholders to provide mobility-as-a-service. Ford partners with Zipcar to offer car rental services in over 250 college campuses. "Today's students are thinking differently about driving and transportation than they have in the past. This program enables today's new drivers to experience our latest fuel-efficient vehicles, while helping them reduce their cost of living and help relieve congestion on campus. We're looking forward to making Ford a staple of their college experience," said Bill Ford, the executive chairman.

Safety, of paramount importance

Radars, cameras, scanners, and sensors fitted within and outside a car ensure the safety of passengers as well as pedestrians. A majority of car manufacturers have adopted semiautonomous technology in their fleet. Adaptive cruise control, automatic parking, and collision warning systems transform the driving experience. Real-time data from vehicle-to-vehicle and vehicle-to-infrastructure communication systems helps minimize accidents. In addition, it enables traffic control centers to predict traffic conditions and avoid congestion by rerouting flow. An intelligent transportation system ensures better response in case of emergencies.

Optimized driving reduces greenhouse gas emissions significantly. Until autonomous driving becomes a reality, automakers should improve driver assistance systems in vehicles and invest in technologies to minimize the carbon footprint. Climate control systems monitor and analyze air pollution and UV radiation, and automatically calibrate the ambient conditions within the car. Tesla's Model X features a medical-grade high-efficiency particulate arrestanc (HEPA) air purifier.

Manufacturers need to accelerate investment in electric and hybrid vehicles, including the infrastructure ecosystem. The Uber Advanced Technologies Center is collaborating with Carnegie Mellon University to create fully autonomous cars for its e-hailing service. Toyota is experimenting to attain 'zero emissions' across brands by 2050. The company's Mirai uses hydrogen as a power source, and a Lexus fuel cell vehicle will be launched by 2020. Tesla is building a 'Supercharger network' across North America, Europe, and Asia, including wall chargers

at hotels and parking areas, for convenient access to clean electricity.

Flexibility in production and supply chain, a key requisite

Japan sustained its leadership in automobile production and exports for decades due to innovations in quality as well as logistics processes. Japanese carmakers invested in global distribution networks and production infrastructure to minimize costs and mitigate risks. Nissan, Toyota, Honda, and Mazda automated logistics – inbound, intra-enterprise, and outbound – to leverage smart distribution technologies. A lean supply chain helps the companies address demand in any region.

Trade agreements between countries and trade barriers drive vehicle production and sales. Manufacturers in Brazil are protected by high customs duties. However, they can serve only the local market. Mexico, on the other hand, is a member of the North American Free Trade Agreement (NAFTA) and Latin American Integration Association (ALADI). It has boosted the auto industry in the country. Kia Motors, Nissan, BMW, and Mercedes-Benz are establishing manufacturing facilities in Mexico. In addition, the free trade agreement with the European Union (MEFTA) is helping auto as well as auto parts manufacturers grow.

As more and more proprietary systems are embedded for autonomous driving, original equipment manufacturers (OEMs) can expect growing demand for parts and after-sales service. Third-party service providers may be unable to maintain or repair critical safety systems. Moreover, OEMs will be responsible for intuitive recommendations in their smart cars and technical failures. Car sharing, whether in partnership with the OEM or otherwise, will lead to increased usage and faster wear and tear. While it is an opportunity to increase revenue, automakers will need a flexible supply chain for sustainable operations.

Cars of the future need to provide more than mobility. Vehicles should combine computer-aided design, engineering finesse, and functional gadgetry to address safety, pollution, and traffic congestion.

About the Author

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Nitesh is responsible for managing and growing client relationships globally with manufacturing companies across aerospace, automotive, and industrial and discrete sectors. He has been instrumental in establishing the presence of Infosys across Europe. Throughout his journey with Infosys, starting in 1998, he has pioneered the expansion of integrated service offerings around applications, infrastructure, and BPO. Advising clients on large transformation objectives with global scope has been an area of keen interest for him.

Nitesh has been part of the President of India delegations, with former president, Pratibha Patil, for bilateral talks with Switzerland and Cyprus. He has also represented the Indian IT industry in Slovenia and Austria. He has been a member of the jury for several internal and external awards, most notably the European Business Awards. He is a recipient of several Infosys excellence awards in areas including sales management, client relationship, unit management, and people development.

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FROM DARKNESS TO LIGHT: THE FIVE 'Ds' CAN LEAD THE WAY

Green energy and digitization of services today provide a great opportunity for inclusive growth – going beyond mere electrification. The five Ds of power management can help achieve this.

Technology makes the world a smaller, better place. Much of our 21st century sophistications are attributable to advances in technology. But even today, people across vast swathes of the planet seem to be living in the dark ages. Almost 1.3 billion people do not have access to electricity. If the statistic is staggering, the solutions beg a leap of faith and technology – energy from the sun for one hour suffices to meet the world's requirements for an entire year. However, less than five percent of the world's energy requirements are powered by renewable sources. The issue at stake is not mere electrification, but a mission for inclusive growth.

The demand for power is growing exponentially. Limited access to power inhibits development. Elsewhere, an increase in population, economic, and industrial growth, along with a rise in per capita energy consumption due to lifestyle changes, are intensifying the load on the power infrastructure. The concerted effort of industries such as automobile to reduce the carbon footprint by replacing fossil fuels with

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electricity is further driving the demand for power.

Policymakers need to ensure equitable distribution of energy supply, decouple carbon emissions from economic growth, rationalize domestic consumption as well as industrial demand, and foster sustainability of power companies. It can be achieved by focusing on the five Ds (democratization, decarbonization, deregulation, decentralization, and digitization).

Democratization

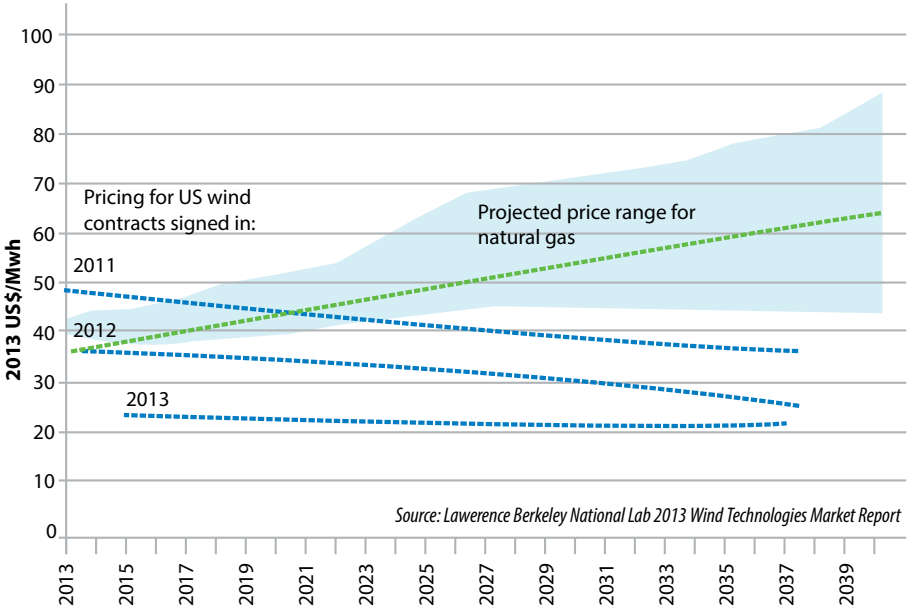
Democratization of energy supply facilitates access to power as well as flexibility to choose the source of power. Sustainable energy boosts economic growth and creates employment in emerging economies. In places with 24x7 power supply, the approach of consumers to renewable energy has changed dramatically over the years. In the formative stages when the price of 'green' power was high, providers offered incentives to consumers to boost demand. But today, consumers in the US, Australia, and Europe are prepared to pay a higher tariff per kilowatt-hour for power from wind turbines and solar farms.

Small-scale or distributed generation is an efficient mechanism to democratize supply across markets. Initially, the cost-effectiveness, flexibility, and scalability of renewable energy were a cause of concern. However, utility-scale wind and solar power projects are now viable due to the sharp decline in the price of solar panels and wind turbines. Additionally, rapid innovation in battery technology to drive consumer level and small-scale storage will further revolutionize this field.

Deutsche Bank expects solar energy to reach grid parity in 80 percent of the global market by 2018. The cost of wind energy is predicted to be below natural-gas-based power in the future (Figure 1). Grid parity with conventional energy sources empowers environment-conscious consumers to reduce their carbon footprint without paying a premium for `green' power.

Wind energy's cost

Recent wind energy prices are **competitive** with expected future cost of burning fuel in **natural gas** plants.



With no fuel cost and zero emissions, wind power provides **clean energy** with long-term, **stable pricing** and serves as a **financial hedge** against fossil fuel price volatility and potential future carbon pricing or regulations.

Figure 1: Cost of wind energy

Decarbonization

Coal-based power plants produce only about 40% of the total energy, but are responsible for more than 65% of carbon emissions. Some power plants have replaced coal with fossil fuel alternatives driven by technological advances in extraction that ensure an abundant supply of oil and gas. Natural gas is a much 'cleaner' source than coal, when methane leakage is circumvented. However, environmentalists warn that the rate of decarbonization needs to be accelerated to achieve the greenhouse gas (GHG) emissions target set by the US and Europe at 80% by 2050.

Further, distributed generation provides affordable and reliable energy, while mitigating carbon emissions and spurring economic growth. Bloomberg New Energy Finance expects global investment in solar installations to increase from the current 2% to 35% by 2040. Countries with rich oil and gas reserves, including Saudi Arabia and the United Arab Emirates, have undertaken programs to improve energy efficiency and reduce GHG emissions significantly.

Along with all this, the power infrastructure needs to be revamped. A majority of the existing power installations will continue to be operational in 2050 while being less productive. Public-private partnerships (PPPs) can better mobilize funds required to transition to a decarbonized energy system. The entrepreneurial skills, project costs, and financial as well as technical risks of large-scale energy projects are best managed by the PPP model.

Deregulation

The energy industry does not provide a level playing field yet. Conventional energy is subsidized in many markets and consumer segments. A conducive policy framework is a prerequisite for clean energy. Government energy policies should foster innovation as well as investment in utility-scale technologies to phase out carbon-intensive production facilities. The potential of solar, offshore and onshore wind, biofuels, marine, and geothermal energy can be realized only with institutional finance as well as regulatory support.

The collapse of two leading solar panel companies – Mark Group and Climate Energy – following a series of subsidy rollbacks in the UK, suggests that the energy sector needs all-around support to realize the 'green energy' vision. Political consensus on reducing GHG emissions to mitigate climate change augurs well for the renewable energy sector. At the United Nations Climate Change Conference in Paris, in December 2015, government and business leaders made a commitment to accelerate energy transformation. Initiatives of the 'Lima-Paris Action Agenda – Focus on Energy' conference will boost energy access and help achieve sustainable development goals by providing a productive and transparent working environment for companies.

The potential of solar, offshore and onshore wind, biofuels, marine, and geothermal energy can be realized only with institutional finance as well as regulatory support.

Simultaneously, initiatives such as the US Clean Power Plan and 'Reforming the Energy Vision' (REV) in New York State address regulatory obstacles and market uncertainties. However, high-level strategies are not sufficient. Global standards to measure and verify real-time energy savings need to be developed. Incentives to encourage replacement of power-guzzling home appliances and industrial equipment with more efficient products are required. Significantly, holistic programs are required to modernize legacy power infrastructures.

Decentralization

The industry has achieved Zero Distance with convergence of the points of generation and consumption. Investment in 'clean' energy sources is growing exponentially (Figure 2). Microgrids and onsite power systems allow enterprises, commercial establishments, and

residential consumers to become self-reliant. More importantly, it reduces overheads and even empowers consumers to sell excess power to the electric grid.

However, the ability to store energy holds the key to decentralization of electric power. Excess energy generated, whether from rooftop solar panels in a home or a wind farm, requires large-scale energy storage systems. At the 2015 Climate Change Conference in Paris, several governments promised to increase research funding for clean energy. Business leaders including Bill Gates and Elon Musk, and agencies such as Advanced Research Projects Agency-Energy (ARPA-E) are building grid-scale batteries that will also reduce the cost of energy storage.

In May 2015, Tesla's wall-mounted Powerwall batteries to store energy from solar panels at home were reported to be sold out within 10 days. The company plans to launch a more efficient version of the battery by August 2016. In a recent announcement, they clearly articulated their focus on the 7 kWh battery which is designed to integrate with solar panels.

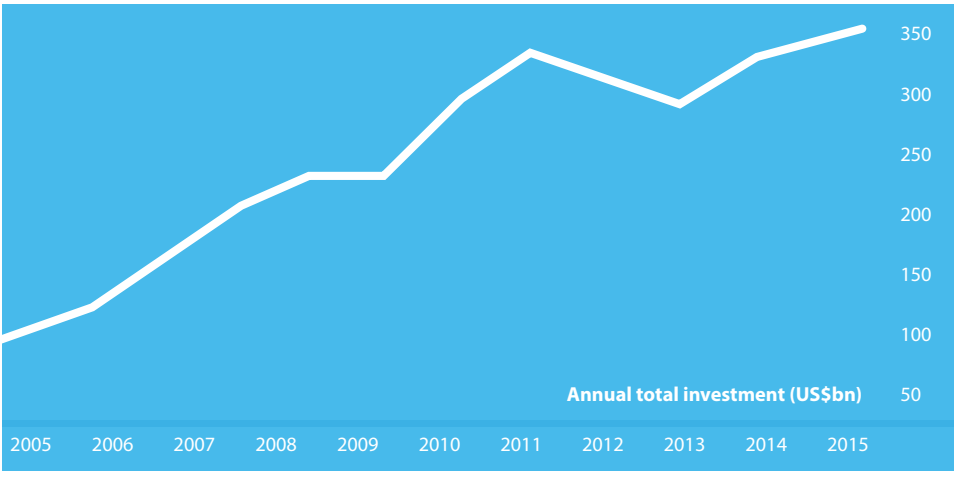


Figure 2: Investment in clean energy

Source: Bloomberg New Energy Finance

Digitization

A 10% reduction in power consumption will reduce carbon emissions by 18% and a 20% reduction in consumption will reduce 48% emissions by 2050, according to Bain & Company. A technological ecosystem can help companies and cities identify energy solutions and ensure the success of energy efficiency initiatives. Further, digital tools and collaboration between stakeholders can drive research and development in achieving an optimal energy mix.

The Internet of Things (IoT) simplifies demand management by integrating diverse points of power consumption. Real-time data from heating, ventilation, and air conditioning (HVAC) systems, industrial equipment, and gadgets help optimize power consumption. For instance, EnerNOC's energy intelligence software helps control electricity consumption in buildings, plants, and production lines. Analytical solutions predict consumption and combine it with weather data to capitalize on renewable sources. Energy management products empower customers to minimize demand and make informed decisions to reduce electricity bills.

Although smart meters and IoT enhance the distribution infrastructure, they increase the risk of data breaches and service blackouts. Security incidents cost the power and utilities industry US$1.2 million in 2014, according to 'The global state of information security survey 2015' by PwC. Advanced security solutions identify vulnerabilities and protect applications, databases, and the network from physical and cyber attacks.

The utility industry needs to be more responsive to the acute energy deficit as well as the preference of the millennial generation for greener energy. The sustainability of utility enterprises will be determined by how smartly they harness, store, and distribute energy.

About the Author

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Ashiss heads Utilities for the Americas at Infosys. Ashiss's areas of interest include application of business intelligence and analytics for process agility and customer loyalty, solutions for grid transformation, and the evolving workforce. He is a keen observer of technology trends and how they impact the energy ecosystem.

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

NATURE IS LIFE – WITH GREEN CHEMISTRY, YOU CAN CHOOSE LIFE

In this article, the Chief Scientist at the Indian Institute of Chemical Technology (IICT) discusses how green chemistry could be the key to reducing environmental footprint of chemical processes, in turn offering a sustainable business approach for the pharmaceutical industry.

Today, life sciences has a pressing imperative – providing effective and affordable medicine. Furthermore, the industry needs a sustainable business approach, since a majority of 'blockbuster' drugs are losing patent protection and returns on R&D spending are shrinking. Pharmaceutical companies invest, on an average, 12 to 15 years and incur a cost of US$2.5 billion to launch a new drug.

Big Pharma has explored several options to address their challenges – internal restructuring, substituting batch processes with flow chemistry, mergers and acquisitions, outsourcing of R&D and manufacturing, and acquisition of experimental drug candidates. Another widely explored option, open source drug discovery, while economically viable, involves issues such as IP rights of discovered molecules. Green chemistry, on the other hand, offers lasting value in terms of lean manufacturing; but it has not been widely adopted.

The pharmaceutical industry generates substantial waste during the synthesis and purification of active pharmaceutical ingredients (APIs) in preclinical and commercial processes. In industrial chemical manufacturing, the E-factor (kilogram waste per kilogram of product manufactured), is the highest in the pharmaceutical industry, ranging from 25 to over 100.

Green chemistry: The context

The pharmaceutical industry generates substantial waste during the synthesis and purification of active pharmaceutical ingredients (APIs) in preclinical and commercial processes. Roger Sheldon, Professor Emeritus of Biocatalysis and Organic Chemistry at the Delft University of Technology, Netherlands, developed the 'E-factor' (kilogram waste per kilogram of product manufactured), a metric to evaluate the environmental footprint of chemical processes. In industrial chemical manufacturing, he found E-factor to be the highest in the pharmaceutical industry, ranging from 25 to over 100. At the other end of the scale, E-factor of the oil refining industry is less than 0.1.

Green practices deliver value across the pharmaceutical value chain. Since chemistry is the lifeline of pharmaceuticals, green chemistry offers a sustainable business approach. The US Environmental Protection Agency (EPA) defines green or sustainable chemistry as, "the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances." In life sciences, green chemistry safeguards the interests of the environment and public health and safety, and furthers the research, discovery, development, and manufacture of medicines.

Safer chemical entities, an urgent need

The 2005 Nobel Prize in Chemistry awarded to Yves Chauvin, Robert H. Grubbs, and Richard R. Schrock provided an impetus for green chemistry. The breakthrough contributions of the scientists in metathesis simplify the synthesis of carbon compounds, which paves the way for more efficient manufacturing of medicines and pharmaceutical products.

The principles of green chemistry can be integrated in the formative phase of drug discovery. It ensures sustainability of products, while addressing public health and environment risks. Pharmaceutical companies and suppliers need to implement, monitor, and measure sustainable chemistry in the manufacture of medicine, whether in batch or continuous production. Regulations should mandate that companies avoid the use of toxic substances, explore the reuse of solvents, and replace hazardous solvents / reagents with biodegradable and energy-efficient alternatives.

Leading universities are sensitizing the life sciences workforce – chemists, biologists, chemical engineers, and drug researchers – about the environment. Harvard University's sustainability plan adopts green chemistry. It proposes to identify hazardous chemicals and eliminate their use on campus. "In our research, and our careers, we must endeavor for a toxicological understanding of the compounds we create and assume the responsibility for determining their ecological fate," says Allen Aloise, FAS Science Director of Graduate Studies at Harvard University. According to Professor Wei Zhang, the Director of the Center for Green Chemistry at the University of Massachusetts, Boston, "Green chemistry is not an independent field but a philosophy that will be a non-separable part of chemistry."

Cleaner solvents, a must

Aqueous effluents and stoichiometric oxidants and reductants, such as $KMnO_4$, MnO_2, $LiAlH_4$, and Zn are the major sources of waste in pharmaceutical processes. Stoichiometric oxidants can be substituted with catalysts to increase process efficiency. Biocatalysis and heterogeneous catalysis production processes ensure higher conversion and yield in reactions. In addition, they realize sustainability through 'lean' manufacturing - optimizing resource consumption, minimizing waste generation, decreasing greenhouse gas emissions, and improving product quality.

Solvents used in organic synthesis play a critical role in making a reaction homogeneous and in allowing molecular interactions to be more efficient. However, the environmental impact of several solvents is a cause of concern. Ionic liquids are an alternative, but the preparation of ionic liquids is tedious. Moreover, the jury is still out on the environmental safety of ionic bonds.

The Indian Institute of Chemical Technology has undertaken extensive research to identify liquid polymers and low melting polymers to replace hazardous solvents such as benzene (carcinogen) and chlorinated solvents (ozone

depleting agents). The Institute has identified eco-friendly solvents, including supercritical carbon dioxide and Polyethylene Glycol (PEG) for industrial application. PEG, which has a low molecular weight (2,000 or lower), is an efficient reaction medium for Pd-catalyzed C-C bond formation. Organic transformation with PEG is rapid and high-yielding. It is superior to conventional solvents and ionic liquid media since reactions take place easily with electron-deficient and electron-rich olefins, and high region and stereo-selectivities.

The green movement

Green chemistry helps Big Pharma improve process efficiency. Janssen, the pharma arm of Johnson & Johnson, anticipates tangible value from green practices. It can reduce raw material requirement by 67%, water consumption by 75%, and hazardous waste generation by 87%, according to Philip Dahlin, Director of Sustainability at Janssen, in the FT Health Report June 2014.

A multidisciplinary approach vastly improves research outcomes and facilitates repurposing of existing drugs. A stellar example is the use of anti-inflammatory drug, aspirin, to manage cardiac disease.

Pfizer is at the forefront of green pharma. The Pfizer solvent guide helps researchers and chemists select solvents for medicinal chemistry based on diverse sustainability criteria. The company's green chemistry and biotechnology program guides the creation of a portfolio of green compounds as well as the adoption of green practices in production processes.

Pfizer, Merck & Co., and Bristol-Myers Squibb have been recognized with the annual US EPA Presidential Green Chemistry Award for implementing environment-friendly drug development and manufacturing processes. GlaxoSmithKline uses an eco-design toolkit for sustainable operations. The toolkit has five modules to help chemists, researchers, and process engineers adopt green chemistry, select sustainable solvents and reagents, and also gain a better understanding of hazardous substances.

The American Chemical Society Green Chemistry Institute (ACS GCI) Pharmaceutical Roundtable seeks to promote green chemistry and engineering among companies involved in R&D and manufacture of APIs and medicinal products. Participating members include industry leaders like – Eli Lilly and Company, AstraZeneca, Merck, F. Hoffmann-La Roche Ltd., Johnson & Johnson, Dr. Reddy's Laboratories, and Pfizer.

Software for sustainability

Cross-disciplinary collaboration is a prerequisite for process and product innovation in the life sciences. Scientists, product specialists, process engineers, and sustainability officers need visibility across the enterprise – research initiatives, procurement and production processes, and packaging.

Software tools integrate green chemistry with pharmaceutical applications, while enabling real-time sharing of information between stakeholders, including suppliers, contract manufacturers, and research organizations. IT systems boost productivity of the research organization and rationalize the cost of drug discovery by eliminating errors and superfluous research / processes.

Research scientists at Pfizer Global Research and Development use a web solution developed by Infosys on the Microsoft .NET Framework 3.0 and Windows Presentation Foundation to store and share knowledge. The application allows researchers to present research findings in 3-D images and graphs, and search databases containing millions of records for specific details such as results of an experiment or the chemical name of compounds.

Interactive dashboards with visualization tools help identify areas where adequate research has not been undertaken. Collaboration tools and unified repositories enable biologists, chemists, and discovery scientists working in diverse therapeutic areas to build hypotheses in real-time, analyze results, eliminate ineffective drug candidates in early stages, and discover hidden connections between

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different experiments across time spans. A multidisciplinary approach vastly improves research outcomes and facilitates repurposing of existing drugs. A stellar example is the use of anti-inflammatory drug, aspirin, to manage cardiac disease.

Molecular modeling and in silico screening accelerate drug discovery. Continuous monitoring of ambient temperature and pressure increases energy efficiency of chemical reactions. Significantly, in-process monitoring minimizes the formation of byproducts. Pharma companies should use tools to assess the environment, health, and safety footprint of their ecosystem.

Sustainable life sciences requires more than environment-conscious pharmaceutical engineers and technologists. We need to encourage green chemistry across the supply chain and practice sustainability at a molecular level.

About the Author

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Dr. Srivari Chandrasekhar received his B.Sc. (1982), M.Sc. (1985), and Ph.D. (1991) degrees from Osmania University, and pursued post-doctoral research at the UT Southwestern Medical Center, Dallas, USA, with Prof. J. R. Falck. As a Humboldt Fellow at the University of Göttingen, he worked on the synthesis of hybrid natural products with Prof. L. F. Tietze.

Dr. Chandrasekhar was instrumental in setting up the state-of-the-art Molbank facility at the IICT for the storage and retrieval of chemical samples for HT screening.

He has over 240 publications in national and international journals. He won the Infosys Prize 2014 in Physical Sciences for his diverse and notable contributions in synthetic organic chemistry with special focus on the synthesis of complex molecules from natural sources. He has devised innovative, practical approaches to pharmaceuticals of current interest to industry.

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GAME, SET, AND MATCH – DATA

Over the past few years, analytics have been contributing to the growth and popularity of tennis. In this article, the leader of IT and Digital Media at ATP discusses how this rapidly evolving field is transforming tennis for all stakeholders – players, organizers, and aficionados.

In the annals of tennis history, the 1980 men's Wimbledon final occupies pride of place. John McEnroe matched wits with Björn Borg. The match was a character study in contrasts. McEnroe, 21 years old, was making his first appearance at a Wimbledon final. Borg, 24, was the defending champion, having won the title for four years in a row. On one side, McEnroe, the fiery New Yorker, was known for his aggressive serve-and-volley game. While on the other, Borg, the cool Swede, wore down opponents with his passive-aggressive baseline game.

Borg led two sets to one. In the fourth set, McEnroe pulled it back with an astonishing 18-16 tiebreak, during which he saved seven match points. In the fifth set, McEnroe won the first two points on Borg's serve. Borg fought back and took the next 19 points. He abandoned his baseline game. Borg served hard at corners, rushed to the net, and volleyed. One statistic summed up Borg's change in strategy – he faulted only six of 31 first serves, which proved decisive in winning his fifth straight Wimbledon.

Every time the ball pings back and forth across the tennis net and a point is won or lost, it is recorded by the match umpire on a tablet device. Just as a player times his advance to the net, similarly today, cloud, big data, analytics, and mobile technologies complement each other, ensuring that the action on court is stored, used, and repurposed for the future.

The epic 1980 Wimbledon final riveted the attention of thousands of courtside spectators and millions on live TV and radio, notably Nelson Mandela in a prison on Robben Island. Today, the ATP World Tour is followed by a legion of fans at home, on-the-go, and at work. The drama of every point during a tennis match is broadcast over the airwaves in real time to the farthest corners of the globe. It showcases a sport in which players – who could easily be mistaken for students of Pythagoras – work angles, unleash top spin, and alternate between forecourt and baseline play.

Every time the ball pings back and forth across the tennis net and a point is won or lost, it is recorded by the match umpire on a tablet device. Just as a player times his advance to the net, similarly today, cloud, big data, analytics, and mobile technologies complement each other, ensuring that the action on court is stored, used, and repurposed for the future. Data is relayed to the scoreboard system, the broadcasters, and media channels in real time. Significantly, each detail or outcome is a data point that helps players better understand their game, identify their strengths and weaknesses, and even analyze the strategy of their opponents. The treasure trove of data harnessed from matches provides fans with an immersive experience. In effect, match data uncovers fascinating possibilities for players, fans, and broadcasters alike.

Game: Data helps players raise their game

"He served better in the fifth than he might have in the whole match," said McEnroe in 'Fire & Ice,' an HBO documentary on the 1980 Wimbledon final. Borg changed tactics and rushed repeatedly to the net to take McEnroe by surprise. Tennis professionals now have the benefit of analyzing match statistics to understand nuances of the game. For instance, at the Barclays ATP World Tour Finals, London, in November 2015, we found new correlations between the top-spin that certain players were generating and their win-rates

Data is adding a new dimension to the game. While fitness, athleticism, and innate skill remain at the heart of the sport, insights from historical match data may well tip the scales in tennis. Coaches can mine historical player data to understand correlations between tactics and outcomes. It can lead to shifts across the board in match strategy against specific opponents, a deeper understanding of a player's game to avoid repetitive strain injury, circadian rhythm before matches, variations in diet, and so forth.

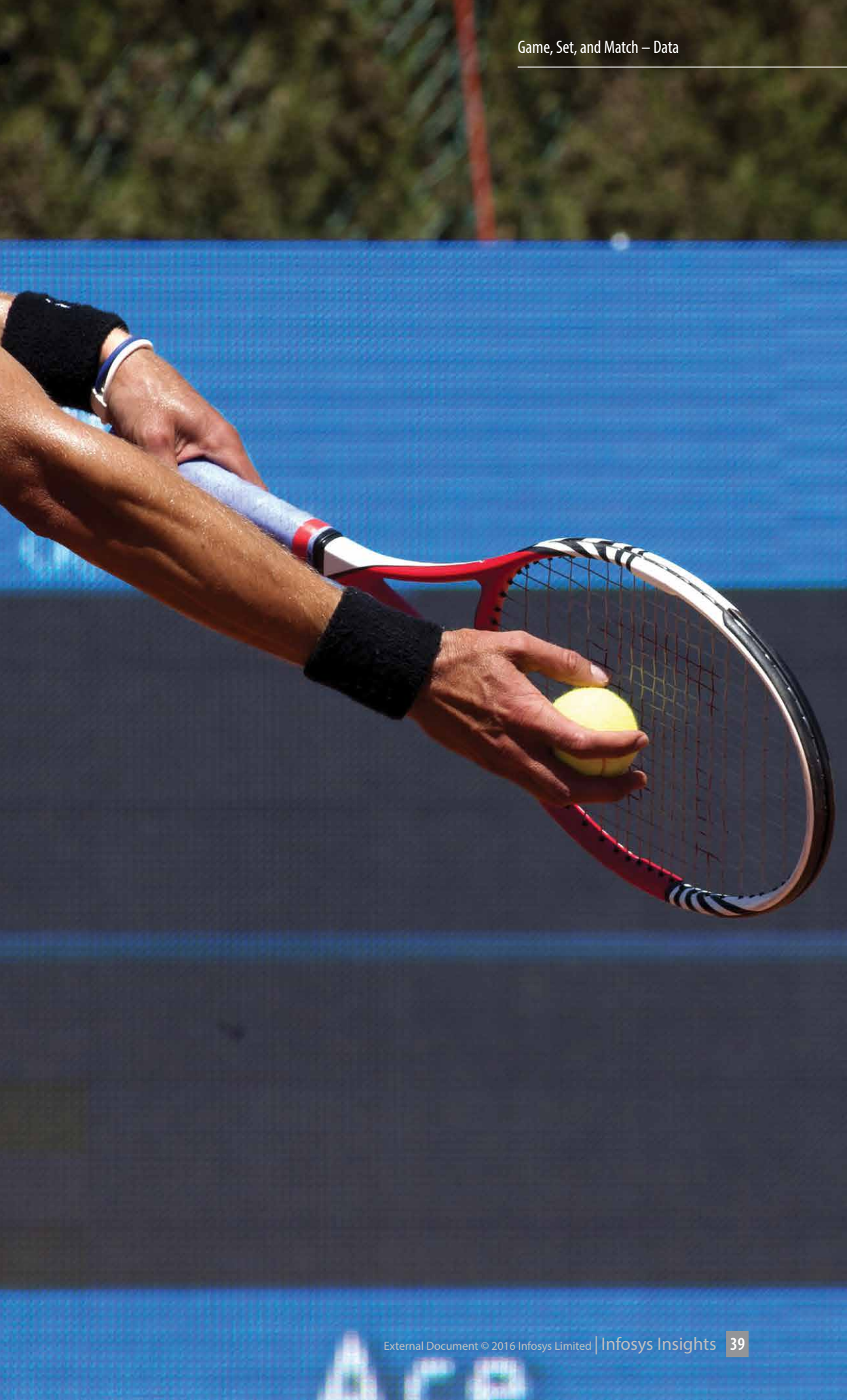
Set: Data resets fan expectations

Tennis, more than any other sport, lends itself to data amplifying the dynamics of a game. The unique character and structure of the sport, the diversity of court surfaces, and playing styles of elite players make fans follow the game. Data adds to the stickiness quotient with player comparisons, insights into player strengths on different surfaces, and endurance over five-set matches. Data helps tennis engage more intimately with the millennial generation. It brims with interesting possibilities – in-the-moment insights are fast finding a place along with post-match analysis. With access to historical data during a match, on a video streaming app, millennials will be able to amplify such insights by sharing thoughts and predictions on social media and offering sharp analysis worthy of pundits.

Speaking of which, data analytics also provides commentators with granular insights on live TV, keeping millions of viewers glued during a high octane match. Nuggets of wisdom and quirky anecdotes of commentators contribute to tennis classics being part of tennis folklore. A case in point is Brad Gilbert, former tennis player and ace tennis commentator today. 'BG' is popular for his perspective on what players are thinking as much as his game plan catchphrases, "give 'em the fearhand!" and "bach-hand."

Match: Data retains the aura of tennis

The ATP has a rich repository of match data going back to the 1990s. It offers context and shares hidden patterns that allow players to take crucial decisions before, during, and after each match. From a fan standpoint, data provides the tennis community with a 'long tail' of information, which helps fans interact with each other and connect with iconic players. Data that captures every ball pinging across the net and each ball hitting chalk on tennis courts increases the engagement and magnifies the appeal of tennis.



Of course, data cannot be the be-all and end-all to determine player performance and outcomes in tennis. Intrinsic factors such as match day fitness, mental approach, stamina, and endurance have an important bearing on the final outcome. All factors being equal, data can uncover subtle points, which can influence the trajectory of a match at the highest levels of tennis. While modern players can benefit from rich data visualization, tennis history could have been rewritten if data supported a player's strategy. Borg might have won one of the four US Open finals he played, if he had access to useful data.

At one level, the game of tennis is a purist's delight with two players striving to outwit each other across the net. At another level, tennis is a fascinating subject for a classical mathematician unveiling interesting formulas every time a point is won or lost. In the not too distant future, we could witness a tennis champion thanking his data scientist in addition to his entourage and coach in his acceptance speech after a final. It may well be the ultimate compliment, and a smashing one, to the science of data.

Infosys is the Global Technology Partner of ATP World Tour, leveraging mobility, cloud, and analytics to transform the experience of tennis fans and players the world over.

About the Author

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Murray is a Senior Executive with the Association of Tennis Professionals. His technology background includes extensive experience in big data, along with real-time and enterprise systems in the entertainment, transportation, hospitality, and retail industries, including building a real-time scoring system for tennis to track hundreds of millions of data points on a global basis.

Murray has provided strategic analysis and pragmatic advice to boards, executives, and managers on topics such as strategic planning, organizational effectiveness, and best methods to leverage technology to their strategic and commercial advantage.

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PERFORMANCE, SCHEDULE, COST CONUNDRUM IN LARGE COMMERCIAL AIRCRAFT DESIGN

Many events and concerns have shaped the large commercial aircraft industry – from deregulation in the US in the late 1970s, to the more recent strengthening of the dollar against the euro. What are the biggest concerns for the industry today and how can these be addressed? The CTO of Spirit AeroSystems, Inc. provides the answers.

Like most industries, the large commercial aircraft industry has undergone major transformations in the last hundred years that it has been around. But the past 35 years have been significant, throwing up many tough challenges for players in the industry. Consider these: A significant player in the past, Lockheed, is nowhere to be found today in this market. An upstart conglomerate, Airbus, came from nowhere in the late 1970s and has today become a primary air transport manufacturer. Boeing, meanwhile, absorbed its former chief competitor, McDonnell Douglas, in a merger in 1997. More recently, challengers from Brazil, Canada, Japan, China, and Russia are gaining traction in the smaller single-aisle airplane marketplace. These examples raise an important question – what issues have caused these radical changes?

The list is long. The US deregulation in the late 1970s caused severe price competition. Access to slots (gate positions) at airports became limited and as global economic cycles waxed and waned, travel did the same since it is strongly tied to the Gross Domestic

The most important early decisions are around getting the airplane 'correct' for its market segment. Performance rules early on. How many seats? How much range? What is the weight? What are the aerodynamics and controls needed to make all these synchronize around a design?

Product (GDP). Travel was also intensely affected regionally by the events of 9/11 and Severe Acute Respiratory Syndrome (SARS). Even though those were one-time events, they had a long-lasting effect on travel. The price of fuel has also been a significant challenge for aircraft designers. The cost of fuel skyrocketed as a barrel of oil went from US$10 to US$50, and later US$140, now back to US$30. The volatility in oil prices makes it difficult to set fuel burn requirements for an airplane five years in the future. Recently, the strengthening of the dollar against the euro has become important as well, since most airplane contracts are in US dollars. In contrast, most labor and material costs are in the local currency where products and parts are built.

Bigger concerns: New technology and long design cycle time

While all these challenges are daunting, I consider long design cycle time and the propensity for new technology to have more greatly hindered the ability to quickly and reliably bring to market next-generation commercial airplanes.

Many are familiar with the stories and legends of the 1930s and 1940s according to which airplanes were designed, built, and flown in a matter of two years. For instance, the B-26 went from a paper concept to being operational in two years. Martin submitted its design in July 1939, flew the airplane in November 1940, and began deliveries to the US Army Air Corps in February 1941, eventually producing over 5,000 B-26 bombers. The B-17 Flying Fortress had a similar timeline, progressing from specification to prototype fly-off in a single year.

War time focus, energy, and requirements are not the same as for a 20-year commercial airliner. It would be facetious to claim that such a timeline could work today in commercial aircraft. However, the duration to design, certify, and put an airplane into service has steadily grown. According to Aviation Week Intelligence Network, the DC-9 had only 205 days between first flight and delivery. The 777 first flew in June 1994 and was delivered in June 1995. Many of the most recently developed airplanes have taken over 550 days between their first flight and delivery to an airline. The Concorde had more than 2,400 days between its first flight and first delivery. It is likely that the new technology needed to fly faster than the speed of sound in a commercial airplane, caused the long development time.

The performance, schedule, and cost conundrum

The driving requirements today are much different. Air travel is becoming a commodity as are the airplanes that carry us. Passengers care about safety, while getting from point A to point B, and most choose flights by price. The airlines want as many seats as is practical with the appropriate range to travel between the most desired city pairs.

Why don't airplane builders work on the cost of their products early in a program? Early in my career, I had a chief designer who had three cards pinned to his office wall. He arranged them in top to bottom order in terms of current importance. At the beginning of a program, the cards read performance, schedule, and cost – in that order. Sometimes during the program, they would switch order, but cost was always last. Cost consideration must be a priority but it should not become the compromise point for designers.

The most important early decisions are around getting the airplane 'correct' for its market segment. Performance rules early on. How many seats? How much range? What is the weight? What are the aerodynamics and controls needed to make all these synchronize around a design? Secondly, the schedule becomes a key. The many gargantuan tasks include engineering, planning, build, system design and testing, ground and flight testing, and certification. Generally, the engine manufacturer will be running a parallel track program to certify the engine one year before the airplane so it will be ready for its first flight.

Much money is invested at this stage of the program. Nonrecurring costs such as engineering, tooling, factory buildings, and equipment are committed and plans implemented. Large bets are made on which technology can be ready in time for production and how much it will save in recurring cost when production is at maximum rates. Other recurring costs include

direct hand labor, support labor, purchased parts, overheads, and depreciation.

In Dr. Leland M. Nicolai's book, *Fundamentals of Aircraft Design* (1975), he points out two critical items:

1) The majority of the aircraft life cycle costs (around 90 percent) are cemented in the first two years of design
2) The selection of new technologies that are not mature can cause costs to skyrocket

Dr. Nicolai closes with a note about the "painful compromise a designer must make between performance and cost."

The feasibility and viability imperative

The solution appears to be self-evident: Create the business case for new features and technology and do not include a feature or a new technology just because it is the 'next big thing.' Ensure that what is desirable is not only feasible from an engineering perspective but also viable economically. Determine the target cost and ensure that the target cost is met on each of the subsystems of the product.

Seems easy enough. Some industries, indeed, tend to do this better than others. Automobile manufacturers have target costs allocated down to the subsystem level. A designer keeps working until the design meets all three requirements. The margin for cars is much smaller. Imagine being US$300 high on a US$15,000 car. If a model price point is missed, that car will be a failure.

Even within the commercial aircraft industry, engineers encounter such dichotomies every day in solving problems of functionality versus manufacturability, or strength versus weight, and they succeed in designing and building a marketable product. Why then, in such an acutely cost-conscious market, do we still have aircraft programs that result in products that cost more than what the customers are willing to pay?

Almost every large aircraft program is plagued with the high production cost problem. Predictably, product launches are followed by months, and sometimes years, of effort to optimize the cost by modifying the designs, manufacturing process, or the supply chain until the product becomes viable. So much so that engineers have accepted this as the norm. They make decisions by prioritizing performance and schedules and are resigned to the fact that they will address the `cost issue' when they get to the `cost reduction phase' of the program. While this prevalent practice often helps meet the cost targets eventually, it is a highly suboptimal process with a lot of cost reduction opportunities left on the table.

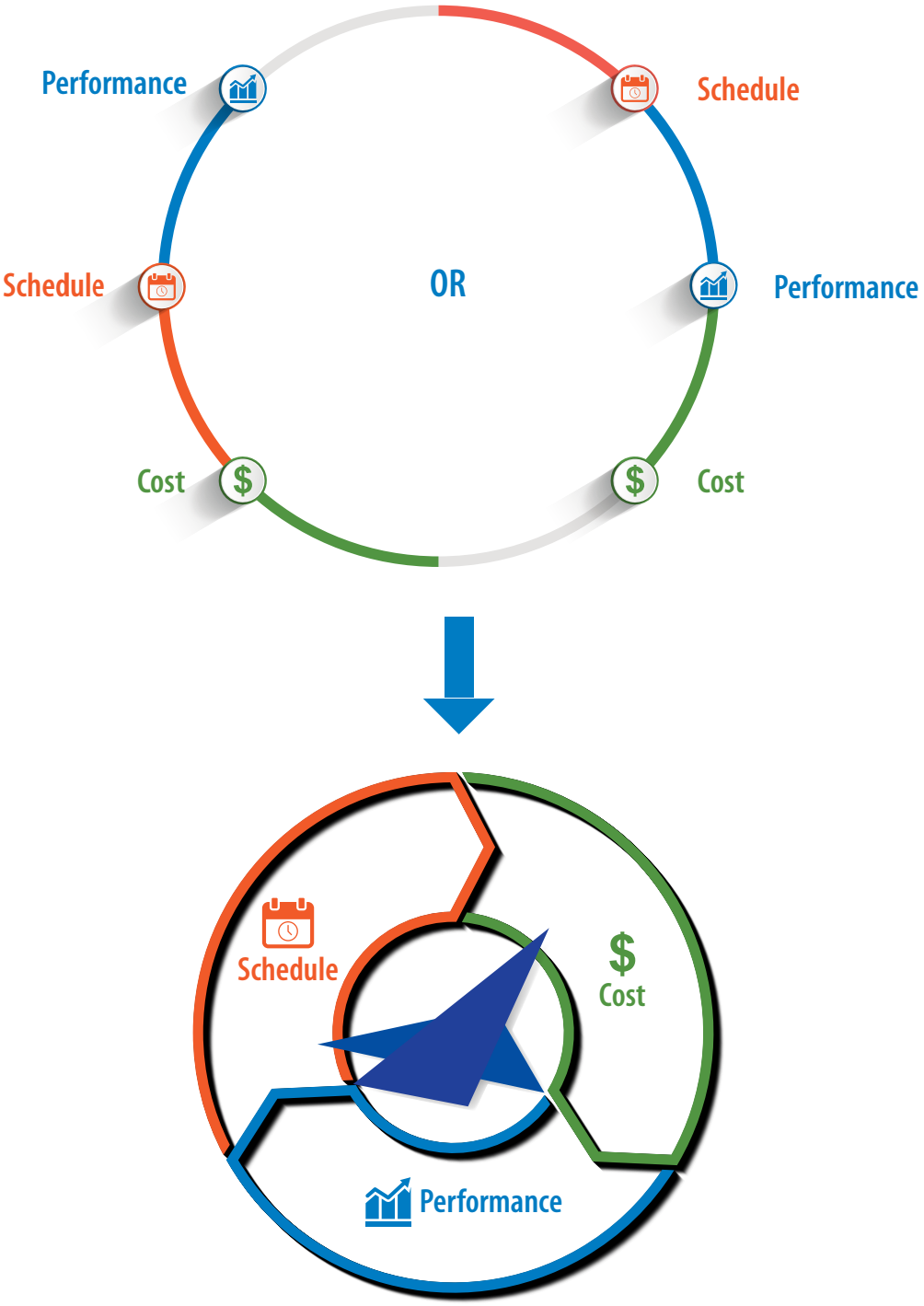
The post facto design space is rather severely constrained for the engineer. Most of the designs are frozen and render themselves 'untouchable' due to high collateral impacts. The supplier base is identified and contracts are frozen, and significant investments are made in manufacturing tools and fixtures. For every cost savings opportunity identified, you can't implement three others because you no longer have the business case to make the changes.

After every such cycle, for everyone concerned, it is always – "give us one more chance and we won't mess up this time." But the cycle seems to repeat itself despite everyone's best efforts.

In trying to architect a solution for this problem, I kept going back to the three cards of performance, schedule, and cost.

How do I stack these cards so that my engineers don't have to choose one over the other, but rather achieve all the three objectives simultaneously?

How does one go about changing the DNA of the organization to concede equal priority to cost?



In answering these questions, we looked at the existing models of concurrent engineering and development within the aircraft industry. For example, most improved cost design ideas tend to increase weight. But over the years, the industry has built a strong process and a working model to set weight targets, monitor weights with each step of the design evolution, and consistently achieve such aggressive weight targets. Similar challenges exist when it comes to designing for strength, produce-ability, and sustainability. Each day, these challenges are overcome through communication, feedback, and exchange of ideas within an integrated function team construct.

The solution is to base the design-to-cost working model on the same lines of the integrated functional teams:

- Provide equal standing for the cost engineer as other functional groups
- Strengthen his / her role by enabling signature authority for the cost engineer
- Enable the design engineering community on design-to-cost best practices and empower them with the right tools and training
- Make some considerable investments in this area and augment that with consistent messaging from the leadership team

Commercial aviation has not only endured, but flourished in the past 100 years, despite challenges. Design-to-cost is just another hurdle that can be conquered with an integrated, prioritized approach.

About the Author

John A. Pilla
Senior Vice President of Engineering and Chief Technology Officer of Spirit AeroSystems, Inc.

In his role, John has responsibility for engineering and R&D across all programs, and also leads Spirit's IT organization. Prior to this assignment, he served as senior vice president and general manager of Airbus Programs, and SVP / GM of Propulsion Aerostructures at Spirit.

John graduated in 1981 from the University of Kansas with a degree in aerospace engineering. His career at Boeing Wichita began as a stress analyst in 1981. He worked on Nacelle Programs, company IRAD, and the A-6 Replacement Wing. He completed a master's degree in aerospace structures in 1986. In 1997, John led next-generation 737 engineering programs, including the development of the 737-900 fuselage and empennage. In 2000, he led the Define Team on the 777LR airplane, and in 2001, he became the director of business operation. In the spring of 2002, he graduated from Wichita State University with a Master of Business Administration degree. In 2003, he became the director of product definition and manufacturing of the new Boeing 787 program. At the time of the divestiture of Boeing Commercial Airplanes Wichita Division in June 2005, he became vice president / general manager – 787. In 2008, he served as chief technology officer.

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DIGITAL'S NEXT STOP – FARMING

Digital technologies are beginning to transform farming, and hold the potential to resolve the growing food demand – by maximizing yield and minimizing resources and waste.

Just yesterday, within weeks of the start of the North American planting season, Indiana farmer Trent Boyd was installing field tiles. To those unfamiliar with farming, field tiles are a network of black pipes laid about 30 inches below the soil's surface, and, depending on the farmer's preference and the crop, about 40 feet apart. They run laterally until they meet a larger drainage pipe or ditch, similar to a household drain operating on a massive scale. Farmers like to joke that water never, ever runs uphill. The laying of field tiles is an example of the many important tasks a farmer must accomplish before the spring planting; from that point until harvest, the focus turns to coaxing maximum yield from the crops while optimizing the inputs.

Proper drainage and irrigation is one element of farming that can tip the scales between feast and famine. We humans should know – people have been farming for many thousands of years. And for the bulk of that period, calculating the right field grade and slope was an intricate and important part of the process. One of the proudest

Food is probably the most basic and essential necessity of life on this planet. Yet even today, a significant percentage of the world's population does not have enough food to eat. With the world's population projected to reach nine billion by 2050, it's no wonder that the technological transformation currently affecting farming can have far more enduring effects than another social media app.

accomplishments for men of the 18th century enlightenment, like George Washington, was to become a land surveyor.

Until about a decade ago, it was not uncommon for farmers to prepare their fields like they did in Washington's day; spending hours per acre using surveying tools and making complex calculations in paper notebooks regarding the layout of the land. Yesterday, Mr. Boyd, a partner at Boyd Grain Farms in southwestern Indiana, hopped into his tractor, and using a digital GPS system that relayed information back to a base station, determined the grade and slope of every square inch of a 40-acre field and simultaneously, laid the field tile. What used to take weeks is now completed in a couple of hours.

Undoubtedly, the digitally powered human revolution sweeping the globe is on full display in the Silicon Valley. But there are other valleys – consisting of millions of acres of farmland – that have been quietly powering the human revolution just as profoundly as anything to come out of the Silicon version. Food is probably the most basic and essential necessity of life on this planet. Yet even today, a significant percentage of the world's population does not have enough food to eat. With the world's population projected to reach 9 billion by 2050, it's no wonder that the technological transformation currently affecting farming can have far more enduring effects than another social media app.

Farmers are using technology to grow more crops using less acreage, water, fertilizer, and fuel than at any time in history. They're empowered by advances in digital surveying systems like the one Mr. Boyd uses, and also by gigantic leaps in how seeds are developed to withstand unexpected changes in the climate. They're designing pest-resistant crops, which means farmers will no longer have to spray chemicals over large swathes of land and hope that the pesticide sticks to the plant and isn't part of the run-off into a local water supply instead.

Beyond Silicon Valley, other technology companies are also changing the world in ways that are just as powerful. Dozens of companies are developing products that improve crop and animal health, boost the nutritional value of farm products, and make farming more productive and efficient. These enterprises are dedicated to taking on global problems worth solving.

I come from a long line of farmers and still help my family manage land in southwest Indiana, some that we've harvested for generations. Although I've spent my career at technologically savvy digital corporations, I always look forward to each opportunity to return to my family's farm. In fact, the world of high-tech shares characteristics with today's farming: the basic mandates of a modern company include maximizing yield while minimizing waste and inefficiencies, reducing our carbon footprint, and designing and marketing products and services that help improve the human condition. In essence, accomplishing more with fewer resources for more consumers.

Along the way, the organizations I work with as clients of Infosys, want to leverage technology to give their customers or constituents more power and choice, as well as to give their employees more options when it comes to navigating the marketplace. Everything I've just described is equally true for the rapidly digitizing farm of today.

Seed research

My cousin, Mike Kavanaugh, is the Product and Agronomy Manager at a seed corn company called AgriGold Hybrids. With a Master's degree in soil and crop science from Purdue University, his specialty is to push the boundaries of agricultural science – and that means using technology to mitigate risk in the field. To a farmer, risk runs the gamut of things such as pests, disease, climate, crop characteristics, and probably the riskiest of all, time. These are elements of farming over which, until recently, a farmer had little control.

With the advent of biostatistical analysis, however, scientists can establish the characteristics of various strains of seeds in the laboratory long before they hit the soil. The result is that agricultural experts like my cousin can choose the finest seeds that eliminate guesswork and save precious time during the growing season. By the time those seeds are planted, farmers have a clear understanding about how they will perform

Beyond Silicon Valley, other technology companies are also changing the world in ways that are just as powerful. Dozens of companies are developing products that improve crop and animal health, boost the nutritional value of farm products, and make farming more productive and efficient. These enterprises are dedicated to taking on global problems worth solving.

under a wide array of conditions. Moreover, genetic improvements to seeds allow farmers to focus on high-yield crops that have the most nutritional benefits for the end consumer.

Maximizing crop yield

Seed research is only the beginning of how farmers are solving a worldwide problem. There is also a digitally enabled process known as 'variable rate seeding' that uses data such as soil analysis to know not only which types of crops will grow optimally in what part of a farm, but also how many seeds to plant per acre. In the recent past, farmers would have to wait until the harvest season to evaluate which crops grew better in certain sections of the field and institute their planting regimens for the next growing season. Now, time is on the farmer's side. They can use digital sensors and monitors to solve yield-limiting mysteries in the field while these are happening. Real-time analytics has saved millions of dollars' worth of crops.

A digitally enabled process known as variable rate seeding that uses data such as soil analysis to know not only which types of crops will grow optimally in what part of a farm but also how many seeds to plant per acre.

Near exactness with Global Positioning System (GPS) technology has improved accuracy of soil sampling. This in turn has enabled variable rate fertilizer applications to optimize the yield environment of specific fields, creating better fertilizer efficiency and timeliness. In 2015, AgriGold research in the US Corn Belt showed over 5 bushels per acre increase compared to field check strips, when digitally changing the population of seed on the go, within a field.

Minimizing resources and waste

The assets and inputs needed to make a farm as efficient as possible are expensive parts of the equation. Whether it's a tractor, bailing turbine, or other mechanized equipment that run on fossil fuels, or varieties of fertilizer that help crops get the most from a growing season, digital farmers are leveraging tools that help them use less and yet reap more. For instance, digital tools have created programs of multi-hybrid seeding where a farmer can plant one or more hybrids or varieties in one geographical area.

The point is that hybrids can thrive in more than one environment; so the farmer can use overly wet areas of the field and, on the other end of the scale, drought-prone areas of the same field to plant a combination of hybrids or varieties of the same crop. The hybrid that can thrive in a water-logged environment would shut down when its seeds got to the drought-prone area. But within feet, if not inches, the other hybrid would pick up and thrive in that area. Not to waste even an acre, the `in-between' areas are where both crops would conceivably thrive. Digital monitors relay data back to the farmer, who then knows when and where to plant seeds more likely to thrive in that soil. In 2015 AgriGold research in western Iowa showed a 7.8 bushel per acre advantage when changing hybrids on the go, while using a 24-rope hybrid planter.

The digital journey that has transformed the farming industry has many benefits. Farmers now have the capability to understand the climate before they even plant a crop. That's the future. My cousin likes to say that the world of digital farming is just now dipping its toe into the water. Of the many benefits and changes that digitization has brought to the practice of farming, arguably, the most significant one is that farming has become a forward-looking industry. Everything about farming used to depend on evaluating last year's crop, weather, and soil to make decisions as to how to prepare for the next growing season. That means that for tens of thousands of years, farmers relied upon past data with little visibility into the future. Now farmers can analyze a weather trend in real time or study the characteristics of a seed and its potential performance long before it is planted.

A verdant, bright future ahead

The possibilities for Planet Earth are tremendous. It starts with grassroots innovation in some of the remotest farms on earth – places that don't yet have access to a computer. But what they do have is ingenuity and innovative thinking. Take the story of Pandharinath More, a resident of Maharasthra, India, who demonstrates that grassroots innovation remains alive and well. Pandharinath is a 66-year-old farmer who anticipates the arrival of the Internet of Things. Every year, he makes the bulk of his income during the precious couple of months between November and January when he cultivates onions. It's the only time of the year this cash crop will grow; so a farmer like him wants to achieve the longest season possible

The problem Pandharinath faced was how best to plant seedlings at the beginning of each growing season. It's the most labor-intensive part of the two-month process. So he got to work creating an onion transplanter. It took him 43 days to invent and build a piece of farm machinery at a whopping total cost of US$725. This tractor-drawn implement can simultaneously perform three functions – transplanting onions, applying fertilizer, and making equally spaced irrigation channels. Pandharinath's invention has made being an onion farmer in India a far more lucrative pursuit than it was even a year earlier.

Another inspirational story of agricultural innovation comes from the Hussain brothers in the Darrang district of Assam, India. Mohammed and Mushtaq Hussain are rice farmers who became fed up with frequent power outages that interrupted their water pumps. Rice paddies fail pretty quickly without lots of irrigated water. Sure, you can turn to diesel pumps if the electricity is spotty in your area. But diesel fuel is expensive and a drain on resources. After watching a kite fly high into the sky from a gust of wind, the Hussains got the idea to assemble a windmill that could power their irrigation pump.

They searched for building materials that were abundant, cheap, and strong. Their prototype was a combination of bamboo, polypropylene, iron rods, and rubber from old

tires. The rotation of the windmill cranks the handle up and down, creating a continuous flow of water for their farm. They built their prototype in only four days, and the final product cost less than US$70 – 90 percent less than commercially available models! Better still is that they can dismantle the entire structure in under an hour and carry it to another field or even another farm if needed. This innovative story is well-known in the farming community because of the low-cost, high-value application of technology to improve the human condition.

The investment community has taken notice; venture capitalists are taking a strong interest in the ancient industry of farming. Monsanto made news when it bought weather big data company Climate Corporation in 2013 for US$1 billion, creating a large payout for its investors. Last year, a group known as the Farmers Business Network, received a US$15 million investment round led by Google Ventures. Their goal is for their team of rural data scientists from around the American Midwest to make agricultural data more accessible. The more farmers know about what crops are doing well and under what conditions, the more chances they have to improve yields.

Another venture capitalist firm, Kleiner, Perkins, Caufield and Byers, has funded a group that claims to have aggregated data on the performance of seven million acres of farmland across 17 American states. The database also includes information on more than 500 seed varieties and crops such as alfalfa, corn, wheat, and soybeans. None of this widespread sharing of highly detailed knowledge would be possible without big data and its underlying technologies.

Using real-time and predictive analytics, as well as big data pertaining to crops, seeds, weather, and soil, humans have the opportunity to improve productivity for land all over the world. From Indiana to India, think how much more productive these farmers will become as they become fully connected to the Internet of Things. The endgame is that as the population of the planet continues to increase, agriculture will keep pace, and no one will go hungry. That's a problem not only worth solving, but it's one that's being solved today by farmers around the world who are embracing new technologies that are revolutionizing their industry.

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THE METAMORPHOSIS OF THE CIO

'Tell me what your business wants and we will find a technology innovation.' As implausible as it may have sounded a few years ago, this really is the top priority of the modern CIO. The writing on the wall is clear – active CIO involvement in business is the only way to prepare enterprises for the future.

Profound transformations don't happen overnight. Just ask a Chief Information Officer (CIO) of any global enterprise who's been in the position for about a decade. I choose 10 years because that's roughly the amount of time we've witnessed it takes for a complete metamorphosis of the CIO's role in digitally directed enterprises.

Today, large enterprises spend, on an average, a quarter of their marketing budget on the digital medium. This amount is expected to increase to 75 percent in the next five years. As such, CIOs are more than simply technology-minded executives who 'keep the lights on' and oversee large enterprise resource planning (ERP) projects. The most progressive global enterprises now know that the CIO is perhaps the most important C-suite executive, other than the CEO himself. That's a bold statement, to say the least. So you're probably thinking to yourself: Just what is the job description of this modern CIO? Should he have business skills or technology skills? Should he be internally focused or externally focused?

Becoming a transformative CIO is not about being perfect. It is about achieving business outcomes. To be successful with innovation in mind, one has to be what I refer to as ***`DATE' — Different, Agile, Tolerant, and Enthusiastic.***

The modern CIO

Today, the marketplace has begun to change, and with it, some forward-looking enterprises too. CIOs of these enterprises have moved closer to their enterprise strategy to drive efficiencies in an effective and structured manner. Some of those CIOs have understood the importance of being customer-focused and have started assisting businesses with technology innovations. For instance, refer to the four quadrants below that I use to illustrate the transformative role of today's CIO. There is no quantum leap from quadrant to quadrant. The CIO must still thrive in the lower left-hand quadrant. From there, he can use his skills to influence both the upper left-hand and lower right-hand quadrants. These are the two quadrants that contain elements that a CEO notices when improved or changed for the better, and that ensures the CIO's movement to the upper right-hand quadrant. It is in this quadrant that he should be collaborating with the CMO and setting strategy alongside the CFO.

Business skills **Internally focused** Driving productivity improvements Driving cost reductions	**Business skills** **Customer focused** Driving business innovations Driving business transformation
Technology skills **Internally focused** Keep systems running	**Technology skills** **Customer focused** Assisting business with technology innovations Delivering large scale programs

"Tell me what your business wants and we will find a technology innovation." If a CIO uttered this sentence a decade ago, eyes might have rolled at board meetings. But today, with social media, mobile, analytics, and the cloud driving corporate strategy, the most effective CIOs are pushing strategy, rather than being pulled along by it. This shift within the C-suite is not as seamless as it sounds. It calls for un-learning some of the basics, adapting to the new environment, and innovating with speed.

I would like to share the story of two CIOs who were attempting to implement an e-commerce platform. The first CIO embarked on a traditional IT exercise that involved running a tender process, selecting the packages, and setting up the infrastructure. Everything took more than a year, yet he was not close to delivering the program. The other CIO took an innovative approach. Because he understood the need to deliver business value, he stitched a portfolio of cloud-based solutions and delivered the program in 12 weeks. The cloud-based solutions costed the company US$5 million. But since he was up and running in three months, his company posted a revenue of US$2 million a month from the online platform. That is US$18 million in revenue in the nine months in which the first CIO was attempting to set up his own infrastructure. Although the first CIO thought he saved his company money, his efforts essentially cost the company US$13 million in wasted time-to-market, assuming (generously) that he was online within 12 months instead of his competitor's three months.

The paramount role of the CIO

An industry that demonstrates that some CIOs are firmly at the helm of strategy formulation, is retail. I know of a leading apparel company that tests its new designs, not in the physical world, but, online. Based on consumer responses, the company decides what will be in its product launch and plans its supply chain accordingly. Then there's a consumer packaged goods company that is focusing on changing its business model and selling products online, directly to consumers. This way, it is competing head-on with its physical distribution channel and online retailers. Yet

another company analyzes its sponsorship deals and systematically mashes multiple sources of data to determine marketing investments for the future.

CIOs have the power to transform once-moribund enterprises into nimble, digital-savvy ones. The paramount role of the modern CIO – as part of the C-suite executives in an enterprise, while they formulate strategy – is that of the security chief. Take an informal survey – scan white papers, press releases, and company communications, and you'll find that very few address online security breaches because it's the issue most enterprises wish would go away. But hackers appear to stay one step ahead of enterprises – even those companies with the most technology-heavy budgets. It's up to CIOs to assert their expertise in this area and demonstrate just how much money they could be saving their companies by checking cybercrime and fraud.

On January 8, 2016, for example, Time Warner Cable, one of the world's largest media and entertainment companies, discovered that approximately 320,000 of its customers might have had their e-mails and passwords stolen. What was even more troubling was that Time Warner Cable was unable to explain how the company was hacked. Whatever way the company spun it, it remained a major embarrassment and was another validation to allocate whatever a CIO needs to make an enterprise and its consumers secure from cybercriminals.

CIOs have the power to transform once moribund enterprises into nimble, digital savvy ones. The paramount role of the modern CIO – as part of the C-suite executives in an enterprise while they formulate strategy – is that of the security chief.

An expert says that the CIO could be the only barrier between the enterprise and powerful hackers. CEOs and CIOs alike are learning the hard way that their security measures might not be as robust as they think they are. Ask yourself: What is the value of all your company's sensitive information? Is it R&D? Is it analyses of the markets and its major competitors? Think of the consequences if all this data were stolen by hackers and sold to the highest black-market bidder. Analysts rightly hold that CEOs should stop viewing risk management as merely an IT problem. When their CIOs suggest novel security measures that overshoot budget, the CEO should cut funding elsewhere and redirect it to security.

Changing dynamics between the modern CIO and senior leadership

So what exactly should the CIO be focusing on at the moment? First, be sure to get the basics in place. By that I mean beyond ensuring that systems are running and all hygiene requirements are met. Have strategic conversations aimed at setting up an enterprise for the future. An enterprise needs experts with the right skills who can ensure that the team has a good appreciation of the mix of business and technology. In addition, strategic conversations drive a clear meritocratic enterprise. The best people for the job will rise to the top in no time. Secondly, collaborate, collaborate, and collaborate.

It is imperative that CEOs and CFOs treat the CIO as a full-fledged creator and implementer of the enterprise-wide strategy. And for CMOs, the imperative is even more vital – they should be working in tandem with CIOs because marketing is a function that lives and dies by the hand of IT. A collaborative effort of CMO and CIO will propel enterprises forward in ways that boards of directors never even dreamed of a decade ago.

For most of the 100 years that General Motors has been making automobiles, its marketing efforts tended to showcase technology in the context of overall options available in new models. Information technology tended to be relegated to options such as OnStar, its in-vehicle security, turn-by-turn navigation, and remote diagnostics features. And then there was the infamous EV1 in the 1990s, a terrific electric-powered car which ultimately flopped because the CMO and CIO were

not in the closest of corporate relationships. On the other hand, in mid-January 2016, at the annual Consumer Electronics Show, the chairman and CEO of GM, Mary Barra, unveiled a prototype of an electric car that will come with "an unparalleled level of connectivity." The image of GM's CEO on stage touting web connectivity at the Consumer Electronics Show was a watershed moment in the rise of the CIO's influence. Here was Barra, telling the technology-savvy crowd that companies such as Apple and Google lack experience in manufacturing cars and that they don't have the extensive network of dealerships and service centers that GM does. There's no doubt then, that General Motors has fully integrated the CIO into its strategy. And it shows.

The DATE formula of a CIO's success

All of these examples remind us to be constantly mulling over actions with innovation in mind. Enterprises should adopt two speeds so that big bang innovations can occur, and so can 'slow simmers' that often result in more innovative and enduring results. Becoming a transformative CIO is not about being perfect. It is about achieving business outcomes. To be successful with innovation in mind, one has to be what I refer to as **`DATE' — Different, Agile, Tolerant, and Enthusiastic.**

Being different allows the development of IT along two timelines – two-speed IT. ***Being agile*** means you are willing to move fast after aligning to your enterprise's many goals. ***Being tolerant*** means you allow people to fail, if failure is a natural part of their quest to become as innovative as possible. Then, there is the ability to remain ***enthusiastic*** throughout this challenging process.

The role of the CIO will only continue to expand as technology will become integral to every function in an enterprise. The CIO must understand business realities and define her success parameters. It's even more important that other corporate leaders understand the huge degree by which the role of the CIO has transmuted. Today, the CIO might just be your enterprise's most underutilized asset.

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Ambeshwar (Amby) has over 17 years of experience in the IT industry with specialization in the retail, CPG, and logistics business. He has worked with several clients in IT consulting and services across Europe. As a senior leader, he brings in-depth experience in sales and client relationship management.

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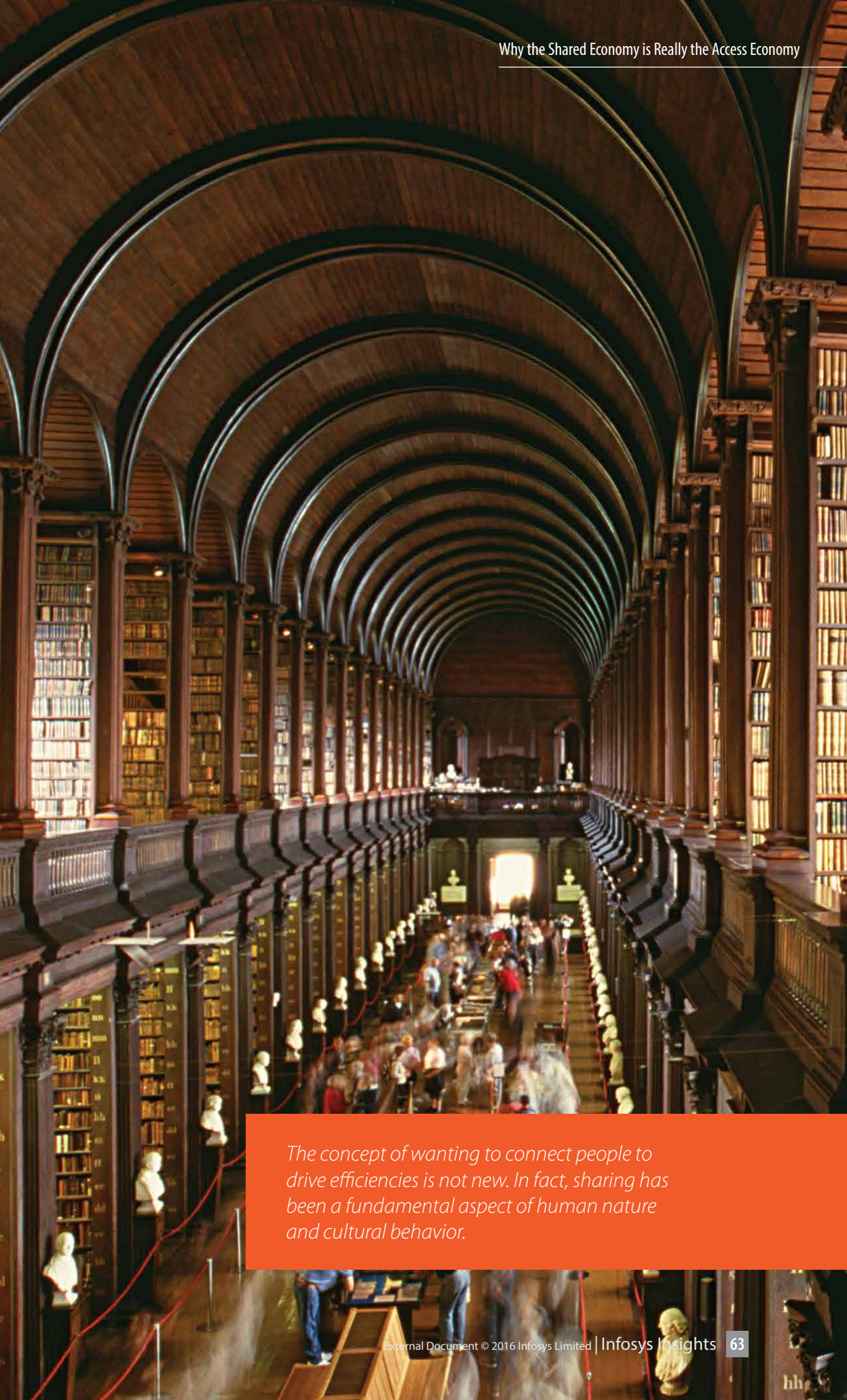
WHY THE SHARED ECONOMY IS REALLY THE ACCESS ECONOMY

We are living in an extraordinary moment in history – where consumers value access more than ownership, and this makes economic sense, too. What are the drivers of this new economic reality? How can businesses prep themselves up for it? Read on to learn more.

A new television advertisement shows a tired businessman sitting in crowded airports, stuffy airplanes, and rancid reception areas, only to get home and finally, be rewarded by sitting behind the wheel of his own car. Our protagonist comes home from an arduous business trip and gets to drive his own car alone and in Zen-like peace. But in the shared economy, he would feel a sense of pride for sharing his car with three other commuters so that they collectively reduce their carbon footprint. Just one car on the road versus four.

To some, the shared economy is a utopian vision for the future that may be enabled by advances in information technology. Using information technology, resources that would otherwise go unused (those three other car seats, for example) are utilized instead by people – sometimes complete strangers – who need to travel to the same place (using



The concept of wanting to connect people to drive efficiencies is not new. In fact, sharing has been a fundamental aspect of human nature and cultural behavior.

the car example). To others, the shared economy has socialist overtones where everyone can stake an equal claim to existing resources.

Not a utopia, but a business reality today

To start with, there really is no sharing going on in a purely economic sense. Ubiquitous IT platforms are creating peer-to-peer networks that allow civic-minded people to be aware of opportunities to reduce, reuse, and recycle. So, strictly speaking, the middleman who provides the platform isn't sharing anything. His innovative business is merely connecting parties that would have otherwise not known about the other, and among these parties, goods and services are rented out at a price.

In the shared economy, he would feel a sense of pride for sharing his car with three other commuters so that they collectively reduce their carbon footprint. Just one car on the road versus four.

A Harvard Business School study makes a cogent case for renaming this phenomenon the `access economy'. Robust IT platforms allow more and more people to access goods and services which sometimes have the appearance of sharing. But make no mistake about it: The sharing (or access) economy is truly about utilizing every resource and byproduct by virtue of the fact that we're increasingly connected in a digital world.

Economically speaking, IT has empowered businesses and individuals alike to leverage every efficiency out of existing business models. There is yet another term for these developments: Collaborative consumption. According to Ericsson's Mobility Report, there are currently 2.6 billion smartphone subscriptions in the world. The report's research points to an increase to 6.1 billion by the year 2020.

Already, the access economy has shown its influence and strength through crowd-funding. Up until a few years ago, an entrepreneur would have limited options in obtaining capital for a new business – a bank loan or an infusion of cash from a venture capital firm. Now, that entrepreneur can post her business vision to any number of crowd-funding platforms and connect with potential investors. The technology platform typically gets a cut of whatever amount of money the entrepreneur raises from investors.

Drivers of the access economy

The concept of wanting to connect people to drive efficiencies is not new. In fact, sharing has been a fundamental aspect of human nature and cultural behavior. The oldest communities in recorded history – city-states that date back more than 5,000 years – were based around the concept of villagers sharing goods to form a community and most efficiently feed and protect its inhabitants. That same sense of sharing to save money and resources can be seen even today. Across many parts of the world, it has been typical for a family vacation to be planned around visiting other family members in another part of the world. Accommodation and food costs are minimized because everyone is staying with relatives. An early semblance of Airbnb.

Today, the owner of the apartment isn't necessarily a member of your family and is instead `sharing' (or, more accurately, giving access) with you for a profit. Technology has been the game changer, powering millions and millions of these connections and that too on-demand. The confluence of three factors is driving the access economy into the mainstream:

1. Credit (or blame) the global economy. Experts in monetary policy have written that nearly eight years into a global economic crisis and the resulting slump, new ideas about what is socially acceptable in entrepreneurship have popped up everywhere. Do you really want a stranger sleeping in your bed when you're not at home? It is a business model born of a sluggish economy. Simply put, people who don't need income to support themselves don't sell their beds to strangers. People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who were employed by companies that offered them health benefits, offices, and equipment, and a structured environment to work, are now among the vast masses of the unemployed. Their response to their dire predicament is to become entrepreneurs by using these technology-enabled access platforms. Now that the subpar economy has taken its toll, after eight straight years of malaise and rampant unemployment, people are becoming more creative about making a living.

2. Add to the prolonged global financial crisis, the rapid development of information technology, and you have a system in which people are making once-unheard-of business models, incredibly successful. Platforms such as online marketplaces and services platforms are giving rise to an on-demand economy.

Make no mistake about it: The Sharing (or Access) Economy is truly about utilizing every resource and byproduct by virtue of the fact that we're increasingly connected in a digital world.

3. Finally, the supreme thrust towards this new paradigm has come from the arrival of the millennial buyer. A watershed event, really. The millennial buyer takes pride in her ability to save not only money, but also ecological resources. Because millennials are relatively young and the global financial crisis has been relatively long, we have an entire generation that is happier to `experience' something rather than `own it'. They also have a green conscience, and want to be associated with sustainable and fair business practices.

Watch outs for businesses

The access economy will compel every business to rethink their business model, either to stay relevant, or drive more opportunities. Innovation in the access economy will have the following considerations common across all types of businesses:

1. A new price-to-value curve

In this new access model, expect a shift in the price-to-value curve. For millennials, affordability will be less of a concern. Those wanting to 'own' will have the option to recover money through sharing – so durability, quality, and brand will become important. Others who are happy with just 'experiencing' will be charged marginal prices. Here, again, brand and quality will be important decision factors. Brands should therefore resonate with millennials and acquire all the qualities the millennials value; for example, the high price of a Patagonia jacket is worth it because of its brand recognition, the company's commitment to sustainable practices, and the existence of its Worn Wear collection – gently used Patagonia-brand clothing that is cheaper than the new stuff.

Patagonia is also a part of `ifixit.com', an IT-enabled community of people who are committed to repairing and reusing used things. All of this fits seamlessly into the mindset of the millennial consumer.

2. A strong message

Sensibilities around consumption have changed largely due to the millennial mindset, which has been shaped by democratization of information, meritocracy, egalitarian and fair practices, and a consciousness to preserve our planet and its resources. So to connect with millennials, who comprise a vast majority of consumers, businesses must be genuinely committed to one or more of these values.

Some women like to shop for clothes but don't know what to do with their older outfits when faced with a storage space crunch. On platforms such as Poshmark and Tradesy, you can post photos of your favorite Tory Burch or Gucci haute couture and connect with shoppers anywhere around the world who are looking for a bargain – even for high-end goods that are never sold at sale prices in their original boutiques.

Another platform, LeftoverSwap, connects you to local people who wouldn't mind coming by your house and eating a leftover

slice of pizza. You arrange online to connect with them and give them the pizza slice. Theoretically, no food goes waste. But what about the fossil fuels burned in the car trip to get to that one slice of pizza? Is one slice worth the trip, after accounting for the carbon footprint of the person who wants the pizza?

3. New roles in the economy

Businesses can choose from many roles in the new, emerging economy. They can choose to be the 'creator' of all the innovation by extending their business model. General Motors recently bought Lyft, a ride-sharing service which was once a close competitor to Uber. Other car makers are following a similar strategy to stay relevant, fearing that ride-sharing apps and driverless cars can be disruptive to their existing businesses.

Other businesses may choose to leave this space to the Silicon Valley start-ups, and instead be a 'provider' or a 'consumer' of such services. The logistics industry has jumped on this opportunity with companies such as uShip or Lojistic, that are marketplaces which help connect shippers with carriers. Carriers have the opportunity to lower the empty miles traveled by posting available capacity on routes in near-real time. Shippers, especially the smaller ones, get an opportunity to find the best freight deals.

4. Building trust

This is going to be challenging indeed. It will also be the maker or the breaker for any business adopting the sharing model. The poster boy of the access economy, Uber, has been challenged in several cities across the globe every time the perceived trust was broken. The company continues to work on making their rides safer for both passengers and drivers, with features such as sharing the estimated time of arrival with family and friends, round-the-clock `incidence response

teams', and cashless transactions. In May 2016, Uber announced that it will bar any driver who knowingly denies a ride to a passenger because the person is traveling with a service animal. This was done as part of the settlement of a lawsuit brought by advocates for the blind, and it also elicited Uber's commitment to educate its drivers over their legal obligations to transport passengers with guide dogs and other service animals.

As businesses design end-to-end transactions in the access economy, the checks and balances have to be carefully devised at every step to build trust for both the provider and the consumer.

New synergies

How soon will established businesses rethink their business models and carve out their roles in this new world? As we innovate to find a place in the shared economy, we will only multiply opportunities and not cannibalize existing businesses. The shared economy holds the promise of democratizing consumerism. Imagine a world where the experience of consuming goods and services is not constrained by your purchasing power. Wouldn't that result in a boom in the markets you serve? If you are watching this development from the sidelines, it is time to jump right in. The access economy is not merely a trend, but a manifestation of the zeitgeist, spurred on by economic factors and the Digital Revolution.

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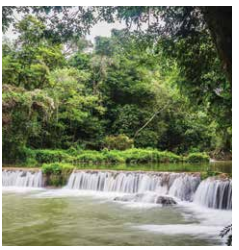
DATA, DATA EVERYWHERE: HOW CAN IT BE MONETIZED?

Deriving insights from petabytes of information assets cannot happen in a silo. The data boundaries created by legacy technologies must be brought down, in order to create a boundaryless enterprise where data flows freely and can be easily harnessed to get a complete and a granular view of the business.



Walmart, the global retail major, processes one million customer transactions every hour. Akamai Technologies, a leading content delivery network, analyzes 75 million events every day for targeted online advertising. These examples barely scratch the surface. Predictions are even more staggering: IDC anticipates 450 billion online business transactions daily, by 2020!

Digital technologies have transformed the data ecosystem, through the quantum and depth of data, the producers and consumers of data, and most important, the intrinsic value of data. Every business captures and analyzes diverse data streams – transactions, supply chain, operations, products, market dynamics, social sentiments, and customer data that includes their demographic profile, location, preferences, and behavior.

The existence of petabytes of information assets raises pertinent questions that enterprises need to address: How can stakeholders access quality data, on demand? What is the monetary value of the available

Enterprises need to collect data from business processes, Internet of Things, and machine learning applications, while breaking down boundaries that confine data to silos, and create a 'golden copy' of data. It requires a data strategy that transcends mobile BI, data and process integration, and master data management initiatives.

data assets? Can data streams be monetized in terms of customer loyalty, cost efficiency, revenue growth, risk mitigation, regulatory compliance, renewed operations, and/or new products and services?

Robust data strategies that ensure on-the-go data access, real-time data sharing, 360-degree view of customers and operations, and predictive insights can help enterprises monetize data. However, traditional database management systems, business intelligence (BI) tools, and analytical engines do not allow enterprises to capitalize on the compounding effect of big data, cloud computing, mobility, and social media. The primary challenge is: data boundaries.

Bring down the walls

A hierarchical organization structure and functional boundaries create silos that prevent seamless communication as well as collaborative decision-making. In turn, it results in flagging productivity and subpar operations. On the other hand, in a boundaryless enterprise – one without vertical or horizontal barriers, as envisaged by Jack Welch, the erstwhile CEO of General Electric in 1990 – internal and external stakeholders collaborate, making the enterprise more and more efficient, responsive, and resilient.

Similarly, a prerequisite for data monetization is the elimination of data boundaries. The free flow of data can be inhibited by boundaries created by diverse factors – physical location, IT infrastructure, business processes, application portfolios, enterprise policies, and industry practices. Moreover, the separation of transactional and analytical workloads via operational data stores, data warehouses, and data marts affects data quality.

Enterprises need to collect data from business processes, Internet of Things, and machine learning applications, while breaking down boundaries that confine data to silos, and create a 'golden copy' of data. It requires a data strategy that transcends mobile BI, data and process integration, and master data management initiatives. An integrated platform to gather, cleanse, query, analyze, and visualize data will help monetize data within and beyond the enterprise.

MONETIZE DATA

WHAT	HOW	WHY
▸ Real-time data managed by technologies such as SAP HANA, NoSQL, MongoDB, and Cassandra ▸ Structured data managed by Teradata, Netezza, etc. ▸ Unstructured data managed using technologies such as Hadoop	▸ Identify usable data ▸ Integrate and manage multiple data sources ▸ Deploy advanced analytics models ▸ Transform into a progressive enterprise to use data and analytics effectively	▸ Solve business problems in real-time ▸ Predict challenges and outcomes well in advance ▸ Capitalize on business opportunities

Data-oriented enterprises discover value quickly and better manage information. In addition, accurate analysis enables enterprises to glean business insights. A boundaryless data platform is the backbone of such data enterprises. It serves as a unified data and analytics stack to monetize large volumes of complex data from diverse streams.

Keep it simple and make it scalable

A boundaryless data platform breaks down system, technology, process, deployment, and organizational barriers, and integrates the data chain – from creation to consumption. The platform, whether hosted on-premise or on the cloud, streamlines information management by simplifying the discovery of information assets, personalizing data, facilitating collaboration, and ensuring secure access.

Boundaryless data platforms support a consumption-driven approach, as well as the application of information semantics, to boost

usability across all types of data, including master, transaction, machine-generated, social, and connected enterprises data. The platform incorporates a data lake to manage raw, enriched, and analytics data.

A data lake is the building block of boundaryless IT architecture. Metadata-driven data lakes capture and store unlimited amounts of structured and unstructured raw data, irrespective of the format, source, or schema. It enables seamless interoperability between domains and applications with a business-centric semantic model. Data enriched using a data grid is stored in the 'enriched zone' and is used to build analytical models. Analytical reports are ploughed back into the data lake.

The data grid addresses the challenge of boundaries at the portfolio and enterprise level with a secure semantic integration engine. It leverages virtual / federated / ETL technologies to connect heterogeneous data sources and convert raw data into meaningful information. Information assets connected to the grid by the metadata-driven semantic engine help business users search diverse data assets easily and consume contextual data.

The 'golden copy' of consumption-ready data can be referenced for all business transactions. MDM allows application of appropriate business taxonomies for data domain elements, thus eliminating data inconsistency, duplication, and redundancy.

The boundaryless data platform adopts master data management (MDM) practices to create a comprehensive view of critical data domains such as customers, products, suppliers, and employees. The 'golden copy' of consumption-ready data can be referenced for all business transactions. MDM allows application of appropriate business taxonomies for data domain elements, thus eliminating data inconsistency, duplication, and redundancy. In addition, MDM enhances the accuracy and reliability of data, and improves data ingestion.

Gain rich insights

A boundaryless data platform renders the concept of 'internal,' 'external,' or 'functional' data obsolete. It automates data operations for smooth interoperability. All stakeholders can mine relevant data for near real-time decision-making. Visualization tools to analyze data from any perspective empowers users across functions, including finance, supply chain, sales, marketing, and customer service, to use common data sets for developing unconventional solutions to business problems.

A unified data platform transforms the enterprise through self-service analytics. Business users can interpret data accurately, explore relationships between different entities across the data landscape, and uncover correlations as well as hidden patterns between seemingly unrelated data streams. Users can query interdisciplinary data, gain a nuanced view of the business, and generate actionable insights. Outcomes can be predicted accurately before the enterprise invests time and money.

Boundaryless data platforms maximize data harvested by the enterprise. This helps financial service managers create customer micro-segments, and consumer packaged goods companies predict demand for a product across marketing channels. Oil and gas companies can use the boundaryless data platform to optimize their maintenance schedule. Unified data platforms help retailers improve markdown planning and enable airline carriers to adopt a dynamic pricing strategy for passengers as well as cargo.

Every industry benefits from seamless data flow and predictive analytics. Rolls Royce uses data and high-performance computing across design, manufacturing, and after-sales support for its jet engines. Telstra uses customer data to prevent customer churn as well as network data to address or preempt network dysfunction. Avis harvests several data sources, such as rental history, service issues, demographics, corporate affiliation, customer feedback, and social media

references, to undertake a valuation and assess the profile of customers.

Boundaryless data flow empowers companies to monetize data residing beyond their enterprise as well as the industry. Retailers and banks use customer location and activity data gathered by communication services providers for contextual offers and targeted promotions. Weather aggregators help shipping companies make sense of meteorological data and better manage voyages and operations. The GPS navigation system in 'smart' cars predicts feasible routes based on dynamic traffic conditions.

In summary, analytics should be at the heart of the enterprise fabric. While quality data is essential to solve daily issues, analytical tools that capitalize on boundaryless data flow provide panoramic and granular views of the business. The ability to see the hidden and predict the unknown, improves productivity, spurs decision-making, and determines the business trajectory.

About the Author

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Satish has been with Infosys for over two decades. In his current role, he is responsible for the Data Analytics practice at Infosys. Prior to this, he has played various delivery leadership roles across the manufacturing, healthcare, life sciences, financial services, and retail verticals. He is the recipient of multiple Infosys Excellence Awards, for his contribution to service delivery and nurturing some of the key client relationships.

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PREVENTIVE MEDICINE, THE FUTURE STATE

Over the next two decades, medicine is slated to change from its current reactive form of treatment, to a more proactive, personalized form. As the industry takes its first steps towards preventive medicine, we explore the factors driving this change, the challenges, and the opportunities.

The pharmaceutical industry is in a state of flux. Besides a dwindling drug pipeline and patent expiries across the world, one of the biggest concerns for the industry are the spiraling costs of research and development, necessary for new drug discoveries. Plus, the end customers of the pharma sector, including governments, patients, and insurance companies, are becoming increasingly reluctant to pay the escalating prices for new medicines.

They are demanding more value for lower prices. This sea change raises concerns for the pharma industry that is already facing issues with the existing pharmaceutical model, which is not likely to yield traditional profits or meet these growing demands. Thus, the industry has started looking for a sustainable model.

Preventive medicine: The next big step

Non-communicable diseases such as cancer, diabetes, and heart disease account for about seven out of ten deaths in America and are responsible for nearly 75 percent of America's health spend. Preventive medicine can help reduce these numbers. At the industry level, the practice of preventive medicine, as opposed to the more traditional reactive

Novo Nordisk, a multinational pharmaceutical company based in Denmark, has embraced preventive medicine measures in an exemplary fashion – working with their partners, including policymakers and health organizations, they are raising awareness, improving access to care, and investing in research.

medicine, helps decrease the cost of patient hospitalization, which puts a huge burden on the system.

The burgeoning field of preventive medicine is a multifaceted system that depends on the collaboration between Big Pharma and start-up biotechs, as well as corporate HR departments and their wellness programs, occupational medicine, and public health officials. The success of preventive medicine depends on such a large ecosystem – especially on the collaboration of private enterprise and public institutions – and of course, leveraging the new, emerging technologies in big data, analytics, and digitization.

Novo Nordisk, a multinational pharmaceutical company based in Denmark, has embraced preventive medicine in an exemplary fashion. Working with the company's partners, including policymakers and health organizations, they are raising awareness, improving access to care, and investing in research. Its program, 'Cities Changing Diabetes,' explores and develops effective ways to address the issue of diabetes across metropolitan areas. It has become a roadmap of sorts for pharmaceutical companies to put preventive medicine into practice.

Today, the technology exists that allows companies to analyze client genome information, clinical or biological makeup, and lifestyle issues. All these factors are combined to prescribe suggestions that are tailor-made for the client based on her genetic composition. Arivale is a biotechnology company that has made big strides in this area; and according to Clayton Lewis, its co-founder, the key focus for the company is to offer solutions that enable the prevention of diseases.

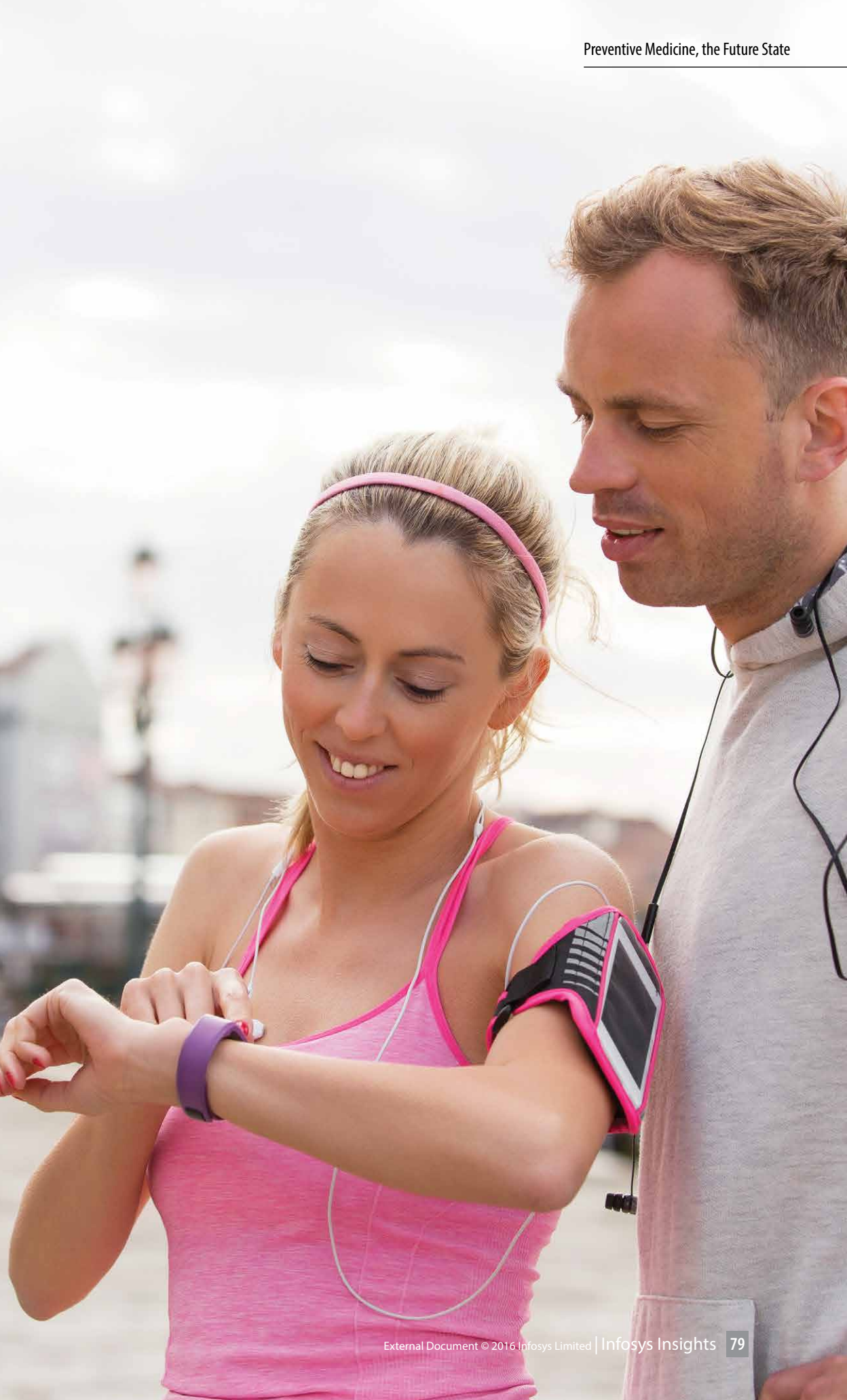
The availability of health-related information on the Internet, including esoteric data, as well as some popular wearables – such as Fitbit and iWatch, which track our daily activities and the corresponding bodily functions – have led today's individual to be aware about one's health and therefore, more oriented towards preventing health issues and diseases.

Another company, Quanterix, has developed a technology platform with single-molecule sensitivity that helps identify the presence of proteins released in the presence of diseases, even before the symptoms show up. For instance, potential heart attacks can be diagnosed with Quanterix's technology, which measures the presence of a protein called troponin before the person experiences the attack.

The global pharma giant, Eli Lilly, has undertaken a critical double-blind study in which the company discovered encouraging data that has proved that investigational medicine for migraine prevention can help not just prevent migraines, but also cluster headaches. Most patients suffering from debilitating headaches like migraines, currently get relief only with strong drugs. A preventive medicine for a condition like a migraine can go a long way in allowing sufferers to lead relatively normal lives.

Pivotal role of technology

Many revolutionary technologies are coming together to enhance health, medicines, and caregiving in general. The most fascinating aspect, of course, is that these advancements tend to originate in the information technology sector. The same technology that knows that a customer prefers a certain make and style of shirt in a store, and is instantly sent a customized offer to his mobile device while he is in a shopping mall, is what is set to transform the health and welfare of human society. These technologies, which can make short order of the biggest of big data in nanoseconds and pinpoint treatments and medical courses of action, are the tip of the iceberg when it comes to preventive medicine.



Surveys indicate that a majority of the people are keen to monitor their health. The availability of health-related information on the Internet, including esoteric data, as well as some popular wearable devices – such as Fitbit and Apple Watch, which track our daily activities and corresponding bodily functions – have led today's consumer to be more aware about health. This awareness, in turn, has encouraged people to become more oriented toward preventing health problems and diseases. Back in 2007, the concept of `Quantified Self' was started in the Bay Area, advocating the use of technology to track a person's daily activities in order to measure wellness and health.

IT is providing the technological framework that allows the design of personalized treatments based on family histories and genetic indicators. Because of IT, a patient can go beyond `self-tracking' and now has the option to find out about a disease she is prone to contract. Additionally, her doctors get the opportunity to manage the disease at an early stage. From that perspective, preventive medicine is empowering people to be more conscious about their health and lifestyle.

Questions, doubts, challenges

Such encouraging instances notwithstanding, life sciences companies have been wary of making big investments in drug R&D programs that focus on preventive medicine. Companies are uncertain about how evaluation and approval of preventive drugs can be done on time, and marketed to the right audience. Some of the questions holding them back are:

- Is the burden real?
- Are people going to be open to knowing their risk?
- Will drug development be possible at the scale at which it will be needed?
- Will this allow for patent protection?
- Who will pay?

These questions are valid concerns to explore. Pharma companies should make a consolidated list of the core competencies they possess and the areas of disease prevention they can handle. If there are areas that they cannot address, they can perhaps collaborate with other companies that have competencies in those areas. Doing so will save both time and effort.

Let us examine some of these concerns and provide some perspectives.

• Who will bear the cost of new, expensive drugs?

With disruptive innovations, newer business models will emerge.

Let us take the example of the curative drug Sovaldi, to address this question. Considering the cost and the uncertainty around a cure will be factors at play in preventive drugs – just like Sovaldi. This drug has had an excellent track record of curing Hepatitis C. It costs about US$1,000 a pill, and a grand total of US$84,000 for the complete treatment. Gilead, the pharmaceutical company that created the drug, priced Sovaldi accordingly.

The pricing strategy seems to have worked; enough people are willing to pay the US$84,000 to cure themselves of Hepatitis C. Sovaldi, an antiviral treatment aimed at people who already have the disease, does not work universally. However, in many cases, Sovaldi can cure those afflicted with the deadly and debilitating Hepatitis C virus.

IT is providing the technological framework that allows the design of personalized treatments based on family histories and genetic indicators. Because of IT, going beyond `self-tracking', a patient now has the option to find out about a disease she is prone to contract. Her doctors get the opportunity to manage the disease at an early stage.

It will be a far different situation in a country like India. In the case of Sovaldi, the Indian government would not allow Gilead to use its American pricing strategy, considering the context of affordability will completely change in a developing country. It has been mandated that the entire course of treatment – US$84,000 in the United States – be lowered to a total of US$900 in India. So who would absorb the cost if the discount is that steep? It would have to be the insurance companies and the government. The taxpayers will be paying for the drastically reduced cost of the treatment program, and insurance companies will pass on those extra costs to the consumers. In the end, Gilead would recover the cost of its expensive drug, no matter who pays and at what point in the process.

• What about the regulatory conundrum?

For curative medicines, there has been a direct connection between the drug and the patient with a specific disease. For preventive medicines, there is now an indirect connection between the drug and a healthy person or a person who is susceptible to the ailment.

Elias A. Zerhouni, MD, who led America's National Health Institutes and Centers from 2002 to 2008, in an interview during his NHI leadership, outlined what was then the upcoming field of preventive medicine. He accurately predicted that we are in a revolutionary period of medicine and referred to the `four Ps' of medicine – predictive, personalized, preemptive, and participatory.

The four Ps require patient involvement well before the disease strikes, as opposed to the doctor-centric, curative model of the past. The future, he said, is going to be patient-centric and proactive. It must be based on education and communication. Still, these factors will bring about complexity when it comes to regulations.

• Will people be open to knowing about their innate health risks?

Development of genomic analysis is precipitating, along with preventive medicine, the development of personalized and precision medicine.

The significant shift in thinking and approach is towards truly individualized care. Instead of a one-size-fits-all medicine, which can lead to unnecessary and even harmful treatments for some patients, advanced genomic testing devotes its attention to studying a single individual – the patient whose tumor is being tested. When a study group has just one participant, scientists can focus all their efforts on attacking that patient's tumor at its source, that is, the mutations coded in the person's DNA.

Let us take the example of cancer treatment. The traditional approach is that cancer is

defined by where it occurs in the body (e.g., lung cancer). Then, the treatment that follows is directed toward the lungs using various types of chemotherapy.

In recent years, though, researchers and physicians have found that a particular cancer in one patient doesn't necessarily behave the same way in another patient – even though the cancers are in the same location. Some cancers even bear similarities to cancers that were once thought to be completely different. A breast tumor, for example, may look and act like a lung tumor. By looking at the tumor's genetic profile with genomic testing, physicians might be able to recommend a drug or protocol not previously considered. Imagine using a traditional breast cancer therapy to prevent a lung tumor.

Another approach with enormous potential is what is known as chemoprevention, which is the use of various agents to stop the initial phases where cancerous cells begin to mutate. Interest in this area of research has spiked because doctors are increasingly understanding the biology of how cancer begins and how they identify potential molecular targets. When people know about their vulnerability to diseases, they will be more likely to discuss prevention with their doctors.

• How to create a market for preventive medicine / prevention approach to healthcare?

The market for preventive medicines will function in a pay-for-outcome model, among others. An existing example of this model is the Social Impact Bond (SIB), also known as a Pay for Success Bond or a Social Benefit Bond. Whatever the name, think of the bond as a kind of contract between an investor and a public sector that is committed to improve social outcomes. The idea here is that improving social outcomes translates into public sector savings. In such an arrangement, the private sector pays for smaller-scale, exploratory social interventions. If the specific program goals are met, the investors receive a payout. As these programs prove themselves, they can eventually be considered for use on a larger scale with public sector funding.

SIBs are not as common in the United States as they are in the United Kingdom. In a report released in April 2016, Mark Pauly, a professor of healthcare management, economics, and public policy, at the University of Pennsylvania's Wharton School, along with his colleagues, studied the potential for Social Impact Bonds in the pharma industry. Professor Pauly concluded that for SIBs to work in this industry, there would have to be a concrete, provable cost reduction in a program.

Another success factor would be to engage investors in the projects. Better still, private entrepreneurs might be inclined to accept lower returns than they might in a traditional investment because they are investing in the name of altruism. But they do not want to settle for zero returns, either. Having private sector investors tends to ensure that a

project is not only funded, but carried out successfully.

An American project, Social Finance, is currently working on a pilot program that it hopes to turn into the first major healthcare SIB in the nation. It is based in Fresno, California, which has one of the highest rates of asthma among American children. According to a report by Healthcare Finance News, 20 people are treated every day in the emergency room for asthma complications at a cost of some US$35 million annually.

Members of Social Finance are working with 200 low-income families to provide education and home care to reduce environmental factors that can aggravate asthma. Their goal is to reduce emergency room visits by 30% and hospitalizations by 50% over the course of a year, which the group estimates could save US$5,000 per child annually. Insurance claims data will be used to measure cost savings. Indeed, as the pay-for-outcomes paradigm becomes increasingly successful, people who eat healthy and adopt healthy lifestyles will receive attractive incentives for doing so.

The global potential

Preventive medicine is taking shape in markets that can afford access to cutting-edge IT. Therefore, it has the potential to become a truly global solution, especially when integrated with the existing systems in developing countries, such as telemedicine.

The retail, manufacturing, aerospace, and financial services industries are using software, hardware, and big data-crunching programs as keys to unlocking solutions to decades-old problems. So too, are leaders in the life sciences and healthcare sectors – specifically in the context of preventive medicine. This new way of approaching health and wellness will be a fundamental transformation, not only in the way the healthcare ecosystem operates, but in collective attitudes toward health.

About the Author

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Since joining Infosys in 1998, Subhro has held multiple leadership positions in areas such as client management and delivery in the Life Sciences and Infrastructure business units. He has worked on large, complex, strategic initiatives for clients across multiple service offerings, such as management consulting, IT, and BPO services across the globe. In his current role, he is accountable for the Infosys Life Sciences business.

Prior to his current responsibilities, Subhro was responsible for managing client relationships for a top-five pharma company in the US. This account today has expanded to include IT, BPO, and consulting services spanning the US, Europe, and Asia. In addition, he has played multiple roles in project delivery, where he successfully delivered development, reengineering, and maintenance projects within budgets, ensuring high customer satisfaction.

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STAYING RELEVANT TO SURVIVE

Recently, Infosys conducted a survey and the insights gained were vital to understand what keeps top minds ticking across various industry verticals. The study concluded that technology is the biggest concern for respondents across industry groups, for its ability to shore up as well as shake up their business, and for its potential to solve their biggest challenges. So, it is only natural that technology should drive their priorities for 2016.

With an eagle eye-focus on the future, we would like to highlight certain key points in order to present what the landscape looks like now, as well as what you can expect it to look like in the future. It is important to take heed of crucial factors that will drive product differentiation for your business when it matters the most.

STAYING RELEVANT TO SURVIVE

TECHNOLOGY DISRUPTION IS REAL

US$4 trillion

Revenue that financial services incumbents stand to lose to new technology-driven players, according to a recent report

BUT CHALLENGES MAKE IT HARD TO MOVE FORWARD

Ramifications of technology for business
64%

Building business agility and efficiency
52%

Managing rapidly changing compliance dynamics
40%

Managing technology obsolescence
24%

ORGANIZATIONS MUST EMBRACE CHANGE FAST

53% say selection and implementation of the right technology is crucial, but only **29%** are in a state of readiness

CHANGE OF PERCEPTION IS KEY

Technology needs to be viewed as an **ENABLER** not as a **DISRUPTOR**

BECAUSE THE CONSEQUENCES COULD BE GRAVE: STAGNATION AND OBSOLESCENCE

The Role of Technology

How does industry view technology's role, capabilities, benefits, and the impact it has? As seen below, almost all industries view technology as a catalyst to improve **people productivity** and **business efficiency.**

Communication

Improves people productivity	Improves business efficiency
82%	81%

Manufacturing

Improves people productivity	Improves business efficiency
80%	80%

Banking

Improves people productivity	Improves business efficiency
79%	78%

Insurance

Improves people productivity	Improves business efficiency
81%	81%

Retail

Improves people productivity	Improves business efficiency
78%	80%

Utilities

Mitigates loss of knowledge from attrition	Improves business efficiency
81%	86%

Healthcare

Improves **business efficiency**

81%

Services

Improves **people productivity**

81%

NOTES

NOTES

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