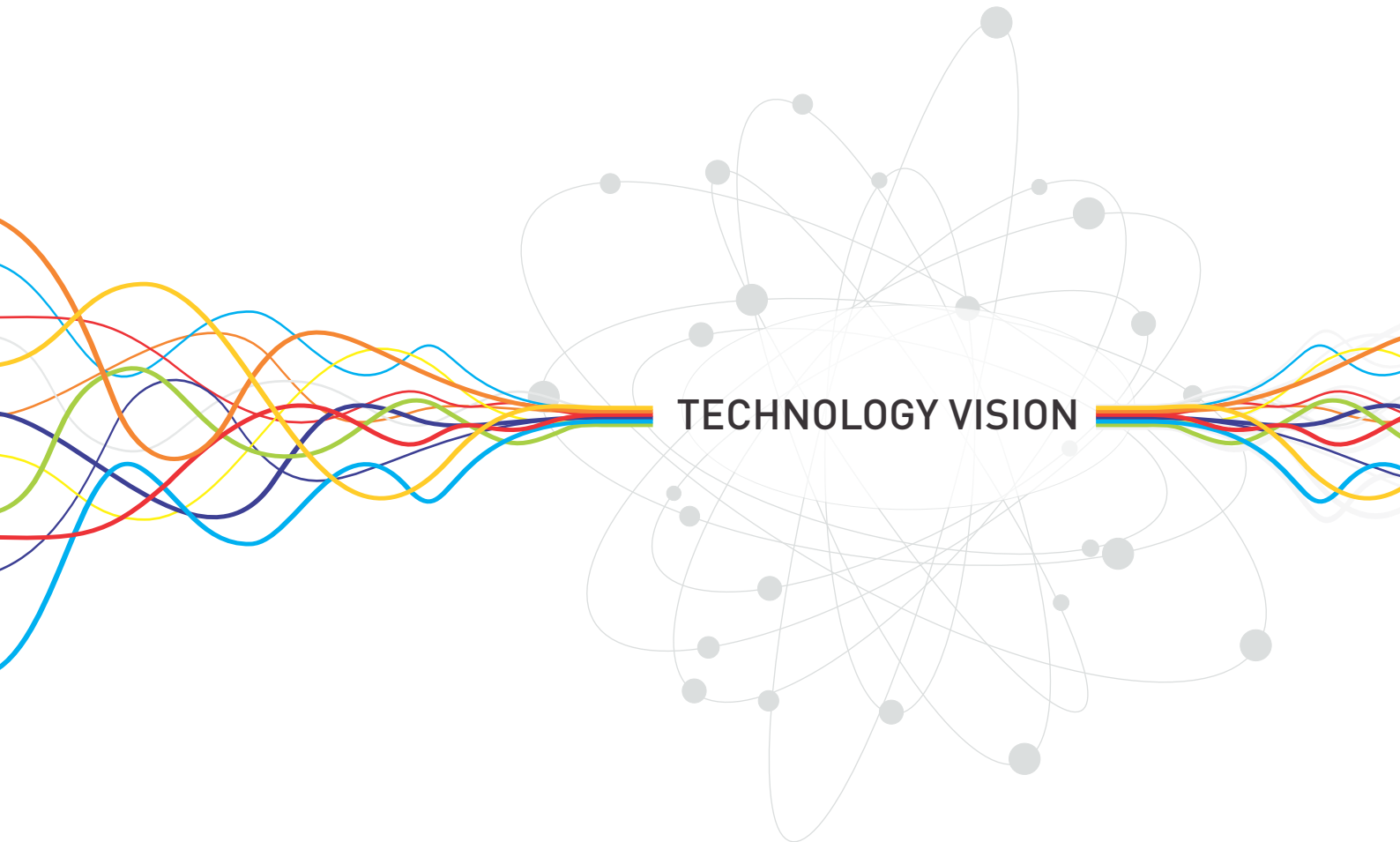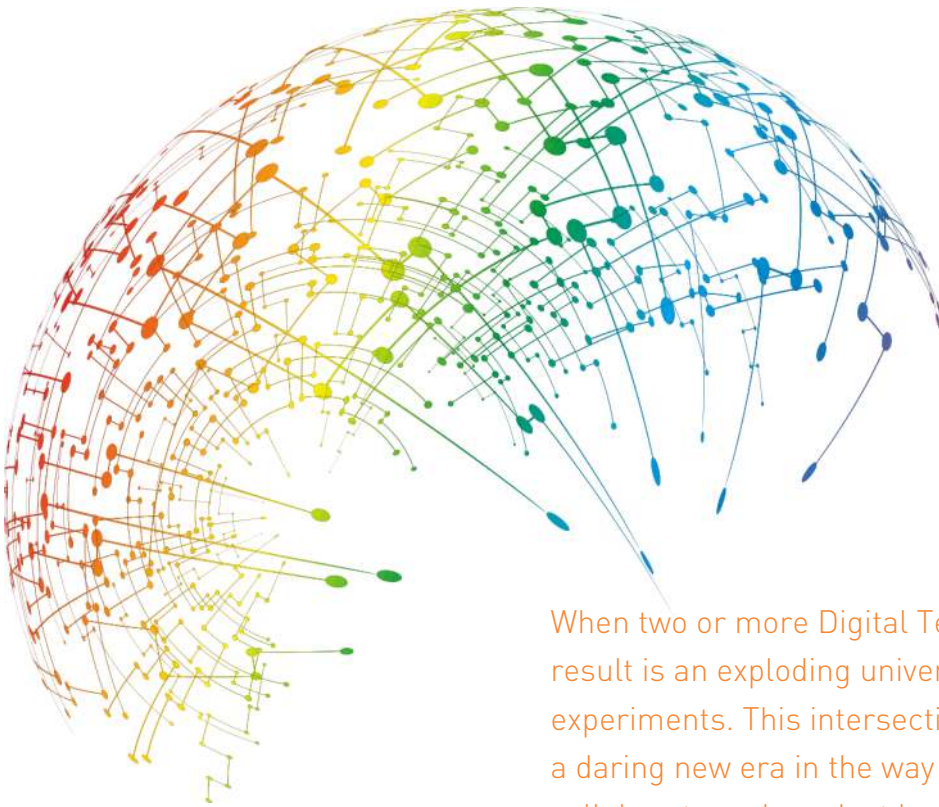**WIPRO**
Applying Thought

INNOVATION AT THE INTERSECTION OF TECHNOLOGIES

TECHNOLOGY VISION

When two or more Digital Technologies intersect, the result is an exploding universe of ideas and exciting experiments. This intersection of technologies is sparking a daring new era in the way we interact, communicate, collaborate and conduct business. The outcomes of these interactions and experiments challenge the imagination, defy categorization and have left businesses searching for fresh opportunities.

The New Tech Cosmology
The exploding universe of ideas and experiments

The intersection of technologies is creating an unprecedented multiplier effect. When immersive user experience technologies, edge based multi-functional devices, intelligence augmented systems coupled with "as a service" or "on-tap" or "always-on" technologies intersect, blend and work in tandem, path breaking futures unfold. A valuable example is YouTube. The rich media social network was born at the intersection of the Internet (packet data switching), cheap video cameras, data compression technology, easily available storage, widely accessible computing power and autonomous self-publishing, annotation, content promotion and commenting systems. YouTube itself had to wait to go viral. This happened with the advent of smartphones. Mobile devices allowed users to not just capture and upload video from anywhere, anytime using mobile networks (EDGE, 3G and LTE), but also view it instantly from anywhere, anytime.

Consider the vast changes that have taken place around us

Barely a decade ago we had desktops and notebooks. Today we have tablets, e-readers and smartphones. We had news in the morning papers and then on television. Now we have it instantly on social media like Twitter and YouTube. We bought albums and CDs. Now we have iTunes and Spotify. We had unwieldy cameras. Now everyone uses pocket smartphones. We shot pictures on cameras and developed film. Now we Instagram and Flickr them. We used to cut coupons in newspapers. Now they are sent to our phone, based on who we are and where we are (and our shopping habits). We had printed maps. Now we have GPS and dynamic guidance with live crowd-sourced traffic data. You had to fill gas into cars. Now just plug in the electric power train and pull out the solar roof. We went to banks or ATMs for transactions. Now banks come to us on our smartphones. We can transfer cash by just tapping NFC-enabled phones / devices. Even the mouse click will soon be history. An entire generation will grow up interacting with machines using voice, touch and natural gestures.

For a wider perspective on the future imagine what happens when datagrams-meet-NFC-meet-video-meet-gesture-meet-machine-vision-meet-big-data-meet-mobile-meet-Cloud-meet-infinite-other-technologies. The answer is: a Big Bang. The same as when universes collide and absolute magic is created, provocative new visions are conjured, ground breaking ways to solve problems emerge and incredible new truths are thrown up. It's a new tech cosmology we are mapping, first hand.

Last year, after 224 years of dominating our lives, Encyclopedia Britannica went out of print. Kodak, the company that created the first digital camera in 1975 shut down. Ironically, it is Kodak's US$ 4 billion in research that has ensured a camera resides in your smartphone. Today there are almost 6 billion mobile phones – or roughly as many as people on planet earth. No one needs to own computers. Or even go to an Internet café. Just use a smartphone and gain access to infinite computing capability and storage in the Cloud. From wherever you are – first world, third world or flying somewhere in between. Pay over the air for the service, instantly, without having to write a check. Underlying this is a phenomenon of strategic importance to businesses. It is the trend of delinking asset ownership from capability. These are profound developments in how we view business. They will leave a lasting impact on society.

What is the business impact of these radical changes?

The Crossroads of Technology

At the intersection of these technologies there rises a shared world that is radicalizing the notion of services, education, entertainment, commerce, healthcare, banking, media, manufacturing, travel, law, governance, safety, politics and society itself. It is forcing us to reimagine everything.

Where are we headed? We believe to greater heights of efficiency. We believe we will see magnitudes of change in end user driven process experience. As an example, in the mid-70s, computers could deliver just over 10 million computations per kilowatt of energy. The laptops of 2010 were delivering over 1 quadrillion computations using the same energy. Energy requirements are expected to fall by half every 1.5 years. This means we will have even smaller and more powerful devices and sensors to generate and collect `nano' data - or customized, fine-grained, detailed data that captures every nuance of every interaction and transaction. Nano data processed in Cloud and made accessible in real time over mobile networks will enable a new order of intelligence processing. This will lead to the dynamic creation of new services and products. This will change user experience beyond current comprehension. What we have here is the intersection of a vast number of technologies. It's the chemistry between energy management, miniaturization, machine data, Cloud technologies, mobile networks and analytics that makes this possible.

We are tremendously excited about the future. At Wipro, our mission is to nurture and develop breakthrough solutions brought together at the intersection of these technologies. We know that we don't have to stop at predicting the future for digital natives. We can create it. We can ensure we also win that future for our customers.

Dr. Anurag Srivastava, CTO, Wipro Technologies

The Emerging Technology Landscape

We are harnessing the new tech cosmology to create breakthrough applications and solutions. By "breakthrough" we imply products, services, processes, ideas and answers that were not possible before. We do this by mapping the future that is unfolding. Our thinking and efforts are guided by the following five technology scenarios that ensure Wipro has a differentiated offering:

1 Intelligence Augmentation:

Research firm IDC had predicted that digital data from sensors (industrial, medical, public safety, etc), cameras, transactions (ATM, credit cards, shopping), online exhaust (website interactions), social interaction, open data (ex: weather, public transport schedules, etc.), historic data (demographic profiles, educational records, insurance claims, immigration archives, etc), production and enterprise data from within businesses, etc would have grown to 2.7 zetabytes in 2012, up 48 % from 2011.

With the proliferation of data, the challenge is to get to the sweet spot in the ocean of information (as quickly as possible). For this, it is essential to progressively:

1. Focus on the management of high-volume data at low storage costs.
2. Adopt and develop large scale data processing technologies to make real time business decisions.
3. Mix data from multiple sources within and outside the enterprise, integrate unstructured / semi-structured data and augment data with intelligence using machine learning.
4. Visualize the data based on the domain and the context.

The world is migrating towards an economy where experience takes precedence over ownership of assets. Today, it is possible to capture and analyze data in order to rebalance the experience economy.

Let's see how this translates into reality. Could meteorological data be combined with power requirements to mitigate the effects of hurricanes like Sandy that left over 6 million customers in 15 US states and Washington without power?

On the other side of the hurricane is recovery. Such hurricanes present a unique opportunity to test bisecting technologies. After Sandy, power grids have witnessed varying degrees of damage and degradation. Can remote assessment be made, circuit by circuit, so that repair crews can be given condition-based data that prioritizes work along with ensuring that the right spares / components are made available at exactly the right locations? Using such technologies the power utility does not have to wait for traditional run-to-failure of components that causes further inconvenience to customers.

Wipro's focus: Wipro is devising methods to extract valuable insights out of data by developing highly intuitive sense making systems. For example, we have developed ways to combine and correlate customer, product and market data from various internal and external sources like social data and open data to gain insights about customer needs and behavior, product issues and competitive positioning. We have created low-cost applications that can be embedded in smartphones to measure vibrations in a vehicle in real time that can help determine when the vehicle needs servicing, before it breaks down. In addition, fleet owners can determine which of their drivers are performing better, based on driving patterns measured by the stream of continuous data generated by the app. The same data can be used by insurance companies to arrive at more accurate insurance premiums.

2 Immersive Experience:

Google's study, "The New Multi-Screen World: Understanding Cross-Platform Consumer Behavior" showed that 90% of those surveyed move between devices such as smartphones, PCs, tablets or TV to accomplish a goal (such as making a purchase). According to Forrester's "The Tablet – TV Connection 2012" report, 18% of tablet owners are connecting their tablets to their TVs. Experience and social aspects are driving consumers towards an on-demand connected world. By the end of 2015, DisplaySearch forecasts that over half a billion connected televisions will have shipped.

At the intersection of physical and digital life are new forms of interacting with content and information, exploring ideas, making decisions and expressing thought and opinion. Consumers want Augmented Reality to overlay their physical world with digital information. Consumers want immersive experiences and these can be achieved progressively by:

1. Removing or lowering the man-machine barrier through new technologies such as gestures, touch, speech, specialized eyewear etc.
2. Moving users closer to digital consumerism where money is dematerialized and can be transferred between buyer and seller just by the tap of an NFC enabled device; point and know systems where, as an example, users can point a camera at an artifact (say a building or a restaurant menu) and know more about it, etc.
3. Bringing convergence between the physical and cyber worlds. For example, an operator sitting in the US can manipulate a mining device in Africa; a designer could create a product in one city and have it instantly "printed" in 3D in the place where the customer is located.
4. Crowd sourcing or using the collective economy for designs, development, ideas and just about anything that the human race desires.

The implications of consumers adopting a digital life are profound. Assets and resources need not be owned by consumers or businesses – they can be requisitioned when required. In addition, digital access to data, assets and resources that can be manipulated or used remotely will be a growing need.

Wipro's Focus: Wipro has a deep understanding of what it means to create immersive experiences that will define the future of digital life. For example, it has created a virtual fitting room that uses exciting new technologies such as surface computing, maps the skeletal frame of the shopper and allows them to try hundreds of clothes virtually. In the event that a shopper fails to find something appropriate, the system can send the shopper's preferences to multiple designers, along with body measurements. Such a system has the possibility of allowing customers to crowdsource designs customized for them. Wipro has also built a framework to recognize objects in the physical world to correlate the digital information about the object in the context of user activity and intent. One use of such a framework is to eliminate the need to refer to physical manuals, paper and mobile devices while performing maintenance and repair tasks on complex machinery through the use of augmented reality eyewear.

3 Smart Systems:

The number of computing and sensory devices has already outnumbered humans by several magnitudes. To build truly smart systems that go beyond carrying out or monitoring tasks in this world of "connected everything", it is important to factor the environment, ambient intelligence and contextual interactions. These systems are capable of self-learning and self-correction through a combination of IT, the environment and artificial intelligence.

These cyber-physical systems become smarter as they progress through the four levels described here:

1. Monitoring of data from equipment, enterprise and environment for predictive maintenance and intelligent control actions.
2. Decentralized and self-organizing supply chain systems consisting of smart agents that take intelligent decisions to optimize performance.
3. Systems capable of sensing the environment and reporting anomalies or taking automated actions.
4. Systems capable of monitoring health of people and their environment, detecting health emergencies and responding to them.

Wipro's focus: Wipro is harnessing the power of sensing technologies that are capable of going well beyond the task of monitoring and are capable of executing smart decisions, based on learning. As an example, Wipro's Innovation Lab has created a health necklace for use by patients who are receiving step-down treatment after surgery. These patients don't need to remain in the hospital but require constant monitoring of vital body parameters..

The light-weight medical grade necklace has electrodes that monitor 3 channels of ECG, heart rate, respiratory rate, body impedance and body movement using in-built accelerometer. The data is transmitted via Bluetooth to a mobile device with the patient and sent over mobile networks to hospital monitoring systems.

The monitoring system uses sophisticated algorithms to alert doctors when required and the patient can be called in immediately for treatment. The same data, if it were to be recorded by trained paramedics would be discreet. In the case of the necklace, the data is continuous, allowing doctors to reach better decisions than they could before.

4 Ubiquitous Enterprise:

As the growing population of digital systems, devices and sensors turns into a massive hyper connected electronic network of goods and services, the challenge will be to maintain computing landscapes that can scale effortlessly and work round the clock without any downtime. Such systems may need to reshape themselves based on the edge device being used to access them. At times these systems may need to trade off functionality or consistency in order to service volumes or optimize resource utilization.

This would mean a three-step change for business:

1. Enhance enterprise IT systems from their current focus on efficiency to effectiveness; move from being a system of record (data) to a system of engagement (customer focus); and reduce the number of platforms and applications.
2. Use new age development methodology, polyglot programming, development automation and enterprise app stores for rapid response to market needs.
3. Create multi-channel, variable functionality with always-on computing architectures for massive scale benefits, reducing cost per transaction.

Wipro's focus: Businesses and organizations will no longer find it feasible to be unavailable even momentarily (the birth of the Always-On Enterprise). Wipro understands that this is an extraordinary challenge that will tax IT systems, architectures and eventually impact scale and reliability. The Next Generation of IT systems will address the challenges of availability on scale, they will move from efficiency to effectiveness and will erase the boundaries between personal and enterprise computing. We are working on creating architecture blueprints and frameworks for building Service Cloud that will speed up development and deployment of new solutions in an enterprise. These will help deliver next generation data warehouses that process massive amounts of data from non-traditional data sources in real time alongside the enterprise data and help build Enterprise App Stores that support the next generation of client devices and applications and more. Our goal is to enable IT to change at the speed of changing business situations like mergers, acquisitions, spinoffs, business model changes etc. and maintain the service levels and user experience during this change.

5 Next Generation Materials & Manufacturing

Next Generation Materials and Manufacturing is an economic phenomenon. Products or services are delivered in ways that consume fewer resources. This can be as mundane as reducing physical materials in making a widget or as revolutionary as obviating the need for the physical product entirely. Next Generation Materials and Manufacturing fall under four clusters:

1. **Digital substitutes:** Exploit the increasing range of opportunities to replace physical things with digital substitutes. We can see this phenomenon around us. Some examples are downloading or streaming music, video, games, books and software rather than purchasing it or transporting it in physical form. Digital substitutes are also playing a key role in building new plants for manufacturing or new product prototyping. Between 60 to 70% of complex products today are designed and tested using simulators. These enable vast savings in product development as well as reducing cycle time.

2. **Product Dematerialization:** Move from physical to virtual, miniaturization, and eco-efficient products. Product dematerialization is seen increasingly using processes and technologies such as 3D printing or Additive Manufacturing. These materials are light-weight and unconventional. There are several advantages to the emerging science and engineering behind product dematerialization: inventory management can be simplified, labor can be reduced, manufacturing can be moved closer to markets, products can be launched faster and personalized and emerging trends such as social manufacturing can be tapped into.

3. **Context aware and smarter products:** With the proliferation of sensors and networks, newer products are being created. Many of these can be controlled by a smartphone and would be aware of the context they operate in. Technologies such as these would be aimed at monitoring the environment and predicting behavior or requirements to take appropriate action in an autonomous way. There are several such scenarios that consumers would benefit from. As an example, think about using smart jackets that automatically heat or cool depending on ambient temperature to ensure comfort.

4. **Nano materials and bio-synthetics:** New materials that use nano technology to mimic human tissue. They present the possibility of creating a direct interface to biological organisms. These could lead to new approaches in medical sciences.

Wipro's focus: At Wipro we are currently focusing on virtual factories, product personalization through 3D printing, efficient manufacturing using smart sensors and nano technology to build next generation devices. Wipro is a member of the Aerospace Network Research Consortium (ANRC) that works in various cutting edge areas that have potential to define the next generation aerospace network. ANRC research areas are categorized under Network architectures, Wired and wireless systems and networks, Virtualization and Simulations.

Wipro's Open Execution Model

Technology is morphing as it draws new ideas into its fold, as it interacts with the physical world, and draws upon a number of skills and experiences far too complex to nurture within an organization. Wipro's Open Execution Model is meant to tap into global networks where ideas can be crowdsourced, where skills for the future can be tapped into and where niche talent can be engaged with.

Open Execution is a way of opening up application (code) development to a large external group (not only employees) in the form of a public request. This request for input can be in different formats (competitive or collaborative). The idea is to extend the workforce beyond traditional organizational boundaries and drive next generation innovation. Wipro's Open Execution Model relies on connectivity and collaboration to drive next generation innovation, tapping into resources within and outside the organisation.

We have created a 'Technovation Centre'; we incubate emerging technologies, build prototypes and develop breakthrough applications. The Centre fosters a culture of innovation. It helps nurture our vision to be at the forefront of technology evolution and empower our customers to do business better.

Unlocking the CEO / CIO opportunity

Given the sweeping changes we are about to witness, what is a CEO or a CIO to do? The answers can be confusing and challenging. This is because the future continues to remain, if anything, more uncertain and unpredictable than before. However, instead of focusing on a particular technology or a process, the approach from a CEO / CIO point of view should be to look at near term, midterm and long term scenarios to navigate their businesses towards smarter outcomes.

Near Term Process Differentiation:

One of the key challenges before organizations is to improve customer experience and simultaneously reduce the (operational) friction between virtual and real-world assets. This can be achieved through process optimization, leading to differentiation. CEOs and CIOs should ask themselves: Can all our touch points be enhanced and supplemented by new digital technologies? Can we reduce human intervention? Can customer interactions be made 100% consistent and reliable? We need look no further than a bank customer (and which of us isn't a bank customer?). Bank customers typically have a vast number of queries and requests. These are related to their accounts, to investment instruments and for administrative tasks (statements, check books, stop payment, close fixed deposits, start recurring deposits, etc.). These processes have a high impact on the customer side. Ideally, the bank should turn all these interactions into natural language queries that can be made available to the customers. Every business has a set of high-impact customer-facing processes that need to be examined for process transformation to create a differentiator.

Mid Term Process Disruption:

Ideally, an organization's next step after improving processes would be to create far-reaching process disruption. This would mean eliminating process steps that are time consuming or impact the cost side. In other words, process disruption should ideally translate into process dissipation. Industries such as heavy engineering, automotive,

oil and gas, would benefit tremendously from such process dissipation. Their impact would be far reaching. Automobile manufacturing plants have begun their journey towards process dissipation. Mahindra Reva's solar-powered, networked, compact car, the e2o, has shrunk assembly steps from the 150-odd of traditional automobile manufacturing to a frugal 28. The impact of such re-engineering is significant. There is immediate improvement in manufacturing time, lowered costs and improved quality (since the points at which quality needs to be monitored have been reduced). One of the invisible outcomes of such process dissipation is the ability to replicate plants and processes with higher efficiency and accuracy.

Long Term Sustainable Leadership:

In order to gain sustainable leadership and competitiveness, businesses will need to find the opportunities for new or enhanced products, services and business models at the intersection of various technologies we discussed above. To build sustainable leadership, organizations will have to pay close attention to the convergence of edge technologies and screens (smartphone, tablet, specialized device/ instrument/ sensor, laptops, desktops and TVs) along with convergence of networks and networking technologies (NFC, Bluetooth, RFID, Wi-Fi, GSM, 3G, LAN, WAN, etc.) as well as disparate data capabilities (audio, text, images, video) and social and behavioral changes being influenced by these technologies. For example, in future, businesses will have to device ways where customers and employees stop worrying about the channel they use and can interact with the business seamlessly across channels with straight through processing: everything between the customer and the enterprise asset (human or machine) will become invisible.

	Travel Expense Management	Customer Service	New Product Rollout
Near Term Process Differentiation	Do It Yourself – travel requisitions and mobile expense settlement on the go	Single view of the customer – record of products in use, history of earlier service, location, preferences etc	Reduce Product Life Cycle – 3D product visualization and modelling and concept validation using social media
Mid Term Process Disruption	Extend app to partner eco-system - integration with providers like Expedia, Make-my-Trip, change itinerary online	Seamless multi-channel service delivery including the mobile channel; addressing the last mile ie field support	Prototyping on the fly using 3D printers, real time collaborative product design with supply chain partners and customers
Long Term Sustainable Leadership	Integrate with payment gateways for reconciliation and final payment and settlement Near real time reports and dashboards on trips and expenses	Personalized buddy app with natural language interface, Personalized/ individualized services, Problem solving by intelligent smart agent	Personalized / individualized product design, dynamic manufacturing and 3D factory. Capabilities like print a product at home or at remote locations

Wipro's Technology Edge

The intersection of technologies is helping us create breakthrough applications and solutions, providing us a unique differentiator. Wipro straddles the entire breadth of technologies required to make initiatives and ideas that bisect a success.
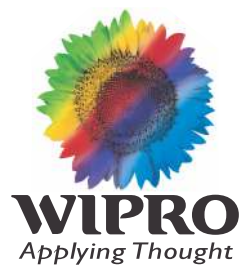
Our Impact: The four vectors of data on a gigantic scale that provides instant insights; the ability of consumers to make deep emotional connects through immersive experiences; networked systems that almost radiate intelligence; and businesses that are always on and are continuously morphing to customer needs, help Wipro:

- **Create new products and services:** Wipro can help sense the need for products and services before the consumer even knows they are needed; products and services can be created at optimal costs; new product and service roadmaps can be accurately drawn within the design phase; products and services can be created with minimal impact on the environment.
- **Reach new markets:** Wipro can address consumers in new markets instantly, drawn upon these markets for product requirements, design, enhancements, localization and feedback.
- **Enhance user experience:** By ensuring that the intersection of the physical and digital worlds is seamless Wipro is able to meet the expectations of the new generation of Digital Natives who value experience more than ownership.
- **Bring quantum shifts in operational efficiencies:** By tapping into the power of machine and human networks, Wipro is able to create a multiplier effect and bring quantum shifts in operational efficiencies and productivity. These are not incremental changes, but giant shifts in creating new business models and reducing operational costs thus giving a competitive advantage to businesses.

The radical changes we are witnessing are helping create a more inclusive world with advanced levels of transparency and public participation. They are bridging the gap between man and machines. Indeed, even bridging the gap that exists within humanity. They are removing barriers between enterprise and consumers. They are shrinking time between ideas, thoughts and execution. They are eliminating the friction in business. Above all, they are ringing a bell, reminding governments and business leaders, policy makers and public watchdogs that the world is changing at a furious pace. And it is important to begin to change now.

References

i.   http://www.news.com.au/business/kodak-to-stop-making-cameras/story-e6frfm1i-1226267309632

ii. http://www.itu.int/dms_pub/itu-d/opb/ind/D-IND-ICTOI-2012-SUM-PDF-E.pdf

iii. http://www.technologyreview.com/news/427444/the-computing-trend-that-will-change-everything/

iv. ibid

v.   http://www.forbes.com/sites/roberthof/2012/08/29/consumers-juggle-four-screens-daily-but-marketers-havent-yet-followed-them/

vi. http://blogs.forrester.com/sarah_rotman_epps/12-04-11-the_tablet_tv_connection

vii. http://informitv.com/news/2011/07/07/halfabillion/

viii. http://www.livemint.com/Leisure/V7vVAL6P6yuTA8NqBrR8NP/Mahindra-Reva-E2O--A-moment-in-the-sun.html

WIPRO
Applying Thought

About Wipro Ltd.

Wipro Ltd. (NYSE:WIT) is a leading Information Technology, Consulting and Outsourcing company that delivers solutions to enable its clients do business better. Wipro delivers winning business outcomes through its deep industry experience and a 360 degree view of "Business through Technology" - helping clients create successful and adaptive businesses. A company recognized globally for its comprehensive portfolio of services, a practitioner's approach to delivering innovation and an organization wide commitment to sustainability, Wipro has a workforce of 140,000 serving clients across 60 countries.

For more information, please visit **www.wipro.com.**

DO BUSINESS BETTER