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# Innovations with Smart Service Systems: Analytics, Big Data, Cognitive Assistance, and the Internet of Everything

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# Innovations with Smart Service Systems: Analytics, Big Data, Cognitive Assistance, and the Internet of Everything

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**Abstract:**

Service innovations, enabled by the confluence of big data, mobile solutions, cloud, social, and cognitive computing, and the Internet of Things, have gained a lot of attention among many enterprises in the past few years because they represent promising ways for companies to effectively and rapidly deliver new services. But one of today's most pervasive and bedeviling challenges is how to start this journey and stay on course. In this paper, we review some of the important developments in this area and reports the views voiced by five industry leaders from IBM, Cisco, HP, and ISSIP at a panel session at the 24th Annual Compete through Service Symposium in 2013. Panelists provided an extensive list of recommendations to academicians and professionals. The biggest conclusion is that all of the information and communications technology (ICT)-enabled service innovations need to be human-centered and focused on co-creating value.

**Keywords:** Big Data, Analytics, Digitization, Smart Service Systems, Innovation, Cognition, Digital Service Innovation.

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# 1 Introduction

Information and communication technologies (ICTs) are a fundamental driver of today's growing service economy. Growing knowledge of designing, executing, storing, transmitting, and reusing ICT along with the evolution of digitization and the Internet are creating opportunities for organizations to configure service-based business models to increase their competitiveness and revenue growth. More specifically, properly digitizing processes (i.e., digital services) with IT provides organizations with the means to improve their effectiveness, efficiency, and innovativeness by 1) making it possible to inform consumers more effectively for value co-creation; 2) improving collaboration (e.g., inter- and intra-organizational workflows and business processes for B2B2C service offerings); 3) facilitating new types of services (e.g., Google, online banking); 4) separating a service's production and consumption, which allows better storability, transportability, and access to knowledge-based services (e.g., tax software, online classes); 5) integrating customers into creating and delivering services (e.g., online educational services, health information systems); and many other ways (Demirkan & Delen, 2013). According to Accenture Technology Visions 2014 and 2015 (Daugherty, Biltz, & Banerjee, 2014; Daugherty, Banerjee, & Blitz, 2015), digitization is a new layer of connected intelligence that augments the actions of individuals and organizations, automates processes, transforms data, and incorporates digitally empowered systems into our lives, increasing our insight into and control over the tangible world. With digitization, everybody can create data with interactions.

As a result, big data has emerged as the latest trend for organizations to differentiate themselves and become more innovative and competitive (Eaton, Deroos, Deutsch, & Lapis, 2012). According to Gartner Research, the worldwide market for analytics will remain top focus for chief information officers (CIOs) through 2017 (Gartner, 2013). Global market research and consulting company Markets and Markets has anticipated the global BI and analytics market will grow from USD$13.9 billion in 2013 to USD$20.8 billion by 2018—a compound annual growth rate (CAGR) of 8.3 percent (James, 2014). Even though 73 percent of companies intend to increase spending on analytics and making data discovery a more significant part of their business intelligence and analytic platform architecture, 60 percent feel they don't have the skills to make the best use of their data (James, 2014). On the other side, according to Computerworld, "More than half of all business intelligence and analytics projects are either never completed or fail to deliver the features and benefits that are optimistically agreed on at their outset". Moreover, previous generations of decision-support technologies have frequently failed to deliver their full potential in practice, and many businesses are struggling to make sense of their already large volumes of data (Gillon, Aral, Lin, Mithas, & Zozulia, 2014). While there are many reasons for this high failure rate, the biggest is that companies treat these projects as just another IT project (Demirkan & Dal, 2014). Further, an acute shortage of skills and unclear roadmaps threaten businesses' ability to address emerging opportunities and risks.

Despite the fact that the academic literature on the opportunities to create value through data-driven decision making continues to grow (Brynjolfsson, Hitt, & Kim. 2012; Davenport, Barth, & Bean, 2012; Dhar, 2013), organizations are still having lots of research- and education-related challenges and opportunities with digitization and big data solutions (Moore, 2011; Murphy, 2013).

A recent panel at the 24th Annual Compete through Service Symposium on November 2013 brought together leading researchers and practitioners to share knowledge and insights on service innovations, digitization, and big data. The session discussed what is new about these trends to understand the implications for education, research, and businesses. From the practitioners' eyes, we look for emerging trends and innovations in technology-enabled service innovations.

In Section 2, we discuss big data's foundations. In Section 3, we organize the panel and the practitioners' viewpoints. Finally, in Section 4, we summarize our contributions and provide recommendations.

# 2 What Is It, Where Does It Come From, And How Is It Used?

Big data, which means many things to many people, is not a new technological fad. It is a business priority that has the potential to profoundly change the competitive landscape in today's globally integrated economy. In addition to providing innovative solutions to enduring business challenges, big data and analytics instigate new ways to transform processes, organizations, entire industries, and even society altogether.

Traditionally, the term big data has been used to describe the massive volumes of data analyzed by huge organizations such as Google or research science projects at NASA. But, for most businesses, it's a

relative term: “big” depends on an organization’s size. The point is more about finding new value in and outside conventional data sources. Pushing the boundaries of data analytics uncovers new insights and opportunities, and “big” depends on where you start and how you proceed. Big data is the term for a collection of data sets so large and complex that it becomes difficult to process using on-hand database-management tools or traditional data-processing applications. The challenges include capturing, curating, storing, searching, sharing, transferring, analyzing, and visualizing data, among other things.

A simple answer to where big data comes from is “everywhere”. Data sources that organizations have ignored because of the technical limitations are now treated as gold mines. Big data may come from Web logs, RFID, global positioning systems (GPS), sensor networks, social networks, Internet-based text documents, Internet search indexes, detail call records, astronomy, atmospheric science, biology, genomics, nuclear physics, biochemical experiments, medical records, scientific research, military surveillance, photography archives, video archives, GPS cameras, large-scale e-commerce practices, Internet search histories, retail transactions, genomic/biomed research, and so on.

However, big Data is not just “big”: it is also associated with other characteristics, such as:

- Volume, which concerns 1) data at rest, and 2) storage
- Velocity, which concerns 1) data in motion / streaming data, 2) bandwidth (measured in milliseconds to seconds), and 3) data processing (i.e., how fast data is being produced and how fast it must be processed to meet the need/demand).
- Variety, which concerns data’s many forms (i.e., structured, unstructured, text, multimedia, video, audio, sensor data, meter data, html, text, emails, and so on)
- Veracity, which concerns data in doubt (uncertainty due to data inconsistency and incompleteness, ambiguities, latency, deception, model approximations, accuracy, quality, truthfulness, or trustworthiness of the data)
- Variability, which concerns data in change (the differing ways in which the data may be interpreted, different questions require different interpretations, data flows can be highly inconsistent with periodic peaks)
- Value, which concerns data for co-creation (the relative importance of different data to the decision-making process)

Organizations are finding managing large amounts of data (big data) increasingly challenging. This challenge is only growing because of cheaper storage and the evolution of digital data and information-collection devices, such as mobile phones, laptops, sensors. Also, with more connected devices, objects, applications, and machines, individuals are increasingly turning their attention to the online world. For example, IDC estimates that the Internet of things will reach approximately 212 billion devices in 2020 (IDC, 2013). Cisco predicts that the Internet of things’ (bringing together people, process, data, and things to make networked connections) market will be worth USD$14.4 trillion over the next decade (Cisco, 2013). According to the McKinsey Global Institute, of the five billion mobile phones in use in 2010, 12 percent were smartphones, but this figure has grown rapidly by 20 percent each year: Apple sold nine million iPhone5s phones alone during initial weekend of 2013. Moreover, the organization estimates global data to grow by 40 percent per year: as it is, people share 30 billion items on Facebook every month (McKinsey Global Institute, 2011). Facebook, a social networking website, is home to 40 billion photos, and Wal-Mart handles more than one million customer transactions every hour, which feeds into databases estimated at more than 2.5 petabytes. There are 4.6 billion mobile-phone subscriptions worldwide, and up to two billion people use the Internet (The Economist, 2010). As such, we are obviously living in an era of data and information. In this paper, we explore what companies such as Cisco, IBM, and HP are doing to leverage it to increase their revenue.

## 3 Organization of the Panel

Haluk Demirkan (University of Washington–Tacoma) organized and led the panel, which was presented at the 24th Annual Compete through Service Symposium (http://wpcarey.asu.edu/symposium) in sponsorship with IBM on November 6-8, 2013 at Phoenix, Arizona. Around 200 people who represented 65 national and international companies attended the symposium. We detail the symposium, including a sample list of companies represented, in Appendix A.

Panelists were (in order of their presentation):

- Charlie Bess, Fellow, HP Application Business Services Americas Chief Technology, HP
- Dr. Jim Spohrer, Director of IBM University Programs and Cognitive Institute, IBM
- Dr. Ammar Rayes, Cisco Distinguished Engineer, Cisco
- Dr. Don Allen, Global Program Lead of Cisco Systems, Cisco, and
- Yassi Moghaddam, Exc. Dir. of the International Society of Service Innovation Professionals (ISSIP).

We provide a brief background of each panelist at the end of this paper.

Haluk opened the session by overviewing IT-enabled service business models. Currently, there are four primary paths of service business models: 1) How to improve service operations… because services as a percentage of GDP…, 2) Service transformation/infusion… transforming goods—dominant companies to services and solutions enterprises…, 3) Service orientation… because it may enable agility in today's complex business environments…, and 4) Digital service innovation … the path to success in Internet and mobile age.

Over the last decade, IT innovations including cloud computing, big data, analytics, social, mobile, the Internet of things, and others that have increasingly made our world more interconnected and complex. These dynamic developments have eroded the boundaries between previously separate IT processes, architectures, infrastructure, services, and networks and led to new ways of designing, executing, storing, and transmitting data and information (Figure 1).

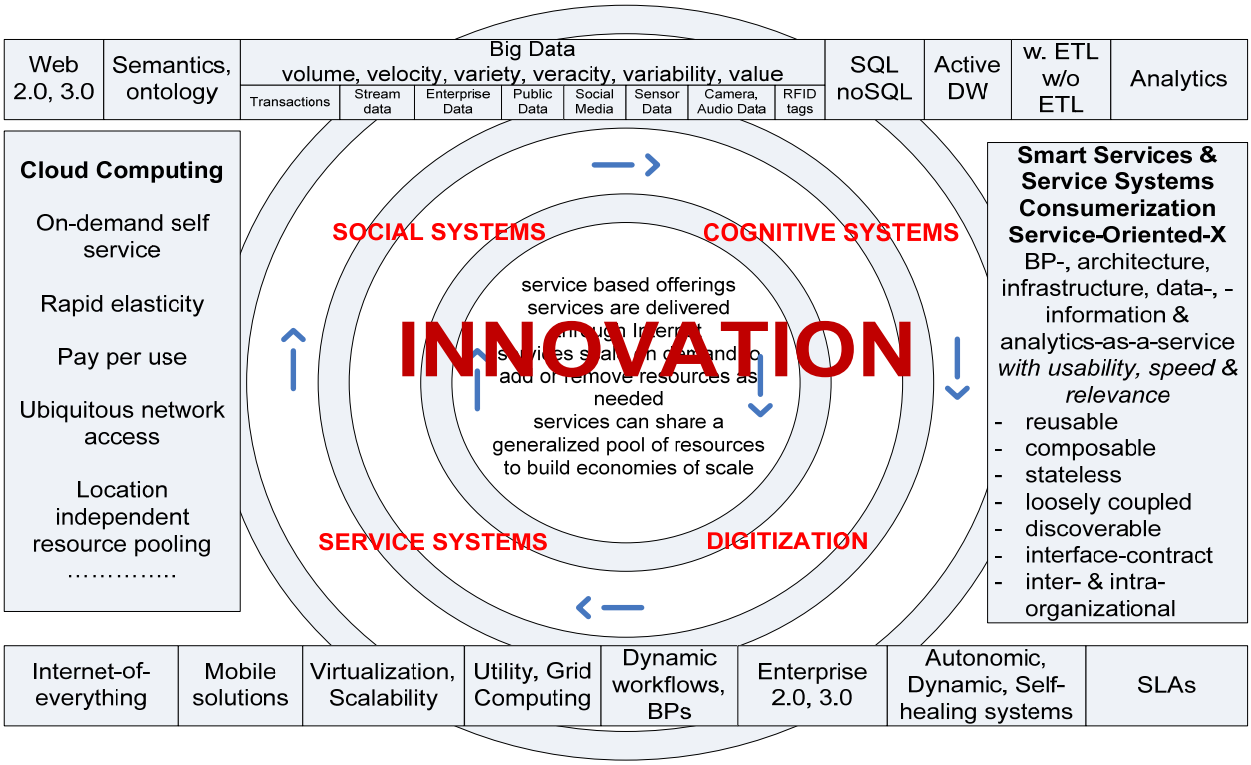


**Figure 1. Conversion of ICTs (Adapted from Demirkan, 2013)**

As such, we think that maybe it's time to rethink ICT and service innovation from new organizational and technical vantage points.

We summarize the panelists' comments about the issues they addressed below:

- Charlie Bess discussed what today's megatrends and technical enablers are.
- Dr. James C. ("Jim") Spohrer presented his view of big data and smart analytics in the context of service systems and discussed how big data and analytics are related to social and cognitive computing.

- Dr. Ammar Rayes presented his view of big data and advanced analytics in the context of growing developments and usage in the Internet of everything.
- Dr. Don Allen presented his view of "services, big data analytics and the human in the middle".
- Yassi Moghaddam presented the ISSIP's views on smart analytics.

All panelists briefly responded to the various inter-dependable questions before the session was opened to the audience for questions and a general panel discussion.

## 3.1 Charlie Bess: Service Analytics Megatrends and Technical Enablers

According to Charlie, there is a great deal of change taking place in business today. The changes can seem overwhelming, but many can be predicted. All organizations regardless of their industry will be impacted by these megatrends: the trends that are forcing organizations to move to the next level. Figure 2 illustrates a few of them.

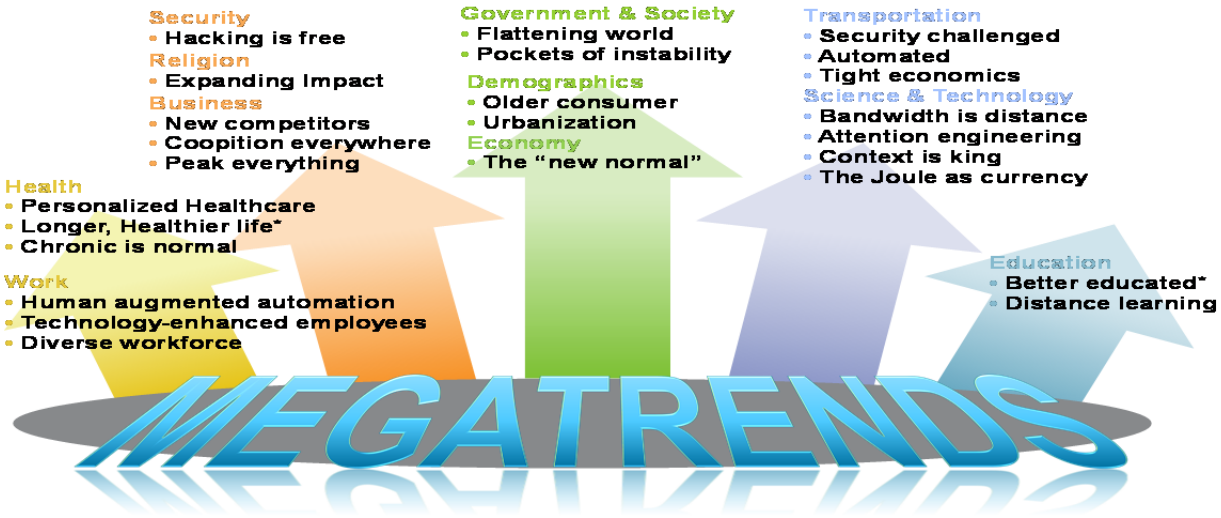


**Figure 2. Megatrends (Used with Permission from HP)**

As humans live longer, their societal roles will change. Many desire more education, and bandwidth is becoming the measure of distance, which means that distance learning for the masses will shift how we view education in the future. In addition to these business enablers, significant shifts are occurring place on the technical front. Most of the IT systems in production today are based on a scarcity model, but many of those restrictions are no longer true. We're moving into an age of unlimited data and abundant networking capability (both wired and wireless) that can transport all that information to a near-limitless number of computing capabilities (Figure 3) (even compared to just a few years ago) that make available whole new levels of access to applications and intellectual property.

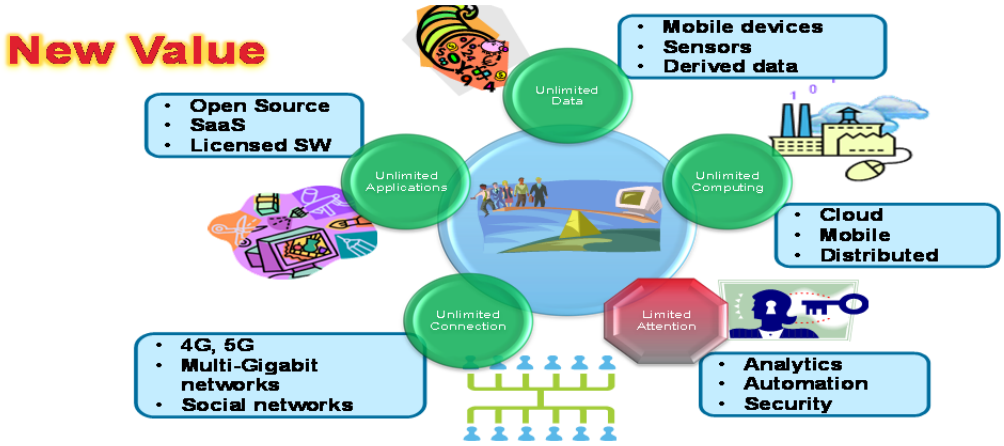


**Figure 3. Technical Capabilities (Used with Permission from HP)**

But, even with all that abundance, scarcity will still exist. Employees' attention on key initiatives will still be scarce. Security and privacy will also scarce. Each organization needs to understand what is abundant to them and what remains scarce and maximize the value of what's scarce by effectively consuming what is abundant. Fortunately, for strategists, several laws that exist that have held the test of time, such as Moore's law and Metcalfe's law, that individuals and organizations can use to predict the future, which allows them to shift their initiatives to address their goals.

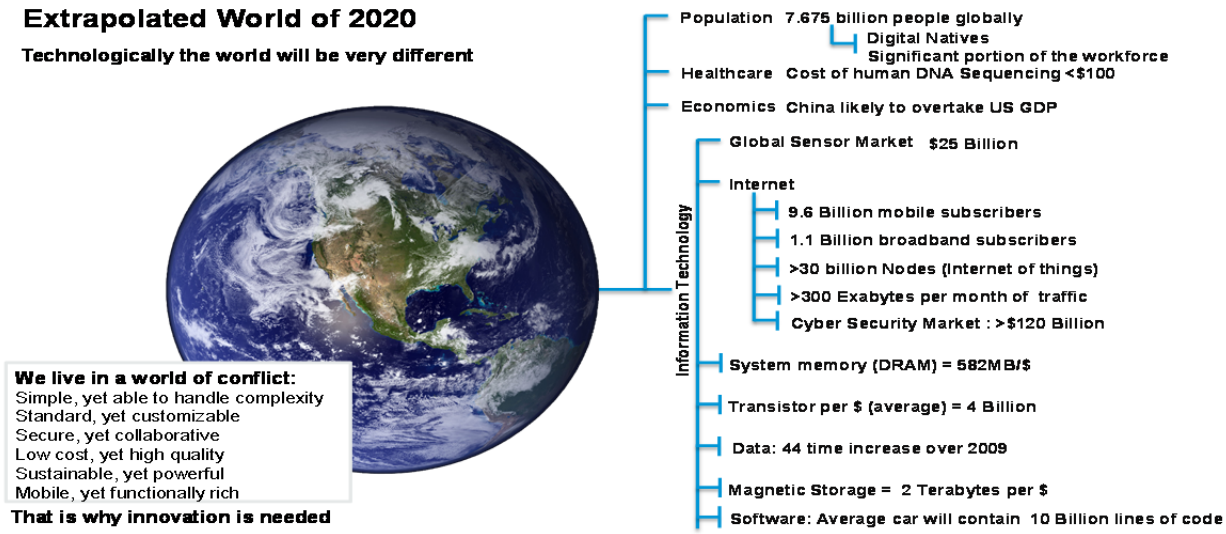


**Figure 4. Extrapolated World of 2020 (Used with Permission from HP)**

This extrapolated view (Figure 4) can help society resolve some of the fundamental conflicts that it faces, such the fact that people want systems that are:

- Secure and yet collaborative, and
- Standardized and yet customizable.

It's with these diametrically opposed requirements where real innovation and opportunity exist. According to Charlie, one of the biggest challenges is that scarcity affects value. Too often, organizations behave like what is valued for its scarcity will still be true in the future or like what constrains them from generating value a certain way will still constrain them going forward. Most of the IT systems currently in production are based on a scarcity model, but these design assumptions may no longer be true. Data is not going to be scarce in the future, but the business context that the data describes still be. Employees' attention will certainly will be scarce. If we need to consume more (of what's abundant) to generate even more value from what's scarce, that is not a bad thing.

## 3.2 Dr. James C. Spohrer: Service Systems and Cognitive Assistants

According to Jim, what qualifies as "big data" is a moving target. In the 1950s, megabytes (10**6 bytes) were considered big data, but today that is small data. For example, in a single day, the New York Stock exchange generates a million times that amount. Because of IT innovations in storage, processing, and bandwidth, today's global data storage is measured in zettabytes (10**21 bytes), and many businesses consider terabytes (10**12 bytes) to be "big data". For example, Google stores thousands of terabytes or petabytes (10**15 bytes) and CERN's Large Hadron Collider can generate terabytes of data each second (Cern, 2015; Collins, 2013).

IT as a service is an ongoing area of innovation, which makes it easier and more economical for customers to benefit from big data in the cloud. In a 2012 IBM and University Oxford report on the real uses of big data, over 60 percent of respondents surveyed indicated big data as a source of competitive advantage in their industry or markets (Miele & Shockley, 2012).

Jim also explained how big data and analytics are related to smart services and smart planet (Figure 5). According to Jim, because business and societal systems are instrumented (sensors), interconnected (data stored in the cloud and accessible from mobile devices), and intelligent (cognitive systems can provide customers with high-quality recommendations and help customers make better data-driven decisions), we can say that business and societal systems are getting smarter. Across all sectors, systems—transportation, water, food, manufacturing, energy, communications, retail & hospitality, finance, healthcare, education, and even government systems—are becoming smarter. In addition, of course, we would expect smarter systems to waste fewer scarce resources and lead to more productive and sustainable systems. Many types of smarter service depend on IT as a service, including big data analytics. From rerouting traffic around congestion to personalized medicine avoiding drug interactions, smart service depends on better data and better models of value realization. Scare or uncertain data and outdated or inappropriate models of customer value realization can be problematic. Accurate measurements of a dynamic world and accurate knowledge about a dynamic customer are needed to provide smart service.

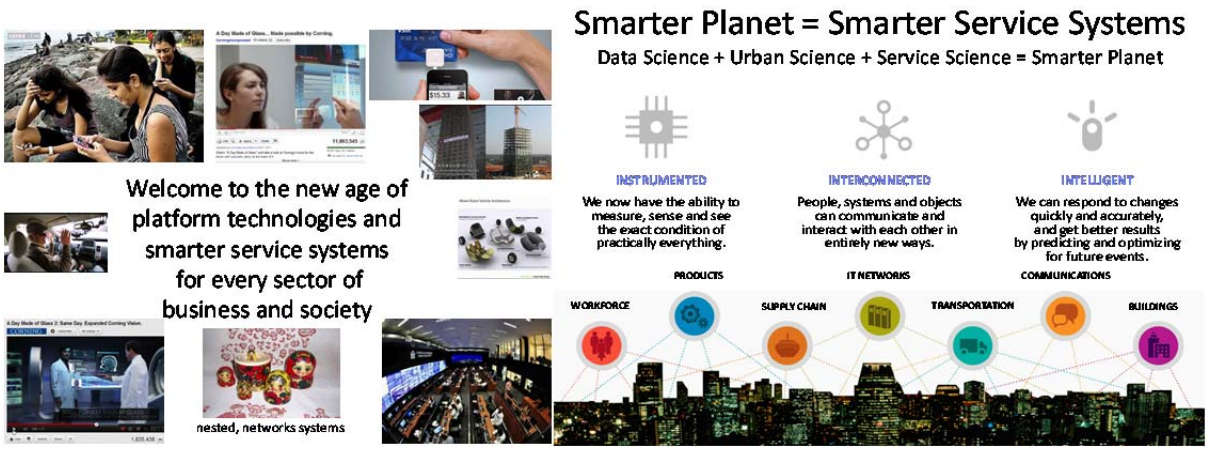


**Figure 5. Smart Services and Planet (Used with Permission from IBM)**

In Jim's view, social computing can be both a source of information about the world and about a specific customer. Recommendations engines such as those used by Amazon can suggest options to customers based on thousands of other customers like them. However, social media websites such as Facebook, LinkedIn, and Twitter can also provide insights based on friends and peers to tune recommendations. Of course, smart phone vendors such as Apple, Google, Samsung, Lenovo, and others can also benefit from geospatial and other types of interaction data.

According to Jim and many others, nearly all professions—from doctors to lawyers to scientists—are being transformed through access to more data. Information-intensive service sectors, including education, are finding new ways to give student teams the experience they need by using tools and statistical techniques most relevant to their profession (Figure 6). For example, lawyers can use natural language processing tools to search mountains of evidence in both a less costly and more efficient manner. IBM is working with more than a thousand universities globally to provide access to real-world

tools for optimization, predictive modeling, and data mining. All disciplines can benefit from revised curriculum and an understanding of the types of data and tools available to their professionals. In the future, cognitive systems that know more about the papers professionals have read can also boost productivity and creativity of individuals, teams, and organizations.

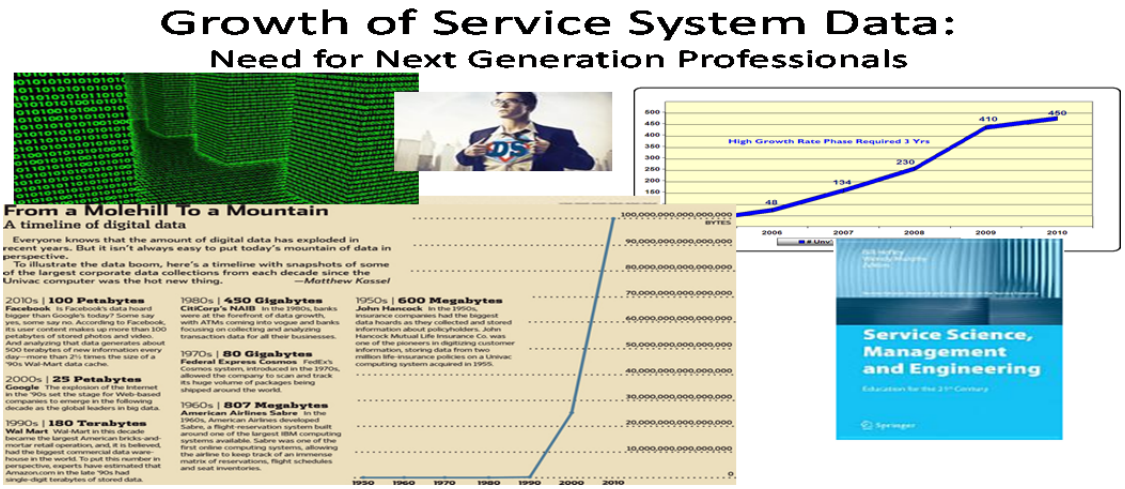


**Figure 6. Need for Next-generation Professionals (Used with Permission from IBM)**

These next-generation professionals will be more than I-shapes with depth in one area and become more T-shaped with depth and breadth for working on multidisciplinary teams to solve complex problems. The International Society of Service Innovation Professionals (http://www.issip.org) promotes smart service innovations and the development of more T-shaped professionals spanning disciplines, sectors, and cultures.

The biggest challenge is also the biggest opportunity: life-long learning to improve quality of life for individuals in regions around the world. T-shaped professionals are known for their empathy for their customers and for their teammates—they have a passion for learning and seeing the opportunity in new innovations. T-shapes are sometimes known as adaptive innovators with empathy for their customers and teammates.

## 3.3 Ammar Rayes: Internet of Everything

According to Ammar, as we become more connected via the Internet of everything (IoE), many service providers are asking themselves why they would minimally sell a device and forgo very essential feedback information when they can also sell enhanced service contracts for, for example, advanced and service level agreement (SLA) monitoring. More importantly, service providers are interested in obtaining such feedback from devices and customers to determine the most essential set of future enhancements. Feedback information may be categorized by market segments but generally include common set of specific information such as features used the most, features use the least, features never used, and feature usage patterns.

Also, with these solutions, the advantages for organizations may be more significant. Customers can now outsource the management of their devices/networks by taking advantage of cloud computing and virtualization and demand guaranteed level of service agreement that includes automatic diagnostic, optimal performance, and high availability. Such a model has allowed customers to concentrate on their core business by leaving the infrastructure and IT support to the experts.

Emerging big data and smart analytics is driving this new world in which every connected product turns manufacturers and, in many cases, others along the value chain into a new kind of “smart service” business. This new model is bending the traditional linear value chain into a “feedback loop” through which data will continually flow back through the complex business systems that create, distribute, and service those products. Early adopters of proactive big data and analytic via connected services are creating unprecedented performance and unique barriers to competition that underscores the strategic impact of intelligent device networking on after sales and services management. For example, with smart trucks, one can continuously monitor the integrity of perishable goods (Figure 7).

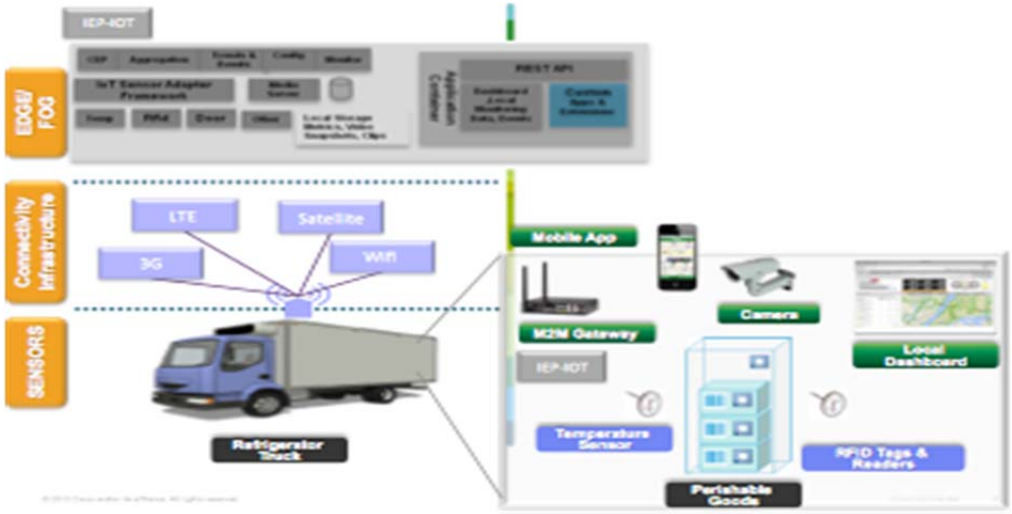


**Figure 7. Smart Trucks (Used with Permission from CISCO)**

In Ammar's definition, big data is datasets whose volume, variety (structured and unstructured), and velocity requirements are beyond the ability of standard software tools to capture, manage, and process data in a tolerable elapsed time. Analytics is the discovery of meaningful patterns in data relying on statistics, computer programming, and operations research to approach problems in business and industry. On the other side, business intelligence is applications used to analyze an organization's raw data to provide historical, current, and predictive views of business operations and customer behavior to help make stronger business decisions.

For example, in the below figure with smart trucks, perishable goods' integrity can be continuously monitored with:

- IOT sensor adapters enables data collection and filtering
- Edge logic for data aggregation and cloud processing (logging/analysis, etc.)
- Local Wi-Fi connectivity and cloud connectivity infrastructure
- Edge complex event processing, which enables higher-order business events and actions (e.g., anomaly detection), and
- Edge visualization capabilities to render data needed in a truck.

He also discussed about two case studies from JPMorgan Chase and Great Western Bank (see Table 1).

Ammar also provided simple process steps for IoE-enabled smart analytics projects:

1. Determine the required data from sensors, devices, and people. This is perhaps the most critical and difficult steps—especially for new technology. Statics can only be defined if the outcome/value is predetermined.
2. Once the statistics are determined in step 1, advanced protocols may be required to collect (or sense) the required information.
3. Once the data is collected at (or close to) the source (at the frontend, client site), real-time local analysis (e.g., by the collection agent itself) will be required. Traditional local analysis includes on-board diagnostics that identify problems and fix them at the source (e.g., high-temperature, very high utilization that may cause global instability, sensor failure).
4. Advance and secure APIs to transmit collected (or locally analyzed) data from the device to the cloud / backend systems secularly for long term analysis and trending.
5. Data privacy and security need to be designed: methods to entitle, validate, parse, and analyze the collected data once it is received by the backend system. Hence, entitlement, data validation, data parsing, and data analysis requires interactions with the supplier/partner backend systems and databases including intellectual capital information
6. Algorithms to calculate service-based performance (e.g., end-to-end service SLA), diagnostic, and security compliance measures should be calculated at the backend.

7. Identify the thresholds (e.g., quality of service, grade of service) should step 6 estimated measures be evaluated against.
8. If step 6 estimated measures are above the threshold, take real-time and/or non-real time actions in the impacted device and/or the network.
9. If action is needed, plan for which secure protocol should be used access the device/network from the backend system and take action?
10. Finally, plan for which trending algorithms should be used to predict future measures?

He finished his opening statement by mentioning some challenges:

- What data to track and collect for analytics?
- How to collect such data from a wide range of services?
- Which methods/techniques to structure various type data in a timely fashion?
- Which systems/algorithms/solutions to get the business intelligence out the collected data?
- Which techniques to trend the data and determine the set of potential future services.

**Table 1. Example Big Data Implementations from JPMorgan Chase and Great Western Bank**

| JPMorgan Chase | Great Western Bank |
|---|---|
| • Generates a vast amount of credit card information and other transactional data consumers<br>• It combines that database (>1.5 billion pieces of information), with publicly available economic statistics from the U.S. government<br>• Then it used new analytic capabilities to develop proprietary insights into consumer trends, and offer those reports to the bank's clients. The technology allows the bank to break down the consumer market into smaller and more narrowly identified groups of people, perhaps even single individuals.<br>• Those new reports can be generated in seconds, instead of weeks or months.<br><br>JPMorgan Chase, Bank of America, Citigroup and Wells Fargo have been using big data solutions to quickly process info from social media posts and emails. They also use analytics to analyze internal bank records and correlate them with the above given banks a more accurate picture of their customers, and a better ability to predict which customers are likely and credit-worthy buyers of new financial products. | • The bank used to send out promotional mailings offering customers rewards for opening new checking accounts.<br>• Customers would make an opening deposit on the account and then the account would stay dormant - Great Western Bank would lose money on those accounts.<br>• Now, the bank is using big data tools from Microsoft to target only more profitable customers in its marketing campaigns.<br>• With fewer customers visiting branches, the bank's staff doesn't have the one-on-one time to develop an understanding of what the customer wants.<br>• Great Western already has seen improved returns on its mailing campaigns using analytics-driven marketing.<br>• The next step in Great Western's big data strategy is to incorporate and analyze data from social media to help draw in younger customers: catch people in their 20s before they get a car loan and a home equity loan. |

## 3.4 Don Allen: The Human in the Middle

### 3.4.1 What is the Human Side of Digitization and Big Data?

The term big data is used to describe the collection of large and potentially complex data sets containing both structured and unstructured data into commonly accessible data sets. Individuals have described it as having the potential to be as important to business and society as the Internet is to business today. Big data represents the technology that can help aggregate data sets that were traditionally stored in siloes, organized around specific applications (business transactions) or tasks (content search), and stored in relational data bases or file systems located in the company's data center. Access to these traditional data sets was optimized around specific transactional uses such as business transactions (tasks). Big data has the potential to aggregate a large number of these transactional or task-oriented data sets into a single ubiquitous access point where behavioral and statistical analysis techniques can be applied to uncover new behavioral patterns and market segments. With the advent of cloud technologies—specifically cloud storage—it has become cost effective for companies, governments, and other organizations to store large volumes of unstructured and semi-structured data in "the cloud"—typically in off-premise and oftentimes off-country data centers. The extension of storing this data outside of the tradition corporate IT sphere of

control has introduced several significant security and privacy issues for consumers (humans), companies, governments, and service providers.

Many factors combine to form a human's view of big data and define the role humans play (Figure 8) in the big data universe. Privacy and security are the common focus of most big data laws, policies, and standards being developed. There are, however, other topics with a human focus that need to be considered in the big data discussion such as the monetary value and ownership of the data. This section contains information on big data issues as they relate to the human side of big data.

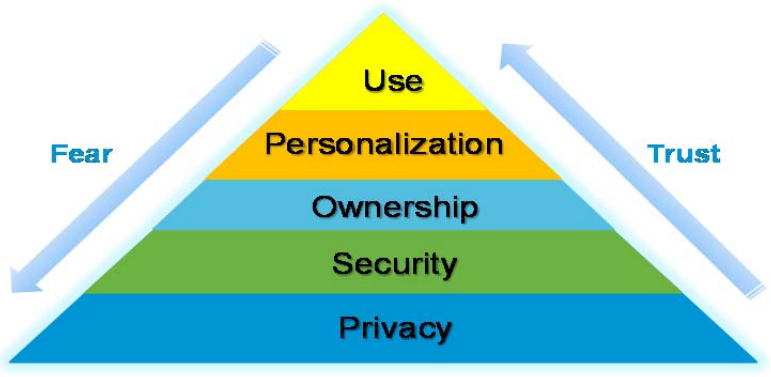


**Figure 7. Human Big Data Hierarchy of Need (Used with Permission from CISCO)**

Personal privacy is a first principal in addressing big data people-focused issues. The loss of personally identifiable information through a breach in security is often sensationalized in the media, which has raised public awareness about it. Breaches of corporate data have resulted in significant monetary, brand, and consumer confidence losses. Traditional and social medial have stressed the importance of properly protecting personal information, and government and standards organizations are diligently establishing and updating policies about securing personal information. Governments are increasing the enforcement of privacy laws through creating and funding departments focused on privacy protection. Standards and government policy makers must continue to refine and update their policies as big data analytics evolves. The identification of what is considered private personal data is core to developing the laws and policies required to govern it.

Anonymity (the act of remaining publically unknown) and control over it is an important aspect of a person's life, particularly when it comes to navigating the Internet. Anonymity is becoming increasingly more difficult to maintain as more Internet sites are requiring information from users to use a provided service or to obtain "registered" user access to services they provide. When presented with the decision to provide this information, people must weigh the risk of sharing to the benefits of the service. Website sponsors are producing extensive terms of use and privacy policies that users must accept during registration. Issues of trust, site ownership, data security, and concerns over how the provided information will be used and a lack of oversight and penalty if it is inappropriately used are common. Article 17 of the new European Union General Data Protection Regulation includes a provision that will give people the "right of erasure" (renamed from the previous term "right to be forgotten") to address some of these concerns. Under the article, people are granted the right to request their personal data be erased, including links to, copies of, and any replications of private data provided to a third party. Ensuring people have the ability to erase their personal information is a significant first step; the next logical step is assisting people in tracking the businesses to whom they have provided information and implementing policies that support citizens to remove their data when they deem appropriate.

Securing big data is a leading concern and focus for security experts responsible for protecting a company's reputation and customer's data and for governments protecting their citizens and their sovereignty. Prior to the advent of big data, security standards and policies focused on securing information from breaches or leakage stored in a company data centers. Security breach exposures have been well documented and sensationalized in the media: for instance, the recent Target data breach affected tens of millions of customers and may have an impact on Target's profits longer term. Security research is increasing in areas such as intrusion detection in high-speed networks, anomaly detection, and cryptography in response to the increasing number of cyber-attacks. Experts anticipate an increase in

the number of security breaches and attempts, and big data storage will increasingly become the targets of such attacks in part due to the large amount of data stored.

"Who owns the data?" is a question whose answer impacts how other big data issues are addressed. This question has gone largely unaddressed outside of personally identifiable information laws, policies, and standards. Clearly, a person owns their own PII and can lend it out to businesses and governments for use. In such a situation, the information is shared for a specific use with the expectation that it can and will only be used for the prescribed purpose. Consumers expect that their information will either being deleted or anonymized when that purpose is served. People are most familiar with demographic and statistical data when it is aggregated with other data and presented in charges and statistics describing large groups of people. The value of a single data point in an aggregated set of data is relatively small and insignificant and is lost without the context of the other data in the set. The value of non-PII data that is continuously being collected and captured tied to a particular person is not as obvious. As more and more companies amass large data sets of businesses' and people's habits and activities, the fuel needed to run the big data analytics engines. How much would a pharmaceutical company being willing to pay a person who maintains an extensive electronic medical history, including exercise regimens, eating habits, and lhow long they had taken a specific drug? Who has ownership rights to the data? Ownership of medical history is straightforward because it has been consistently identified as personal information. Ownership of exercise and eating habits becomes complicated if a person uses an equipment supplier's website or a free application to track and store that information. The ability for a person to sell the non-medical information will depend on the usage agreement accepted when signing up to use the provided service. Creating standard agreements for these situations would enhance big data's access to this information and address privacy concerns for the people agreeing to them.

Aggregating data from different data sets has the problem of losing security context. A user who provides data in one context—say, to apply for a home equity loan—may not have wanted to allow that data to be consolidated with data they provided when they registered for a sweepstakes drawing to support a marketing campaign for houses for sale in Aruba.

Don finished his opening statement with how service science, service innovation, and service design disciplines have the opportunity to shape and influence how big data addresses these issues through establishing interface between service businesses and the people that use them. Identifying and defining service-centered interactions between users and business which data collection, usage, ownership, privacy, and security in the context of service delivery and co-creation of value would provide a context in which solutions can be developed. Big data's impact on the "service-for-service exchange" and service value creation where the value equilibrium between service provider and service consumer may be disrupted by the change in service relationship. Understanding the roles and motivations of the participants in the service relationship and the development of value-in-context models is critical to addressing big data's application to services.

## 3.5 Yassi Moghaddam: Professional Societies

Yassi overviewed ISSIP. In her opinion, smart analytics are the foundation for data-aware sensing smart service systems (whether products or services) that enable organizations to co-create value for customers in new and innovative ways. Today, social, mobile, big data, cloud, the IoT, and many other emerging solutions are making our world more instrumented, interconnected, and complex. Yet, most organizations struggle with complexity: most professional organizations do a great job of focusing on one discipline, function, or industry sector but not on the interconnections that is causing the complexity. Smart analytics enable individuals and organizations to understand, manage, and leverage this complexity and help solve business and societal problems. ISSIP's mission is to promote smart service systems and service innovations for our interconnected world.

The availability of more data about people and things allows physical assets that traditionally were only consumed as goods to be disaggregated and consumed as services. We are seeing a shift in value creation from value being created in traditional industry boundaries to being co-created at the intersections of multiple industries and with customers' participation. Service Innovation is "a combination of technology innovation, business model innovation, social-organizational innovation…with the objective to improve existing service systems (incremental innovation), create new value propositions (offerings) or create new service systems (radical innovation)". Today, most "innovation" frameworks and research and development dollars are focused around product innovation, and very little attention so far has been given to service innovation. As a result, many companies have missed (or will miss) out on the tremendous

service innovation opportunities that increasingly resides at the intersection of ICT-enabled complex service systems.

While the ISSIP is a professional society designed to focus on the interconnected nature of value co-creation for smart service systems (tech, biz, social, etc.), other organizations are responding to these changes and needs in different ways:

- Universities: service-oriented research and academic programs have been on the rise over the last decade. Hundreds of universities across the globe now offer either a degrees or interdisciplinary courses focuses on service science, management, engineering, or design.
- Businesses: businesses are increasingly seeing a need for a different type of professional—one that has competency in an at least one area but has the flexibility to collaborate with other across many and co-crate value with others.
- Governments: in 2013, the U.S. National Science Foundation started a program on a multi-disciplinary research program to promote smart service systems as a way to build innovation capacity in the US.
- Professional associations: during the last decade, many professional associations have started special interest groups focused on the challenges and opportunities of service innovation. In 2012, Cisco, HP, and IBM in collaboration with several universities founded the International Society of Service Innovation Professions (ISSIP.org) whose mission "to promote service innovation for our interconnected world" with a focus on promoting service innovation in education, research, practice, policy making, and professional development.

She finished her opening statement by discussing what the most important skills are. To understand, manage, and thrive in the 21st century, data professionals like service professionals must become more T-shaped. This means that, to be an excellent service professional or a data scientist, in addition to being deep in at least one discipline, function, and vertical industry, one must also be a savvy entrepreneur; have high emotional intelligence; be inquisitive about people; develop empathy to understand other disciplines, functions, and even industry verticals; understand systems; manage complexity; and value diversity of experience, knowledge, geographic location, and ethnicity.

# 4 Recommendations from Industry Experts

At the end of the session, panelists were asked to briefly provide recommendations from the discussion, which we use to summarize the discussion here.

### 4.1.1 Recommendation: Be Flexible and Adapt and Generate Energy from Change

According to Charlie, the rate of change and transformation is increasing. There are many different forces pushing businesses to change and adapt, which will be enabled by IT and essentially add fuel to the fire. We need to stop thinking of change as a periodic disruption of the status quo and instead see it as a river of change. It may go slower or faster, but it doesn't stop. We need to be flexible and adapt and generate energy from it, not try to hold it back. Part of this means that the key role of the educator is teaching students how to learn *continuously*.

### 4.1.2 Recommendation: Become T-shaped

Jim also thinks that education is extremely important for sustainable innovations. He recommends individuals to become more T-shaped. He things that we need to create an education service system that includes student, faculty, and industry mentors. Of course, social media skills and use of social media tools also play for individuals' growth.

### 4.1.3 Recommendation: This is an Ecosystem

According to Ammar, the key element of this innovation process is the ecosystem support (i.e., today's services are really offered and deployed by a single vendor). Suppliers sell services to enterprises. Enterprises sell services to end customers. Services are often deployed and sometimes supported neither by the supplier nor the enterprises by fourth or fifth party. Collecting and tracking data (e.g., how the service is used by end customers, how the service is deployed and what is needed to improve such deployment, and how the service is supported and what is needed to improve such user experience?) is

very challenging with this model. In fact often, suppliers do not get any feedback from end customers. Hence, they need models, algorithms, and solutions.

### 4.1.4 Recommendation: The Human in the Middle

According to Don, data privacy and security issues need to be addressed with people in mind and a trust relationship developed between people and those accessing and analyzing the data they produce. Organizations need to establish and abide by data usage agreements, and ensure people's right to purge themselves and their data from the big data analysis engine, and develop service relationships using big data analytics that stay true to the co-creation of value mantra. Secrecy needs to be avoided and full disclosure supported. Students need to be educated on both the benefits and risks of a world where everything they post on social media, share with others, or is monitored can find its way into a system where it can be analyzed and acted on. For those educating the future big data analysts, remember the social value that can be realized through analytics—it is not all about targeted advertising. Privacy is a critical issue, so we also need to identify policy relevant issues and share them.

### 4.1.5 Recommendation: Think of Education as a Service

According to Yassi, companies must think of their business (whether a product or service) as a service platform. In this paradigm, products are platforms for a service (e.g., the iPhone or iPad is a platform that through the App Store and iTunes enables hundreds and thousands of services). Think of education as a service and provide the learning opportunities based on service-dominant thinking.

As such, the key takeaways from the panelists include:

- The best way to take advantage of the future is to actually plan for what it will be like and then take advantage of what will be abundant and scarce for you.
- The service dominant logic (Vargo & Lusch, 2004) is a new way of looking at the world in terms of service-for-service exchange, and new types of IT platforms (make use of big data and analytics) are interconnecting people, business, citizens, and governments to co-create new smart service offerings. All professionals can benefit from understanding both a service logic perspective and the role of IT platforms in scaling the benefits of new smart service innovations globally, rapidly, and sustainably.
- We need to develop human understandable, industry-consistent policies for data usage and privacy so users do not have to read and approve a policy for every application or service they use—something akin to the software licenses for open source software.
- Big data analytics will have the biggest impact on those at the pointy end of the stick: people. People are complex creatures driven by emotion, fear being one of the strongest. As such, we need to understand the fear and ensure that it is emoted at the proper level at the proper time.
- We need to initiate and support research that sheds light into the interconnected nature of value co-creation around traditional boundaries (i.e., industries, companies, nations, etc.).

To generate value from big data and analytics, we need to do several things. First, we need to recognize and explore the opportunities and also possible risks that big data analytics presents. Second, we need to collect structured and unstructured data from multiple sources (such as business and IT applications, IoT/IoE networks, sensors and applications, social and mobile networks, videos, pictures, and text). Processing and parsing the data closer to the source (e.g., fog computing rather than centralized cloud computing) is very important because of challenges with moving large amount of data from one location to another. Of course, we will need smart analytics such as cognitive engines, machine learning, neural networks, and other things to analyze data in a speedy manner. In this process, understanding and applying good human decision making processes are also very important. We cannot let machines make all decisions. Think of learning as a life-long endeavor beyond university competency in developing emotional intelligence that builds and nurtures online and off line value networks. We need research and development to understand how individual privacy can be ensured and maintained from a platform infrastructure perspective when data is aggregated from different disparate systems.

The broad conclusions of the panelists were that the big data ecosystem (e.g., people, data, smart analytics, cognition, IoE) provides myriad opportunities for individuals, organizations, and overall society to thrive. But, the key for success is education. Learning is never over: it is a lifelong skill that needs to be exercised regularly to keep individuals strong and relevant in this ever-changing world. Once students

graduate, that is when the real learning will begin. We, as professionals, need to become T-shaped to understand the diversity of data's sources and co-create value at the intersection of traditional boundaries.

As we automate action, we can improve interaction, the exchange of ideas, creativity, and innovation. With the abundance of IT capabilities, many of even the knowledge worker's roles can be automated by using pattern recognition, workflows, and other techniques that have been around and are becoming more sophisticated. Organizations can leverage these aspects to reduce their time-to-value generation and discover new and innovative frontiers to generate value. Ultimately, big data has the promise to release us from the mundane so we can apply our creativity to make life more interesting and rewarding.

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# Appendix A: Brief Information the 24th Annual Compete Through Service Symposium

URL for the symposium: wpcarey.asu.edu/symposium

Number of symposium attendees: 234 (164 professionals, 70+ students and academicians from over 65 national and international companies)

Haluk Demirkan (University of Washington—Tacoma) organized the panel, which was presented in partnership with IBM on November 6-8, 2013 at Phoenix, Arizona.

Link to the symposium brochure: http://wpcarey.asu.edu/sites/default/files/uploads/center-services-leadership/cts-2013-brochure.pdf

Sample companies that attended:

- AAA
- Abbott Laboratories
- Avnet
- Blue Cross Blue Shield
- Boeing
- Cardinal Health
- Cisco
- Comcast
- Dell
- Edward Jones
- Fedex
- FEI
- First Solar
- Honeywell
- HP
- IBM
- Insight
- Intel
- ISSIP
- Petsmart
- Siemens
- The Co-operators
- USAA

## About the Authors

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**Yassi Moghaddam** is the Executive Director of International Society of Service Innovation Professionals (issip.org, a professional association with a mission to promote service innovation for our interconnected world, and advance the professional development of service innovators across the globe), and Managing Director of Stradanet, a Silicon Valley based consulting firm where she supports multi-million dollar innovation and transformation projects within Fortune 500 companies, and service platform and ecosystem strategy development within startup companies. Previously, she was the VP of Strategy and Business Development at Mojo Mobility, a VC-backed company with smart wireless charging solutions, VP of Marketing at ASIP Inc, a VC-backed Princeton University incubator, and Director of Marketing Alliances at Avici Systems, the provider of industry-first terabit router. Earlier in her career, Yassi held senior product and technical management positions at Lucent and AT&T Bell Laboratories. Yassi holds an MBA from Columbia University, MSEE from Georgia Institute of Technology, and a BSEE from University of Oklahoma.