ENTERPRISE ARCHITECTURE (EA) – A BLUEPRINT FOR CHANGE

APPENDIX E – TECHNOLOGY TRENDS

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TECHNOLOGY TRENDS

The following information was compiled by as an independent validation of the Top Priority Areas identified by the CIO and State of Hawai`i Working Groups.

E.1.0 INTRODUCTION

This appendix highlights certain critical technology trends that will be of strategic importance for the State of Hawaii during the 2012 – 2015 period. Factors that denote high strategic significance include the potential for significant positive or negative impact on the business of the State, the possible need for major investments in these technologies, and the high potential for adverse consequences if the State is late to adopt.

A strategic technology can be an existing technology – like cloud computing – that continues to evolve and become suitable for a wider range of uses. Or it might be an emerging technology that offers an opportunity for strategic business advantage for early adopters or the potential for significant market disruption in the next five years.

This is an uncommon time in the evolution of the IT industry. Rarely do we see so many powerful forces in play at one time. These major trends are evolving rapidly, converging with one another, and already impacting business operations in major ways. Whether or not organizations have previously thought of their businesses as being inherently digital entities, the convergence of these forces makes that fact clear. The IT industry now offers an exciting new set of tools, and these are opening the door to a new set of rules for operations, performance and competition. This is an opportunity for IT to truly help elevate business performance, and the IT Strategic Plan and Enterprise Architecture for the State of Hawaii are designed with that central goal in mind. The strategic technologies discussed in this section are shown in the Figure 1.

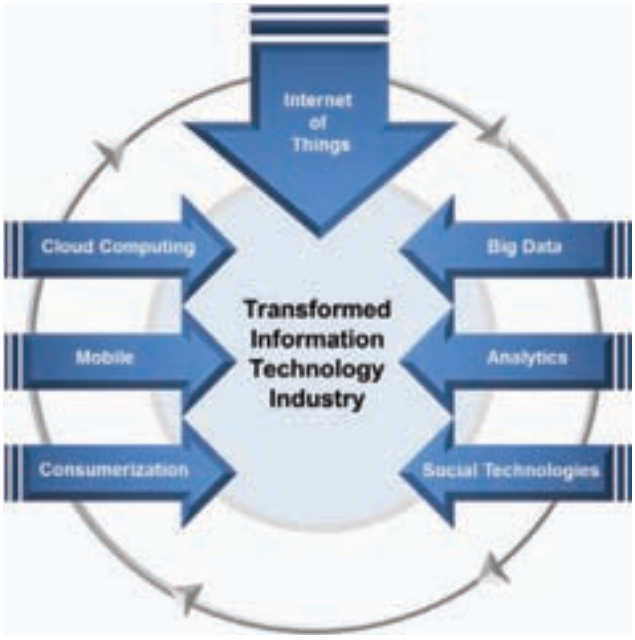


Figure 1: Strategic Technologies and Trends Roadmap

EVERYTHING IS INTERCONNECTED

Even though the strategic technologies and trends shown in Figure 1 are discussed individually in this document, it is important to note that all are interrelated and often interdependent. For example, cloud computing and mobile technologies increasingly go hand in hand. Similarly, the Internet of Things, mobile, consumerization Big, Data, and analytics are often tightly interdependent concepts.

As time goes on, more and more organizations will tend to view all of these developments as being highly interdependent, as shown in Figure 2.

Given these interdependencies, the most effective way to leverage these strategic technologies and trends for improved business performance is through the holistic perspective offered by a well-managed enterprise architecture process.

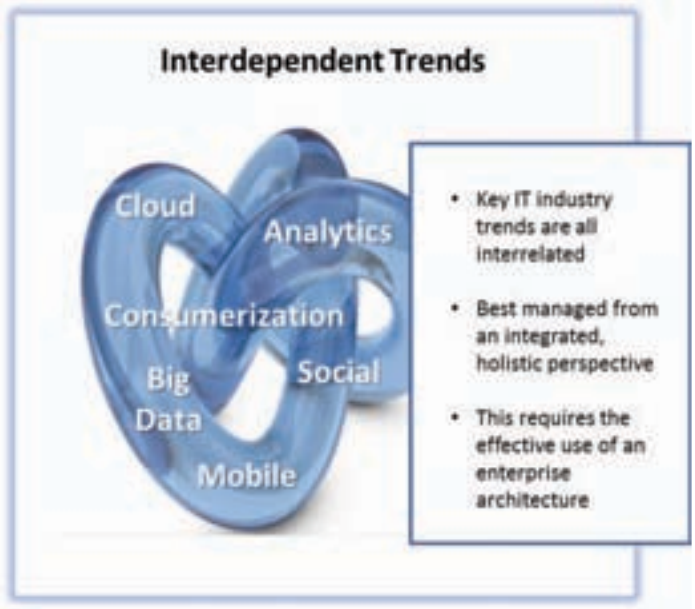
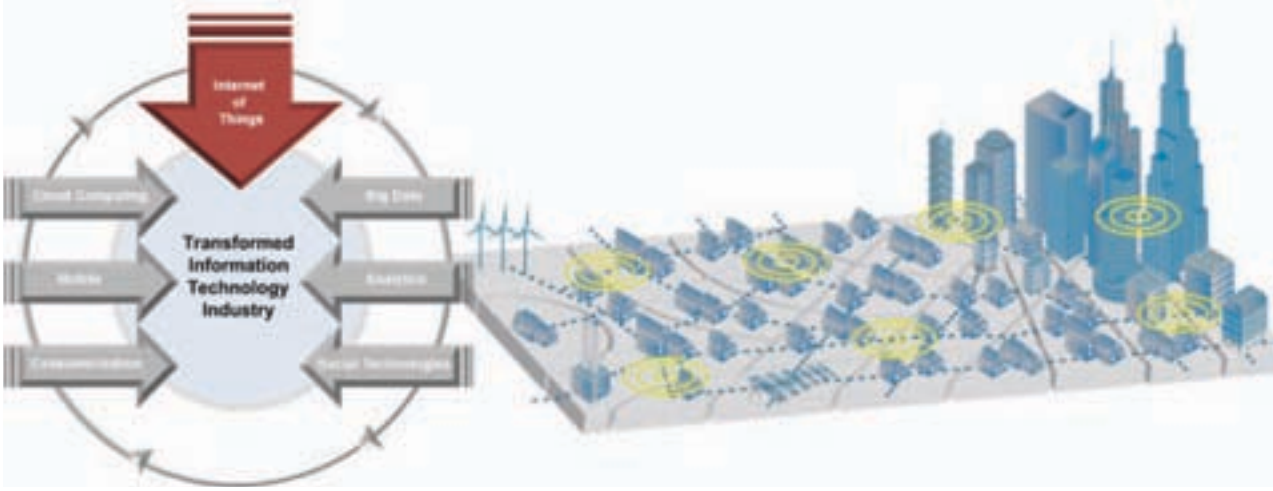


Figure 2: Technologies and trends are interrelated and interdependent

E.1.1 INTERNET OF THINGS



Across all industries around the world, more and more devices and processes are becoming embedded with sensors, giving them the ability to communicate. The resulting information networks are creating create new business models, improving business processes, and reducing costs and risks.

Traditionally, information has moved within organizations along familiar routes. Proprietary, structured information has been typically stored in databases and data warehouses. This information was then analyzed in reports – often with a backward-looking focus – and then rises up the management chain. Information also originates externally—gathered from public sources, harvested from the Internet, or purchased from information suppliers.

But the predictable pathways of information are changing. With embedded sensors of all kinds, the physical world itself is becoming a type of information system in what is often called the "Internet of Things." These sensors and actuators are embedded in physical objects—from roadways to buildings to trucks to pacemakers— and linked through wired and wireless networks, often using the same Internet Protocol (IP) that connects the Internet.

These networks generate huge volumes of data that flow to computers for analysis (refer to Big Data below). When objects can both sense the environment and communicate, they become tools for understanding complexity and responding to it swiftly. What's revolutionary about all this is that these physical information systems are now beginning to be deployed to work largely without human intervention.

As shown in Figure 3, a few years ago the traditional flows of information began to change, almost imperceptibly at first, but then in a surge of change. Myriad devices were soon connected to the Internet, and people were creating content in multiple forms, for consumption by a wide variety of users, on an increasing array of devices. That proliferation is still happening, with important implications for all organizations in all industries.

The Internet of Things infographic shown in Figure 3 was

developed by Chris Humphrey of Intel. It provides a snapshot of how the number of connected devices has exploded since the birth of the Internet and the PC, as well as a glimpse forward to 2020.

For the original infographic discussion refer to: http://newsroom.intel.com/docs/DOC-2297

As this chart illustrates, the Internet may be huge, but it's going to get a lot bigger. For example, there will be 31 billion devices and 4 billion people will be connected to the internet by 2020.

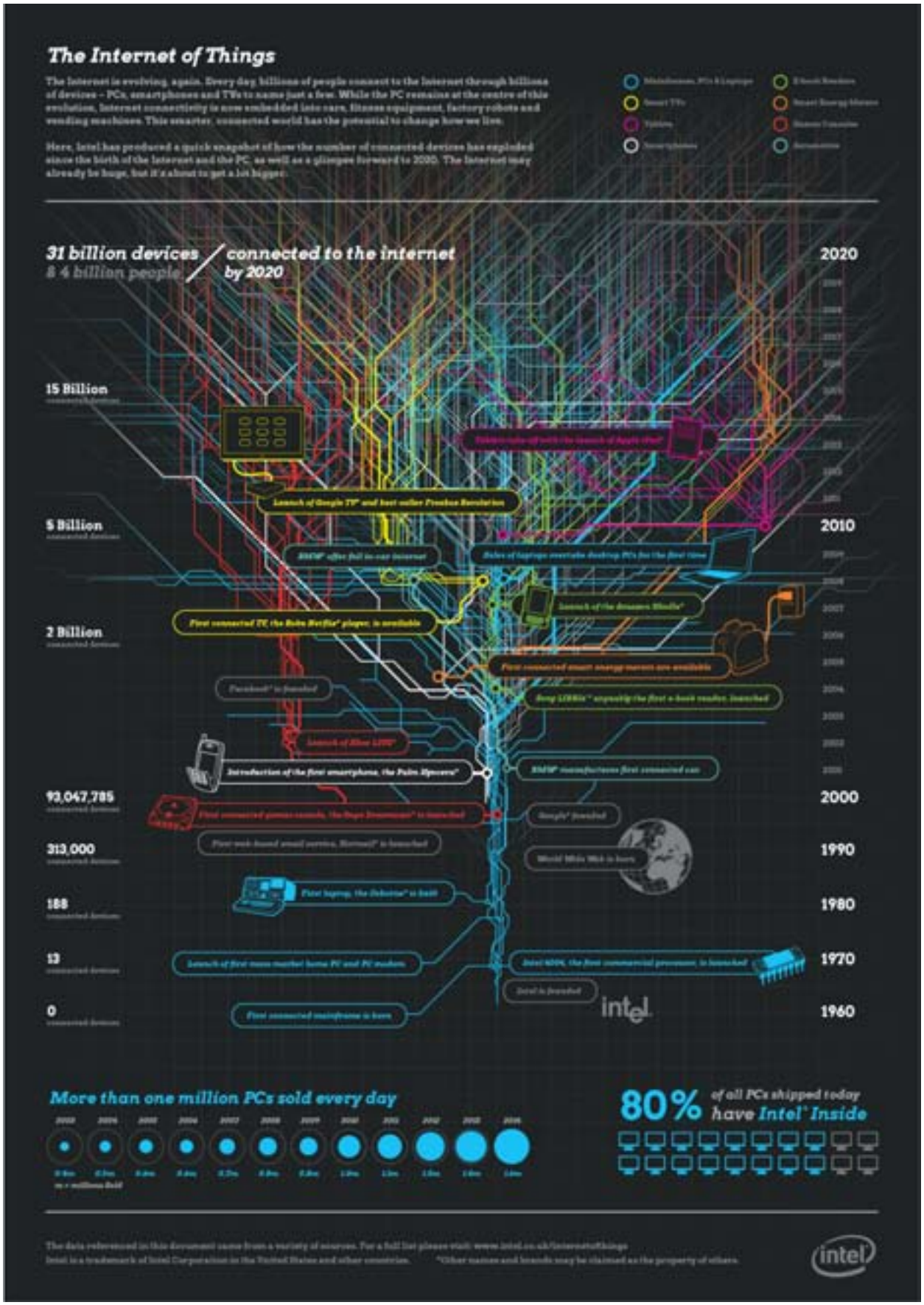


Figure 3: The Internet of Things (From Intel, Inc.)

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Here are a few other important facts and figures from the chart:

- During 2008, the number of things connected to the Internet exceeded the number of people on Earth. By 2020, there will be 50 billion things connected to the Internet. And these things are not just smartphones and tablets. For example, a Dutch startup called Sparked is using wireless sensors on cattle. When a cow is sick or pregnant, the sensor sends a message to the farmer. With these devices, each cow transmits 200 megabytes of data every year.
- By the end of 2011, 20 typical households will generate more Internet traffic than the entire Internet as it existed in 2008.
- With the new IPv6 protocol, we now have 340,282,366,920,38,463,463,374,607,431,768,211,456 possible Internet addresses, or 100 for every atom on the face of the Earth.

The "Internet of Things" is obviously closely related to Big Data (with embedded sensors being a major contributor to Big Data), as well as new-era analytics, through which all of this information is put to effective, forward-looking business use.

All of these developments have important implications for information technology is organized and managed across the State of Hawaii.

E.1.2 CLOUD COMPUTING

Cloud computing has been a major technology trend for the past three or four years now. But the cloud model continues to evolve rapidly and will have an even more sweeping impact for most companies across most industries over the next three years.

All IT vendors and service providers understand this importance and have cloud computing offerings and services as a core central element of their own strategic roadmaps. This means that as we move through 2012 and beyond, we will see the full range of large enterprise IT providers fully engaged in delivering a range of offerings to build cloud environments and deliver cloud services

E.1.2.1 DEFINITIONS AND BENEFITS

What is the cloud and what are its benefits? There are countless views on these questions, so it is best to turn to the most widely accepted source of official guidance, at least in the government environment, the National Institute of Standards (NIST). Here is a summary of the NIST position on cloud computing:

http://www.nist.gov/itl/cloud/index.cfm

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essential characteristics (On-demand self-service, Broad network access, Resource pooling, Rapid elasticity, Measured Service); three service models (Cloud Software as a Service (SaaS), Cloud Platform as a Service (PaaS), Cloud Infrastructure as a Service (IaaS)); and, four deployment models (Private cloud, Community cloud, Public cloud, Hybrid cloud). Key enabling technologies include: (1) fast wide-area networks, (2) powerful, inexpensive server computers, and (3) high-performance virtualization for commodity hardware.

The Cloud Computing model offers the promise of massive cost savings combined with increased IT agility. It is considered critical that government and industry begin adoption of this technology in response to difficult economic constraints. However, cloud computing technology challenges many traditional approaches to data center and enterprise application design and management. Cloud computing is currently being used; however, security, interoperability, and portability are cited as major barriers to broader adoption.

Wikipedia offers a good summary of cloud computing benefits and key characteristics:

http://en.wikipedia.org/wiki/Cloud_computing

- Agility improves with users' ability to re-provision technological infrastructure resources.
- Application programming interface (API) accessibility to software enables machines to interact with cloud software in the same way the user interface facilitates interaction between humans and computers.
- Cost is claimed to be reduced and in a public cloud delivery model capital expenditure is converted to operational expenditure. This is purported to lower barriers to entry, as infrastructure is typically provided by a third-party and does not need to be purchased for one-time or infrequent intensive computing tasks. Pricing on a utility computing basis is fine-grained with usage-based options and fewer IT skills are required for implementation (in-house).
- Device and location independence enable users to access systems using a web browser regardless of their location or what device they are using (e.g., PC, mobile phone). As infrastructure is off-site (typically provided by a third party) and accessed via the Internet, users can connect from anywhere.
- Virtualization technology allows servers and storage devices to be shared and utilization be increased. Applications can be easily migrated from one physical server to another.

- Scalability and Elasticity via dynamic ("on-demand" provisioning of resources on a fine-grained, self-service basis near real-time, without users having to engineer for peak loads.

- Security could improve due to centralization of data, increased security-focused resources, etc., but concerns can persist about loss of control over certain sensitive data, and the lack| of security for stored kernels. Security is often as good as or better than other traditional systems, in part because providers are able to devote resources to solving security issues that many customers cannot afford. However, the complexity of security is greatly increased when data is distributed over a wider area or greater number of devices and in multi-tenant systems that are being shared by unrelated users. In addition, user access to security audit logs may be difficult or impossible. Private cloud installations are in part motivated by users' desire to retain control over the infrastructure and avoid losing control of information security.

- Maintenance of cloud computing applications is easier, because they do not need to be installed on each user's computer and can be accessed from different places.

E.1.2.2 CURRENT STATUS

Cloud momentum is strong and building. Most enterprises have already moved from trying to understand what cloud computing means to making decisions on selected workloads to implement on various cloud options. Many companies began their cloud experimentation with the safer, but more limited, "private cloud" option. However, movement toward the public cloud option is accelerating rapidly. "Hybrid cloud" computing, which integrates aspects of external public cloud services and internal private cloud services, as well as the capabilities to secure, manage and govern the entire cloud spectrum, has been a major focus for 2012 and will remain a central focus the next three years.

Organizations that choose to stay with the private cloud model for a while will be challenged to bring operations and development groups closer together. They will have to come up with ways to reconcile certain aspects of ITIL – which entails rigorous processes – to synch with key attributes of the private cloud model – which often entails agility and speed on the applications side. Many organizations will migrate toward "DevOps" concepts (designed to better link development and operations) in order to approach the speed and efficiencies of public cloud service providers.

As noted above, the concept of cloud computing has been around for quite a while. (It was referred to as "utility computing" in its early phases of evolution.) But it was not until about 2007 that the concept began to jell as a clear and promising IT solution model for the mass of organizations. It then took another year or so for the idea to be taken seriously by many companies.

As a result of its short history, many of cloud concepts and terms continue to evolve. For example, today we have such terms as public cloud, private cloud, hybrid cloud, community cloud, personal cloud, infrastructure a service, platform as a service, software as a service, data as a service, and so on. New names and variations among these names will appear as time goes on. These are too many names for what is basically a single underlying concept (utility computing), so we will eventually see convergence and simplification.

E.1.2.3 COMPOSITE CLOUDS

Most organizations will require a blend of the currently defined cloud options, customized for their particular business needs. In this forecast, we call these optimized combinations of cloud options "composite clouds" (Figure 4). Skilled "cloud brokers," either internal experts or external providers, will offer cloud brokerage services to help companies define a composite cloud architecture that is optimal for their specific needs.

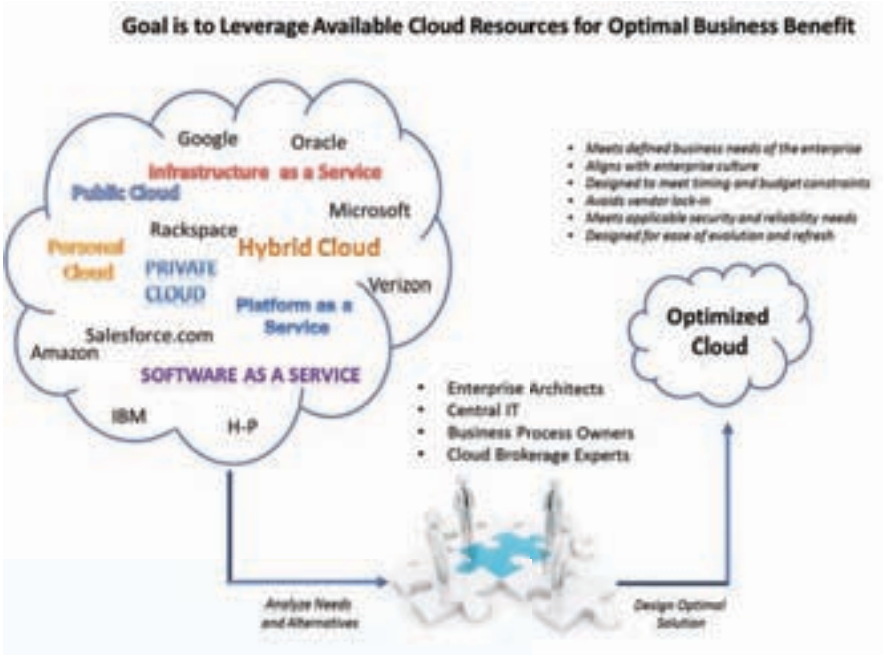


Figure 4: The Composite Cloud

"Composite" clouds represent an advanced form of cloud services that are only now in the early stages of adoption. They are analogous to the hybrid model but more encompassing in terms of the use of all available options to meet defined business objectives. The large business and technology consulting company Deloitte calls these optimized cloud combinations "Hyper Hybrid" clouds. But by whatever name, the approach will rapidly become the norm for cloud services architecture as all types of organizations will be trending toward composite clouds. The State of Hawaii is also moving toward an optimized composite cloud approach.

E.1.3 MOBILE

In recent years, the combination of smart mobile devices and mobile applications connected to high-speed networks and the cloud has fundamentally changed the IT industry, as well as most businesses. The mobile revolution has also led to the consumerization of IT and remains a key strategic opportunity for all organizations, including the State of Hawaii.

E.1.3.1 RAPID GROWTH IN MOBILE CONTINUES

Mobile communications is "moving to a new level" according to a new World Bank report released in July 2012. http://www.rappler.com/world/8786-it-s-a-mobile-world

The report says more than three-fourths of the world's population now has access to a mobile phone and a fast-expanding range of uses for the technology. There are currently over 6 billion mobile subscriptions globally, up from just below 1 billion in 2000. "Mobile telephony has been one of the most quickly adopted technologies of all time," the report said. "Even more astounding, mobile networks have roughly doubled in size every two years since 2002.

This "mobile revolution" is transforming the way people live, helping to create new businesses, and changing the way we communicate. This includes mobile apps, a companion area of growth for mobile devices. Over 30 billion mobile applications were downloaded in the past year, extending the capabilities of phones and making them integral parts of our personal and business lives. Mobile applications not only empower individuals but have important cascade effects, stimulating growth, entrepreneurship, and productivity throughout the economy as a whole.

Gartner says at least 50% of enterprise email users will rely primarily on a browser, tablet, or mobile client instead of a desktop client by 2016. Mobile application development projects targeting smartphones and tablets will outnumber native PC projects by a ratio of 4-to-1 by 2015. Gartner also states: "Smartphones and tablets represent more than 90 percent of the new net growth in device adoption for the coming four years, and increasing application platform capability across all classes of mobile phones is spurring a new frontier of innovation, particularly where mobile capabilities can be integrated with location, presence and social information to enhance the usefulness."

E.1.3.2 MOBILE-CENTRIC APPLICATIONS AND INTERFACES

The user interface model that has been the norm for more than 20 years is changing. Interfaces with typical windows, icons, menus, and pointers will be replaced by mobile-centric interfaces emphasizing touch, gesture, search, voice and video. Applications will shift toward more focused and simple models that can be assembled into more complex solutions, which are still simple and intuitive for the end user.

These changes will drive the need for new user interface design skills. Developers must be able to build application user interfaces that span a variety of device types, potentially from many vendors. This requires an understanding of fragmented building blocks and an adaptable programming structure that assembles them into optimized content for each device. Mobile consumer application platform tools and mobile enterprise platform tools are emerging to make it easier to develop in this cross-platform environment. HTML5 is one long term model that addresses some of these cross-platform issues. Gartner says that by 2015, mobile Web technologies will have advanced sufficiently, so that half the applications that would be written as native apps in 2011 will instead be delivered as Web apps.

E.1.3.3 U.S. GOVERNMENT EMBRACES MOBILE

In May of 2012, the U.S. Federal government released "The Digital Government Strategy." This 12-month action plan for the deployment of new technology is designed to enable the delivery of digital information and services anytime, anywhere, on any device, safely and securely-throughout the Federal workforce and to the American public. The report states that:

http://www.cio.gov/pages.cfm/page/Creating-a-Futureready-Digital-Government-Today

The use of laptops, smart phones, and tablets in government agencies continues to rapidly grow. Mobile computing enables the implementation of effective telework across the Federal government to ensure the continuity of operations as well as reduce management costs and the Federal government's footprint, which ultimately leads to higher-performing and more efficient organizations.

Workplace as a Service (WPaaS) will provide a virtual desktop interface that looks and feels like a traditional desktop while leveraging the power, security, and data provided by the department's two Enterprise Data Centers. This virtual desktop enables DHS personnel to perform their mission wherever there is access to the Internet or the DHS internal network, including through the use of handheld devices like smart phones and tablets. WPaaS delivers multiple benefits by replacing traditional desktops and laptops with virtual computing that provides as-needed operating systems and applications at monthly, pay-per-use service with scalability-all supported by a robust security model. WPaaS promises to reduce operating costs, increase operational flexibility, and simplify administrative management, while efficiently using resources by eliminating surpluses of outdated and underutilized equipment.

The essential elements of interoperability and openness, reduced and transparent operational costs, strategic planning from the outset and effective portfolio and program governance ultimately enable the government to move to and effectively capitalize on new technologies in the 21st century. The Digital Government Strategy provides a solid execution plan to leverage the power of today's technologies and provide more open, efficient, and effective services for the American public.

DISCUSSION

As noted above, advances in smartphones and other mobile devices, notably tablet computers, are transforming them from items of convenience to the primary means of digital interaction. Mobility will not just connect more of the economy to the Web, but also offer advantages previously impossible in business. By putting mobility at the heart of their product and their organizational processes, government entities and companies will better engage customers, constituents, and employees. The power and adaptability of smartphones and tablets have convinced hundreds of millions of users—not just young people— to abandon laptops or leapfrog past them altogether.

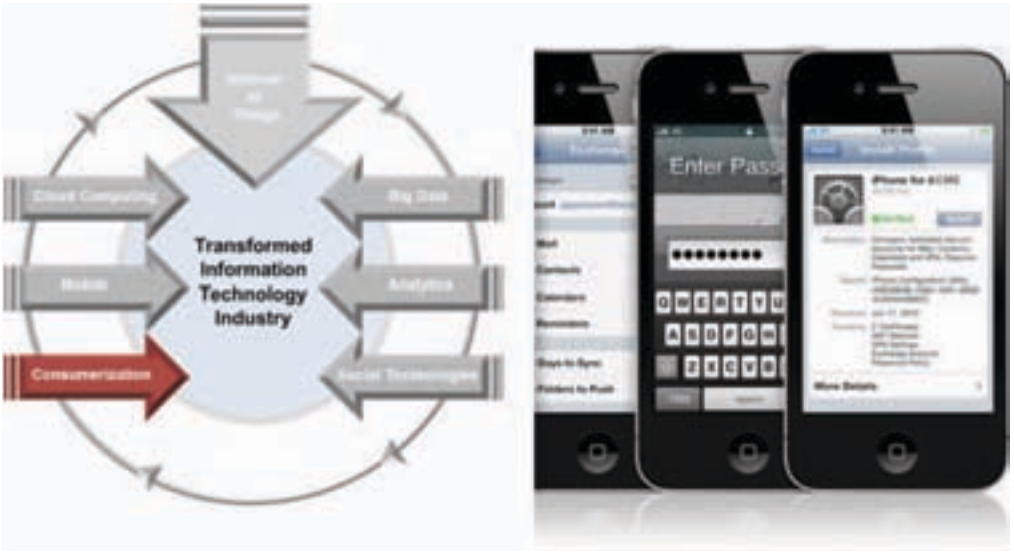
Mobile life opens up myriad possibilities for companies, in both commerce and the workplace. By enabling connections anytime, and making productive use of the dead time that comes even in busy lives, these devices enable far more frequent and multi-dimensional interaction than was practical before.

KEY STRATEGIES

Against this backdrop, it is clear that organizations in all industries, including state government, must become mobile-friendly. Some organizations still see mobility as presenting excessive risk and limit employees' use of smartphones. That can discourage the very kinds of people organizations most need today. Instead of reacting with excessive control and risk avoidance, organizations are shifting to a mindset that draws on the energies of employees, especially younger ones. The goal is to develop policies that respect essential security needs while fostering versatile communication and collaboration.

Future advances will make what is already an engaging and accessible environment only more so. Organizations cannot afford to miss out of these opportunities to improve business performance. Mobile functionality will extend beyond what we can now imagine. New operating systems offer richer and more user-friendly interfaces. New chips and receivers achieve wider coverage and much faster connection, as well as longer battery life. Mobile devices can now be always available, connect instantly, and offer rich, natural interaction. Combine pervasive access with data processing in the cloud – overcoming the once formidable processing advantage of personal computers – and mobility becomes the platform of choice.

The mobile revolution is a major factor in the information technology strategy and architecture for the State of Hawaii.



E.1.4 CONSUMERIZATION

Consumerization is a term used to describe the growing tendency for new information technology to emerge first in the consumer market and then spread into business and government organizations. The emergence of consumer markets as the primary driver of information technology innovation is seen as a major IT industry shift because large business and government organizations dominated the early decades of computer usage and development. That is no longer the case.

Consumers today have more choice, more options, and more flexibility in the technology that they use every day—from powerful mobile devices and computers to the social networks that they use to connect with each other. As that technology spills over into their professional lives, the line between personal and professional use is blurring. People want to use the same technology at work as they use at home.

Although consumer technology offers some great potential benefits for the business, it also represents added risk in terms of security, privacy, and compliance. For IT, it's about striking a balance between user expectations and enterprise requirements.

Consumerization is forcing businesses, especially large enterprises, to rethink the way they procure and manage IT equipment and services. Historically, central IT organizations controlled the great majority of IT usage within their firms, choosing, or at least approving, the systems and services that employees used. Consumerization enables alternative approaches. Today, employees and departments are becoming increasingly self-sufficient in meeting their IT needs. Products have become easier to use.

As a result, there is increasing interest in "Bring Your Own Device" or BYOD strategies, where individual employees can choose and often own the computers and/or smart phones they use at work. The Apple iPhone and iPad have been particularly important in this regard. Both products were designed for individual consumers, but their appeal in the workplace has been significant and growing.

Equally importantly, large enterprises have become increasingly dependent upon such "consumerized" services as search, mapping, and social media. The capabilities of firms such as Google, Facebook, and Twitter are now essential components of many firm's marketing strategies.

One of the more serious implications of consumerization is that security controls have been slower to be adopted in the consumer space. As a result there is an increased risk to the information assets accessed through these less trustworthy consumerized devices.

E.1.4.1 IMPLICATIONS FOR LARGE-SCALE COMPUTING

In addition to the mass market changes above, consumer markets are now changing large scale computing as well. The giant data centers that have been and are being built by firms such as Google, Apple, Amazon and others are far larger and generally much more efficient than the data centers used by most large enterprises.

Supporting these consumer-driven volumes requires new levels of efficiency and scale, and this is transforming many traditional data center approaches and practices. Among the major changes are reliance on low cost, commodity servers, software-defined data centers, and largely unmanned data center operations. The associated software innovations are equally important in areas such as algorithms, artificial intelligence, and Big Data. In this sense, consumerization seems likely to transform much of the overall computing stack, from individual devices to many of the most demanding large-scale challenges.

E.1.4.2 IMPLICATIONS FOR CENTRAL IT

As users take more control of the devices they will use, business managers will be exercising more control of the IT budgets. This will change many long-standing practices built around the premise that central IT would manage and control these budgets. The IT organization of the future must be adept at coordinating those who have the budget, those who deliver the services, those who secure the data, and those consumers who demand to use their own technologies in ways that optimize their own performance and contribution to the goals of the business.

E.1.5 BIG DATA

Flowing in part from the Internet of Things and the Mobile Revolution discussed above is "Big Data," perhaps the most discussed major trend in 2012, and likely to remain so over the next couple of years.

O'Reilly Radar says Big Data is data that exceeds the processing capacity of conventional database systems. The data is too big, moves too fast, or doesn't fit the strictures of typical database architectures. To gain value from this data, organizations must choose alternative ways to process it.

The effective use of Big Data has become viable as cost-effective approaches have emerged to tame the volume, velocity and variability of massive data. Within these data lie valuable patterns and information, previously hidden because of the amount of work required to extract them. To leading corporations, such as Walmart or Google, this power has been in reach for some time, but at a fantastic cost. Today's commodity hardware, cloud architectures, and open source software bring Big Data processing into the reach of the less well-resourced. Big Data processing is eminently feasible for even the small garage startups, who can cheaply rent server time in the cloud.

E.1.5.1 COMPANIES ARE CAPTURING AND DIGITIZING MORE INFORMATION

According to IDC, the world produced one zettabyte (1,000,000,000,000 gigabytes) of data in 2010. Fueling this data explosion are over six billion mobile phones, 30 billion pieces of content shared on Facebook per month, 20 billion Internet searches per month, and millions of networked sensors connected to mobile phones, energy meters, automobiles, shipping containers, retail packaging and more (see Internet of Things above). But that is just the beginning. IDC says that by 2020, the amount of data will have grown 44-fold, to 35 trillion gigabytes. Fueling the growth will be the evolution of all major forms of media – voice, TV, radio, print – from analog to digital.

E.1.5.2 THE THREE V'S OF BIG DATA

Big Data is best thought of as a platform – an evolving collection of tools, skills, technologies, and methods – for transforming all of this data into actionable items for business decision making.

As noted above, Big Data is no longer a specialized issue reserved for cutting-edge technology companies. It is evolving into a viable, cost-effective way to store and analyze large volumes of data in a multitude of forms and formats across many industries.

Big Data does not just include big volumes of data (terabytes and petabytes), but also the need for faster access to that data, as well as the need for integrating structured data with unstructured content.

One popular way to describe Big Data is through the "Three V Methodology." This is a comprehensive strategy for addressing

all aspects of Big Data, and balancing the technical aspects of all three dimensions such that the target data architecture satisfies an organization's needs on all three dimensions: Volume, Variety, and Velocity.

The journal Data Science Central offers a chart by Diya Soubra that shows how these three factors define Big Data (Figure 5).

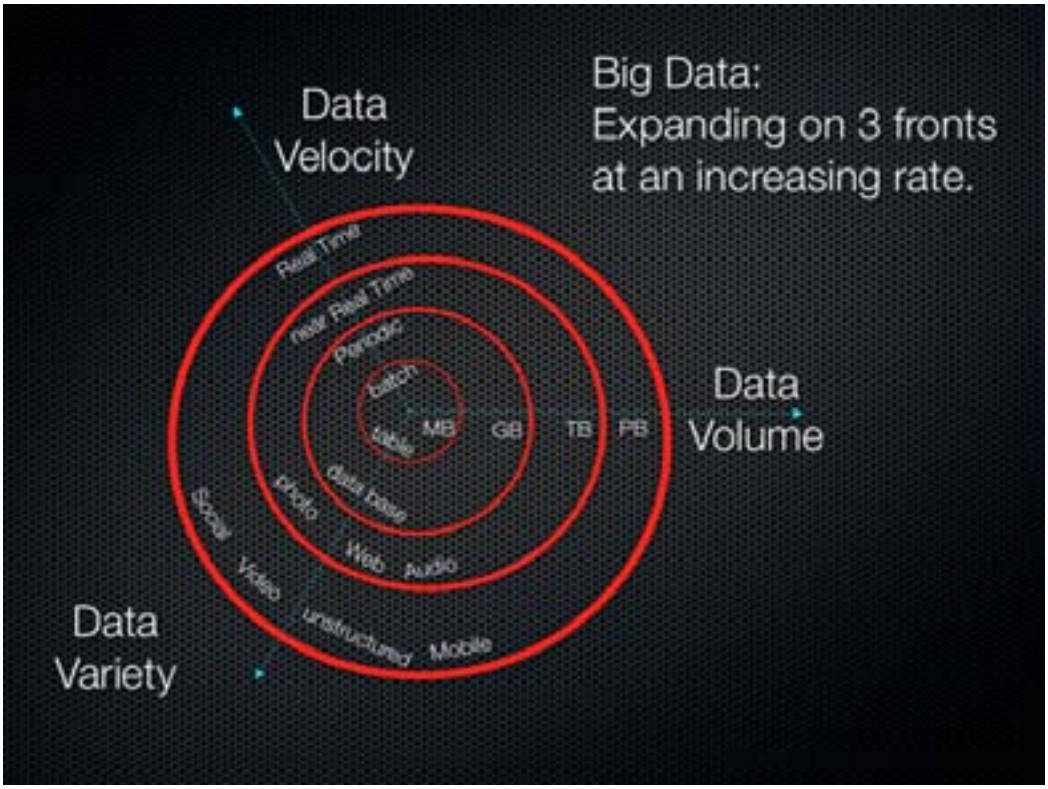


Figure 5:The three V's of Big Data

E.1.5.3 SOME BIG DATA TOOLS AND PRODUCTS

Big Data technologies like Apache Hadoop provide a framework for large-scale, distributed data storage and processing across clusters of hundreds or even thousands of networked computers. The overall goal is to provide a scalable solution for vast quantities of data (terabytes/petabytes/exabytes) while maintaining reasonable processing times.

These systems are incredibly effective for storing and analyzing large volumes of structured as well as unstructured or semi-structured data such as text, web or application logs, email, web pages, documents, and images.

Forbes Magazine has put together a nice chart presenting a snapshot view – it is changing fast – of the Big Data Landscape, as shown in Figure 6.

http://www.forbes.com/sites/davefeinleib/2012/06/19/the-big-data-landscape/

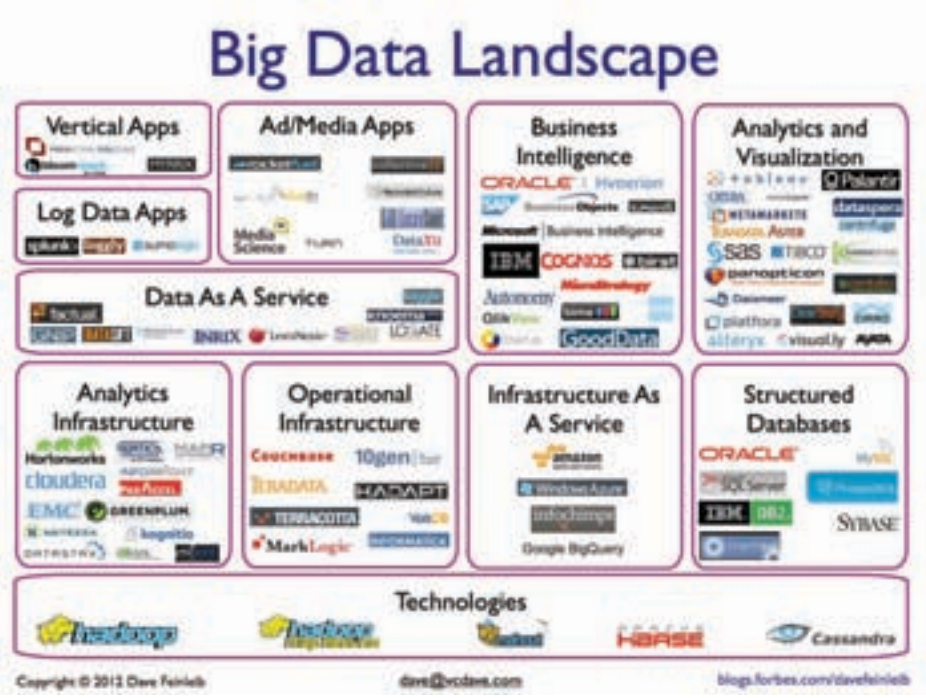


Figure 6: Big Data Landscape

The barriers to entry for Big Data analytics are rapidly shrinking. Big Data cloud services like Amazon Elastic MapReduce and Microsoft's Hadoop distribution for Windows Azure allow companies to develop Big Data projects without upfront infrastructure costs and allow them to respond quickly to scale-out requirements. Commercial vendor support from companies like Cloudera can speed development and deliver more value from Big Data projects. Bundled server options such as Oracle's Big Data Appliance offer fast setup and scale-out solutions. Finally, modular data center designs are emerging as a way to efficiently manage hardware and scale-out rapidly and cost-effectively.

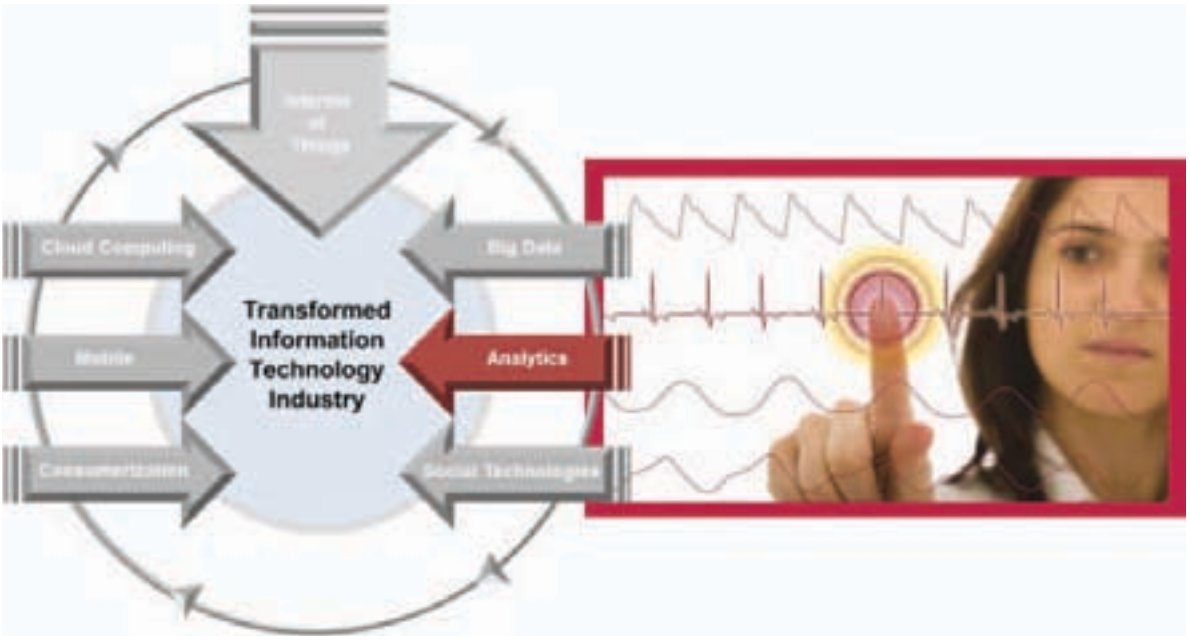
Harlan Smith, Manager, Hitachi Consulting, says in an article in the Wall Street Journal the companies likely to get the most out of Big Data analytics include:

http://allthingsd.com/20120110/big-data-analytics-trends-to-watch-for-in-2012/

- Supply chain, logistics, and manufacturing — With RFID sensors, handheld scanners, and on-board GPS vehicle and shipment tracking, logistics and manufacturing operations produce vast quantities of information offering significant insight into route optimization, cost savings and operational efficiency
- Online services and web analytics — Internet companies invented Big Data specifically to handle processing information at Internet scale. Implementation of these analytical platforms is now viable for smaller online services companies to provide an edge over competitors for advertising, customer intelligence, capacity planning and more. Companies who don't offer online services but do have an ecommerce or other online presence will benefit greatly from understanding customer behavior and buying patterns via clickstream, cohort analysis and other advanced analytics.
- Financial services — Financial markets generate immense quantities of stock market and banking transaction data that can help companies maximize trading opportunities or identify potentially fraudulent charges, among various other uses. New regulations also require detailed financial records to be maintained for longer periods.
- Energy and utilities — Smart instrumentation such as "smart grids" and electronic sensors attached to machinery, oil pipelines and equipment generate streams of incoming data that must be stored and analyzed quickly to uncover and fix potential problems before they result in costly or even disastrous failures.
- Media and telecommunications — Streaming media, smartphones, tablets, browsing behavior and text messages are captured at ever-increasing rates all over the world, representing a potential treasure trove of knowledge about user behavior and tastes.
- Health care and life sciences — Electronic medical records systems are some of the most data-intensive systems in the world and making sense of all this data to provide patient treatment options and analyze data for clinical studies can have a dramatic effect for both individual patients and public health management and policy.
- Retail and consumer products — Retailers can analyze vast quantities of sales transaction data to unearth patterns in user behavior and monitor brand awareness and sentiment with social networking data.

Big Data adoption will continue to be driven by the need to remain competitive is a world driven by the Internet of Things and the Mobile Revolution.

To accomplish this, companies will need to intelligently incorporate Big Data into their existing information management systems and take advantage of the developing ecosystem of integration and analysis tools. As we move into the age of Big Data, companies that are able to put this technology to work for them are likely to find significant revenue generating and cost savings opportunities that will differentiate them from their competitors and drive success well into the next decade.



E.1.6 ANALYTICS

Across all industries around the world, organizations increasingly understand the need to get full business value from the massive amounts of information their organizations are rapidly accumulating (see Big Data above). New technologies are collecting more data of different kinds than ever before, and organizations must leverage new technologies to obtain business value from this data. The ability to analyze data to find out what happened in the past and why it happened are no longer adequate. With today's face pace of change, leaders and front-line, customer-facing employees need to know what is happening now, what is likely to happen next and, what actions they should take for optimal results. That is where a new era of analytics comes into play.

E.1.6.1 WHAT DOES THE TERM "ANALYTICS" MEAN?

"Analytics" is a term that means different things to different people. Basically, it involves the discovery and effective (that is, timely and clear) communication of meaningful patterns in data. Analytics often entails the simultaneous application of statistics, computer software, and various other context-specific methods and technologies to glean insights from data. Data visualization methods are often used to communicate these insights. Analytics are usually based on modeling requiring extensive computation (see Big Data above) and thus the algorithms and software used for analytics tend to bridge the disciplines of computer science, statistics, and mathematics. Here are a few of the many domains where analytics is exerting an increasingly important role:

- Healthcare
- Supply chain
- Consumer behavior
- Intelligence
- Retail sales
- Financial services
- Risk and credit
- Marketing
- Behavioral sciences
- Fraud prevention
- Telecommunications
- Transportation

Here are few of categories of activity that can be defined as falling under the broad umbrella of analytics:

- Statistics – Apply statistical data analysis to drive fact-based decisions.
- Text Analytics – Optimize the value buried in unstructured data assets.
- Predictive Analytics and Data Mining – Build descriptive and predictive models and deploy results throughout the enterprise.
- Data Visualization – Enhance analytic effectiveness with dynamic data visualization.
- Forecasting – Analyze and predict future outcomes based on historical patterns.
- Model Management and Monitoring – Streamline the process of creating, managing and deploying analytical models.

- Operations Research – Leverage optimization, project scheduling and simulation techniques to identify the actions that will produce the best results.
- Quality Improvement – Identify, monitor and measure quality processes over time.

E.1.6.2 KEY TRENDS IN ANALYTICS

Accenture recently made some projections as to the key trends taking place in the area of analytics. Paraphrasing and condensing their projections, they are:

Big Data becomes a central focus in key analytics domains

Whether organizations desire this development or not, they will soon be confronted with Big Data challenges. They will either have to learn how to manage and use this proliferation of data or risk being inundated by it. Most will develop (or acquire) the skills and methods needed to manage Big Data, and they will apply appropriate analytics methods to use it effectively. Methods for storing and processing Big Data, such as Hadoop and MapReduce, have grown rapidly in popularity and use. This is happening because many organizations have already begun to experiment with Big Data technologies as a complementary form to traditional data warehousing architectures. Going forward from 2012 through 2015, many of those organizations will move out of the experimental phase and launch production deployments. However, the scarcity of skills in Big Data technologies will continue to present challenges.

Self-service and mobile BI become increasingly popular

The rise in the consumerization of IT (see above) together with the increasing demand for real-time location and context-based business information will place a premium on the simplicity, flexibility, and the reach of self-service and mobile analytics options. The move toward end user self-sufficiency will impact the way BI and analytics insights are developed, consumed, and delivered. New form factors will bring improvements to the user experience, including mobile BI, integrated analytical search, in-memory analytics, interactive visualization, and data discovery. These trends will present yet another set of challenges to central IT, which will be responsible for managing new and more diverse communities of empowered users, but without excessively limiting the new-found freedom and flexibility of empowered users.

Analytics becomes a normal business activity, not a one-off special function

In the past, analytics activities were typically performed in the background by groups with highly specialized skills (but sometimes lacking in business knowledge). Today's organizations are applying analytics techniques across all parts of the enterprise, often directly by business process owners and experts, to support critical decisions in real time. This trend reflects a deeper move toward institutionalizing key aspects of the analytics process. This enables more end users to access, understand, and act upon analytical information in the context of their own routine business processes. As end users become more familiar with analytics and embed it in their normal activities, they will become more expert in the discipline and move beyond foundational analytic tools to more advanced capabilities. This process of maturation in analytics will be driven be the growing amount of data to be managed and increasing demand for more accurate and actionable insights.

The cloud becomes increasingly important

As noted above in the section on cloud computing, the cloud can offer major economic advantages for enterprise processes that require computing and data storage resources, which analytics often does. Therefore, as organizations deal with severe budget pressures, as well as analytics skill shortages, they will continue to focus on cloud-based solutions as part of their overall analytics strategy. However, broader adoption of the cloud in support of analytics will have to take into account business requirements for key data security, management, and architecture considerations.

Social networking will play a larger role into corporate decision making

Social technologies and methods will be used to help perform analytics, collaborate on decisions, and communicate results. As analytics and social collaboration capabilities begin to coalesce (Figure 2), companies will be forced to look at enterprise collaboration in a way that is tied to key business processes and goals. This includes data analysis and decision–making, both within the enterprise and across the extended enterprise.

E.1.6.3 THE EMERGING ROLE OF THE DATA SCIENTIST

The tsunami of data mentioned above in such sections as The Internet of Things and Big Data is creating the need for a new role in enterprise IT. This role requires a unique blend of business, technical, and communications skills. The term "data scientist" has been given as the job title for an employee or business intelligence consultant who excels at analyzing data, particularly large amounts of data, to help a business gain a competitive edge. This position is gaining acceptance with large enterprises interested in deriving meaning from Big Data, the voluminous amount of structured, unstructured and semi-structured data that a large enterprise produces.

A data scientist possesses a combination of analytic, machine learning, data mining and statistical skills as well as experience with algorithms and coding. Perhaps the most important skill a data scientist possesses, however, is the ability to explain the significance of data in a way that can be easily understood by others. This in turn requires the ability to understand the

business needs of the customer for whom data science services are being provided.

A data scientist helps companies make sense of the massive streams of digital information they collect every day, everything from internally generated sales reports to customer tweets. As the CEO of EMC Corporation said, "data scientist doesn't only look at one data set and then stop digging. They need to find nuggets of truth in data and then explain it to the business leaders."

Data scientists have been a fixture at online companies like Google and Amazon for years. But increasingly organizations across all industries, government and private, are hiring computer science and business technology experts who can analyze all their data and provide intelligence that leads to better business decisions or new products.

Data science has become such a hot field that EMC convened the first-ever data scientist summit in Las Vegas in May of 2012 and 300 people attended. In August of 2011, AOL Jobs called data scientist the "Hottest Job You Haven't Heard Of." To land one of these positions, AOL suggests that professionals should earn a general business degree, such as a Bachelor of Business, and focus on bolstering their technical background. Today, many schools offer technology certificates in subjects like data mining and data analysis, which can help people gain the high-tech skills they need if they already have a bachelor's degree in a business-related discipline.

E.1.7 SOCIAL TECHNOLOGIES

An organization's ability to learn, and translate that learning into action rapidly, is the ultimate competitive advantage.

– Jack Welch

In his classic 1990 work "The Learning Organization," MIT's Peter Senge defined learning organizations as:

Organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together.

The basic rationale for such organizations is that in situations of rapid change, such as we face today, only those that are flexible, adaptive, and productive will excel. To possess this capability, organizations need to discover how to tap people's commitment and capacity to learn at all levels.

While people as individuals have the capacity to learn, the structures in which they have to function are often not conducive to reflection and engagement. Furthermore, people may lack the tools and guiding ideas to make sense of the situations they face. Organizations that are continually expanding their capacity to create their future require a

fundamental shift of mind among their members. And they require a modern collaboration infrastructure.

A Senge noted in his research, when you ask people about what it is like being part of a great team, what is most striking is the meaningfulness of the experience. People talk about being part of something larger than themselves, of being connected, of being generative. It becomes clear that for many of us, our experiences as part of truly great teams stand out as singular periods of life lived to the fullest. Some of us spend the rest of our working lives looking for ways to recapture that spirit. Modern social technologies and related methods make these kinds of experiences much more likely.

In recent years, social technologies and methods have provided the means to achieve the kind of vision Senge had in mind when he defined the learning organization. The State of Hawaii will leverage these technologies and methods to help ensure that the State becomes an exemplar among all states in our ability to learn, collaborate, communicate, and operate in an agile and highly responsive manner to better meet the needs of our citizens.

E.1.7.1 THE RISE OF ENTERPRISE 2.0

Even though the use of social networking technologies and methods within the enterprise, often referred to as to as "Enterprise 2.0," is not new, these technologies will continue to exert a major influence in enterprise IT over the next three years and will play a key role in the State of Hawaii's IT Strategic Plan. This is important because Enterprise 2.0 represents a fundamental change in how organizations operate, and companies will continue to develop competitive advantage and deliver improved services through the use of these technologies.

E.1.7.2 NUMEROUS OPTIONS ARE AVAILABLE

One of the most popular forms of Enterprise 2.0 is the business wiki. The wiki is a tried-and-true collaborative system that is good for small tasks, like keeping up with a staff directory or a dictionary of industry jargon, as well as large tasks, like charting the development process of large products or holding online meetings. This is one the easiest ways to begin implementing Enterprise 2.0 into the workplace.

Blogs can also enhance communication and collaboration within an organization. For example, a human resources blog can be used to post corporate memos, and frequently asked questions can be quickly asked and answered in blog comments. Blogs can also be used to keep employees informed of major events concerning the organization or happening within an agency or department. In essence, blogs can provide that top-to-bottom communication that management needs to provide while doing so in an environment where employees can easily ask for clarification or make suggestions.

For larger companies, social networking can also provide an excellent way to find specialized skills and knowledge in a timely way. Through "profiles," for example, a person can detail the projects they have worked on and the various skills and knowledge they have. These profiles can then be used by others to search and find the perfect person for helping out with a particular task. For example, if a state agency head is having a meeting with an international company and would like to have an employee on hand that speaks a specific language, a quick search of the state's social network can create a list of candidates.

Large IT vendors, like SAP and Cisco Systems, now say the market is ripening up for a more mature and robust version of social networking. Vendors are starting to think about how to integrate with existing business systems, with supply chain management representing one area of huge, untapped potential.