
SIIA WHITE PAPER

Data-Driven Innovation

**A Guide for Policymakers:
Understanding and Enabling the
Economic and Social Value of Data**

PUBLIC POLICY

**Software & Information
Industry Association**
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The Software & Information Industry Association (SIIA) is the principal trade association for the software and digital content industries, representing approximately 700 member companies worldwide. SIIA provides services in public policy, business development, corporate education and intellectual property protection. For more information, visit www.sii.net.



Data-Driven Innovation

A roadmap for understanding and enabling the economic and social value of data

Introduction

Whether you have been hearing about “business intelligence,” “data analytics,” or the infamous term “big data,” there is one reason for all of the excitement about data right now and why you should care. It is this:

Data-Driven Innovation (DDI) presents tremendous economic and social value, capable of transforming the way we work, communicate, learn and live our lives.

While data analytics have been around for quite some time, what’s new is the increasing capacity for enterprises and governments to analyze and use this information— from a variety of voluminous sources of structured and unstructured data, real-time and static — to innovate and improve the outcomes of everyday life.

A range of previously unimaginable applications of DDI are already being produced—or will be in the near future. These innovations are making people’s lives better and safer and more prosperous, while also improving energy efficiency and saving money.

SIIA created this white paper to explain the nature of DDI, how it empowers enterprises and governments to benefit individuals, and show how it is already enabling economic growth. The paper details how changes in information technology (IT) products and services and the increasing use of data are combining to foster transformative innovation that will greatly benefit how we learn, do business and live our lives, while greatly stimulating economic growth.

Because DDI is so vital to economic and job opportunity, the paper also provides specific recommendations for policymakers and governments to help enable the fullest societal and economic benefits of data-driven innovation.

While offering tremendous benefits, DDI is not without challenges. And for this reason, this paper highlights the importance of, and opportunities for, good data stewardship – a core framework upon which entities and governments can act responsibly. In this context, good data stewardship means implementing organizational policies that facilitate responsible information collection and use, and incorporating privacy considerations in the conception phase of products and services.

Executive Summary

The amount of data produced and the rate of its growth have been building for some time, and this trend is expected to continue indefinitely. Research has shown that the amount of information stored worldwide grew to 161 exabytes per year, up from 5 exabytes in 2003, roughly equal to the amount of information stored in 37,000 libraries the size of the U.S. Library of Congress.

But it is not just the increase in volume, but rather the types of data more frequently being collected – and their ability to be leveraged – that are the true revolutionary drivers behind Data Driven Innovation (DDI). Of course, transformative data can be big or small, or even the “needle” of data found in a giant haystack. Whatever the size of the data set, the key to DDI is the ability to capture, comingle, store, verify and analyze relevant data, and then integrate the results into established processes to derive innovative practical outcomes.

Today we are at a key inflection point in the history of information technology (IT). The last decade has brought about significant advances in IT, representing an evolution from a specialized tool into a pervasive influence on nearly every aspect of everyday life. This rich new environment is the driving force behind DDI, galvanized by the convergence of advancements such as cloud computing, the rise of internet-connected devices and social interactivity, and the increasing availability of pervasive analytics (often collectively referred to as CMSA for Cloud, Mobile, Social, Analytical).

At the same time, consumers and businesses have expressed legitimate concerns about how data is being stored and used, making stewardship essential both as a business practice and a policy consideration.

What does DDI mean for Economic Growth?

It is difficult to quantify the full economic impact of DDI because it takes place across various sectors of the economy. DDI has already begun to spur substantial economic and job growth in the U.S. and around the world.

Recent research by Gartner quantifies the impact of DDI in IT spending and job creation. In research around big data — or “data collected and analyzed from every imaginable source,” — Gartner projects that such data analytics and related capabilities will drive \$34 billion of IT spending in 2013.¹ Further, these technologies are becoming an engine of job creation as businesses discover ways to turn data into revenue. By 2015, innovation around data is projected to help create 4.4 million IT jobs globally, of which 1.9 million will be in the U.S. Further, applying an economic multiplier to those jobs, Gartner expects that each big data IT job added to the economy will create employment for three more people outside the tech industry in the U.S., adding six million jobs to the economy.²

Gartner’s conclusions closely track recent research by the Centre for Economics and Business Research (Cebr). In an independent economic study conducted in 2012, Cebr investigated how organizations in the United Kingdom could harness the economic value of data through the adoption of data analytics. Cebr established a measure of the aggregate

economic benefits that could be gained for organizations in the private and public sectors in the UK, terming the economic value of data as “data equity.” In identifying six mechanisms, including customer intelligence, supply chain intelligence, performance, quality and risk management and fraud detection, Cebr estimates that data equity was worth £25.1 billion to UK private and public sector businesses in 2011. Further, Cebr notes that increasing adoption of big data analytics technologies will result in bigger gains, and we expect these to reach £40.7 billion on an annual basis by 2017.³

The core of DDI is increasing efficiency, saving money and precious resources, benefiting all sectors of the economy and improving the quality of life. From safety and security, to environmental and infrastructure, health outcomes and education the opportunities for DDI are endless. This paper highlights a diverse set of case studies that are only the tip of the iceberg for what is possible in the years ahead.

DDI, Built on a Foundation of Good Data Stewardship

For DDI to reach its full potential, it must be built on a foundation of good data stewardship and trust. Transparency is the critical first step. When provided to consumers, transparency fosters a relationship built on trust where information is shared willingly because the value of the service provided merits sharing the information. Beyond transparency, information security, data quality and accountability are other critical elements.

For DDI to reach its full potential, it must be built on a foundation of good data stewardship and trust.

In the current global marketplace, a high baseline of corporate responsibility is critical for business success. Fortunately, the evidence is very strong that technological privacy enhancements will increasingly be “baked-into” the vast majority of data-driven products and services, where technologists embrace a thoughtful approach to the design and deployment of advanced analytics on data sets of various sizes. Further, enterprises and governments can do more by embracing ethical practices in collecting, analyzing and applying data to innovative solutions. To that end, SIIA promotes enterprises and governments to exercise a set of best practices to be applied at various stages in the data lifecycle.

Policy Recommendations

Technologists, privacy advocates and policymakers can work together to foster the societal, governmental and business opportunities provided by DDI, while also meeting the challenge of protecting privacy. To that end, SIIA urges policymakers to proceed cautiously if formulating any new data policies, as these are likely to steer the future of DDI and the scope of what is possible for American innovation for decades to come. Policies that seek to curb the use of data could stifle this nascent technological and economic revolution before it can truly take hold. **SIIA’s fundamental principle for policymakers is to avoid creating broad policies that curb data collection and analysis.**

A second crucial principle is that policies must not be developed today which are based on a snapshot of current technology. Today’s dynamically evolving IT ecosystem is certain to

be very different tomorrow. Policies should allow for the long-term evolution of IT in ways that cannot yet be predicted. This calls for flexible, open-ended rules rather than specific mandates.

More specifically, SIIA recommends that policymakers continue to assess current policies, opportunities and challenges of DDI by embracing the following key recommendations.

- 1. To meet its full potential, DDI requires a policy framework that provides for an evolving view of privacy rights based on risk and societal benefits.** Policymakers should thoroughly consider the opportunities and challenges of DDI, while balancing the spectrum of privacy laws and potential privacy risks, and recognizing that socially acceptable norms of privacy are evolving along with technology.
- 2. The principle of data minimization should be re-interpreted in light of DDI.** In this context, data minimization should not become a rigid construct formally established through legislation or regulation. Rather it must continue to remain a key element of good data stewardship, which balances risk. The combination of technological privacy techniques and adherence to a set of responsible data principles can create an effective framework for data minimization that balances privacy with innovation and accounting appropriately for risk.
- 3. Policymakers should encourage de-identification as a way to balance the needs of DDI and privacy protection.** Some of the most important outcomes of DDI do not rely on personally identifiable information. Even if personal information is collected, it can often be immediately de-identified in a way that does not affect its value or utility for accomplishing important public and social objectives. Public policy should encourage this de-identification of personally identifiable information, where appropriate, but avoid broad mandates to this end.
- 4. Uniform rules should not apply broadly to the collection of personal information and the role of consent.** Questions about the collection and use of personal information, along with questions about the role of consent, cannot be altogether avoided. Of course, expectations surrounding the collection and processing of personal information are not purely personal. They reflect entrenched social norms regarding the appropriate flow and use of information. Policymakers should continue to consider the practicability of obtaining true and informed consent and be targeted and specific about which circumstances require explicit consent for the collection of personally identifiable information.
- 5. Policymakers should promote technology neutrality and avoid technology mandates.** Technology neutrality has long been a widely recognized guiding policy principle, particularly for Internet-based IT. These long-held principles for resisting technological mandates and maintaining technological neutrality are especially important for the DDI ecosystem, which has at its heart the goal of constant innovation. Policies must continue to encourage innovation to find faster, better, and less expensive ways to enhance outcomes, privacy, and security.

6. Open standards are critical enablers of DDI, but they must continue to evolve through industry-led standards development organizations, not governments.

The ability to integrate multiple data sources is a key element of DDI. Therefore, open standards are critical to combining a wide range of data sets across myriad analytics environments and applications. Governments can play a key role as a facilitator and convener, applying open standards practices to their own data, and encouraging and facilitating coalescence around open standards, but they must resist the temptation to enact policies that impose requirements around specific technical standards or try to create new standards where they may not exist.

7. Policies should allow data collectors and controllers to work with data management and analytics suppliers to comply with privacy and security rules through contracts across varying jurisdictions.

As data-driven innovation increasingly involves multiple parties providing value to customers, privacy and security rules and contracts should work together to provide protection for data subjects — even when data flows across jurisdictional boundaries. Governments should allow their data policy frameworks to interoperate to ensure that data management and analytics services can be provided across borders by global companies that operate in many jurisdictions.

8. Policies must continue to balance the need of protecting the privacy of students, while enabling DDI to greatly enhance the teaching and learning experience.

Students, families and schools are increasingly using technology for the benefit of providing a superior, customized learning experience tailored to students' individual needs. Providers of technology-based educational products and services — including in the areas of instruction, curriculum, assessment, data management, and enterprise management — are increasingly analyzing data to provide this superior learning experience. This is a benefit to students and educational institutions that can realize cost savings through more efficient teaching methods. Policies should be careful to balance the need to adequately protect children's privacy without undermining the ability of these providers to leverage DDI.

9. Governments should adopt policies that leverage DDI to make government more efficient and effective and reduce government waste.

Today, governments at all levels are under increasing pressure to reduce their cost of operations, while improving productivity and providing better citizen services. Technologies that leverage data analytics to provide innovative functions and services hold the key for governments to provide improved services and to better understand how well they are fulfilling their missions. Therefore, policies should increase the use of data analytics — pulling data from myriad sources — to make strategic decisions, to encourage research and development around data science, and encourage training for data scientists and professionals, arming them with strong data analytics skills that are already in high demand in both the public and private sectors.

- 10. Governments should continue to embrace open data policies and public-private partnerships that maximize access to critical public data.** Governments at all levels possess treasure troves of valuable data that have gone largely untapped for many years. More than ever before, citizens want access to government data, and they want it applied in innovative ways to which they are increasingly becoming accustomed. An effective way to maximize the full potential of DDI is for governments to embrace open data policies, to use public-private partnerships to provide access to critical public data, and to adopt enterprise architectures that enable sharing. These steps will put public sector data to innovative uses that can reap the economic and societal benefits of DDI.

What is Data-Driven Innovation, and Why Now?

As the leading representative of the software and digital content industries, SIIA has long anticipated the opportunities that will arise from the evolution and convergence of information and computing platforms. The last decade has brought about significant advances in IT, where it has effectively evolved from a specialized tool into a pervasive influence on nearly every aspect of everyday life.

To understand what's powering DDI, it is useful to take a closer look at two related developments. First, technology is rapidly evolving away from the static personal computing model, to a more nimble, powerful computing environment. New technological developments have created what SIIA refers to as Next Generation Information Technology Ecosystem. At the same time, the amount of data being generated has grown exponentially, as has the ability to extract analytic value from a wide range of this data. Following is a closer examination of these two trends driving DDI.

Next Generation Information Technology

IT is evolving more rapidly today than ever before, and we are at a key inflection point. This rich new environment is the driving force behind DDI, galvanized by the convergence of advancements such as cloud computing, the rise of internet-connected devices and social interactivity, and increasing availability of pervasive analytics (often collectively referred to as CMSA for Cloud, Mobile, Social, Analytical).

Over the last couple years, these technologies have advanced from “early adopter” status to mainstream, and we are now experiencing the build-out and adoption of platforms, products and services that have gathered force to enable value-generating overlays of social business and pervasive analytics.⁴ In this dynamic new realm, consumer and business users alike have access to myriad internet-connected devices that can generate data inputs and reap the benefits of innovative data outputs virtually any time, anywhere. This reality is changing user behavior and expectations, and therefore business models.

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Cloud, Mobile, Social, Analytical: What does the new environment look like?

- **Cloud Computing: Abundant High Performance Computing Power on Demand**

There are several key attributes of cloud computing that have enabled it to become a revolutionary step in the evolution of IT. These critical components are the shift to a remote computing model that is massive and scalable. The notion of large-scale computing infrastructure, platforms and software, all able to be provisioned quickly as a service makes cloud computing a key driver of DDI. As we defined in our 2011 White Paper,⁵ cloud computing has leveled the playing field for enterprises and governments of all sizes, as it removes the hurdle of needing to purchase and maintain independent computing infrastructures.

- Mobile: Proliferation of Internet-connected devices provides ubiquitous data**
The significance of mobile computing is multi-faceted. Most obviously, the proliferation of smart phones and tablets are creating tremendous new opportunities for users to access advanced computing power “in the cloud” with anytime, anywhere Internet connectivity and computing. But more importantly, what is occurring — and this will soon be much broader than smart phones and tablets — is Internet ubiquity. Ranging from vehicles to household appliances and beyond, there is a growing supply of data inputs, sensors and interfaces, coupled with a growing demand for them from users. Software and apps are rapidly evolving as services offered seamlessly across devices and computing platforms.
- Social: Enhanced communicative and collaborative data environment**
The third element of new transformative technology is the proliferation of social interconnectivity. This concept began years ago with the birth of social networking, and is rapidly expanding as social technologies are incorporated as components of other software, services and platforms—making all functions and decisions inherently more communicative and social. The increase in social interconnectivity via these new methods has fostered the creation and application of social data. Cloud computing is spurring new computing devices and platforms, and social interconnectivity is dependent on the proliferation of cloud computing and these devices and platforms. Over the next decade, new applications of social interconnectivity will provide communicative, data-driven intelligence and entertainment far beyond our current expectations.
- Analytical: Broad usage of software with advanced data analytical software**
Extensive digitization and advancements of microprocessors, storage, sensors and communications technologies have resulted in a tidal wave of data that is growing at a compounding rate. Many enterprises and governments have struggled for years to process and manage all the data that they gather and are exposed to. However, advanced business analytics software has quickly begun to fill this void, enabling organizations to rapidly mine vast amounts of data and uncover hidden insights and patterns. New technologies help organizations get their arms around the vast quantities of data, making the prospect of gaining insight not only feasible, but also increasingly cost-effective. Enterprises and governments now have access to software solutions, including statistical software products, business intelligence suites, predictive industry applications and analytical modules of major enterprise systems. These tools are able to work with distributed data to perform analysis regardless of where the data resides, to scale as data volumes grow, to deliver response times driven by changes in behavior, and to automate decisions based on analytical models.

CMSA: Technology Enablers of Data-Driven Innovation

Cloud
scalable, remote computing

Mobile
Internet ubiquity

Social
interconnected and communicative

Analytical
data intelligence

Extracting New Value from Data Volume Growing Exponentially

The amount of data and the rate of growth have been building for some time, and this trend is expected to continue indefinitely. Research has shown that the amount of information stored each year grew to 161 exabytes per year, up from 5 exabytes in 2003, roughly equal to the amount of information stored in 37,000 libraries the size of the U.S. Library of Congress.⁶ The McKinsey Global Institute estimates that data volume has been growing 40% per year, and will grow 44 times this rate between 2009 and 2020.⁷

However, despite the quantity and volume of data, perhaps too much emphasis is placed on the notion of data being “big.” It is not just the increase in volume, but rather the types of data more frequently being collected and their ability to be leveraged that are the true revolutionary drivers behind DDI. In many ways, focusing solely on the volume of data misses the key point that meaningful data comes in all different shapes and sizes. Transformative data can be big or small or even the “needle” of data found in a giant haystack. The key to DDI is the ability to efficiently and economically extract value by enabling high-velocity capture, discovery, and or analysis.⁸

Transformative data can be big or small or even the “needle” of data found in a giant haystack.

Whatever the size of the data set, the key to unlocking DDI is the ability to capture, comingle, store, verify and analyze relevant data, and then integrate the results into established processes to derive innovative practical outcomes. But because data is increasingly deriving from relatively new types of data sources that previously weren’t mined for insight, many entities are neither accustomed to dealing with such large volumes of unstructured data, nor making use of information from these sources. Therefore, much of the information available to enterprises isn’t captured or stored for long-term analysis, and opportunities for gaining insight are missed.

The economic and social value of different types of data varies significantly. Beyond traditional data analytics, what really drives DDI is the treasure trove of less structured data: weblogs, social media, email, sensors, etc. Typically there is good information hidden among a larger body of non-traditional data; the challenge is in identifying what kinds of data would enhance or transform user experiences.

While data comes in myriad forms and derives from a variety of sources, the following three types are at the heart of data-driven innovation:

- **Traditional enterprise data** – includes a wide variety of customer information from CRM systems, transactional ERP data, web store transactions, general ledger data. Traditional data formats tend to be relatively well described and change slowly. In contrast, non-traditional data formats exhibit a dizzying rate of change. As new services are added, new sensors deployed, or new marketing campaigns executed, new data types are needed to capture the resultant information.

- **Machine-generated /sensor data** – includes Call Detail Records (“CDR”), weblogs, smart meters, manufacturing sensors, equipment logs (often referred to as digital exhaust), trading systems data. Machine-generated data is produced in much larger quantities than non-traditional data. For instance, a single jet engine can generate 10TB of data in 30 minutes. With more than 25,000 airline flights per day, the daily volume of just this single data source runs into the petabytes.
- **Social data** – includes customer feedback streams, micro-blogging sites like Twitter, social media platforms like Facebook and Google+, and myriad others. Social media data streams – while not as massive as machine-generated data – produce a large influx of opinions and relationships that are valuable to customer relationship management. Even at 140 characters per tweet, the high or frequency of Twitter data ensures large volumes (over 8 TB per day).

Some experts have predicted that the “big data” phenomenon is already beginning to evolve into a common practice in leading information architectures, and it will therefore once again become ‘just data’ as we adapt to this ‘new normal.’⁹

The Data-Driven Revolution – What are the economic effects and what does this mean for individuals, business, government and education?

The rapidly evolving IT ecosystem and data explosion are combining to transform how we communicate, learn, transact, and consume information. Entrepreneurs and established businesses are putting data to work to change the world for the better, applying their innovations to everything from roadways, to financial services, healthcare, consumer goods and food production.

A range of previously unimaginable applications of DDI are already being produced—or will be in the near future. These innovations are making people's lives better and safer and more prosperous, while also improving energy efficiency and saving money. In turn, DDI has already begun to spur substantial economic and job growth in the U.S. and around the world. This chapter explores economic forecasts and highlights case studies that demonstrate how DDI is benefiting individuals, businesses, governments and education.

Data-driven innovation Spurs Economic Growth and Job Creation

It is difficult to quantify the full economic impact of DDI because it is taking place across various sectors of the economy. Similar to the challenges of assessing the impact of cloud computing, the blending of these four key technological developments transform how business is done and the way services are offered.

Regardless of the challenges, recent research by Gartner quantifies the impact of DDI in IT spending and job creation. In research around big data – or “data collected and analyzed from every imaginable source” – Gartner projects that data analytics and related capabilities will drive \$34 billion of IT spending in 2013.¹⁰ Further, the firm concludes that these technologies are becoming an engine of job creation as businesses discover ways to turn data into revenue. By 2015, the firm expects data to lead to the creation of 4.4 million IT jobs globally, of which 1.9 million will be in the U.S. Further, applying an economic multiplier to those jobs, Gartner expects that each big data IT job added to the economy will create employment for three more people outside the tech industry in the U.S., adding six million jobs to the economy.¹¹

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Gartner's conclusions closely track recent research by the Centre for Economics and Business Research (Cebr). In an independent economic study conducted in 2012, Cebr investigated how organizations in the United Kingdom could harness the economic value of data through the adoption of data analytics. Cebr established a measure of the aggregate economic benefits that could be gained for organizations in the private and public sectors in the UK, terming the economic value of data as “data equity.” In identifying six mechanisms, including customer intelligence, supply chain intelligence, performance, quality and risk management and fraud detection, Cebr estimates that data equity was worth £25.1 billion to UK private and public sector businesses in 2011.

Further, Cebr notes that increasing adoption of big data analytics technologies will result in bigger gains, expected to reach £40.7 billion on an annual basis by 2017.¹²

Case Studies

The end result of DDI is increasing efficiency, saving money and precious resources, benefiting all sectors of the economy and improving the quality of life. From safety and security, to environmental and infrastructure, health outcomes and education, the opportunities for DDI are endless. Following are a series of case studies highlighting entities that leverage data from myriad sources across a diverse set of IT platforms, utilizing a wide range of data analytics to provide cutting edge data-driven innovation solutions. These are only the tip of the iceberg for what is possible in the years ahead.

- **Pearson - Enabling the Digital Ocean to Improve Student Outcomes**

Today, we're in the digital ocean. We can gather information about students' daily learning activities and interactions with content as they happen in computer-based instruction. The increase of technology-based learning in schools enables us to have all students doing meaningful activity on digital devices. Computers now allow us to capture all kinds of data about what students do as they interact with learning material, seamlessly recorded as they go about their daily learning activity. These interactions can produce an "ocean" of data that, if used correctly, can give us a completely different view of how students progress in acquiring knowledge, skills, and attributes.

This ability to capture data from everyday student learning activity should fundamentally change how we think about assessment.

Invisible assessments allow us to gather information much more frequently without interrupting the flow of instruction, hence the term "invisible." This lets us provide teachers, students, and parents with feedback about progress immediately and in time to make adjustments to teaching and learning. It also eliminates the common complaint about the heavy time requirements of traditional assessment.

By capturing many, many observations of a student's learning activity over time, we are able to build models of student learning and proficiency without the pressure of performance on a single test.¹³

- **University of Ontario Institute of Technology: Leveraging Data to Improve Patient Outcomes**

The rapid advance of medical monitoring technology has done wonders to improve patient outcomes. Today, patients are routinely connected to equipment that continuously monitors vital signs such as blood pressure, heart rate and temperature. The equipment issues an alert when any vital sign goes out of the normal range, prompting hospital staff to take action immediately, but many life-threatening conditions do not reach critical level right away. Often, signs that something is wrong begin to appear long before the situation becomes serious, and even a skilled and experienced

nurse or physician might not be able to spot and interpret these trends in time to avoid serious complications.

Project Artemis, part of IBM's First-of-a-Kind program which pairs IBM's scientists with clients to explore how emerging technologies can solve real-world business problems. The system captured the data stream from bedside monitors and processed it using algorithms designed to spot the telltale signs of nosocomial infection. The truly significant aspect of the Project Artemis approach is how it brings human knowledge and expertise together with device-generated data to produce a better result. The system's outputs are based on algorithms developed as collaboration between the clinicians themselves and programmers. The algorithm concept is the essential difference between the Artemis system and the existing alarms built into bedside monitors.

The flexibility of the platform means that in the future, any condition that can be detected through subtle changes in the underlying data streams can be the target of the system's early-warning capabilities. Also, since it depends only on the availability of a data stream, it holds the potential for use outside the ICU and even outside the hospital. For example, the use of remote sensors and wireless connectivity would allow the system to monitor patients wherever they are, while still providing life-saving alerts in near-real time.¹⁴

- **Intuit: Empowering Small Businesses with Data**

Running a small business is a lonely job at times. Key business decisions are too often made in a vacuum, without access to pertinent data. In this new era of big data, Intuit is working to give small businesses powerful, data-driven insights once only available to much larger businesses.

The Trends feature in Intuit's QuickBooksOnline empowers small businesses to benefit from the power of their own data as well as the collective wisdom of fellow Intuit customers. Trends anonymously aggregates customer data, allowing small businesses to see how their income and expenses stack up against similar businesses. For example, a roofer in Philadelphia grossing \$250,000 a year can compare results with other roofers in the area or across the country. Is that revenue good or bad? Is five percent growth normal or better than companies in your area like you? With Intuit Trends, small businesses can now answer those questions in seconds.

An Intuit customer in Illinois uses Trends to see how his consulting firm's expenses compare to others in his industry. The business can easily recognize if it needs to continue to increase its profit margins and reduce costs to stay competitive. Trends make it easy for them to stay aware of what is going on in the industry and make key business decisions.¹⁵

- **Memphis PD: Policing Smarter, Not Harder**

Blue CRUSH (Criminal Reduction Utilizing Statistical History) is a data analytical initiative that provides the Memphis Police Department (MPD) the ability to gain an advantage through

insight and agility. At the heart of it is a predictive model that incorporates fresh crime data from sources that range from the MPD's records management system to video cameras monitoring events on the street. In the realm of crime-fighting analytics, there's a fine line between the "interesting" and the actionable. It is strength in the latter that makes Blue CRUSH stand out from its predecessors. Blue CRUSH lays bare underlying crime trends in the way that promotes an effective fast response, as well as a deeper understanding of the longer-term factors (like abandoned housing) that affect crime trends. It happens at the precinct level. Looking at multilayer maps that show crime hot spots, commanders can see not only current activity levels, but also any shifts in such activities that may have resulted from previous changes in policing deployment and tactics.

At each weekly meeting, commanders go over these results with their officers to judge what worked, what didn't and how to adjust tactics in the coming week. They might see, for example, how burglaries are down in one ward, but up another, or where thieves are stealing cars in one ward and dumping them in another. What's striking, says MPD Chief Godwin, is the granularity. "We're catching this immediately and we're doing it every day," he explains. "On short notice, we're able to shift officers to a particular ward, on a particular day, right down to the shift level. It's a bit like a chess match and it's enabling us to make arrests we never could have before."¹⁶

- **Scripps Health: Assessing patient data to improve emergency rooms**

Scripps Health, a nonprofit community health system, innovative and patient-focused process that has virtually eliminated wait times and has changed the way the hospital delivers care to patients seeking treatment in the emergency department at multiple campuses. Scripps is changing its culture from one in which quality is measured almost entirely by the performance of physicians, to one in which quality is measured by the performance of the processes, systems and teams that support them. They don't want physicians to be exclusively responsible for quality, but for quality to be measured by the team.

To inform its approach to these changes, Scripps collected and analyzed variation data, or information about whether a particular process was in control. For example, in anticipation of re-engineering its emergency room procedures, Scripps collected and analyzed massive amounts of data on wait times and cross-referenced the information against the type of injury, tests that were ordered and how long it took to discharge the patient. Then they did extensive simulation of our processes using real-life data, modeling how new and different processes might work.

Scripps found that the triage process added an unnecessary and wasteful step in getting patients from the door to a doctor. It was adding time and cost to the system, and not adding significant value. So the company eliminated it. They reduced the critical door-to-doctor time, add capacity to our emergency rooms and improve the quality of our service. As they build a new hospital, Scripps Health is looking into whether they even need to build a waiting room in the ER.¹⁷

Good Data Stewardship is the Foundation for Data-Driven Innovation

As highlighted in the previous chapter, the ability to extract value from data is an engine for innovation and opportunity. Of course, without the appropriate precautions, the collection and usage of some data can pose risks. It is essential that enterprises and governments do not underestimate this risk, and they must think strategically about providing privacy and security protections commensurate to the sensitivity of data, to ensure that it is used, and not abused.

For DDI to reach its full potential, it must be built on a foundation of good data stewardship and trust. Transparency is the critical first step. When provided to consumers, transparency fosters a relationship built on trust where information is shared willingly because the value of the service provided merits sharing the information. Beyond transparency, other critical elements include information security, data quality, and accountability. In the current global marketplace, a high baseline of corporate responsibility is critical for business success. Below we highlight two of the most important and widely implemented elements of good data stewardship.

Privacy by Design

“Privacy by Design” (PbD), is widely recognized internationally as an effective practice for developing privacy compliant information systems. It establishes that privacy should be embedded into new technologies and business practices, right from the outset - as an essential component of fundamental privacy protection.¹⁸

PbD advances the view that the strength of a privacy measure should be commensurate with the sensitivity of the data it protects. It also supports the premise that voluntary privacy protections can be more effective than regulatory frameworks, as entities focus on privacy assurance from the beginning. Customers can hold entities accountable to this, as customer trust is critical for success. Therefore, privacy by design is a more effective approach than either privacy by default, or privacy as an afterthought. PbD can be achieved by applying seven key principles for embedding privacy into the product or service design as it is built. It begins with the establishment of the appropriate level of privacy in the product or service design phase and also includes the appropriate level of transparency, respect for users and end-to-end security.¹⁹

Preventing privacy risks was the central motivation of PbD when it was conceived many years ago, and it has only grown more pertinent with the explosive growth of data collection and analytics. When technologists think about privacy implications early on in the lifecycle, they have a better chance of baking-in privacy-enhancing features, and facilitating the deployment and adoption of these systems.²⁰ A lot of high-value analytics can be done by simply looking at faceless customer data. In this approach, analysts only know each customer by an arbitrary, non-traceable number.²¹

Fortunately, privacy and responsibility can be advanced in this age of DDI because the technological advancements that contribute to this phenomenon also enable greater privacy protections. For example, “anonymous resolution” is just one new technique that makes it

possible for entities to discover records of common interest (e.g. identities) across systems without the transfer of any personally identifiable information.²² This and other privacy enhancing technologies can significantly reduce the risk of unintended disclosure while enabling technology to contribute to critical societal interests such as clinical health care research, aviation safety, homeland security, and fraud detection.

As DDI advances, companies might consider providing de-identified data to their customers with contractual restrictions on re-identification. This can be an effective approach for preventing the re-identification of individuals over large data sets. It is also a good example of how to embed privacy protections during the architectural, design and construction phase of the process.

The evidence is very strong that technological privacy enhancements will increasingly be “baked into” the vast majority of data-driven products and services, where technologists embrace a thoughtful approach when they are engaged in the design and deployment of advanced analytics on data sets of various sizes.

Best Practices for Enterprises and Government

While building in privacy-enhancing technology by design can go a very long way to protecting privacy in collecting and analyzing data, enterprises and governments can do more by embracing ethical practices in collecting, analyzing and applying data to innovative solutions. That is, discussions with leading companies has led to the conclusion that organizational policies that govern information collection, management and application can help to meet the various different legal, social and cultural requirements and expectations around the world.²³ Based on these existing proposed policies and input from member companies, SIIA promotes enterprises and governments to exercise the following best practices at various stages in the data lifecycle:

- Anonymize personal information whenever practical.
- Assess whether particular uses of data are consistent with cultural and social norms about acceptable activities, and take steps to comply with these norms, refraining from collecting and utilizing information that could have adverse affects on the individuals or the government/enterprise.
- Apply accountable processes to analytics, acknowledging that analytics can have a negative as well as a beneficial impact on individuals, and continually review and revise the use of data and analytics to maintain relevance.
- Develop internal policies that center on forward-looking rules of data management and training of personnel, appropriately tailored to counter risks.
- Implement appropriate safeguards to protect the security of information that is used — determine the sensitivity of data and provide appropriate data security and safeguards proportionate to the risk.

- Maintain data quality standards, or good data hygiene, applying regularly to make sure that data is relevant and useful.
- Consider the special vulnerability of children, and apply responsible and reasonable policies for children's data.

Recommendations for Policymakers and Governments

The rapidly evolving Internet-enabled, data-driven ecosystem described in the previous sections is transforming how we communicate, learn and consume information. Like all technological advances, this innovation presents both opportunities and challenges. Consumers, citizens and society as a whole can benefit greatly from DDI in many ways, including improving health outcomes, streamlining and protecting financial services, enhancing education, and improving and maximizing our physical infrastructure.

Of course, there are a wide range of perspectives about the implications of data's growing role in everyday life. On one end of the spectrum, there is distrust of the use of data beyond limited, specifically identified purposes. This distrust heeds a call to minimize data collection and use for fear that it inhibits privacy. On the other end, there is the recognition of data as a valuable asset that is empowering innovation and economic opportunity. Data's use should be balanced to protect privacy and prevent harm to citizens and consumers. Technologists, privacy advocates and policy makers can work together to foster the societal, governmental and business opportunities provided by DDI, while also meeting the challenge of protecting privacy.

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SIIA urges policymakers to proceed cautiously if formulating any new data policies, as these are likely to steer the future of DDI and the scope of what is possible for American innovation for decades to come. Policies that seek to curb the use of data could stifle this nascent technological and economic revolution before it can truly take hold. **SIIA's fundamental principle for policymakers is to avoid creating broad policies that curb data collection and analysis.**

A second crucial principle is that policies must not be developed today which are based on a snapshot of current technology. Today's dynamically evolving ICT ecosystem is certain to be very different tomorrow. Policies should be made today that allow for the long-term evolution of the industry in ways that cannot yet be predicted. This calls for flexible, open-ended rules rather than specific mandates.

More specifically, SIIA recommends that policymakers continue to assess current policies, opportunities and challenges of DDI by embracing the following key recommendations.

1. To meet its full potential, DDI requires a policy framework that provides for an evolving view of privacy rights based on risk and societal benefits.

As technologies evolve to become more personalized and instrumental in all facets of our lives, our experience and expectations of privacy also evolve. In the past, privacy was viewed as a personal good, rather than a societal one. As such, privacy was regarded as a matter of individual choice and responsibility.²⁴

However, as identified in this paper, DDI will continue to challenge this individualist paradigm of privacy. The socially beneficial uses of data made possible by data analytics are often not immediately evident to data subjects at the time of data collection. It is therefore critical for policies to balance principles of privacy against societal values such as public health, national security, economic growth, the environment, and more in ways that do not put the entire burden on the individual.²⁵

The possibilities created by technological changes like DDI bring about new social norms and expectations about the flow of information. Privacy expectations not only differ across societies, but they evolve over time. Policy frameworks must therefore remain sufficiently flexible to accommodate these evolutionary changes.

Policymakers should thoroughly consider the opportunities and challenges of DDI, and balance the spectrum of privacy laws and potential privacy risks, while recognizing that socially acceptable norms of privacy are evolving along with technology.

2. The principle of data minimization should be reinterpreted in light of DDI.

Fair Information Practice Principles (FIPPs) have provided guidelines for policymakers and data stewards regarding responsible information management practices for many years. However, over time, it is critical to reexamine and reinterpret these principles in light of changing technological capabilities and shifting expectations of privacy. DDI by its nature creates this need for appropriate implementation of the data minimization principle, which comprises recommendations for data purpose specification and use limitation.

This principle says that data should only be collected for a very specific purpose, identified and clearly limited in advance, and then should be discarded as soon as this narrow purpose is accomplished. This notion of data minimization is meant to protect individuals from privacy harms by collecting only the minimum amount of data and then destroying it as soon as possible.

While the objective is laudable and the approach very practical in certain instances, there is a tension between this method of protecting privacy and the new capabilities of DDI, which often thrives on enormous volumes of data and the discovery of novel, unanticipated connections within them. DDI is about maximizing data to identify new meaning and values among a wide range of seemingly unrelated data.

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In this context, data minimization should not become a rigid construct formally established through legislation or regulation. Rather it must continue to remain a key element of good data stewardship, which balances risk. For instance, there is no business need to store credit card security codes after a transaction has been processed, and saving such information creates substantial fraud risks. A reinterpreted data minimization principle would dictate that such information not be retained.

The combination of privacy by design techniques and adherence to a set of responsible data principles can create an effective framework for data minimization that balances privacy with innovation and accounts appropriately for risk.

3. Policymakers should encourage de-identification as a way to balance the needs of data-driven innovation and privacy protection.

Some of the most important outcomes of DDI do not rely on personally identifiable information. Even if personal information is collected, it can often be immediately de-identified in a way that does not affect its value or utility for accomplishing important public and social objectives. This allows for robust privacy protection, since the data can be effectively purged of all reference to a specific individual for innovative and societally beneficial purposes.

The era of DDI complicates the discussions surrounding the definition of “personally identifiable information,” clearly casting aside the technical discussion about what is or is not personal, and focusing on which activities are desirable and socially acceptable. The caution here, however, is that if information that is not individually identifiable comes under full remit of privacy laws based on a possibility of it being linked to an individual at some point in time through some conceivable method--no matter how unlikely-- this could not only prohibit many beneficial uses and benefits of data-driven innovation, but it could also destroy the incentive to de-identify the data.²⁶

Public policy should encourage this de-identification of personally identifiable information, where appropriate, but avoid broad mandates to this end.

4. Uniform rules should not apply broadly to the collection of personal information and the role of consent.

Expectations surrounding the collection and processing of personal information are not purely personal. They reflect entrenched social norms of the appropriate flow and use of information.²⁷ These social norms are then embodied in legal, social, and cultural systems that differ across myriad countries and jurisdictions. Policymakers face the challenge to reconcile these different systems in a world where data easily crosses not just borders, but legal and cultural boundaries.²⁸

Policymakers should continue to consider the practicability of obtaining true and informed consent. Often the requirement to get consent acts as a barrier to socially beneficial uses of information, not because people object to the collection or use, but because the process of obtaining consent is itself too cumbersome and expensive.²⁹ Public policies should also recognize that in some cases consent should not be required at all, as many current privacy rules already recognize in the case of fraud prevention or security risk mitigation. In other cases, consent should be assumed from the context,

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and subject to a right of refusal. Policy makers need to be targeted and specific about which circumstances require explicit consent for the collection of personally identifiable information.

5. Policymakers should promote technology neutrality and avoid technology mandates.

Technology neutrality has long been a widely recognized guiding principle for technology policies, particularly Internet-based IT. This was first recognized within the U.S. government in 1997, with the Framework for Global Electronic Commerce, a framework that has stood the test of time in establishing broad principles for regulating IT, that “rules should be technology neutral (i.e., the rules should neither require nor assume a particular technology) and forward looking (i.e., the rules should not hinder the use or development of technologies in the future).” By contrast, Government-mandated technology standards, can freeze the development of new technologies, or disadvantage entire categories of market players.

These long-held principles for resisting technological mandates and maintaining technological neutrality is especially important for the DDI ecosystem, which has at its heart the goal of constant innovation. Policies must continue to encourage innovation to find faster, better, and less expensive ways to protect privacy and security.

For instance, while technology that designs protection in the concept and engineering phases (e.g. privacy by design) provides the most efficient way to provide for data privacy and security. Government policies requiring specific technological solutions have consistently proven to be ineffective. For example, mandating types of encryption or approaches to de-identification might seem like good approaches for enhancing privacy and data security, but such approaches continue to prove incapable of keeping up with technological evolution. There is almost always a better way to accomplish a given purpose waiting around the corner.

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6. Open standards are critical enablers of DDI, but they must continue to evolve through industry-led standards development organizations, not governments.

The ability to integrate multiple data sources is a key element of DDI. After all, machine-readability is the key to data analytics and the “connectability” of data to other data. Therefore, open standards are critical to combining a wide range of data sets across myriad analytics environments and applications. Open application programming interfaces (APIs) also enhance innovative uses of data that enable applications to interact effectively. Conversely, the advantages of DDI could be squandered where boundaries are erected unnecessarily by proprietary data standards and closed APIs.

As DDI and data centers continue to evolve, practical, cost effective new practices will continue to drive data analytics and network architectures based on open standards.

Industry-led standards development organizations are well suited to determine which standards will best implement the policy goal of data interoperability.

Governments can play a key role as a facilitator and convener, applying open standards practices to their own data, and encouraging and facilitating coalescence around open standards. However, governments must resist the temptation to enact policies that impose requirements around specific technical standards or try to create new standards where they may not exist. Attempts to dictate interoperability conditions could have the undesirable consequence of reducing the marketplace to a standardized set of products and services.

7. Policies should allow data collectors and controllers to work with data management and analytics suppliers to comply with privacy and security rules through contracts across varying jurisdictions.

As DDI increasingly involves multiple parties providing value to customers, privacy and security rules and contracts should work together to provide protection for data subjects — even when data flows across jurisdictional boundaries. The privacy and security rules that apply to an entity that itself collects and analyzes data should continue to apply when the entity collaborates with outside firms in the data management and analytic process.

The legal responsibility for compliance with privacy and security obligations should remain with the entity that collects and controls personally identifiable information. Companies providing data management, processing and analytics services to these data controllers should not be independently subject to these legal requirements. The data controller should pass the privacy and security obligations on to its data processors through the terms and conditions of its contracts, and they should allocate liability for compliance according to these contracts.

In this way, privacy and security protections can cross jurisdictional boundaries in an efficient, practical way. Data protection authorities who want to ensure that their rules are enforced when data is processed abroad need not demand that every country in the world has the same data protection rules as they do. Rather, they need to ensure that a company's corporate rules and its contracts with outside parties bind the company to provide the appropriate type and level of privacy and security.

Governments should allow their data policy frameworks to interoperate to ensure that data management and analytics services can be provided across borders by global companies that operate in many jurisdictions. The goal is to make it feasible for global companies to have a manageable set of internal rules and external contracts that would allow them to operate in many different jurisdictions.

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8. Policies must continue to balance the need of protecting the privacy of students, while enabling DDI to greatly enhance the teaching and learning experience.

Students, families and schools are increasingly using technology for the benefit of providing a superior, customized learning experience tailored to students' individual needs. Providers of electronic, computer-based, educational products and services – including in the areas of instruction, curriculum, assessment, data management, and enterprise management – are increasingly analyzing data to provide this superior learning experience. This is also a benefit to students and educational institutions that can realize cost savings through more efficient teaching methods.

In many cases, personally identifiable information is either not collected, or if it is collected, it is de-identified. Typical program evaluations require student-level data but do not need to know precisely who each student in the program is. In some cases, a software application – e.g., assessment, grade book, student information system, etc. – is licensed and enables schools to build their own files or databases. In other cases, educational service providers provide a platform that the educational entity is solely able to utilize and that also has controls for data access.

To the greatest extent possible, data driven analysis to improve educational programs should protect student privacy by using anonymous or pseudonymous data. However, this is not always possible or desirable. In cases where personal student information is necessary, adequate additional steps must be taken to safeguard student privacy, including steps to protect student information from unauthorized access and to prevent it from being used for non-authorized purposes. Policies should be careful to balance the needs to adequately protect children's privacy without undermining the ability of these providers to leverage DDI. Binding agreements between the educational agencies or institution can effectively ensure that personally identifiable student information is adequately protected in the course of data-driven educational services and research.

9. Governments should adopt policies that leverage DDI to make government more efficient and effective, and reduce government waste.

Today, governments at all levels are under increasing pressure to reduce the overall cost of operations, while improving productivity and providing better citizen services. Government's acceptance and utilization of new technologies is needed to enhance government's mission. Technologies that leverage data analytics to provide innovative functions and services hold the key for governments to provide improved services and to better understand how well they are fulfilling their missions.

On a day-to-day basis, government agencies collect, create, store and manage large volumes of data. Whether the data is from one-on-one interactions with citizens,

Governments should adopt policies that embrace a culture of analytics, where the focus is on knowing, rather than guessing.

transactions online, visits to web pages, or interactions on social media, government agencies are creating enormous volumes of structured and unstructured data daily, which makes extracting knowledge a challenge.³⁰

Leveraging data analytics effectively can help governments understand program trends and match data across government, helping weed out waste, fraud, and abuse. Innovative data technologies help governments identify problem areas before an improper or erroneous payment occurs, and to track the information after its award for assistance with recovery. Data analytics can also help government analysts identify patterns, highlight trouble spots, and extract useful data from an ongoing data flow. Reducing fraud in government programs, performing real-time analysis of traffic patterns and increasing citizen health and safety are all examples of the way DDI can transform governments at all levels. The net result is more a more efficient and effective government that does more with less.

Therefore, governments should adopt policies that embrace a culture of analytics, where the focus is on knowing, rather than guessing. Specifically, policies should increase the use of data analytics—pulling data from myriad sources—to make strategic decisions, to encourage research and development around data science, and encourage teaching and training for data scientists and professionals, arming them with strong data analytics skills that are already in high demand in both the public and private sectors.

10. Governments should continue to embrace open data policies and public-private partnerships that maximize access to critical public data.

The U.S. Federal Government, state and local governments, and governments around the world possess treasure troves of valuable data that have gone largely untapped for many years. More than ever before, citizens want access to government data, and they want it applied in innovative ways to which they are increasingly becoming accustomed.

In response, governments are making more data available with the hope that users will utilize raw data sets to perform analysis, experiments and enhance learning, with the hope that they will in turn develop applications relevant to the mission of government. The US federal government has made nearly 500,000 data sets available to developers on the web through the Data.gov initiative started in 2009, with an overarching goal of a more open and accountable government. To date, nearly 250 citizen developed apps have been created as a result of this initiative – everything from an app that allows you to see where the various superfund sites are to one that measures obesity by county. Under Data.gov, the government itself has created over 1,200 new apps, including popular apps that track US financials and FDA recalls.

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Similarly, state governments are enormous data generation engines. As recently described by the U.S. National Association of State CIOs, (NASCIO), U.S. states and governments are generating data at higher volumes. NASCIO has determined that “the sky is the limit in terms of future data generation based on the growth in mobile applications, sensors, cloud services and the growing public-private partnerships that must be monitored for performance and service levels.”³¹

However, many governments are still struggling to enact policies that enable a streamlined approach to providing open data, and enable innovative applications to draw from this data. Even worse, many governments are continuing to implement policies that restrict access to public data, often in contrast to public records laws that encourage openness and transparency. For example, the U.S. Supreme Court is reviewing a case where application of public records laws in Virginia is attempting to limit access to public information beyond state citizens.³²

An effective way to maximize the full potential of DDI is for governments to embrace open data policies, to use public-private partnerships to provide access to critical public data, and to adopt enterprise architectures that enable sharing. These steps will put public sector data to innovative uses that can reap the economic and societal benefits of DDI.

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