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Harvesting External Data: The Potential of Digital Data Streams

Events, individuals' experiences and actions are increasingly "born digital," captured in real time by ubiquitous sensor networks. These events, experiences and actions are ready-to-process data that is available in continuous streams that are constantly evolving. We explain how to acquire, understand and use real-time digitally generated data for new value-creation opportunities that require new capabilities to be implemented.[1]

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The Growing Opportunities Provided by Digital Data Streams

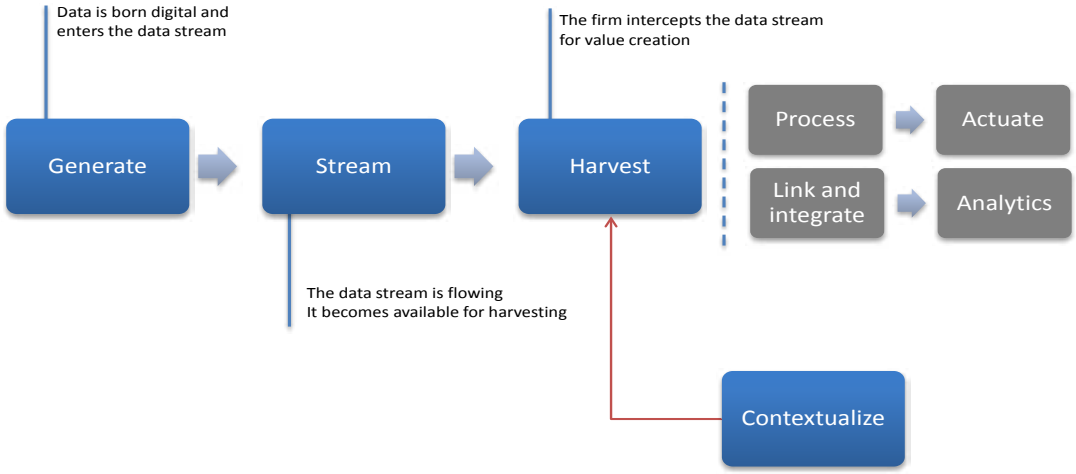
We live in a world where human activity is monitored and recorded, both in terms of physical activities and—even more so—digital activities. Streams of digital data are being created in massive quantities by numerous sensors—data that can be used both for real-time tactics and long-term strategy. In this article, we explain how organizations can leverage these *digital data streams* (DDSs) to increase consumer value and to improve operational efficiency. Much of these data streams flow from consumers using the Internet, but DDSs are generated also from, for example, cars with a speed-pass device driving through a toll booth, personal activity monitored by digital cameras or even a sensor for soil moisture. The challenge is first to understand the potential of DDSs and then take advantage of the opportunities they provide.

Before discussing the elements of DDSs, it's important to distinguish them from "big data," which concerns the vast amount of data available today that stretches the limits of traditional database architectures.[2] Though DDSs are related to big data, they have a different nature.

1 This article is based on research sponsored by the Advanced Practices Council of SIM.

2 See: Beyer, M. A., Lapkin, A., Gall, N., Feinberg, D. and Sribar, V. T. *'Big Data' Is Only the Beginning of Extreme Information Management,* Gartner, April 2011; Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C. and Hung Byers, A. *Big data: The next frontier for innovation, competition, and productivity,* McKinsey Global Institute, May 2011.

Figure 1: Three Stages of a Digital Data Stream



Big data involves mountains of generally static data that can be mined for insight. DDSs are dynamically evolving sources of data changing over time that have the potential to spur real-time action. They are streams of real-time information: a person's mood is captured through a tweet, a restaurant experience is reported in a Yelp review, the presence of an individual at a particular venue is represented by Foursquare's "check-in."

Most critically, people are using mobile devices with increasing frequency for all purposes, creating countless data flows. At the end of 2011, there were six billion mobile subscriptions, equivalent to 87% of the world population,[3] and 12% of these were smartphones. Recent estimates forecast an 18-fold increase in mobile global data traffic by 2016, in the form of video, web and other multimedia content.[4] We believe that it is possible for businesses to take advantage of the real-time nature of these newly generated digital streams.

Our research focuses on the opportunities that arise when companies make use of real-time digital data flows. In this article, we provide a set of frameworks to make sense of DDSs and their potential to foster innovation. Although the field is still new and developing, we provide examples of the opportunities provided by DDSs and describe state-of-the-art uses of digital data streaming.

3 *ICT Facts and Figures,* International Telecommunication Union, 2011.

4 *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2011-2016,* Cisco Systems, Inc., February 2012.

The Anatomy of a Digital Data Stream

As shown in Figure 1, we have identified three stages of how a DDS comes to be and begins to flow.

Stage 1: Generate

This is the stage at which the digital information is created as an event occurs—whether it be a tweet, a Google search or the GPS position of an object. For simplicity we call this real-time digital representation of events *Digital Data Genesis* (DDG). When a DDG event is not isolated, but rather is part of a series or a stream of DDG events (e.g., sensor readings, readings from smart meters or a Twitter feed), there is an opportunity to generate a DDS. For example, a single click on a hyperlink to access a website is the digital representation of a person's action (a DDG event). Activity on the website is a stream of personal decisions, and is aptly called the clickstream, which is a well-known example of a DDS.

Stage 2: Stream

When the data is available, channeled and transmitted as a continuous flow, we refer to it as a DDS. The streaming stage concerns the manner and format in which the data is made available. The stream is characterized by:

1. The type of technologies used to create the channel (e.g., application programming

interfaces (APIs), web crawlers, screen scrapers)

2. The nature of the content (including its accuracy and time span)
3. The source of the data being streamed (e.g., public, business, individual or community)
4. The legal status of the data contained in the stream or derived from it (e.g., rights and sensitivity).

Stage 3: Harvest

At this stage, an organization taps into the DDS and extracts some or all of the data being streamed. The harvest stage is described in terms of the technologies adopted to perform the data harvesting (e.g., APIs, XML messaging, web crawlers, screen scrapers).

In isolation, a DDS typically does not contain enough information to enable value creation. As a consequence, the harvest stage includes a process of adding *context* to the data to augment the information thus acquired. The process of adding context may rely on static information or other DDSs.

In a later section, we provide examples of how this context-creation process occurs. The key point is that the process of harvesting a DDS needs to include both the extraction of valuable data from the DDS, and extracting, refreshing and linking of the appropriate elements of the contextual data.

How Firms Create Value with Digital Data Streams

A firm creates value when it provides customers with a product or service they are willing to pay for. In addition to paying for the service or product, customers often have to expend time and effort when selecting one product over another. A firm creates value with a DDS when it leverages the DDS to increase customers' willingness to pay for its product or service or to reduce the opportunity cost of the resources it uses to create existing value propositions.

Below, we describe the five value-creation mechanisms or *value archetypes,* which are essentially "templates" that allow organizations to create value using DDSs. A value archetype is a basic model for potential value creation with a DDS. Each of the five archetypes represents a class of value-creating initiatives that may employ one or more DDSs. What enables these data streams to contribute to value creation is a *value driver,* which is the unique quality of an activity that is the source of the activity's value contribution. We have identified four value drivers.

Value drivers represent the tangible elements of a DDS that enable a firm to achieve the goals of either increasing a customer's willingness to pay or reducing the opportunity cost of existing resources. DDSs, and the value-creation opportunities they create, surround modern organizations. However, the opportunities are latent in the business environment until DDSs are recognized as tangible resources. A value driver is the mediator between the potential for action and an actual business implementation (i.e., a value archetype). Value can then be created through a mechanism rooted in one or more value drivers.

The five archetypes and four drivers are depicted as a value tree, with the drivers providing the roots for the archetypes (see Figure 2).

Figure 2: The DDS Value Tree

Five Value Archetypes

A value archetype is a basic model for value creation that is based on digital data streaming. Value archetypes are not mutually exclusive, and each organization may create value by using more than one approach simultaneously, as evident in the list of DDS initiatives shown in the Appendix.

1. DDS Generation. A firm may create value by originating the stream of data itself, either knowingly or as a byproduct of other activities. A good example of this value archetype is TripIt,[5] a travel itinerary organization service. Once an itinerary has been created on TripIt, it can be streamed to other partners who can harvest it and create value-added services based on the TripIt platform. Expensewatch.com, for example, integrates a TripIt itinerary automatically to compute expense reports (the Appendix lists further examples of the DDS Generation archetype).

2. DDS Aggregation. With this value archetype, a firm focuses on collecting, aggregating and repurposing a DDS. Socrata (http://www.socrata.com) does this in the U.S. with federal data, acting as a major platform for Open Data[6] and Data.gov initiatives. Federal agencies and organizations generate DDSs, whereas Socrata aggregates them, making them available to the public. Note that the aggregated data made available is created by others.

3. Service. With the Service value archetype, a firm uses one or more DDSs to provide services to consumers or to improve service quality. TripIt takes a step in this direction, and applications like MyCityWay (http://www.mycityway.com/) aggregate hundreds of datasets and DDSs (originating from other entities, such as government sources or the restaurant reservation intermediary OpenTable) to provide consumers with a convenient real-time menu of services available nearby. Similarly, myTaxi (http://www.mytaxi.net) provides reservation and taxi services mainly by collecting the GPS coordinates of both taxis and customers through a mobile application.

4. Efficiency. The Efficiency value archetype uses real-time data streams to optimize internal operations or to track business performance (e.g., waste reduction, response speed). One example is the service made available by Ruter (http://ruter.no/),[7] for the city of Oslo, Norway, and the county of Akershus. Originally known as Trafikanten, this application was created to gather real-time information on the overall state of the city's public transportation system (buses, ferries, trams, metros and trains). Although the intention was to create service value by providing a convenient source of public transport information, the application provided Ruter with real-time status of the city's traffic. This enabled it to optimize the traffic signal priority system, which improved travel times, reduced the number of vehicles and, in general, lowered the costs of transportation. Ruter estimates that the average journey time of buses on some of the most heavily used routes was reduced by up to 20%.

5. Analytics. This value archetype extends beyond Aggregation, with analytics firms processing DDS information to produce analyses or improved visualizations with the objective of enabling better decision making and producing superior insight or knowledge (for example, through dashboards and data mining). Mint (http://www.mint.com/), which is now owned by Intuit, provides an example. In addition to providing its seven million customers with a unified view of their bank, credit and investment accounts, Mint provides them with convenient visual tools to examine the status of their expenses and investments, and with personal recommendations based on their profiles. Mint does this by tapping into the DDSs of the financial institutions with which the customers already have relationships.

Four Value Drivers

Within the framework of the five value archetypes, companies need to focus on and understand the value drivers for each archetype—the enabling factors behind the business opportunity. By identifying value drivers, companies can use DDSs for innovation as they identify new possibilities to create value. In our research, we identified four value drivers.

5 Applegate, L. M., Piccoli, G. and Brohman, K. "TripIt: The Traveler's Agent," *Harvard Business School Case 808-059,* October 22, 2008. TripIt is a one-stop travel organization service that allows users to keep track of their travel plans by forwarding their itineraries and confirmation emails to plans@tripit.com. TripIt then integrates all of those plans into a single itinerary that can be accessed from any Internet-connected device.

6 Open Data initiatives are oriented to distribute and make accessible a portion of the data they collect or produce. The basic concept is that by publicizing data, they could be transformed from assets into productive information resources. Several public sector organizations use Socrata's purpose-built cloud, platform and social technologies to deliver citizen access to information.

7 Ruter is the name of the public transport system in Oslo and the surrounding county.

1. Real-time Sensing. This value driver requires the ability to detect the current state of a given entity. Examples are the location of a plane, the speed of a car or the mood of an individual. We consider the real-time sensing value driver to be the *first-order* value driver, because it is the basis of all of the new value-creation opportunities we discuss in this article. For example, the interactivity of Web 2.0 applications and services such as social networks has created new ways for customers to express themselves in real time. Information harvested from Twitter feeds, blogs and Facebook status updates is now used for brand-monitoring purposes. As the interaction with digital systems increases, companies have an unprecedented ability to automatically and continuously sense the world.

2. Real-time Mass Visibility. This *second-order* value driver is based on real-time sensing. It represents the ability to identify the state of multiple entities in real time, contextualized by their relationships. For example, if real-time sensing makes it possible to locate one vehicle, it is possible to acquire visibility of all vehicles on a road, thus enabling traffic congestion to be detected. An example of how real-time mass visibility of vehicles can be used is ruter.no, which enables the provision of added-value services to vehicle operators in the form of real-time traffic information and more efficient routes. Other examples are TomTom (http://www.tomtom.com), which we discuss below, and Inrix (http://www.inrix.com). TomTom, Inrix and ruter.no aggregate information from a multitude of DDS sources, including telecom operators, road sensors and navigation systems.

3. Real-time Experimentation. Another second-order value driver that also relies on real-time sensing is real-time experimentation. It consists of the possibility to fast cycle reliable data generation and gathering. Comparisons of a control sample to other samples (i.e., A/B tests) on web pages for selecting a layout, or the massive experimentation ongoing in major websites, are examples of this value driver. Through real-time sensing, it is possible to experiment and provide immediate feedback on business decisions, from the change of a webpage layout to more complex information. For instance, newBrandAnalytics (http://www.newbrandanalytics.com) provides a service that extracts specific feedback from customers' unstructured mentions of a firm's products or services on social media channels. Firms can then adjust their behaviors in real time, correct any shortcomings and monitor the outcomes. At the same time, they can experiment with different configurations of the service and fine-tune it on the basis of customers' mentions.

4. Real-time Coordination. The third and final second-order value driver is real-time coordination, which is also based on real-time sensing. This driver is the ability to quickly adjust behavior based on feedback about the current state of other entities. Real-time coordination is at the heart of services such as Foursquare Radar, which enables users of the service to coordinate spontaneously with friends by "sensing" their presence in the area.

In addition to the DDS initiatives quoted above using the four value drivers, many other examples are described in the Appendix.

Value drivers are more fluid than value archetypes. Crucially, value drivers change over time, because they are by nature moving targets. Perhaps the most important insight regarding value drivers is that a company does not have to actually own the data generation asset (the DDS). Instead, all the firm needs is access to the DDS and a concept for how to use that DDS to add value. The criteria for success are based on an organization's ability to identify valuable DDSs, gain access to them with the appropriate tools, properly orchestrate the available resources and invest in DDS initiatives.

Examples of DDS Exploitation

As mentioned earlier, TomTom provides an example of opportunities created by the value-creation archetypes and value drivers. Over the past decade, TomTom has been the market leader in personal navigation devices worldwide, achieving a 45% share of sales in Europe and 21% in the U.S.[8] TomTom experienced fast growth since the introduction of its first device in 2004, with revenues soaring from $39 million in 2003 to $1.9 billion in 2007. Its success came from the design of a ready-to-use device that exploited the availability of GPS signals. In 2006, TomTom also introduced TomTom Mobility for real-time traffic information and TomTom WORK for fleet management.

8 Garside, J. "Harold Goddijn: TomTom's founder needs his business to turn the corner," *The Guardian,* November 24, 2011.

In 2007, at the height of its global expansion, TomTom introduced HD Traffic, which provides real-time traffic information, and Map Share, which offers personal and community-based maps. This move marked a shift toward a content business model, a trend that continued the following year with the acquisition of Tele Atlas for $2.9 billion. The move to a content model was timely, as sales of TomTom's personal navigation devices began to falter in 2008[9] due to competition from smartphones, automobile manufacturers and a weak economy. For this reason, TomTom now focuses on DDS-based services rather than devices, especially real-time services: *"HD Traffic, our real-time traffic solution, plays an important part in our strategy to expand the services we can offer our customers."*[10]

At the heart of HD Traffic are multiple external data streams from multiple sources that TomTom combines to provide its customers with precise real-time traffic intelligence. These sources include GSM probe data, GPS probe data, incident context data, Traffic Message Channel third-party messages and historic data on average traffic speeds. All these sources are then combined by TomTom to provide better routing compared to competitors and non-interconnected devices.

As of 2012, personal navigation device sales contributed 35% of TomTom's overall sales, so the company is clearly generating revenues from other sources. However, transforming a large company from a device manufacturer and marketer into an information provider is no simple feat. Capturing the potential of DDSs appears to hold the key to TomTom's survival.

We also mentioned TripIt, which is now part of Concur Technologies, in our discussion of value creation. TripIt aggregates a traveler's entire itinerary information not by having access to the global distribution system that has been the backbone of the world's travel system, but rather by tapping into external DDSs. TripIt builds itineraries by monitoring traveler confirmation emails that suppliers send in response to a booking (e.g., airlines, cruise lines, hotels, car rental companies).

With access to the traveler's itinerary, TripIt provides a wealth of information services, making it possible for a customer to download all information about the proposed trip on a smartphone, and even automatically rebook when a flight is delayed enough to miss a connection. When a traveler emails a hotel reservation to TripIt, the firm's proprietary parsing software extracts all information relevant to the itinerary from the message, including the hotel's location. TripIt then adds contextual information to the location by using applications that identify landmarks and points of interest, among other processes. Once it has added this contextual information to the DDS of confirmation emails, TripIt is able to produce a master itinerary with automatically computed useful information such as points of interest, weather forecasts and driving directions.

Note that TripIt creates the contextual information using static data. In other business models, the context is itself dynamically generated from a DDS. This is the case with Foursquare's Radar, which provides a dynamic user-generated database of places to match GPS coordinates of users.

In the same way that a wide range of firms has recognized the value of using GPS data, we anticipate that the potential of digital data streams will no longer be the province of a few early movers, but will soon move into the mainstream. The goal for the firms currently using DDSs is to continue to search for DDS opportunities based on the strengths of their existing assets and capabilities. We believe that TomTom's move from devices to services is an example of this type of evolution.

IT Capabilities Needed to Implement a DDS Strategy

Real-time data streams are low-latency, potentially high-volume flows of digital events. They enable a rapid cycle between the occurrence of an event and a possible (re)action, making them ideal candidates for innovative products and services. The relative simplicity of recording, relaying or analyzing the status of a large number of entities provides substantial opportunities for value-creation. Dealing with real-time DDSs requires a different set of organizational capabilities than dealing with a mountain of "big data." Developing these capabilities is the responsibility of the CIO. Our early research suggests that, to implement a DDS strategy, a firm must have a sound footing in the following four areas:

9 Preuschat, A. "TomTom seeks a route back to growth," *The Wall Street Journal Europe,* May 21, 2012.

10 *Annual Report and Accounts 2010,* TomTom NV, 2010.

1. *Dataset:* A DDS strategy hinges on being able to tap into valuable sources. A firm must develop the ability to identify promising internal and external DDSs.
2. *Toolset:* Once a source is identified, the firm must be able to tap into the streaming data. This requires the capability to use appropriate tools to harvest the DDS or multiple DDSs.
3. *Skillset:* A DDS strategy consists of more than simply collecting DDS data. As the five value-creation archetypes show, the firm must develop the competencies to orchestrate the complementary resources necessary to deliver value based on the DDS.
4. *Mindset:* A critical component of innovative initiatives is the willingness to invest and face risks. A hallmark of the successful DDS initiatives we studied was that the mindset of organizational members made them ready to embrace change.

Recommendations for CIOs

To summarize, we offer the following recommendations that we believe CIOs should consider when planning, designing and launching their DDS strategies.

1. Proactively Examine Opportunities to Leverage Existing DDSs

We recommend proactively scanning for DDS-enabled opportunities for value-creation. We believe that CIOs, with their unique blend of technical skills and strategic vision, are ideally placed to identify early on the opportunities for exploiting DDSs. The value archetypes and value drivers described in this article are the blueprints for detecting and envisioning these opportunities.

Once the firm has identified a candidate value archetype, and analyzed the appropriate value drivers, it is necessary to match the recognized potential with available organizational capabilities. As we suggested, these should be articulated in the capacity to identify valuable DDSs, to tap into the information with the appropriate tools, to properly orchestrate the available resources, and to have the willingness to invest in DDS initiatives.

2. Develop the IT Capabilities Needed for the Unique Characteristics of DDSs

The successful implementation of planned DDS initiatives requires an organization to develop the four areas of IT capability described above—dataset, toolset, skillset and mindset. Some organizations, created to exploit the opportunities offered by DDSs, have to create the four capabilities in order to have a product to bring to market (e.g., TripIt). In others, such as TomTom, the development of the appropriate dataset, toolset, skillset and mindset requires the conversion of past practices and assets—which can be even more complex than outright development.

3. Consider Developing a New DDS

The focus of this article is on exploiting existing external sources of data. However, in our research, we also identified many examples of successful innovation through the proactive development of new DDSs. Although this was typically done by startups (e.g., myTaxi), we recommend that CIOs also explore opportunities for generating in-house any data necessary to power valuable DDSs.

A dataset capability is central to this approach, as the value of the DDS cannot be tested until investment has been made to generate it. However, first-mover advantages and barriers to erosion of the advantage could enable those who develop their own DDSs to reap significant rewards. Twitter, Facebook and TripIt are examples of companies that have developed a platform built on top of an internally generated DDS.

4. Be Alert to DDSs your Organization Already Has

While many of the examples of DDS innovators are startups, we are convinced that established firms may have an advantage in this space. Existing firms may well have a dormant DDS potentially waiting to be unleashed. Consider Netflix. After the company introduced its movie streaming service, it had the opportunity to collect and gather additional data on top of simple sales and rentals (for example, in addition to which movie a customer watched, *when* they watched it, *how much* of it they watched). At the same time, Netflix found itself dealing with a new service: *"Streaming has changed not only the way our members interact with the service, but also the*

type of data available for use in our algorithms."[11] Without realizing it, Netflix had created the DDS for its new services.

The pervasive digitization that has occurred in large organizations over the last two decades has made most organizational activities DDG events, and many of them involve streaming. We have identified three steps for taking advantage of this dormant potential:

1. Enable and spur your firm to develop an awareness of the DDSs it has, even though it may not realize it has them. This could be done through a formal inventorying exercise.
2. Identify the value drivers enabled by the DDSs the organization already produces.
3. Match one or more value archetypes to the most promising uncovered value drivers. Once a specific value driver is identified, it is straightforward to develop a business case for the initiative and test whether full development is warranted.

Concluding Comments

In this article, we have explored the value-creation opportunities emerging from digital data streams (DDSs) and provided an initial glimpse of the major managerial implications of this trend. We have also provided recommendations on how to move forward and take advantage of the opportunities provided by DDSs—both external and internally generated streams. In analyzing this new phenomenon, we have attempted to go beyond existing categories and explore new conceptual tools to understand it. Our research has shown that there are significant opportunities for value-creation once organizations have identified digital data streams and treat them as a coherent unit of analysis.

Digital data streams challenge the way organizations have historically extracted value from data. One of the major difficulties for established firms to overcome is that their operations are typically designed for batch processing. But they are now surrounded by constantly evolving streams of real-time data. Harnessing the power of these real-time data flows requires a shift in mindset. We believe that those who can make the shift will find that they can compress the time between the detection of and response to problems or opportunities.

11 Amatriain, X. and Basilico, J. "Netflix Recommendations: Beyond the 5 stars," *The Netflix Tech Blog,* http://techblog.netflix.com/2012/04/netflix-recommendations-beyond-5-stars.html.

Appendix: Initiatives, Archetypes and Value Drivers

Initiative	Archetypes	Description	Drivers
Booking.com	***DDS Generation***	Generates its own real-time stream of room availabilities (199,504 directly contracted hotels). Gathers hotel availabilities through its extranet and allocates them through its website. The generated stream is made available to affiliates, which are rewarded on the basis of an originating fee.	
	Service	Provides its online final customers with a convenient way to benchmark hotel room prices and book online.	
	Efficiency	Improves room occupancy rates for partnering hotels.	***Real-time Sensing***
		Detects in real-time room availabilities in hotels (and relative prices). Reminds hotels of the number of free rooms to "hurry" the purchase. Provides additional real-time services like last-minute offers.	
		Leverages the website clickstream, for example to hurry purchases by showing the number of visitors currently looking at the same offer.	***Real-time Sensing***
Evasori.info	***DDS Generation***	Users can publish online where tax evasion events occur and show them on a map. Users then generate the digital representation of the evasion, and the site streams it. Simple analytics are available, and data can be accessed through a proprietary API.	
		Publishes in real-time tax violations as they occur, including their geographical location.	***Real-time Sensing***
Groupon	***DDS Generation***	Generates its own deals DDS by having businesses create and launch featured deals. The DDS is accessible through an API.	
	Service	Aggregates deals and makes them easily accessible thorough web, API and email.	
		Allows the detection of featured deals in a town. Exploits customer location information to geographically filter the deals.	***Real-time Sensing***
		Provides real-time coordination of users' purchasing behavior. When users find an interesting deal and share it on a social network, coordination emerges through users' connections.	***Real-time Coordination***
TripIt	***DDS Generation***	Automatically generates itineraries accessible through an API for third-party use and services development.	
	Service	Organizes and shares customers' trips by creating a master itinerary for access on a smartphone, calendar or anywhere online. TripIt Pro acts like a personal travel assistant that, by aggregating several external DDSs, keeps travelers informed of flight status, alternate flights and more; TripIt for Business is an easier way for companies to organize travel, keep track of who's traveling when and where, and whether travel dollars are being spent wisely.	
		Allows the harvesting of several real-time DDSs to organize the master itinerary, gathering real-time information on flights status, alternate flights, frequent traveler points and eligible flights for fare refunds.	***Real-time Sensing***
		Provides real-time visibility about travel of a group of individuals who are connected (e.g., co-workers, friends).	***Real-time Mass Visibility***
Adaramedia	***DDS Aggregation***	Leverages proprietary data from trusted sources to connect ads with travelers as they surf the Internet. Using exclusive data, reaches premium audiences of travelers and business decision makers.	
		Real-time identification of website visitors provides better advertising targeting, increasing impressions efficiency.	***Real-time Sensing***

Initiative	Archetypes	Description	Drivers
Factual	***DDS Aggregation***	An open data platform for application developers that leverages large-scale aggregation and community exchange. Makes available datasets on entertainment, health and education, as well as points of interest. Provides access to several real-time DDSs of events or entities' states. As an aggregator, Factual exploits the real-time sensing value driver of other firms or individuals.	***Real-time Sensing***
Influence Explorer	***DDS Aggregation***	Provides an overview of campaign finance, lobbying, earmark, contractor misconduct and federal spending data. Data, accessible through an API, is provided by the Center for Responsive Politics, the National Institute for Money in State Politics, Taxpayers for Common Sense, the Project On Government Oversight, the EPA and USASpending.gov. Allows real-time monitoring of campaign finance, lobbying, earmark funding, contractor misconduct and federal spending data.	***Real-time Sensing***
Infochimps	***DDS Aggregation***	Connects internal data with external data sets accessible through an API. The goal is to streamline access to the world's structured data. Provides access to several real-time DDSs of events and entities' states. As an aggregator, Infochimps exploits the real-time sensing value driver of other firms or individuals.	***Real-time Sensing***
Pachube ("patch-bay")	***DDS Aggregation***	Web-based service that manages real-time data and allows sharing, collaborating and making use of data generated from devices. Acts as a real-time data brokerage platform for the Internet of Things, providing most of its functionality via its API. Allows the sensing of real-time DDSs generated by devices and sensors.	***Real-time Sensing***
Socrata	***DDS Aggregation***	Acts as a major platform in the Open Data and Data.gov initiatives. Federal agencies and organizations generate their own DDSs, whereas Socrata aggregates the DDSs and makes them available to the public. Allows the sensing of several real-time DDSs generated by federal agencies and other organizations. As an aggregator, Socrata exploits the real-time sensing value driver.	***Real-time Sensing***
Spokeo	***DDS Aggregation***	A people search engine that organizes vast quantities of white-pages listings, social information and other people-related data from a large variety of public sources and social networks. Allows the sensing of several real-time DDSs generated from public sources. As an aggregator, Spokeo exploits the real-time sensing value driver.	***Real-time Sensing***
BrandWatch	***Service***	Offers a full range of social media monitoring tools and services, from a simple monitoring project to reports or API integration. Uses real-time sensing of comments about a brand posted on several social websites to gain visibility of the current sentiment relating to a particular product or service.	***Real-time Mass Visibility***
Canal+ Eureka	***Service***	Analyzes 30 million data points a day for the operators of two million internet TV viewers. Tells viewers, for example, that if they liked a particular documentary, they are likely to enjoy another program. Gains mass visibility through real-time sensing of TV viewing, and makes recommendations based on this visibility.	***Real-time Mass Visibility***

Initiative	Archetypes	Description	Drivers
MyCityWay	***Service***	A real-time app that combines urban reference apps and app platforms to provide a new service to customers.	
		Allows the sensing of several real-time DDSs generated from the status of other entities.	***Real-time Sensing***
MyTaxy.net	***Service***	Generates a DDS, which is used to create new convenient services for customers booking taxis.	
	Efficiency	Increases taxi drivers' efficiency by supporting call collection and cab positioning.	
		Detecting a taxi's and customer's positions allows them to be coordinated in real time.	***Real-time Coordination***
Netflix Recommending system	***Service***	Creates value through data streams in form of personalization. Uses self-generated and external DDSs, and social networks, to recommend personalized suggested titles based on a household's preferences.	
		Gains mass visibility through real-time sensing of users, and makes recommendations based on this visibility.	***Real-time Mass Visibility***
TomTom HD Traffic	***Service***	Provides advanced navigation services and real-time routing and traffic information.	
		The aggregation of data from several real-time DDSs (GSM probe data, GPS probe data, incident context data, TMC third-party messages) provides visibility on traffic congestion.	***Real-time Mass Visibility***
ruter.no (Trafikanten)	***Service***	Gathers real-time information on the overall situation of Oslo's public transportation and repurposes it in a convenient web and mobile application to make the lives of commuters and citizens easier.	
	Efficiency	Optimizing traffic signal priority system based on real-time information about the city's traffic improves travel times, reduces the number of vehicles and lowers the costs of transportation.	
		Real-time sensing of the DDSs from public transport operators provides visibility of the traffic levels throughout the whole system.	***Real-time Mass Visibility***
American Car Rental	***Efficiency***	Automatically charges customers exceeding speed limits by monitoring customers' driving speeds in real time.	
		Allows real-time monitoring of a car's speed (and other telemetry information).	***Real-time Sensing***
Autostrade Tutor	***Efficiency***	The police can tap in the camera system used to manage Italian highways to automatically fine speeding drivers.	
		Allows the average speed of each vehicle passing under consecutive "Tutor" enabled gates to be known in real time.	***Real-time Sensing***
Google Trends	***Analytics***	Analyzes a portion of Google web searches to compute how many searches an individual has done for particular terms relative to the total number of searches done on Google over time.	
		Allows real-time sensing of Google users' web searches.	***Real-time Sensing***
Mint	***Analytics***	Provides a unified view on bank, credit and investment accounts by connecting to the DDSs of the originating financial institutions. Value is created as customers get a unified view of their finances, convenient visual tools to examine the status of their expenses and investments, and personal recommendations based on a specific profile.	
		Gains mass visibility of current customers through real-time sensing of DDSs, and makes recommendations based on this visibility.	***Real-time Mass Visibility***

Initiative	Archetypes	Description	Drivers
newBrand-Analytics	***Analytics***	Extracts specific feedbacks from customers' unstructured mentions of brands on social media channels. Firms can then adjust their behaviors in real time on the basis of customers' mentions. Allows fast cycling from customers' feedback to action, enabling firms to fine-tune their offerings on the basis of customers' mentions.	***Real-time Experimentation***
Opower	***Analytics***	Compares the data from a customer's smart meter (anonymously) with that of neighbors, using graphics, bar charts and SMS alerts. Customers are presented with information about behaviors and how to reduce their power consumption. Leverages the grid's smart metering capabilities to provide neighborhood consumption visibility and thus promotes energy-efficient behaviors.	***Real-time Mass Visibility***
TaKaDu	***Analytics***	A software-as-a-service solution for monitoring water distribution networks. Provides the utility with real-time control over network events, using state-of-the-art statistical and mathematical algorithms. Detects, alerts and provides real-time insight on leaks, bursts, zone breaches and other network inefficiencies. Allows real-time sensing of the water distribution network	***Real-time Sensing***

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