



Visionaries 2016

IT as a Platform for Interconnection

— Advanced Techniques for Using Data —

The growing use of digital and network technology has made it possible to obtain data on all sorts of real-world phenomena. How to handle large volumes of diverse forms of data is emerging as a determining factor in corporate value, with the potential to transform the way things are done in the future. Hitachi has been researching the corporate use of data from early on and supplies technologies for the collection and high-speed searching of large volumes of data. It also supplies various techniques for the realtime integration and consolidation of data and its analysis and other uses in the form of big data platforms. Hitachi is playing a leading role in the creation of new value through advanced solutions for the use of data based around open innovation.

Innovation through Tracking Status of People and Things

With information technology (IT) being used in a wide range of situations, from corporate business systems to industrial machinery, infrastructure, smartphones, wearable devices, and vehicles, today's networked society is constantly generating huge volumes of data. Furthermore, there are growing expectations for the achievement of initia-

tives such as social reforms and the development of business models that transcend conventional demarcations by putting these large and diverse volumes of data to use in the form of big data.

Since before the term "big data" was first coined, Hitachi has been engaged in research aimed at producing value from the large volumes of data generated by infrastructure and other industry. Makoto Yasuda (Senior Technology Evangelist,



and is used for applications such as encouraging greater activity at events or shopping centers. Human big data is a solution for measuring the level of activity in an organization by using wearable name tag sensors to measure people's activity. It can be thought of as one example of the IoT. Tracking the status of things has been implemented in systems with sensors attached to infrastructure or industrial machinery and process the operational data in realtime to detect signs of potential accidents or faults and to initiate preventive actions.



Makoto Yasuda

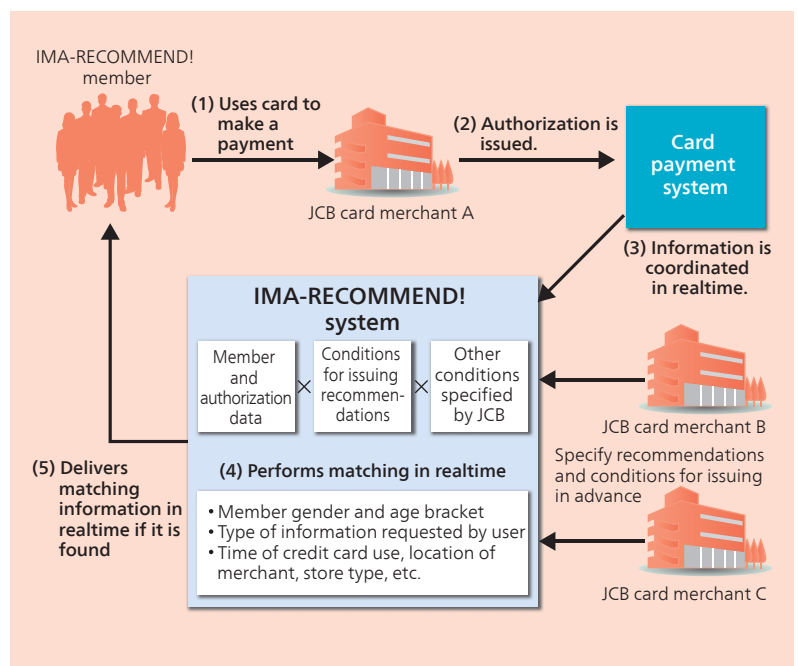
Enabling Realtime Use of Big Data

One example that represents a step forward in the use of big data is IMA-RECOMMEND! in which Hitachi is jointly engaged with JCB Co., Ltd., a credit card company. This service uses the authorization data generated by use of a credit card to trigger analysis and issue coupons for participating stores nearby. The analysis combines the promotional needs of participating merchants with information such as the customer's basic details and preferences to generate a recommendation that matches the needs of both the customer and merchants, and delivers a coupon to the customer's mobile device in realtime. A trial of the service ran for six months from October 2014 in the Shinjuku district of Tokyo, involving approximately 10,000

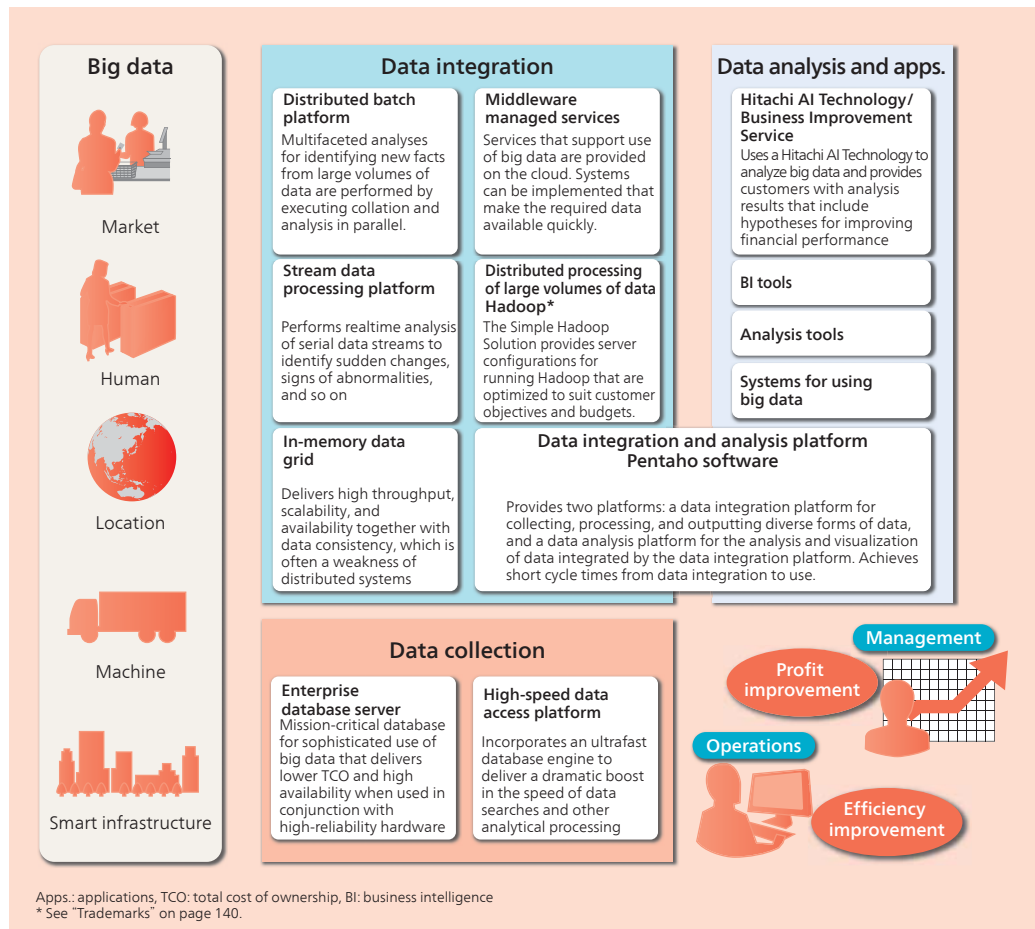
Systems & Services Business, Information & Telecommunication Systems Company, Hitachi, Ltd.), one of the key people engaged in big data applications, describes this work as follows.

"We have developed a variety of technologies for using data to track the status of the three elements of business, namely: people, things, and money, and for utilizing these for business innovation. In particular, we have put a lot of effort into techniques for tracking people, such as human big data and measuring the flow of people, and technologies for visualizing the status of things that can lead to solutions, including what has come to be known recently as the Internet of things (IoT), recognizing these as areas where Hitachi can put its strengths to good use."

Measuring the flow of people involves techniques for measuring how people move through specific areas while allowing for privacy concerns



Overview of the IMA-RECOMMEND! service for issuing coupons and information in response to card transactions. The service pays close attention to realtime performance and location, and issues information by obtaining an accurate assessment of customers' purchasing behavior and matching this with member attributes and preferences.



IT platforms supplied by Hitachi for using big data. Platforms cover a wide range of activities, including data collection, integration, analysis, and use.

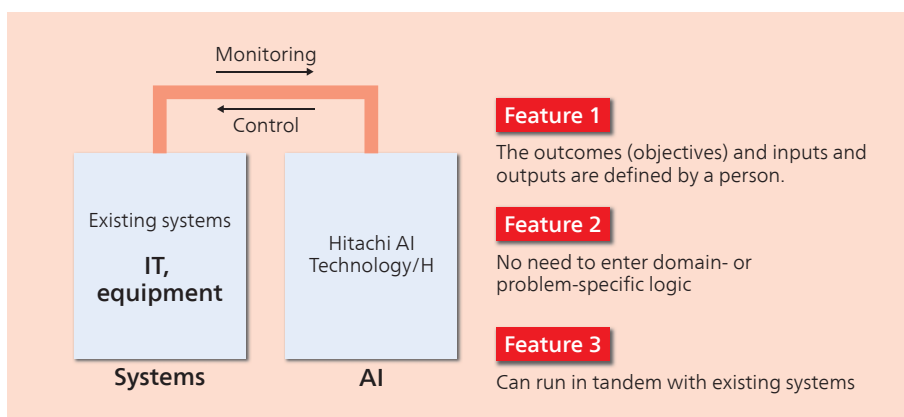
JCB cardholders and 215 participating stores. It resulted in an increase in both visits to participating stores and in the value of purchases.

As Mr. Yasuda explains, IMA-RECOMMEND! is more than just a service for issuing coupons. "The key point is the execution of a sophisticated matching algorithm at high speed that links together data from different areas, namely marketing and the flow of people. This makes it possible to provide people with the information that they need at a particular instant and that is matched to their location, circumstances, and preferences." Widespread applications are expected for this innovative service model, which makes sophisticated use of data to present customers with what they are seeking in realtime and with a high degree of accuracy.

Supporting this sophisticated use of data are IT platforms that incorporate the technologies and know-how built up by Hitachi though its work as an IT vendor. One example is the high-speed data access platform*, which incorporates an ultrafast database engine that can perform searches and

other analytical processing at high speed. Along with data matching for IMA-RECOMMEND!, its applications cover a wide range and include civil defense systems such as one that provides quick predictions of damage due to volcanic eruptions. The integration and consolidation of different types of data, meanwhile, enables the analysis and use of big data in realtime. Hitachi technologies are used in IMA-RECOMMEND! for realtime data integration, and also stream data processing, complex event processing (CEP), and in-memory data grids.

Mr. Yasuda states, "Use of big data extends from uncovering the useful elements contained in data to the point where they enable specific value-creation action. As in the project with JCB, we intend to expand our involvement in collaborative creation and collaboration in the future based on highly reliable IT platforms that Hitachi is uniquely equipped to provide, thereby helping achieve innovation and overcome challenges faced by customers."



Overview of Hitachi AI Technology/H, an AI developed by Hitachi. The AI can learn from data and grow in accordance with the conditions while producing results.



Kazuo Yano

* Utilizes the results of “Development of the Fastest Database Engine for the Era of Very Large Database and Experiment and Evaluation of Strategic Social Services Enabled by the Database Engine” (Principal Investigator: Prof. Masaru Kitsuregawa, The University of Tokyo/Director General, National Institute of Informatics), which was supported by the Japanese Cabinet Office’s FIRST Program (Funding Program for World-Leading Innovative R&D on Science and Technology).

AI Makes the Leap from Data to Value

The use of big data is entering a new phase. To raise that level further, Hitachi has recently augmented its IT platforms with a new proprietary technology called Hitachi AI Technology/H, where AI stands for artificial intelligence. Kazuo Yano (Corporate Chief Scientist, Research & Development Group, Hitachi, Ltd.), who supervised development, looks back on that project as follows.

“Our research into world-leading uses for big data has involved considerable trial and error ranging from looking at individual items and collating widely scattered data to considering how we can create value in ways that generate corporate profit. The gap between data and value is wider than you might think. This led us to start AI development early in our research as a way to bridge this gap in an efficient manner.”

Using golf as a metaphor for the relationship between data and value, whereas the only data that could be obtained in the past was the number of shots for each hole, the use of sensors and other technology means that it is now possible to collect tens of thousands of data points from each hole. It is then possible to analyze this data to identify correlations and generate hypotheses for how to achieve a better score, such as the fact that taking two practice swings results in longer drives. In other words, there is no point in collecting lots of big data that records actual events unless it leads

to better results (small data). The techniques and methods for generating hypotheses for bridging this gap, by identifying correlations, lie at the core of big data applications.

Naturally, these hypotheses can also be generated by drawing on human intuition and rules of thumb. Unfortunately, there is a large cost in time and money associated with acquiring such experience and trying to make sense of large volumes of data.

Mr. Yano expresses his pride in his work by commenting, “Our development has targeted systems in which humans decide those matters that are best left to humans, such as defining the problem and choosing which data to use, while leaving the rest to be taken care of by AI. Such systems can jump directly to the value layer from the layer in which detailed actual data is collected, without human intervention. This is a key feature that currently only Hitachi AI Technology/H possesses.”

Creating Value through Humans and AI Working Together

Hitachi AI Technology/H has been put to successful use in a variety of industries since the research and development stage. When used to issue picking instructions in a warehouse management system, for example, use of the AI shortened the time taken to complete the work by 8%.

Mr. Yano states, “Not only can Hitachi AI Technology/H respond flexibly to changing demand by selecting for itself which big data relating to warehouse management to use, it can also understand the workplace initiatives and improvements made by human staff, formulate hypotheses, learn from the results, and incorporate this into the work instructions it issues. That is, it can make process improvements in cooperation with



Wearable nametag sensors used for the collection of human big data. The sensors are used to measure data on the wearer's movements and to make improvements to things like workplace productivity and employee satisfaction.

human staff.”

Since November 2015, the technology has been supplied as the Hitachi AI Technology/Business Improvement Service for resolving corporate management issues. This service formulates process improvement measures by using Hitachi AI Technology/H to identify elements in business big data that have a strong correlation with such objectives as improving financial performance or reducing costs. The advantages of using AI go beyond a reduction in workload. Its capabilities also extend to identifying correlations between data and business results deemed by human rules of thumb to be of little significance, or devising innovative measures from a different perspective to that adopted by people.

Hitachi AI Technology/H and human big data have also been combined to develop a service that helps overcome challenges by identifying the factors that influence the level of activity in an organization and evaluating the degree of influence. It is currently being used with The Bank of Tokyo-Mitsubishi UFJ, Ltd. in an initiative aimed at improving workplace productivity, and with Japan Airlines Co., Ltd. in a trial aimed at improving employee satisfaction. This technology is likely to be used in a wider range of industries in the future to make improvements in business efficiency and productivity with humans and AI working together.

Mr. Yano states, “What matters is that we can use Hitachi AI Technology/H regardless of the industry. It is able to learn from data and come up with ways of generating value without having first been supplied with specialist expertise. By speeding up the learning cycle across society as a whole, this has the potential to lead to breakthroughs that

will provide a dramatic boost to economic productivity.”

The use of big data and Hitachi AI Technology/H could bring major changes to the nature of business and society.

Incorporation of Advanced Technologies and Different Cultures

As noted earlier, big data means not only that the volume is large but also that it originates from a wide variety of sources. In the use of big data, the significance is in the integration of data of various different types for analysis and the identification of correlations. What matters here are the functions that enable data from different systems to be used together and the platforms that support them.

In June 2015, Hitachi acquired Pentaho Corporation, a US company that develops and supplies software for big data analytics. Pentaho's software supports a diverse range of data and provides advanced functions for integrating data from various business systems and other applications and for performing multifaceted analysis and visualization.

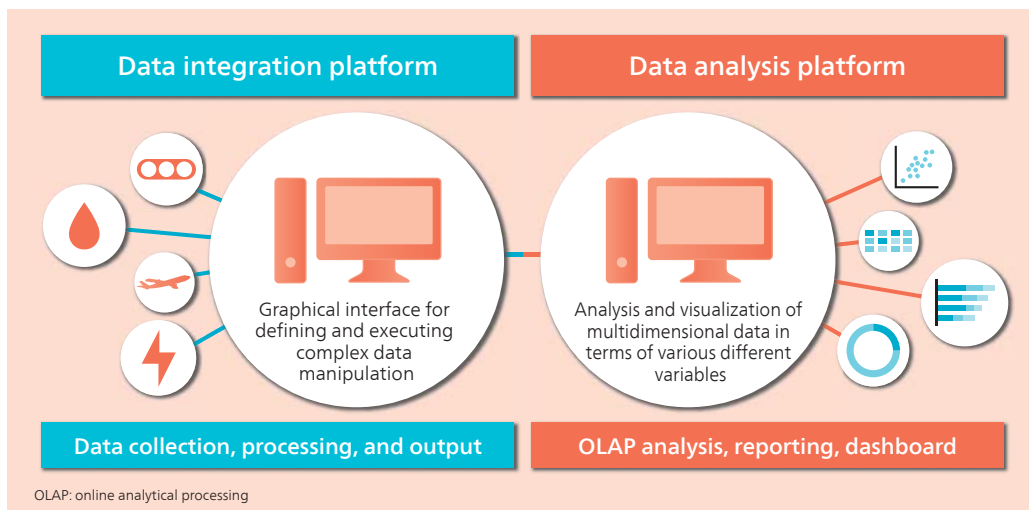
Another major feature of the software is that it is open source. Hiroyuki Kumazaki (President, IT Platform Service Innovation Management Division, Information & Telecommunication Systems Company, Hitachi, Ltd.), who manages the IT platform business, describes these features and the background to the Pentaho acquisition as follows.

“The open source Pentaho software is developed by a community of engineers from around the world. While the software itself is used by more than 1,500 companies, Pentaho has released an enhanced version for which it charges a royalty and which it has made better to use in ways that include conducting testing and adding functions. This business model of drawing on the open source community is new to Hitachi, and as we work on things like collaborative creation and open innovation with customers and partners, as Social Innovation, I see the open source concept and culture as things of great significance that will bring changes.”

The Pentaho software is equipped with functions for everything from integrating data that is spread across systems to its analysis and use. As well as serving as the core of IT platforms that are essential to the use of big data, it is also seen as injecting new genes into Hitachi as the company experiences growing use of digital and network technology and a paradigm shift in business that is



Hiroyuki Kumazaki



Overview of Pentaho software. Pentaho provides two platforms: a data integration platform for data collection, processing, and output, and a data analysis platform for the analysis and visualization of the integrated data.

overturning past wisdom.

New Links Provide a Basis for Value Creation

While use of big data currently remains within the borders of individual companies, what will happen once it expands to encompass multiple companies in the form of a value chain?

The concept put forward by Mr. Kumazaki is large in scope. “In manufacturing, for example, by integrating corporate business systems that form a value chain, including the procurement of parts and materials, product assembly, and the logistics of market distribution, and by analyzing the resulting big data, it will be possible to optimize production by responding in realtime to things like demand fluctuations and changes in the material supply conditions. If we can combine business optimization solutions that utilize components for using AI or data from the Pentaho software or elsewhere by linking numerous different corporate systems together based on the symbiotic autonomous decentralized systems concept, and implement all of this as service platforms that generate a high level of value, it is likely to result in a transformation in the way various different industries operate.” Nevertheless, this is no mere dream.

A recent trend that has attracted attention in the finance sector is that of “fintech,” a term coined in the USA to mean a combination of finance and technology. Similar transformations are also likely to take place in many other industries in the fu-

ture. The essence of this is that advances in IT enable data to be combined and enable companies and other organizations to work together in ways that were never envisaged in the past. These new links will bring major changes to existing industries and serve as a basis for things like paradigm shifts and value creation.

What are needed to encourage such new links are forums that make it easy for anyone to participate.

Mr. Kumazaki states, “Building service platforms that can provide these forums and deliver greater value throughout society is what we are seeking to achieve. Hitachi has built up know-how in a wide variety of working businesses, including industry, transportation, energy, and logistics as well as information and telecommunications, and we have the capabilities and the technology to support integration beyond organizational boundaries. In the future, we intend to take a global approach to accelerating the implementation of service platforms like these, while also dealing individually with issues such as data ownership and maintaining security.”

Work has already started on initiatives that create forms of value that have never existed before from new links that encompass such things as data and organizations and that are enabled by open innovation and the symbiotic autonomous decentralized systems concept, as well as techniques for enhancing the integration and use of big data.