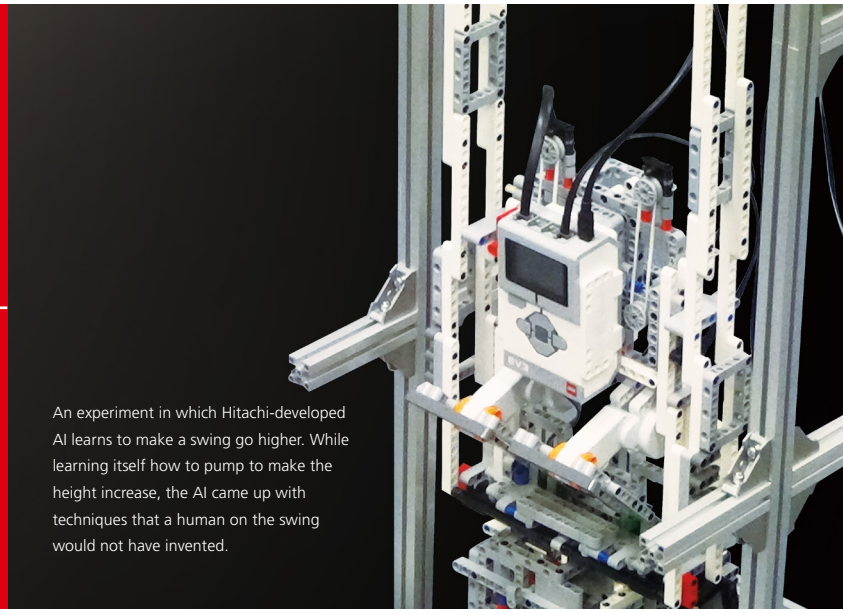
HITACHI'S AI OPENING A NEW ERA

Hitachi AI Technology/H

Hitachi's artificial intelligence technology, Hitachi AI Technology/H, is generating new economic growth with versatility that makes it applicable to diverse industries even in a rapidly changing, unpredictable age.



An experiment in which Hitachi-developed AI learns to make a swing go higher. While learning itself how to pump to make the height increase, the AI came up with techniques that a human on the swing would not have invented.

AI for Continuing Economic Growth

Recent years have seen an increase and diversification of data types and formats, thanks to the rapid spread of cloud computing, mobile devices, and social media, along with the development of new sensor technologies to capture this data.

In previous analyses conducted by human specialists, it was becoming increasingly difficult to test hypotheses through exhaustive sifting of this vast amount of data. As these data-driven results became more inaccessible, it gave rise to social problems, such as a digital divide that was directly linked to an income divide.

In response to these changes, Hitachi developed technology to use and apply this "big data," and in 2012 launched a full-scale big data analysis service. We have relationships with a wide range of customers in the electric power, manufacturing, distribution, finance, transportation, and water industries, and are making efforts to link infrastructure and products using the Internet of Things (IoT) and other means. In 2016, we began providing the Lumada IoT platform, developed as a core for social innovation. One of its basic functions is Hitachi AI Technology/H, or simply "H" hereafter.

Now that Hitachi's H has been put to practical use in various industrial fields, we are building on our findings to improve the future, based on past data, and successfully deriving methods to deal with unknown problems.

Hitachi AI Helping People Work Together

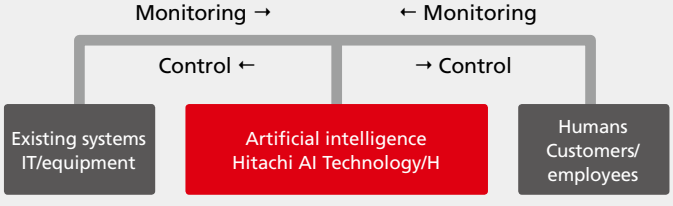
The major characteristic of H is its versatility. Most new technology has a history of being invented first for a specific purpose, later spreading throughout more of industry and society as it is generalized. At Hitachi, our prediction that AI will certainly reach an age of generalization has led us to pursue a more versatile AI implementation from the very beginning.

H has three further characteristics.

(1) Human users define and input the outcome to be achieved.
(2) There is no need to define a specific method to solve the problem or application in question.
(3) H can be applied to existing systems.

For example, when the goal of "increasing sales" is input into H, it analyzes enormous quantities of past data and "thinks" on its own to derive the best method to achieve this. Since it can be added to existing systems, installation costs are also kept down. It is still humans, however, that define the goal for H and implement the measures it recommends. Hitachi H is a system in which humans and AI learn together through data to raise productivity.

Hitachi's Approach to AI Systems



Point 1:
Learn from data and grow while adapting to circumstances to produce results

Point 2:
Optimize the system as a whole, including its human users

Example of AI Development

Versatile Hitachi AI Technology/H can respond to a wide range of work content, and is already producing results in many different industrial sectors.

Versatile Technology for Application in Diverse Fields

Hitachi provides a wide range of services, from construction of electric power facilities, railroads, and other large-scale social infrastructure to manufacture of general household products. The accumulation of business data in these diverse fields worked to our advantage in the development of H. With the same AI software, H provides comprehensive improvement strategies for businesses in completely different industries. Our record to date includes 57 cases in 14 fields, including distribution, logistics, industrial plants, finance, transportation, and manufacturing.

Hitachi has since 2004 been researching and developing technology to objectively measure human behavior. Through our analysis of huge volumes of behavioral data, we have found that people who work in organizations featuring behavioral diversity have high levels of happiness, and that groups with high levels of organizational happiness have high productivity. In other words, employees' happiness is closely related to their organization's activity and should be considered to strongly affect productivity. Hitachi has quantified this as a unique index: "organizational activation." In June 2016, we kicked off a demonstration experiment using H to offer advice to 600 sales and marketing division employees in the Hitachi Group in order to effectively increase happiness. The aim is to raise productivity by providing the organization with fresh energy tied to increased individual happiness.

With AI, Hitachi pursues optimization of overall systems, including the humans that operate them, and is accelerating its Social Innovation Business.

Employees with name-tag-style wearable sensors, which collect data on their behavior when interacting with others for analysis by H.

Contributing to Energy Savings in Railway Operation

With the goal of reducing CO_2 to counter global warming, improved energy efficiency is needed in railway systems in Japan and other countries. Railway systems consume 60% to 80% of their total energy during rolling stock operation, and Hitachi has developed rolling stock and related systems to achieve energy savings. H was introduced to verify these energy-saving effects.

Railway systems collect many different types of sensor information, including through remote monitoring of rolling stock status. H was applied to this data to derive methods to effectively reduce energy consumption. After analyzing a year's worth of data, the program identified various characteristics related to energy consumption from factors including speed, track gradient, and operating schedule. Based on analysis of the massive data on the control of the "notch," equivalent to the accelerator on an automobile, and its electric power consumption, we reduced drive system power consumption by shortening the time of train operation at maximum notch and lengthening the time of notch-off operation. Even greater effects are predicted if operating procedures can be further improved.

Future uses of H for railway systems big data are envisioned to include applications to reduce energy consumption in the auxiliary circuit systems used in air-conditioned cars and door opening/closing, and to make settings with the purpose of achieving riding comfort in terms of noise and vibration. In railway maintenance and management work as well, it may be possible to use H to analyze employee "happiness" and apply the findings to raising work efficiency. In raising car utilization, H is promising for deriving the relationship between car deterioration with age and operating conditions, and may possibly be applied to prevention and detection of equipment failure.

Use in the Field of Finance for a FinTech Age

Financial services have expanded together with the progress in IT. FinTech, a coined term combining the words "finance" and "technology," refers to the new financial services that have appeared in recent years, bringing together finance and IT to improve user convenience. Typical examples of FinTech are services using the Internet to move capital beyond the scope of traditional services and business frameworks, as well as crowdfunding, which procures capital from multiple individuals using social networks.

Hitachi has focused on AI in the financial industry as well, conducting a joint experiment with The Bank of Tokyo-Mitsubishi UFJ that puts human behavior measurement and analysis tools to use in improving quality and supporting work style reforms. Up to now it has been possible to acquire behavioral data on several hundred people in units of seconds, but specialist analysis was required to judge those people's level of contribution to organizational activation, and both time and cost were issues. Hitachi developed name-tag-style wearable sensors to measure people's behavior when in groups. H then analyzed the behavioral data obtained from those sensors, automatically and efficiently producing recommendations on ways of working to raise productivity.

The experiment drew on behavioral data from 40 employees collected over three weeks. It found, for example, that one employee showed a high level of organizational activation on a day when there were frequent short conversations, including greeting others and making brief reports. This demonstrated that while the productivity of specific individuals may decrease with repeated conversations, the productivity of the organization overall can rise. AI analyses that quantify individual contributions to the organization as a whole can be useful for optimizing services and working styles.

AI to Link Manufacturing-Sector Facilities

Use of IoT is progressing in the manufacturing sector. In Western countries, government-led efforts are under way to construct and standardize new industrial "ecosystems" integrating the manufacturing and IT industries.

Hitachi has provided control and production management systems to the steel, automobile, pharmaceutical, and various other industries, and has a proven record in constructing large-scale control systems in fields from energy and transportation to water and sewage. Building on this experience, we produce value by linking various systems to the manufacturing industry and social infrastructure. We have proposed the concept of "symbiotic autonomous decentralization" to promote new growth.

Previously, optimization was limited in scope to analyses on the individual system level and site improvements based on those analyses. Linking factories by symbiotic autonomous decentralization, however, makes it possible to carry out optimization over multiple systems and create new value chains.

Other beneficial effects of linking factories include improved energy productivity and coordination with supply chain management across global sites. An impact is also expected in business continuity plan (BCP) responses to cyber attacks and other factory operation risks.

In some manufacturing sites, H has been used to analyze vast amounts of data collected by control systems on manufacturing equipment, manufacturing processes, and product quality. We have begun to analyze the relation between equipment or processes and quality or yield rate. H can derive statistical characteristics through big data analysis that would be nearly impossible for humans to perform. In manufacturing sites where conditions are inconsistent, due to factors like manufacturing processes that change daily and equipment wear and deterioration, H is useful in defining operating conditions that are appropriate to the changes and obtaining new hints for improvements.

Application Examples of Hitachi AI Technology/H

Just one AI software package has enabled versatile improvement in fields from distribution, logistics, and industrial plants to finance, transportation, and manufacturing

Distribution

Detailed analysis of customer and employee behavior identified "high sensitivity spots" to station employees to boost average sales per customer.
↓
Sales per customer **up 15%**

Logistics

Analysis of daily shipment work results led to work instruction improvement plans for the following day; these were reflected in the picking list (work instruction chart).
↓
Productivity up with **8% reduction in work hours**

Call centers

Data analysis on employee behavior found relationship between verbal support from superiors and order receipt rate. H identified employees needing priority attention.
↓
Order receipt rate **up 27%**

Desalinization plants

Examination of operating history data helped reduce clogging of the reverse osmosis (RO) membrane, a factor impacting uptime for seawater filtration units.
↓
Operating cost: **3.6% reduction**