Featured Articles

AI Services and Platforms
A Practical Approach to Increasing Business Sophistication

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OVERVIEW: Companies have begun working on business improvement initiatives inspired by insights acquired from events occurring around the world. To provide efficient support for these initiatives, Hitachi is working on projects to help solve wide scale problems and assist business growth. Collectively referred to as Hitachi AI Technology, these projects consist of cutting-edge AI technology and solutions driven by AI technology. The Hitachi AI Technology/Business Improvement Service was developed as the first of these projects. The service is designed to help solve management problems in areas such as improving corporate sales and cutting costs. This article describes an overview of this practical AI-driven service designed to increase business sophistication, and looks at the platforms that help make this service possible.

INTRODUCTION

TODAY'S more demanding worldwide market competition is making it difficult just to maintain the same prices for existing standard products and services. This environment is shifting the source of corporate competition toward innovation, that is, the creation of new value. Generally, value creation most often starts from a rediscovery or insight, but people tend to cling to fixed ideas formed from experience. They are often unable to free themselves from a limited range of ideas, and this tendency becomes more pronounced with longer experience. However, at the same time, the difficulty of defining goals (outcomes), recognizing the significance of business data, spotting exceptions, and applying value discoveries to business processes makes value creation difficult for anyone other than highly experienced insiders who are thoroughly familiar with the business. In response to these challenges, Hitachi decided to draw on the strengths of the latest artificial intelligence (AI) technology to boost human understanding and abilities, while creating new value to help solve wide scale problems and assist business growth through human-AI cooperation.

The recent rapid growth and spread of technologies such as cloud computing, mobile terminals, social media, and sensor technology is increasing the amount of data being generated worldwide. Companies have started to draw on these technologies to gain an understanding of various events through data, to learn new insights from this data, and to apply them to policies leading to innovative business improvements. AI is an increasingly promising technology for efficiently assisting these efforts. For example, among sites that have nearly reached the limit of possible improvement with current business methods, there is a lot of demand for AI that can check whether human-created hypotheses are correct or not, or for AI that can devise hypotheses beyond human capabilities. Table 1 shows examples of demands for the use of AI to increase business sophistication in the area of marketing.

Table 1. Examples of Demand for Use of AI to Increase Marketing Business Sophistication
There is increasing demand to identify trends that have been difficult for humans to notice previously, to provide services efficiently, and to innovate business.

Industry/ innovation demands	• Provide services tailored to the interests and preferences of individuals • Improve product stock forecasting precision • Optimize overall expenses such as labor costs and capital investment costs
Expectations for AI	• Identify elements that transform customer purchasing behavior • Identify differences between customers of brick-and-mortar stores and online stores • Identify characteristics of efficient sales activities

AI: artificial intelligence

To meet these expectations, Hitachi is working on projects to help solve wide scale problems and assist business growth. Collectively referred to as Hitachi AI Technology, these projects consist of cutting-edge AI technology and solutions driven by AI technology. The Hitachi AI Technology/Business Improvement Service[1] was developed as the first of these projects. The service is designed to help solve management problems in areas such as improving corporate sales and cutting costs. The following sections of this article describe an overview of the service, an example of its application to the creation of marketing solutions, and the Pentaho software used as the platform that helps make this service possible.

BUSINESS IMPROVEMENT SERVICE OVERVIEW

Using an AI technology developed by Hitachi called Hitachi AI Technology/H (hereafter referred to as H)[2], [3], the Hitachi AI Technology/Business Improvement Service creates business improvement proposals to help solve business problems. H is an AI technology that uses a large volume of complex business-related data to efficiently derive elements with strong correlations to organizational outcomes [key performance indicators (KPI)] and hypotheses for policies to improve them. The service uses H to propose improvement processes for problems facing various industries.

Expectations for AI

Up until recently, experts who manage areas such as quality, sales, and stock have been studying policies for improving KPIs. However, with policy studies done by humans, there have been difficulties making objective evaluations because of assumptions based on preconceptions, stereotypical thinking, and personal hunches and experience. H is expected to overcome these shortcomings by eliminating preconceptions, discovering quantitatively important elements from data previously unused in analyses or proposed hypotheses, and proposing innovative improvement policies that do not rely on the thinking of human experts. But H is simply a tool, and the results obtained from it will vary greatly depending on which business processes its findings are applied to, and how they are used. So the best results are obtained by combining H with additional support services provided by technicians with the expertise to make thorough use of analytical methods and H.

TABLE 2. Challenges when Applying AI to Business
Below are some examples of commonly encountered challenges when applying AI to business.

Application phase	Challenges when applying
Utilizing for business	Even if new suggestions can be acquired by Hitachi AI Technology/H, it is unclear how to use them in business.
AI usage frequency	It is unclear whether AI should be used once, or used repeatedly such as on a daily or monthly basis.
Selecting data parameters	New correlations may be found by increasing the number of data types or volume. But it is unclear how much more data is needed.
Preprocessing of data analysis	Before using AI, outliers must be removed from the data (data cleansing). If data contains many outliers, the analysis results can often be affected.

Issues When Applying H to Business

The measures proposed by H can be appealing, often containing unprecedented suggestions. However, when applying them to actual business, the same sorts of issues faced by every company often have to be overcome (see Table 2).

APPLICATION OF AI TO BUSINESS IMPROVEMENT SERVICE

Marketing Solutions

Hitachi's Business Improvement Service uses AI to propose business improvements for areas such as retail sales, equipment maintenance, finance, and manufacturing. This section provides an example of how the service has provided marketing solutions for areas such as retail sales.

Conventional services analyze data collected from marketing systems [such as customer relationship management (CRM) systems and sales force automation (SFA) systems] to present suggestions to marketing staff with expert knowledge of marketing. However, conventional services are unable to incorporate marketing expertise and business site restrictions into the analysis.

Hitachi's marketing solutions enable input and analysis of a variety of data such as business data sets, marketing staff expertise, site restrictions, and external environmental factors. Expertise that had previously only been tacitly understood as well as new insights can be turned into formalized knowledge and shared to increase the efficiency of the business improvement cycle (see Fig. 1).

In Hitachi's marketing solutions, processes ranging from identifying current issues to measuring the benefits of marketing policies, making evaluations,
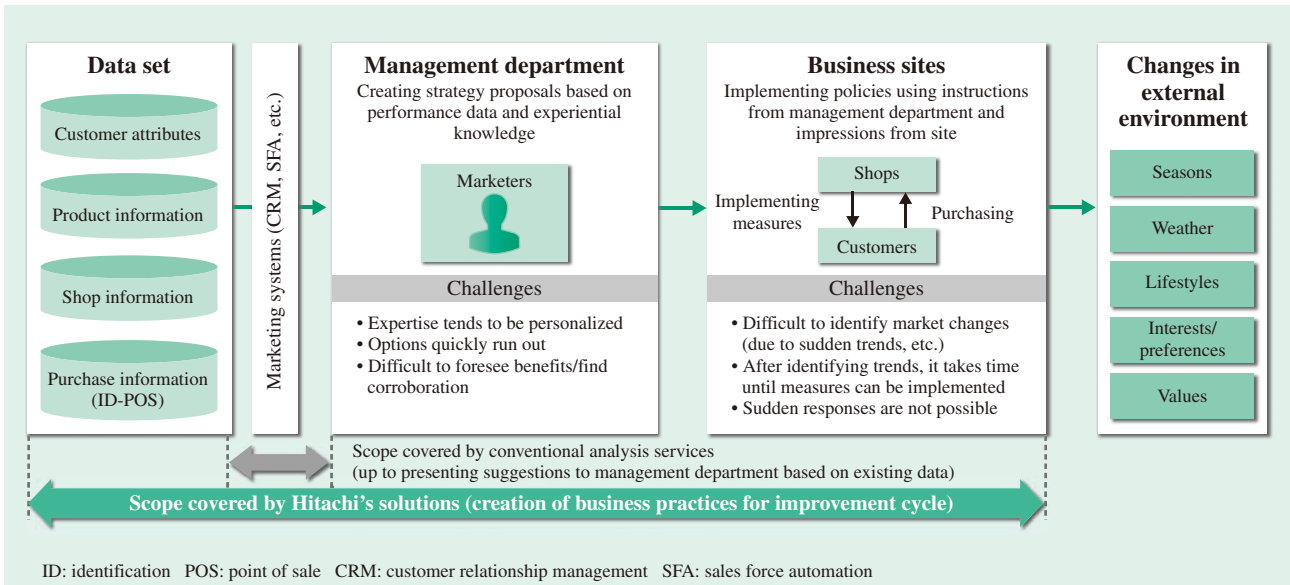
Fig. 1—Scope of Marketing Solution Services.
Marketing solution services provide business improvement cycles including business practices done before/after marketing systems.

and proposing subsequent policies [the plan, do, check, act (PDCA) cycle] are categorized into 10 tasks. These tasks are combined in accordance with the client's business conditions (see Fig. 2). Using H for Task 2 (Proposing improvement measures) enables comprehensive analysis that eliminates fixed ideas, leading to discoveries of new performance indicators for improving business issues (outcomes).

Using H to Formulate Improvement Measure Proposals

This section looks at the example of using of H for retail sales marketing, with sales volume as the outcome. When conventional methods are used, the marketer decides on measures to improve sales using performance indicators derived from previous experience.
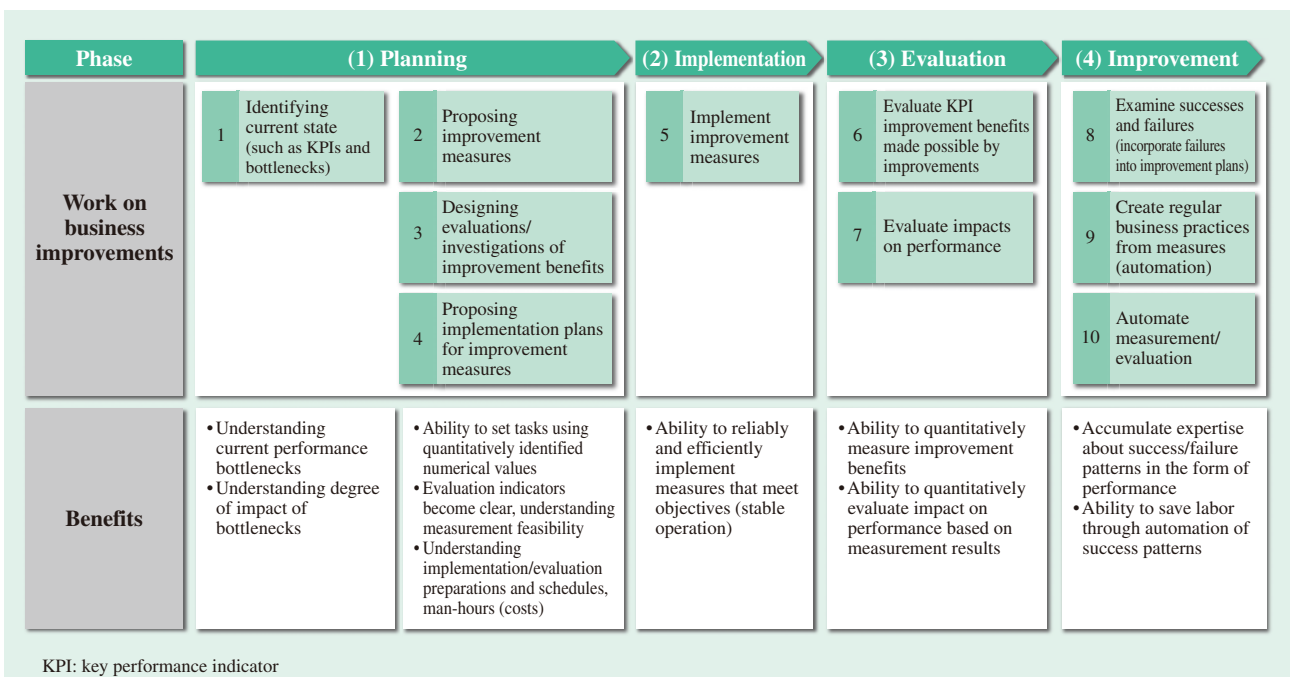

Fig. 2—Tasks for Providing Marketing Solutions.
These tasks provide comprehensive support for planning business innovation, implementing measures, evaluating benefits, and making improvements.
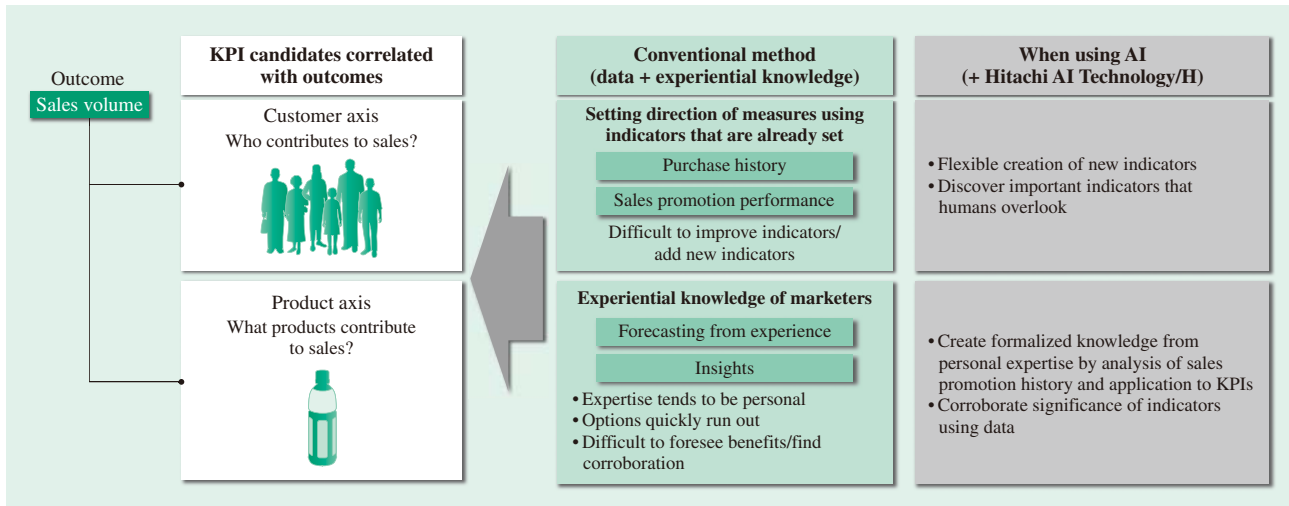
Fig. 3—Application of AI to Proposal of Improvement Measures and Expected Benefits.
The use of AI to discover new indicators enables efficient proposal of innovative policies.

However, analysis using H involves a comprehensive search for measures that improve outcomes, enabling the discovery of previously overlooked effective indicators and important indicators that tend to be missed. Expertise previously considered to be the tacit knowledge of the marketer is turned into formalized knowledge from data, enabling the derivation of new performance indicators. These indicators would previously have been considered to be the marketer's hunches, but since they can now be corroborated by data, they are expected to provide backing for new initiatives (see Fig. 3).

PLATFORM SUPPORTING BUSINESS IMPROVEMENT SERVICE: PENTAHO SOFTWARE

Pentaho Software

Pentaho software[4] is a data integration and analysis platform used to integrate a wide variety of data created from sources such as business systems, sensors, and social media, and to analyze it from various perspectives. Two platforms provide the environment needed for all operations ranging from data collection to analysis/usage. Pentaho Data Integration (PDI) collects, processes, and outputs data, while Pentaho Business Analytics (PBA) analyzes the collected data and provides visual representations of it.

Pentaho software offers benefits that are not available in competitors' products. For example, it enables data integration and analysis to be done on a single platform, shortening the data usage cycle. It also provides an abundant array of connected parts. And

since it is an open source software (OSS) product, it can be quickly adapted to big data technology.

Using Pentaho Software in the Business Improvement Service

Pentaho software is positioned as a data usage platform, where data integration is performed by PDI, the data is then analyzed by H, and finally PBA provides visual representations of the results (see Fig. 4).

Data integration consists of creating visual representations of the data provided by the client to identify the data distribution and attributes (profiling), remove heterogenous data from the original data (cleansing), and join the remaining data to create a data set. These processes are the preprocessing done to enable analysis, and account for over half of the entire analytical work. This preprocessing must be done carefully since it can affect the analysis results if
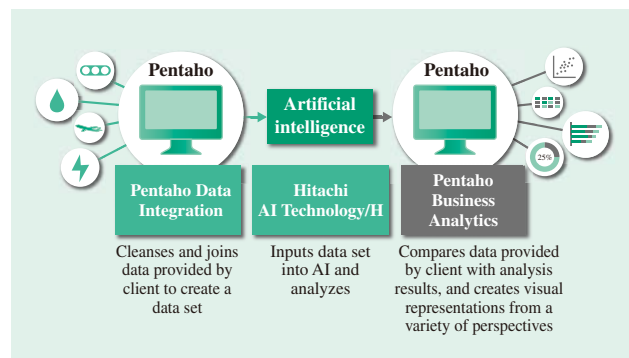

Fig. 4—Link Between H and Pentaho Software.
Data is integrated by Pentaho Data Integration, analyzed by H, and then visually represented by Pentaho Business Analytics.

done inadequately. The profiling process is done using tools such as the R programming language.

The development environment provided by PDI is provided by means of a graphical user interface (GUI), and most operations can be done without programming. PDI jobs (a job is a series of operations that are grouped together) used in past projects can be modularized, enabling them to be used immediately in new projects just by making changes in the applicable locations. Modularization also increases productivity. Even users with no programming experience can combine and define jobs using the GUI, enabling data processing to be done easily. Java* coding will be needed if the required data integration processes cannot be achieved using only the standard connection and processing parts provided by PDI. However, an abundant array of Java methods specialized for data processing are provided, enabling flexible and efficient processing.

Performance data shows that one project involving Java data processing required 16.2 man-days for cleansing and data integration, but only 7.5 man-days for the same processes to be done using PDI, a labor reduction of about 54%. When modularized templates were applied to the same project, the time was further reduced to 3.0 man-days, a labor reduction of about 81% relative to the original Java data processing.

PBA is used to load and create visual representations of the H analysis results and data provided by the client, evaluating it from a variety of perspectives. The benefits of increases in the data volume on performance are relatively small.

In the future, using the Pentaho software as the data processing platform of the Hitachi AI Technology/Business Improvement Service, Hitachi will create templates on it for a wide variety of use cases, aiming to further increase the efficiency of the data integration, analysis, visual representation, and evaluation processes to shorten the process cycle time.

CONCLUSIONS

This article has described a marketing solution that is one of the solutions provided by Hitachi's Business Improvement Service, and the Pentaho software, which is the platform technology that supports it.

The Hitachi Group is studying various types of AI-driven business initiatives, through Group-wide collective efforts. While making use of the successes it has achieved to date, Hitachi will continue working

on collaborative innovation activities with clients and partners, promoting projects that help solve societal issues and aid business growth by applying AI in a wide range of areas.

REFERENCES

(1) Hitachi, Ltd., Hitachi AI Technology/Business Improvement Service, http://www.hitachi.co.jp/products/it/bigdata/approach/ai-analysis/ in Japanese.
(2) K. Yano, "AI for Taking on the Challenges of an Unpredictable Era," Hitachi Review **65**, pp. 14–34 (Jul. 2016).
(3) N. Moriwaki et al., "AI Technology: Achieving General-Purpose AI that Can Learn and Make Decisions for Itself," Hitachi Review **65**, pp. 35–39 (Jul. 2016).
(4) Hitachi, Ltd., Pentaho Software, http://www.hitachi.co.jp/products/it/bigdata/platform/pentaho/ in Japanese.

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