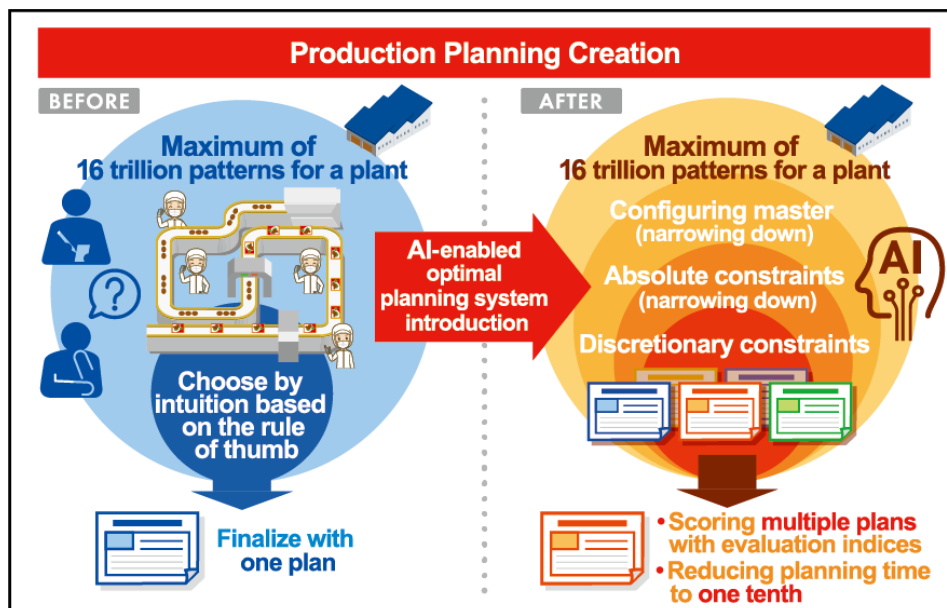


Nichirei Foods and Hitachi Collaborative Creation Toward Full-scale Operation of AI Technology-Enabled Automatic Planning System for Optimal Production and Manpower Allocation in Food Plants
Reproduce and enhance skilled planners' expertise, aiming to build a production system that promptly responds to demand changes and achieves workstyle reform

Tokyo, February 4, 2020--- Nichirei Foods Inc. (“Nichirei Foods”) has introduced an AI-enabled Automatic Planning system that create optimal production and manpower allocation planning to four food plants in Japan, which started full-scale operation in January 2020 through collaborative creation with Hitachi, Ltd. (TSE:6501 / “Hitachi”). This system uses advanced AI technology to reproduce and enhance skilled planners’ expertise, including complex constraint. The introduction of this system allows Nichirei Foods to reduce the planning time to around one tenth compared with the past. In addition, workers with less experience than skilled planners will be able to create more flexible production planning and allocation planning. Therefore, the system is expected to aid workstyle reform by reducing working hours and encouraging holidays. Hitachi verified its effectiveness based on Nichirei Foods’s complex and varied production patterns, constraints and real cases. Using this experience, Hitachi will resolve customer issues on a broad range of industries in the future.

Overview of AI-enabled Automatic Planning System for Optimal Production and Manpower Allocation



Nichirei Foods and Hitachi Collaborative Creation—Background on Development and Introduction

Recently, food manufacturers are required to produce and supply products in response to demand changes. Among the backdrop of the skilled worker shortage associated with the reduction of the working age population, there is increasing importance in the establishment of an efficient production system using advanced digital technology.

In order to provide safe and secure products, Nichirei Foods, a pioneer in frozen food, has continuously worked on IT systems since 2004 for production sites, such as quality management, employment management and security enhancement. In the past, Nichirei Foods's employees, who were familiar with the operations, organized tasks, identified improvement points and applied these factors into the in-house systems, which enabled the building of highly practical and efficient systems.

For production planning and allocation planning, experienced planners have manually created plans by plant, line and production item, based on complex constraints, such as 1) know-how and intuition on the rule of thumb; 2) equipment, delivery time and costs; 3) assignments (work shifts) considering workers' skills; and 4) past extensive planning records. It worked to a certain extent, however, continuing with manual planning has limitations, including difficulties reflecting skilled planners' intuition on the rule of thumb for an IT system. As a result, skilled planners and other workers incurred a large burden, which needed to be improved.

Nichirei Foods, which works on building advanced manufacturing systems using digital technology, and Hitachi, which provides Lumada⁽¹⁾ solutions taking advantage of advanced digital technology and integrating OT⁽²⁾ and IT cultivated for a long time in its experience as a manufacturer, started a collaborative creation to optimize production planning and allocation planning since 2018, by combining their knowhow.

(1) Lumada: General name of solution, service, technology using Hitachi's advanced digital technology to generate value from customer data and accelerate digital innovation

(2) OT: Operational Technology

System Development, System Configuration and Introduction Effects

Construction of AI-enabled automatic planning system for optimal production and manpower allocation, incorporating skilled planners' intuition on the rule of thumb (AI creates optimal solutions from up to 16 trillion combinations in a plant)

First, the two companies used Hitachi's original design approach that generates unconventional new values and ideas, and visualized a series of tasks related to planning. Combining them with a variety of data at the worksite, the companies incorporated the skilled planners' know-how into a Hitachi Lumada Solution called "Hitachi AI Technology/Planning Optimization Service." Over a year since August 2018,

the companies experimentally introduced the system to an office in Nichirei Foods and verified its effectiveness.

The system uses Hitachi's original AI technology that combines machine learning and mathematical optimization technology⁽³⁾ to digitize and weight the planning patterns characteristic to skilled planners, and extracts and combines them for analysis. As a result of the effectiveness verification, among up to 16 trillion combinations in a plant, the companies achieved the automatic planning of optimal solutions for production planning, including production items and production quantities per line daily, as well as allocation planning, including the shift schedule of workers, in around one tenth of the time needed conventionally. In addition, by applying production and allocation planning and then learning the results and issues, the system obtained the capability to reproduce production and allocation planning that satisfy both efficiency and quality similar to skilled planners, which had been difficult to achieve until now. It also allows for building a production system that is promptly respond to demand changes, improving work efficiency, enhancing productivity and providing the opportunity for employees to work freely without the constraints of the workplace. The system offers advantages for both management and employees, which is expected to help accelerate activities on workstyle reform.

(3) Mathematical Optimization Technology: A calculation technique to produce the best possible results while satisfying given constraints. Organizing the points of real problems, representing them with formulas, using an algorithm suitable for the formulas and then calculating the optimal answer.

Future Development after System Introduction and the Ideal Situation

Nichirei Foods plans to deploy and expand the system in the future to 11 domestic plants and other overseas plants. In addition, using digital technology, including this system, it will advance initiatives for productivity improvement, reduce production lead time and inventory, and implement workstyle reform.

Hitachi will expand the "Hitachi AI Technology/Planning Optimization Service" to customers in a broad range of industries, among other Lumada solutions, to contribute to the improvement of social values and the economic values of customers.

Overview and Features of "Hitachi AI Technology/Planning Optimization Service"

Hitachi has extensive experience in the field of traffic control, which is required to instantly satisfy many constraints, such as diagram organization in railways. The mathematical optimization technology, cultivated in these fields, and machine learning technology make up the Hitachi original AI technology "Hitachi AI Technology/MLCP (Machine Learning Constraint Programming)," which is the core technology adopted in this service. With this technology, complex constraints, such as facility operation

conditions, delivery time and costs in production planning and workers' skills and attendance in allocation planning, in addition to a large amount of planning records, are given to machine learning, and the discovered patterns of skilled planners are incorporated into the original optimization engine, quickly producing optimal solutions. Even when constraints cannot be satisfied, skilled planners flexibly create plans by loosening conditions, offering highly efficient plans with know-how based on their experience. By digitizing the know-how, the system supports flexible plan creation even for sudden changes in demand or delivery time. Repeated evaluation by skilled planners and continuous learning by the system about the generated automated plans will enhance the quality of planning.

About Nichirei Foods

Nichirei Foods, a pioneer in frozen food in Japan, has continued to provide useful and valuable products and services for customers, taking advantage of exclusive materials and process technology centered on the frozen food business.

Its consolidated revenue in FY2018 was 226.5 billion yen (consolidated sales of Nichirei Foods Group in the term ended March 2019) and it has 12,218 employees.

For more information, please visit <https://www.nichireifoods.co.jp/en/corporate/>.

About Hitachi, Ltd.

Hitachi, Ltd. (TSE: 6501), headquartered in Tokyo, Japan, is focusing on Social Innovation Business combining its operational technology, information technology and products. The company's consolidated revenues for fiscal 2018 (ended March 31, 2019) totaled 9,480.6 billion yen (\$85.4 billion), and the company has approximately 296,000 employees worldwide. Hitachi delivers digital solutions utilizing Lumada in five sectors including Mobility, Smart Life, Industry, Energy and IT, to increase our customer's social, environmental and economic value. For more information on Hitachi, please visit the company's website at <https://www.hitachi.com>.

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