Making the Manufacturing Industry More Responsive – NEC Manufacturing Co-Creation Program

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Abstract

In today's competitive business environment, Japanese manufacturers face increasing pressure to radically overhaul their production plants and innovate their technology and manufacturing practices as they attempt to generate a new sense of monozukuri*. These changes include supply chain optimization accompanied by globalization, as well as inventory reduction, lead-time shortening, and enhancement of fluctuation response capability. Yet as attractive and essential as all this may seem on paper, the reality is that in many cases actual production sites are only partially optimized and the structures necessary to facilitate these changes remain incomplete. At NEC, we have synthesized the experience and best practices in production innovation and supply chain reform gained through years of trial and error. This paper introduces the NEC Manufacturing Co-Creation Program, which was developed to kickstart efforts by manufacturers to innovate for the future.

Keywords

production innovation, supply chain reform, monozukuri operation process, IT system and assets

1. Introduction - What is the NEC Manufacturing Co-Creation Program?

Beginning in the 1990s, NEC undertook a series of reforms to its business and manufacturing practices one step at a time. These reforms include the implementation of global supply chain management (SCM) reform, management system reform, and monozukuri innovation (**Fig. 1**). Based on the knowledge and experience in production innovation and supply chain reform gained from this process, we launched the NEC Manufacturing Co-Creation Program in October 2012 in order to share that know-how with our customers. The program is based on four main concepts (**Fig. 2**).

2. The Four Main Concepts of NEC's Manufacturing Co-Creation Program

2.1 Craftsmanship - Applying the craftsmanship used to achieve SCM reform to support on-site reforms

A wide range of reforms in actual workplaces have been facilitated by the sophisticated techniques we used to achieve SCM reform. For many years, NEC has been innovating and enhancing monozukuri, putting it into practice in various ways such as mass-production items (mobile phones, printers, etc.), build-to-order (BTO) products (PCs and servers), component products for facilities (semiconductors), and individually made-to-order products (satellites). Through the trinity of three reforms - production innovation, delivery reform, and supplier reform - the "craftsmen" who have been driving our innovation and enhancement of monozukuri are working with clients on-site to help reform operational processes and supply chains.

2.2 Connection - Promoting integrated reforms that connect IT with on-site improvement and operational process innovation

To rebuild the overall mechanism of supply chains covering procurement, production, and marketing, NEC promotes integrated reforms that connect IT with on-site improvement and operational process innovation. This involves supporting kaizen (improvements) in trinity of production innovation, supplier reform, and delivery reform.

* Japanese word that refers to manufacturing that fuses the values of traditional Japanese craftsmanship with future-oriented management and technology.

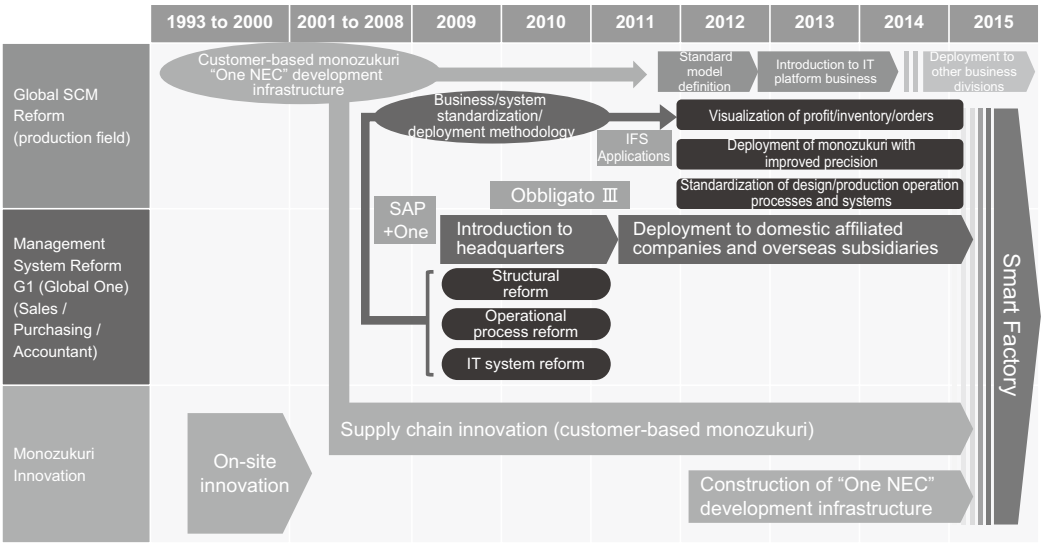

Fig. 1 NEC's commitment to 3 Reforms.

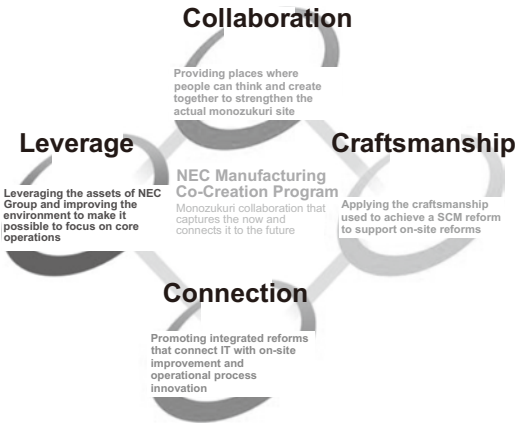

Fig. 2 NEC Manufacturing Co-Creation Program: Main Concepts.

When operational processes and systems are managed incoherently at various facilities scattered throughout Japan and overseas, all kinds of waste is generated. For example, it is impossible to know the quantities and locations of all inventories and products, which makes it difficult to adjust and coordinate production between the facilities. To help solve this problem, NEC offers global SCM solutions, which at their core feature standardization of operational processes and IT systems. In this way, NEC is contributing to customer-based monozukuri by helping achieve flexible production adjustment between different facilities on a global basis.

At the same time, the rebuilt operational processes and supply chains are systemized to maximize performance. Building on a wealth of business applications - including product lifecycle management (PLM), enterprise resource planning (ERP), and manufacturing execution system (MES) applications, as well as SCM applications - and advanced IT platforms including data centers, networks, and clouds, NEC proposes optimal system solutions that incorporate existing systems where necessary and are specifically tailored to meet the situations, budgets, and needs of clients.

2.3 Leverage - Leveraging the assets of NEC Group and improving the environment to make it possible to focus on core operations

We build an environment where our customers can focus on their core businesses by effectively exploiting the assets of the NEC Group. From consulting to system introduction and construction, we can share with our clients a comprehensive range of assets (design, manufacture and distribution consignment, embedded system solutions, facilities, etc.) that have been developed and proven in NEC's pursuit of its own monozukuri.

(1) ODM/EMS services

Two of the key services we offer that are derived from NEC's technical expertise are original design manufacturing (ODM) and electronics manufacturing service (EMS). These services cover not only manufacturing, but also planning, R&D, and design, while being fully capable of meeting requirements for high-mix, low-volume production, high quality, and high reliability.

(2) Operation commission service

We deploy a wide range of commission operations ranging from worldwide procurement of components and maintenance/ servicing to support for quality management including inspection and analysis, as well as access to NEC Group's distribution networks.

(3) M2M utilization solutions

Machine to Machine (M2M) is a means to increase profits

throughout the entire life cycle of a product. NEC Group offers one-stop support for study of how M2M is used in terms of business and technology, as well as the applicability of M2M to actual operations.

(4) Facilities

Dedicated staff with experience in solving the problems of NEC Group plants provide comprehensive outsourcing services for integrated facility management (IFM) - ranging from facility operation management and energy-saving management to ancillary building equipment and layout construction.

2.4 Collaboration - Providing places where people can think and create together to strengthen the actual monozukuri site

In order to strengthen monozukuri where it is actually being put into practice - in factories, offices, and other facilities - there needs to be a place where people can get together with others not only from their own company but from other companies and review monozukuri from various points of view, including case studies from other companies. These "places" will help raise awareness and provide creative stimuli, which could lead to innovation. That's the purpose of the Manufacturing Research Group, which is comprised of 2,316 members from 790 companies as of the end of October 2015*.

This group not only examines case studies of NEC's experiences in its factories, but also provides meeting places where clients can get together and exchange information or share their own experiences in innovation and monozukuri.

3. Activities Promoted by the NEC Manufacturing Co-Creation Program

Four activities promoted by the Manufacturing Research Group are introduced below.

(1) Social gatherings

Combines workshops, lectures based on actual NEC cases, and group discussions on various themes.

(2) Factory tours

Introduces NEC's production innovation by inviting members to visit the NEC Group's production factories (**Photo**).

(3) Theme-based meetings

Held for the purpose of information exchange between different companies about how they have handled specific issues related to monozukuri. Themes include logistics, design/production interfaces, product-contained chemical substance management, and monozukuri human resource development. The Industrial IoT Research Group started in September 2015.

Photo Factory tour.

(4) Manufacturing Co-Creation News

An e-mail newsletter containing information regarding monozukuri is distributed to the members once a month.

4. NEC Manufacturing Co-Creation Program Case Studies

As a result of the activities discussed above, the NEC Manufacturing Co-Creation Program has achieved a number of, concrete effects. The following are some examples.

(1) Visualization of waste in monozukuri and reduction of inventory by 50 percent

Manufacturer A was implementing make-to-stock production on a monthly basis, but production frequently exceeded actual orders. Moreover, the massive inventory required to prevent stockout was overwhelming the management. So the company shifted to the "pull" type production system on a single-product basis using the kanban inventory control system. At the same time, company-wide flows of goods and processes were analyzed to visualize the waste. As a result, the lead time was significantly reduced to less than one fourth while the inventory was reduced to about 50 percent.

(2) Visualization and sharing of information on a global scale to achieve dramatic increase in productivity

With production centers deployed all over the world, Manufacturer B must contend with dispersed data dealing with quotes, estimates, design, manufacturing stored in independent systems at various locations. A huge amount of work was required to sift through and analyze this data in order for the company to keep track of changing circumstances with regard to design and manufacture, as well as component procurement conditions for each product. So they decided to introduce the NEC global SCM solution to build a system that would enable them to visualize and share the required information on a global scale. This has increased the accuracy and velocity of

* For an updated membership number, please visit the webpage for the NEC Manufacturing Co-Creation Program (http://jpn.nec.com/manufacture/monozukuri/).

operations, as well as facilitating a quantum leap in productivity.

(3) Standardization of operation processes and production management processes to complete a flexible production structure inclusive of all domestic and overseas establishments

Manufacturer C was building separate operation processes and production systems according to business fields and factories within its group. Consequently, they were unable to easily implement production transfer and adjustment between global establishments - which created a situation where there was a surplus in resources while certain factories were fully operating.

To solve this problem, the company chose NEC as a partner and commenced global SCM reform with the goal of standardizing all operational processes and production management systems. This helped them to complete a production structure that could cope with the customer-based "pull" type production system. It also enabled them to quickly respond to any fluctuation in demand for products by facilitating production adjustment at their domestic and overseas establishments. In the meantime, they utilized NEC's assets in some of their production fields and physical distribution operations - which enabled them to manufacture products and procure components in optimal quantities when and as required, thereby helping them achieve optimization of production cost and stock components.

5. Practical Case Studies at NEC Group

At NEC Group, we implement various reforms based on the concept of customer-based monozukuri by applying the experience we have gained through monozukuri innovation activities at our own organization and building on the foundation of standardization and deployment methods we have employed in management system reforms. The following are some of the case studies.

(1) Global SCM reform

At NEC Group, we implemented global SCM reform based on standardization of operational processes and production management systems, with a view to expanding customer-based monozukuri on a global scale.

As the first step in this reform, we totally revised the production management system in our IT platform business - the nucleus of which is NEC Platforms' Kofu Plant - the mother factory of NEC's computer production (**Fig. 3**). As well as reinforcing the production structure to cope with a customer-based "pull" type production system, this reform laid the foundation for the standardization of production operation process systems throughout the entire NEC Group. We are moving to deploy this production environment at facilities worldwide in order to achieve optimum ubiquitous manufacturing where it will be possible to produce the same product in any factory in the world.

As for the SCM system, we adopted IFS Applications™, an SCM solution successfully deployed by 166 different companies at 305 locations (as of July 2015). As for the PLM system, we adopted Obbligato, a PLM solution that has been number one in the Japanese market for 20 consecutive years and has been implemented by more than 800 companies. We are committed to supporting the global expansion of our clients in the manufacturing industry by offering the know-how we have gained in this project to our customers.

(2) Integration of development process reform and platform systems

NEC was looking to find a way to create innovative

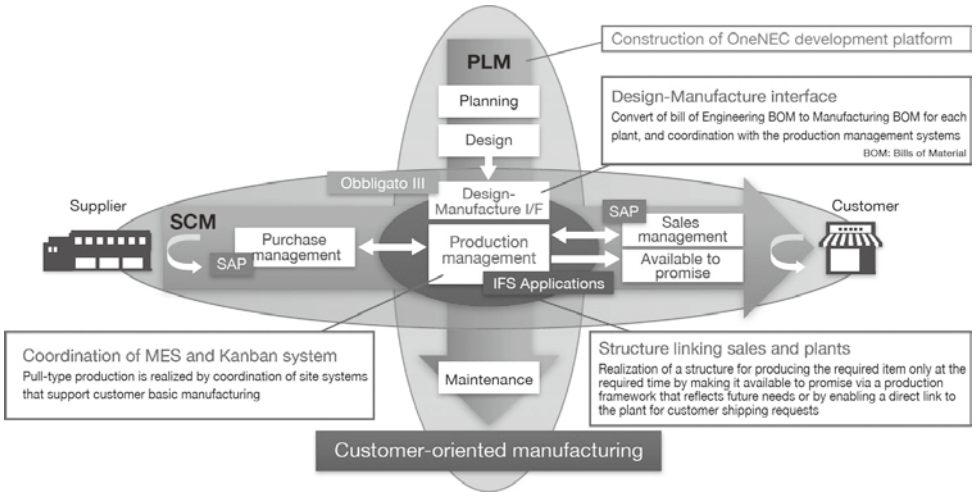

Fig. 3 Overview of IT platform production management system.

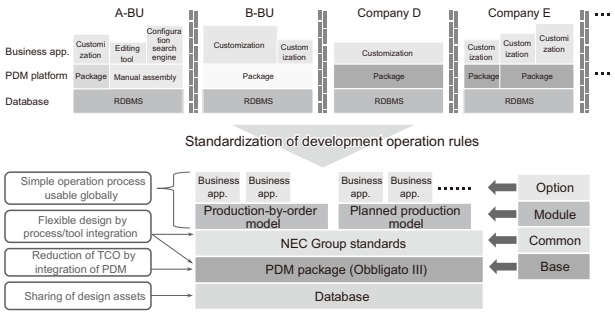

Fig. 4 Conceptual diagram of integration of development process reform and backbone systems.

products that would be able to succeed in the global marketplace by maximally utilizing the technological and human resources already possessed by the group companies. Achieving this was made more difficult by obstacles such as R&D operations that were independently optimized according to multiple business units, as well as by differences in rules and coding systems.

To solve these problems, NEC initiated a group-wide integration of more than 10 product data management (PDM) systems that had been operated independently by various business units (**Fig. 4**). As a result, NEC succeeded in the completion of development platforms that would be able to solve the problems NEC was facing in terms of global response - including effective utilization of technological assets such as design and R&D data and human resources, as well as optimum ubiquitous manufacturing and enhancement of the business continuity plan (BCP) response mentioned in the previous section. Now, NEC continues to vigorously promote innovation of new products that integrate the strengths of multiple businesses.

(3) Optimization of repair component inventory

Optimization of the repair component inventory is one of the most common issues faced by manufacturers. Taking charge of IT support services, NEC Fielding was facing the same problem. However, ensuring precise prediction of future demands for components while suppressing surplus inventories was limited by conventional statistical methodology. Instead, the company uses NEC's original big data analysis technology - heterogeneous mixture learning technology - to accurately predict the demand for components with high shipment frequency. This has helped reduce inventory by about 20 percent (**Fig. 5**). While applying this system to comprehensive inventory optimization, the company is also planning to deploy services that combine NEC's demand prediction technology

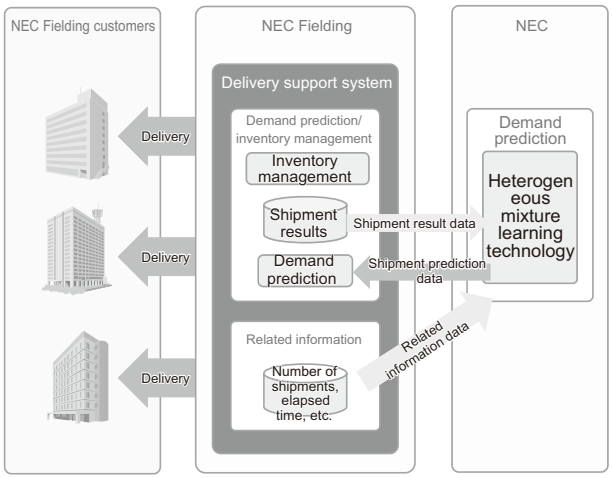

Fig. 5 Conceptual diagram of demand prediction for repair components.

with the business process outsourcing (BPO) technology that takes advantage of our know-how in maintenance operations.

6. Analysis of Monozukuri ICT Based on Discussions with Manufacturing Research Group Members

Following analysis of feedback from members of the Manufacturing Research Group, we found that the issues facing next-generation monozukuri ICT can be summarized into two main points.

(1) Reduction in production cost to optimize price competitiveness

– Minimization of monozukuri cost

- Production at optimal locations according to market size and product segments
- Minimization of production cost to compete with labor-intensive production
- Simplified functionality and monozukuri that match the local circumstances
- Compatibility with smart factories as part of the fourth industrial revolution

(2) Product strategy that transcends price competition

– Maximization of added value

- The Japanese monozukuri expertise can be effective with the following factors: 1) requirements for high reliability; 2) existence of entry barriers for non-commodity products and technologies; 3) various safety and environmental regulations (differentiated by capability to meet strict qualitative and regulatory requirements.

Based on these points, the expectations for the monozukuri ICT and production sites are as follows:

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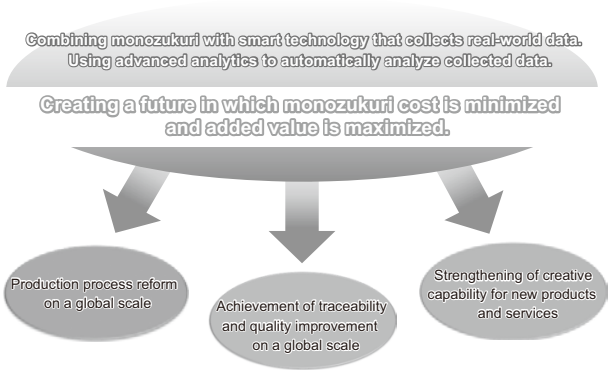

Fig. 6 Values of next-generation monozukuri promoted by NECs.

- Production process reform on a global scale
- Achievement of traceability and improvement of quality on a global scale
- Strengthening of creative capability for new products and services

To meet these expectations, NEC started the above-mentioned Industrial IoT Research Group in September 2015 in order to collaborate with members on how to best introduce effective IoT to monozukuri, as well as application technologies and methods.

7. Future Commitment to the NEC Monozukuri Co-Creation Program

Manufacturers around the world have encountered the waves of value chain innovation utilizing IoT, represented by Germany's Industrie 4.0 and the US's Industrial Internet Consortium (IIC) and are now witnessing rapid progress in the integration of monozukuri and ICT.

Japanese manufacturers are no exception. IoT has become critical to increasing competitiveness and responding to demands from stakeholders. To support these manufacturers in their efforts to implement next-generation monozukuri utilizing IoT, NEC offers NEC Industrial IoT which features: 1) utilization of leading-edge IoT technology, 2) validation by NEC by itself, 3) cooperation with partners, and 4) Co-Creation with customers.

At NEC, we will continue to help manufacturers take advantage of the fourth industrial revolution by minimizing the costs of monozukuri while maximizing added value (**Fig. 6**).

* SAP is a trademark or registered Trademark of SAP SE in Germany and other countries.

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