Warehouse Product Inspection System Achieves Work Efficiency and Quality Improvements

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Abstract

The demand for quality and speed of logistics is increasing year by year. In Japan, however, growing labor shortages are making it difficult to maintain the service levels required by workplace logistics. In particular, inspection work requires a significant amount of labor, which is difficult to replace with conventional technologies. Our proposed Warehouse Product Inspection System achieves improvements to inspection work and product quality simultaneously by making use of the NEC high-speed, high-accuracy image recognition technology. This paper is intended to introduce features of this technology.

Keywords

logistics, labor shortage, image recognition, workplace improvement, work efficiency improvement, quality improvement

1. Introduction

The recent growth of international and EC transactions has been complicating logistics operations in the workplace due to cargo diversifications and an increase in the volume of small cargoes. At the same time, it is also required to maintain and improve quality by meeting the issues brought about by environmental changes.

In Japan, however, the decrease in the working population is tending to deepen the labor shortage problem (**Fig. 1**). Logistics operations involve a wide diversity of work. While the service level requirements of the market are increasing year by year, the difficulty of training suitable labor is making it hard even to maintain the previous levels of service.

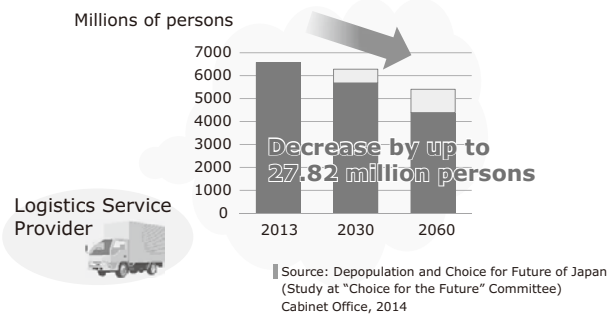

Fig. 1 Decrease of working population.

The circumstances referred to above make it necessary to achieve simultaneously the three goals of a trade-off relationship namely: 1) diversification of services, 2) labor saving, 3) qualitative maintenance/improvements.

2. Applications of ICT in the Logistics Domain

Backed by the recent progress of communications networks and sensing technologies, efforts for digitizing the information in the real world are being advanced using the IoT (Internet of Things) technology. Such efforts are evolving additionally into the digitization of the entire supply chain (Cyber Physical System) by connecting the real world (Physical System) and the cyberspace of ICT (Cyber System).

In the world of logistics, this trend is applied as follows. Firstly, the events and logistic resources (humans,

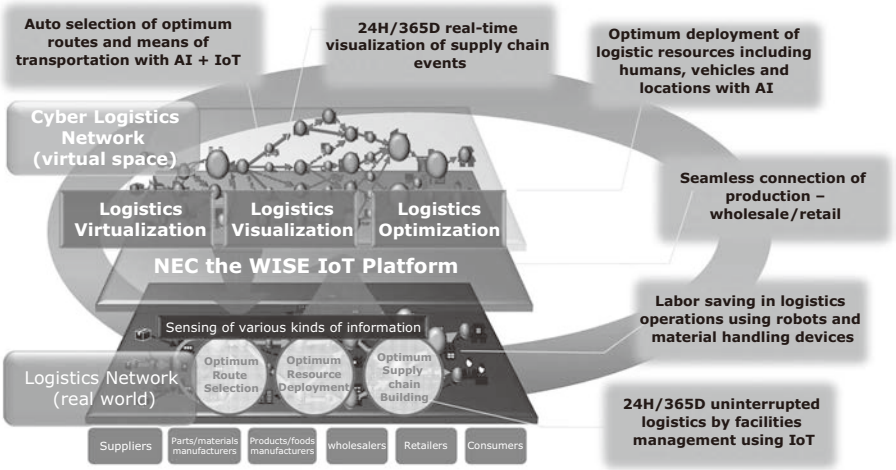

Fig. 2 Cyber Logistics Network.

vehicles, etc.) of the supply chain are collected by means of IoT. Secondly, the collected information is then analysed and converted into knowledge in order to visualize events that may occur in the future. Lastly, feeding these results into workplace logistics enables the optimization of humans, vehicles and transportation routes. This means that more efficient operations become possible when using limited resources (**Fig. 2**).

In the past, logistics operations have been supported by human labor (analogically). However, the complications of the work environment and labor shortages as described in section 1 is making it difficult even to maintain services at levels that are equivalent to the past.

Such circumstances have led us at NEC to assess that the logistics domain has enough capacity to adopt ICT as a solution to these issues.

3. Warehouse Product Inspection System

The Warehouse Product Inspection System introduced here achieves both of more efficiency and better quality in logistics operations by employing the image recognition technology by employing the image recognition technology.

Logistics operations employ a wide variety of automating equipment, such as auto warehouses and digital picking systems aimed at labor saving and efficiency improvements. Nevertheless, most of the inspection operations for checking the types and quantities of merchandise at the times of receipt and shipment still rely on human labor.

Here is a specific example of inspection work: Typically in logistics operations, merchandise carrying barcodes is inspected using handy terminals and that without barcodes is inspected visually. In particular, merchandise such as mail-ordered products, novelty goods and bundled items do not often carry barcodes and thereby necessitate the visual inspection process. It is quite common to find ten or so people engaged in the operation of inspecting those products in a logistics warehouse.

Photo 1 Representative image of Warehouse Product Inspection System.

At NEC, we have long been endeavouring to save the labor involved in logistics operations. An example of such endeavours is the postage automation system that employs practical application of character recognition. This technology automates the postal sorting that used to be performed manually, contributing thereby to a significant reduction in the person-hours.

The Warehouse Product Inspection System has been implemented by NEC based on its long experience in the application of character and image recognition technologies in actual logistics operations. The present solution utilizes a unique image recognition technology

for instantaneous judgment of whether or not the merchandise to be shipped matches the shipment schedule list. Even when ID information such as a barcode is not attached to the merchandise, it may be identified using an actual image of an item as the ID information. This procedure simultaneously achieves improvements in the inspection work efficiency and in the quality (**Photo 1**).

4. Features of the Warehouse Product Inspection System

This section describes three of the main features of the Warehouse Product Inspection System.

(1) Practical use of the image recognition technology in logistics operations

The application of image recognition technology in logistics operations is accompanied by two issues: 1) response delays due to collation and communications processing, and 2) a drop in identification accuracy due to fluctuations in the image capturing environment.

The solution introduced here makes use of NEC's unique high-speed matching processing. Identifying several objects simultaneously in a few seconds and it has been proved capable of withstanding the stress of actual operations.

Another strong point of this solution is that it is free from the effects of environmental fluctuations because identification is possible even when some merchandise is at an oblique angle or when a part of it is hidden (**Fig. 3**).

(2) Utilization of a weight scaling

Combination of image recognition and weight scaling enables, for example, detection of any excess or deficiency of merchandise from different total weights, even when some merchandise is completely obscured. In this way, double-checking based on image and weight can improve the overall accuracy.

(3) Provision of visual inspection support function

A function for supporting visual inspection by humans is also provided. It displays the image of the inspection target merchandise together with the checkpoint name, so that even workers with little knowledge of the merchandise can perform accurate inspections by comparing the actual merchandise and a displayed merchandise image.

Fig. 3 Image of a merchandise identification.

5. The Effects of Introduction

The introduction of the present solution can provide the following three effects.

(1) Work efficiency improvement

Traditional inspection work makes the go/no-go judgment by collation with a list or read-through by several persons. The present solution can reduce person-hours and improve the efficiency of the inspection operations that have hitherto been performed by humans as visual checks or manual work.

(2) Work quality improvement

Inspection operations relying on human work have the potential of causing a certain amount of mistakes due to inadequate merchandise knowledge or experience. A shipping error caused by an inspection mistake leads to a deterioration of CS and/or an increase in person-hours needed in applying countermeasures.

The present solution can prevent inspection mistakes by making judgments using an ICT system. The use of image data also makes it possible to utilize the images shot during an inspection as evidence.

(3) Work standardization

Workers can perform inspections with standardized simple operations. A certain or a higher level of work can be secured for anyone regardless of their knowledge of the merchandise.

This also makes it possible to prevent dependence of work on individual skills.

6. Cases of the Introduction of Warehouse Product Inspection System

This section reports on actual cases of use of the Warehouse Product Inspection System.

(1) Yamato System Development Co., Ltd.

The logistics outsourcing business of Yamato System Development (**Photo 2**) handles catalogues,

Photo 2 Yamato System Development Co., Ltd.

Photo 3 Building Book Center Co., Ltd.

pamphlets, manuals and drug package inserts that do not carry merchandise ID information such as barcodes. As the operation has been based on a double or triple read-through in order to prevent mistakes and secure quality, the large amount of labor required to accomplish it satisfactorily has been an important issue.

However, introduction of the Warehouse Product Inspection System has improved the guarantee of quality assurance using the ICT system and has made it possible to replace the previous double or triple read-throughs with a single inspection process. As a result, the company has succeeded in reducing the time and cost of the entire warehouse work load by 20%.

(2) Building Book Center Co., Ltd.

Building Book Center Co., Ltd. (BBC, **Photo 3**) is a logistics service company handling the publications of the KADOKAWA Group. The company is also in charge of consignation, inventory control and shipment operations for several sites such as network shops selling animation and pop idols merchandise. About 1/3rd of the merchandise handled by BBC is accompanied with amenity goods, but these do not carry barcodes. Consequently, the work for attaching the merchandise codes before inspection and the read-throughs by pairs of workers have been required in order to assure the quality.

At BBC, Warehouse Product Inspection System has succeeded in significantly reducing the labor requirement, including the read-through occasions that were performed by pairs of workers. The freed labor has been assigned to other lines and the overall process operational efficiency has therefore been improved.

7. Conclusion

The greatest advantage of the Warehouse Product Inspection System is its capability of achieving three aspects that used to be regarded as being in a trade-off relationship. These are: 1) diversification of services, 2) labor saving, and, 3) quality maintenance/improvement.

While logistics complications at the workplace and deepening labor shortages are expected to continue into the future, we believe that there are many areas in which such issues can be solved by applying technical innovations based on ICT. The Warehouse Product Inspection System is just one such example that is actually being applied in various workplace of logistics.

In addition to the Warehouse Product Inspection System introduced above. NEC is also dealing with many challenges in the logistics domain both inside and outside of Japan.

In India, we are endeavouring to define logistics visualizations for the Delhi Mumbai Industrial Corridor project.

The arrangement of logistics infrastructures is an important theme in attracting enterprises to invest in India. For this purpose, we have visualized container transport information by attaching IC tags to containers and collecting the location information as each container passes through a gate. This has led to a reduction in the transport lead time, a reduced inventory and improvements in the accuracy of production plans.

As described above, NEC is providing solutions that meet specific issues by combining the latest ICT with proprietary experiences.

In the future, too, we intend to continue to contribute to efficiency improvements and optimizations of the entire value chain by solving the issues found in the logistics domain.

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