A Hypothesis-Driven Approach to Solution Development

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要旨

コニカミノルタでは2017年4月よりデジタルマニュファクチャリング事業部を発足し, 自社やパートナーのセンシング技術を活かしたCPS（Cyber Physical System）をコアとした製造業へのソリューション事業開発を進めることを決めた。ドイツにおいてはIndustry4.0の潮流に乗り，社会ニーズから社会課題を解決する価値を提供するIoTソリューションを開発するためIoT Business Centerを立ち上げた。本稿ではIoTソリューションの一つとして，仮説ドリブンにより開発したロジスティクスソリューションを紹介する。

物流業界はe-commerceの普及・拡大により2025年には約200兆円へと世界市場が拡大すると現在見られている。その市場拡大の中で物流に関わる労働者の業務負荷の増加，労働力不足が大きな社会課題となっている。

本開発では，“複雑で自動化が難しい人手による積荷・積み卸し作業の効率化が進まず，労働者の負荷が増している”という仮説を設定し, ワークフローにおけるヒューマンエラー削減とロスコスト削減という課題に対し，ソリューションの検討を行った。また戦略的パートナーであるMOBOTIX社やSICK社の技術の強みを活かし，コニカミノルタ独自のソリューションを構築した。

このように仮説ドリブンで社会課題に貢献するソリューションの企画から開発までを短期間に行い，ハノーバーメッセ2017での展示を実現し，来場者からも好評を得ることができた。

Abstract

Konica Minolta established its Digital Manufacturing Business Unit in April 2017 with the aim of promoting digital manufacturing solutions with a CPS (cyber physical system) at its core and which takes advantage of our partner companies' sensing technologies. In Germany, Konica Minolta established its IoT Business Center to develop IoT solutions which are driven by market demands for products that provide social value and follow the trend toward Industry 4.0. One such recent endeavor has been to develop a hypothesis-driven approach to solving problems of logistics with an IoT solution.

The logistics market worldwide in 2025 is predicted to be some 200 trillion JPY, and this will be a driving force behind e-commerce market growth. However, obstacles to this market expansion will be the required increase in the labor force that takes place just as Japan's aging population will mean that Japan's labor force is shrinking.

In approaching this logistics problem, we began with this hypothesis: "The manual loading-and-unloading of trucks and other delivery vehicles is complex and difficult to automate. Because of this inefficiency, the required labor force load will increase along with the logistics market." With this as our starting point, we searched for ways to reduce human error and loss cost. Further, we structured our efforts in an open innovation partnership with Mobotix AG and Sick AG, making available to us the formidable technological strengths of these two companies.

Using a hypothesis-driven approach, it took only a short time to develop a solution to the logistical problem of achieving efficient loading and unloading of vehicles. We presented this solution at Hannover Messe 2017, and attendant feedback was exceptionally positive.

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1 Introduction

Konica Minolta's Digital Manufacturing Business Unit promotes digital manufacturing solutions with a CPS (cyber physical system) at its core, and which take advantage of our partner companies' expertise in sensing technologies.

In particular, Konica Minolta aims to connect vertically related companies through their supply chains and to bring solutions to every workflow encountered. This promises to improve the productivity of entire vertical manufacturing processes, spanning the entire chain of companies involved. In Germany, Konica Minolta established the IoT Business Center to develop an IoT solutions which are driven by market needs and by today's trend toward Industry 4.0. This is Konica Minolta's new "Go to market" system, one which aims to transform existing sales companies into integral value providers that employ IoT to solve specific social problems and create value for the customer. This report presents just such an IoT solution, in this case, a hypothesis-driven solution to a logistics problem.

Worldwide, the logistics market for 2025 is forecast to be approximately 200 trillion JPY. This will be a driving force behind e-commerce (EC) market growth. For example, in recent years, the e-commerce market has maintained stable growth with an increasing EC ratio (Fig. 1)[1]. This means that the number of delivery transactions is increasing, and a continuously larger labor force will be needed in the logistics industry. At the same time, developed countries are generally facing declining birthrates and an aging populations that pose an increasing lack of labor. This factor of our economic and social environment is a serious problem facing efforts at market expansion.

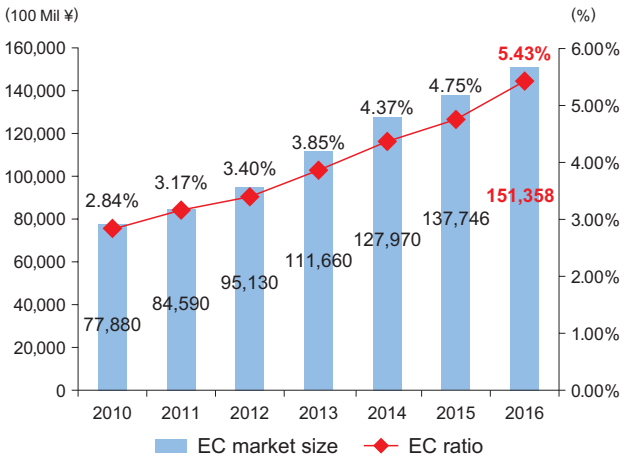

Fig. 1 Transition from business-to-business EC market size and EC ratio in Japan.

Traditionally, delivery companies generally delivered large numbers of the same product in a single delivery. But with the coming of e-commerce, the logistical workflow in deliveries has evolved into the delivery of individual packages or small lots of packages to a large number of destinations. In addition, services such as "same-day shipping" have grown popular at the same time that the market demand for low cost services are stronger than ever. In fact, the number of delivery transactions per driver/operator is increasing, bringing an increase in work force load (Fig. 2)[2]. All this makes it harder and harder to acquire and maintain an adequate labor force, so the logistics industry now faces a serious labor force shortage. Yet, if our hypothesis-driven approach can make headway with this logistics problem, the logistics industry could also provide greater and greater social value. Thus, we turned to the logistics problem and solution presented here.

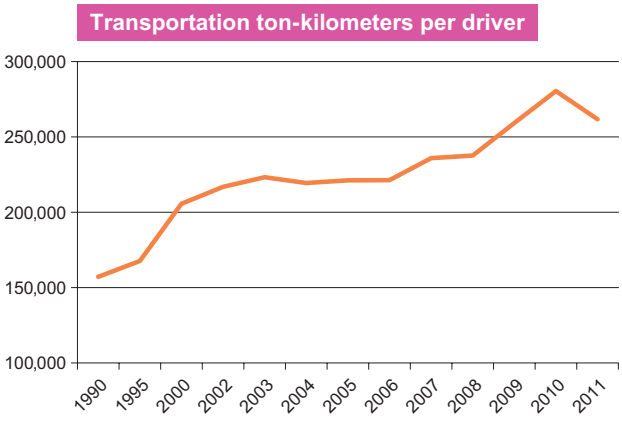

Fig. 2 The rise in the number of transactions and delivery distances per driver/operator in Japan.

2 Customer Issue Hypothesis

In taking a hypothesis-driven approach, we adopted this hypothesis: "The manual loading and unloading process is complex and difficult to automate, so it is inefficient and increases the labor force load." Thus, we sought a solution that would reduce both human error and loss cost that occur in current loading and unloading workflows.

In manufacturing companies, there are two types of logistics workflow: company-to-company logistics and in-house logistics. Industry developments in in-house logistics have taken full advantage of automation, with Amazon being a well-known example. Konica Minolta, too, is constantly refining automation processes at their plants, and this has paid off in significant advances in efficiency.

In company-to-company logistics, the workflow is of two parts: the handling process and the transportation process. As with in-house logistics, automation has been sought in transportation, with, for example, impressive R&D programs into fully-autonomously driven vehicles. But even in the short term, the autonomous platooning of vehicles in caravan is not far off. Because others have occupied this area of research, we turned our own attention to problems involved in the handling process, especially in the manual loading and unloading processes, which are complex and difficult to automate (Fig. 3)[3].

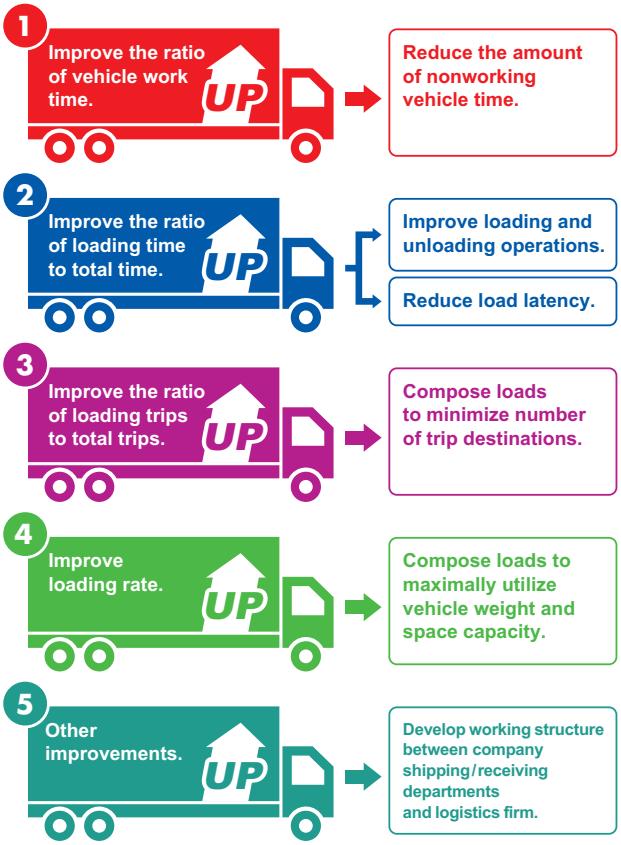

Fig. 3 Logistics of delivery vehicle workflow.

Manual loading and unloading processes require long work hours and the handling of heavy packages. Add to that the great number of packages a driver/operator must handle, and this process is quickly seen to be highly complex and one in which hard avoiding human error is a daunting challenge. Less so in Japan, but, in other countries, package damage and loss generate huge cost. Currently, the number of delivery transactions demanded of drivers/operators is increasing, so we looked for a solution which would accommodate individual package management and would utilize video data to improve human efficiency. Incidentally, some companies are developing package-handling robots, but practical success has eluded them so far.

3 Logistics solution

3. 1 Workflow scenario and solution

In developing our solution, we designed a workflow that manages packages on an individual basis and utilizes video data for concrete evidence of the loading and delivery of packages. Following are our workflow scenarios and solutions.

Loading:

(1) Delivery vehicle arrives at security gate. Management server identifies license plate number from camera image and displays a package list which needs to load from the delivery vehicle on a monitor (Fig. 4).

(2) Delivery vehicle arrives at warehouse. Driver/operator loads packages according to the list after reading the package with a radio-frequency identification (RFID) reader. This operation is recorded as a video evidence, and this video data is managed and controlled along with information about the package found via the RFID tag. If a driver/operator loads the wrong package, the system automatically displays an alert in real-time to prevent this human error.

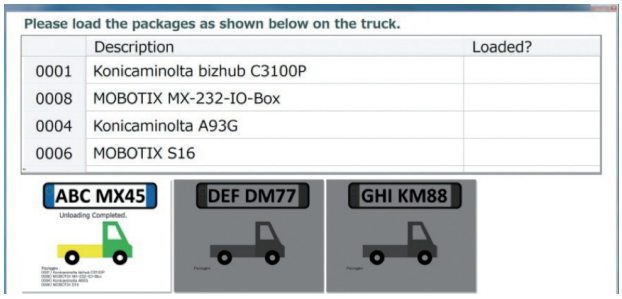

Fig. 4 Monitor display of loading packing list and handling instructions.

Unloading:

(1) Delivery vehicle arrives at security gate. Management server identifies license plate number from camera image and displays a package list on a monitor indicating which packages are tagged to be unloaded from the delivery vehicle (Fig. 5).

(2) Delivery vehicle arrives at warehouse. Driver/operator unloads packages according to the package list. At this time, if the driver/operator selects a specific package from the list data base, the driver/operator can check the status of that package with video recordings (Fig. 6). This reduces the time needed to locate the package and proceed efficiently. Further, just as when loading, the driver/operator can confirm a package's proper handling with the RFID reader, and thus preventing human error in real-time.

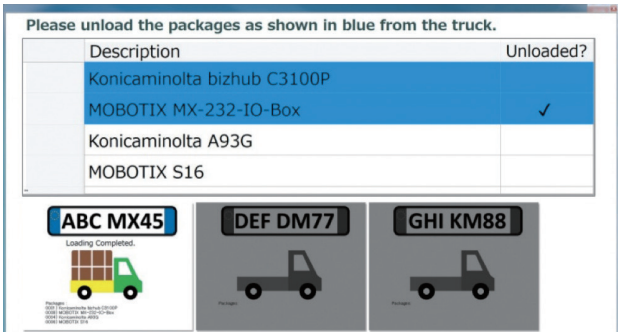

Fig. 5 Display of unloading package list and handling instruction.

Fig. 6 Video evidence of operation.

3. 2 Demo solution system structure

To develop our the solution, we entered into open innovation with Konica Minolta's strategic partners, who provide unique and powerful technologies.
Our solution system was configured as in Fig. 7:

- Management Server for entire system management, License plate recognition, MxMC (Mobotix intelligent video management system)
- Camera (Mobotix S16) for license number plate
- Camera (Mobotix S16, hemispherical lens) for video evidence of operation inside delivery vehicle
- RFID reader (Sick RFH 630) reader for package identification
- Touch panel display for display and user interface and switching hub to connect through network.

Each package has an RFID tag pre-installed with package information.

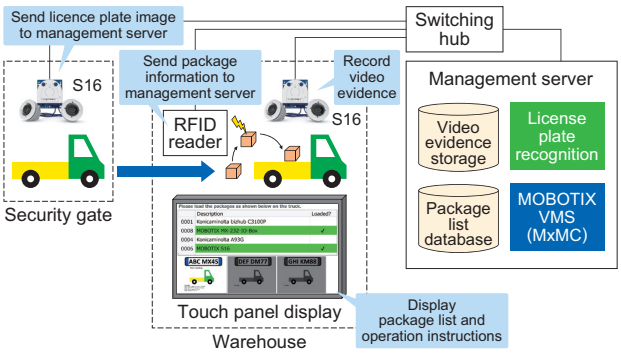

Fig. 7 Demo system configuration.

3. 3 Mobotix AG

In March 2016, Konica Minolta acquired a majority stock share of Mobotix (https://www.mobotix.com) to aid in finding solutions for individual vertical industries as a whole. Mobotix employs a unique decentralized concept in the creation of its high-resolution video systems. We utilized a Mobotix IP camera S16 and the VMS application MxMC in effecting our logistics solution (Fig. 8).

Fig. 8 Mobotix IP camera S16 and VMS application MxMC.

Mobotix is renowned as the pioneer in hemispherical IP cameras. Mobotix image processing technology can convert a fisheye image into images from any angle to cover an entire room with no dead spots (Fig. 9). For the video recording of loading and unloading operations, we selected the S16 hemispheric camera.

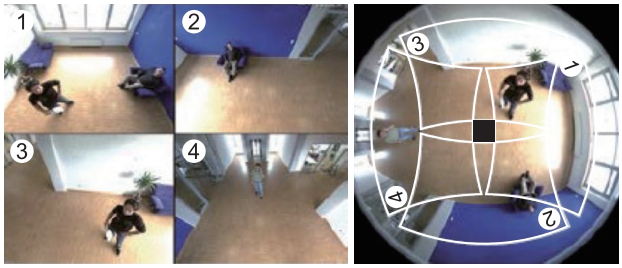

Fig. 9 Four virtual pan-tilt-zoom (PTZ) camera views are derived from a single 360 deg hemispheric camera.

A core system for realizing efficient video management and video searches via RFID tags was achieved with MxPos, a video management and search system that incorporates point-of-sale (POS) at checkout registers with a Mobotix camera. This system records the video of a customer's behavior upon checkout based on a barcode scanning trigger. Further, it allows searching video data based on product data.

A prime feature of the Mobotix camera is its built-in MxLEO (Mobotix lowlight exposure optimization), which automatically sets exposures and operates in low-light conditions to reduce noise and blurring. In addition, unlike h.264, Mobotix's own video CODEC, MxPEG, provides clear pictures in every frame, making it fit for such applications as reading license plate numbers and obtaining face recognition (Fig. 10).

Fig. 10 MxPEG and h.264 cameras compared.

3.4 Sick AG

Sick (https://www.sick.com) is one of the world's leading producers of sensors and sensor solutions for industrial applications. In line with its brand claim, "Sensor Intelligence", Sick focuses on providing high-tech sensor solutions that create added value for customers in a wide range of target industries. Sharing the same vision, on March 28, 2017, Sick and Konica Minolta announced its strategic alliance in furtherance of advanced light detection and ranging (LiDAR) technology. As a first step, Konica Minolta will supply a modified 3D LiDAR to Sick on an OEM basis.

Sick is developing intelligent sensor solutions which are key to reaping the advantages of Industry 4.0. Particularly in manufacturing and logistics, Sick developed "4D Pro", a new track and trace solution that realizes the seamless networking of individual production steps, thus making products traceable during complex production. This optimizes production and delivery networks as a whole. Intelligent sensor solutions generate data and information which enable complete detection, identification, and tracing in the networked process chain.

We adopted Sick's RFID solution because it has exceptionally high read/write performance and robustness, even in outside environments. Further, RFID flexibly integrates with common industrial fieldbuses via 4D Pro compatibility.

We used RFH630 two demonstrate our system, and it realized high performance in package identification. Moreover, UHF type RFID readers will soon enhance our solution because UHF RFID readers can read an RFID tag even at high angles and that greater distances, and this fits our logistics solutions much better when realistic field operations are considered.

4 Conclusion

In developing our hypothesis-driven approach to a logistics solution, we began with macro environment analysis to identify trends and inflection points. After analyzing customer's operations at a field level, and after constructing a hypothesis through which to confront the customer's issues, we sought a best-fit solution. In Konica Minolta's continuing business transformation, this was new challenge. But our exhibit at Hannover Messe 2017 triggered informative and positive feedback from visitors, and this has added to our confidence in our hypothesis-driven approach (Fig. 11).

Our next step will be to achieve proof of concept (POC) in the actual field in 2018 and two simultaneously refine our solution with the realistic feedback that is available only when working at the field level. And, on the technology side, we aim to further upgrade our user interface so that such efficiency-multiplying technologies as mobile/wearable devices and UHF type RFIDs will dovetail with the realities of logistics operations. This will bring us ever closer to our goal of targeting social needs and creating value for people everywhere.

Fig. 11 Hannover Messe 2017.

5 Acknowledgements

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