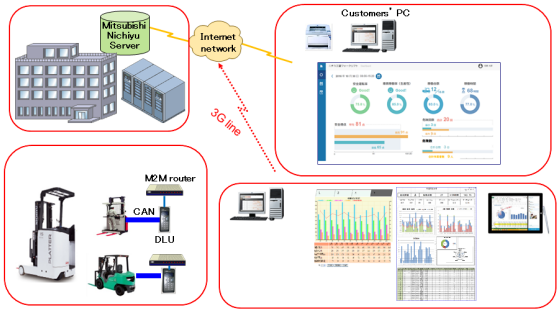
Telematics Service for Forklift Trucks



Mitsubishi Nichiyu Forklift Co., Ltd.

Since the beginning of 1990, Mitsubishi Nichiyu Forklift Co., Ltd. (hereafter, our company) has marketed products that manage various data of the operation instructions and actual operational performance of cargo handling/transfer, as well as the operational status of forklift trucks, using personal computers.

These products enable information to be exchanged between forklift trucks and the office via radio communication. To provide cutting-edge forklift/logistics systems is our company's mission, and we have made efforts to establish a forklift solution adopting new technologies such as IoT to contribute to the development of the logistics industry.

1. Introduction

With the evolution of computer systems and the reduction of infrastructure and communication costs, a market environment in which products with new value can be adopted more easily than ever before is growing. Automated operation technologies for automobiles began with automated operation of agricultural machinery, which is now changing the form that industrial vehicles take. Efforts toward IoT technologies in various industries are becoming increasingly active, and new products are in demand beyond transnational borders. Based on the expertise we cultivated so far, our company aims at "realizing a forklift solution" that is one step ahead of our competitors.

2. Forklift operational management system product for the domestic market

In the IoT concept for forklift trucks, our company has made efforts to visualize the operational status through the application of mobile communication technologies ahead of other industries since the beginning of 1990.

Mitsubishi Heavy Industries Ltd. commercialized the truck management system (TMS) for managing the operational status of forklift trucks at the beginning of 2000 (**Figure 1**).

It was an epoch-making product that enabled the comprehensive operation of forklift trucks to be displayed by collecting CAN (Controller Area Network) data. This data includes the control information of forklift trucks for the collection of data on safe operations, economic efficiency and operation rate, and realizing "visualization" over the Internet. TMS was a pioneer of our company's IoT business toward the improvement of the physical distribution systems of customers.

The former Nippon Yusoki Co., Ltd. commercialized a wireless LAN system for forklift trucks (**Figure 2**) in the 1990s and made efforts towards inventory control and warehousing and delivery management systems. Moreover, the company worked on IT logistics (**Figure 3**) toward the visualization of the operational status by linkage with CAN data, association with cargo handling operations and the realization of safe operations.

- Wireless real-time information exchange between office and forklift trucks (inventory control and warehousing/delivery system)
- Establishment of warehousing management system in connection with production system and order acceptance system

- An RFID or camera is installed on forklift trucks to decrease operations by workers (eliminate errors) in cargo handling work (automatic detection of cargo handling location, automatic reading of pallet information), etc.

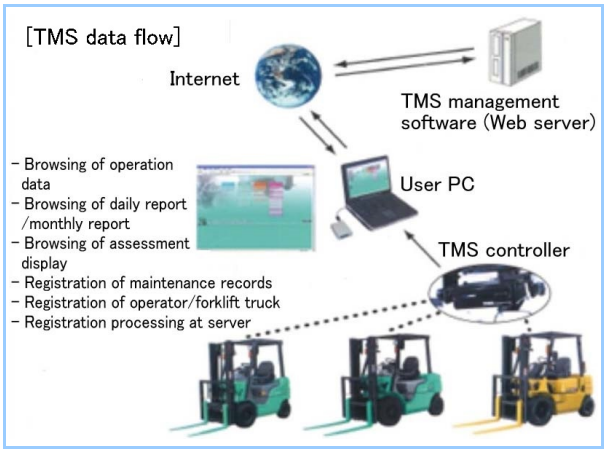


Figure 1 Truck management system (TMS)
Collectively managing actuation, movement and operation using vehicle-mounted controller

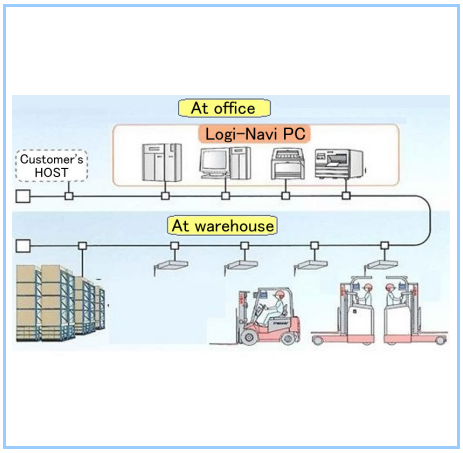


Figure 2 Wireless LAN system
Constituting a system with forklift-mounted terminals

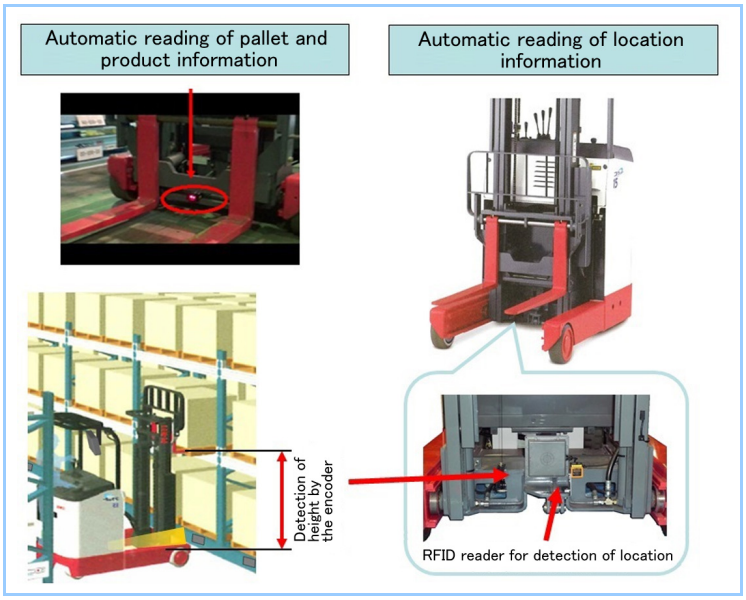


Figure 3 IT logistics

3. Products for overseas

Our company provides the telematics service under the trade names of Abbot in Europe and Liftlink in North America.

This chapter introduces the service under the trade name of Liftlink, which has been provided by MCFA (Mitsubishi Caterpillar Forklift America), our base in North America, since the end of 2014.

This service is one of the services that MCFA provides to dealers (distributors), and it is characterized by the fact that its main targets are dealers and service technicians. The number of connected vehicles has been increasing steadily since the start of the service, and at the time when about 1.5 years had passed, more than 3,000 vehicles had been connected. An outline of the system configuration and the service are described below.

3.1 System configuration

The Liftlink system is composed of a "vehicle-mounted unit," a "data server" and a "Web screen," as is the case with general telematics systems.

(1) Vehicle-mounted unit

The operator's operating information, vehicle status (engine speed, cooling water temperature, motor RPMs, error information, etc.) and GPS information are collected at set intervals and transmitted to the server via the mobile telephone network.

(2) Data server

Data from the vehicle-mounted units is accumulated and extracted upon request on the Web screen.

(3) Web screen

Data is extracted from the data server through the browser, and a live display or analysis display is provided.

3.2 Outline of the service

Forklift trucks managed by dealers are scattered all over vast countries, which is a situation specific to North America, and it is difficult to provide service by frequently making rounds, and service technicians cover wide areas according to their own expertise.

When any problems occur, service technicians prepare replacement parts based on phone calls or e-mails from users and visit them. But it is not uncommon for inaccurate information to be given and it takes one day to make a return trip just for an inspection. In the event of a problem, an error code is displayed on the vehicle's meter panel, but the user may provide the wrong information or make a mistake in reading the code.

To solve these problems, Liftlink provides the following functions:

(1) Dashboard

A summary of the major data is displayed by arranging items like tiles as shown in **Figure 4**. The contents to be displayed, the size and the layout can be customized by each user.

(2) Home screen

The locations, number and states of forklift trucks can be viewed from above and each forklift truck is displayed as a round pin on a map. A normal state is indicated in green and an abnormal state is indicated in red. By clicking each round pin, the major data can be understood. (**Figure 5**)

Figure 4 Dashboard

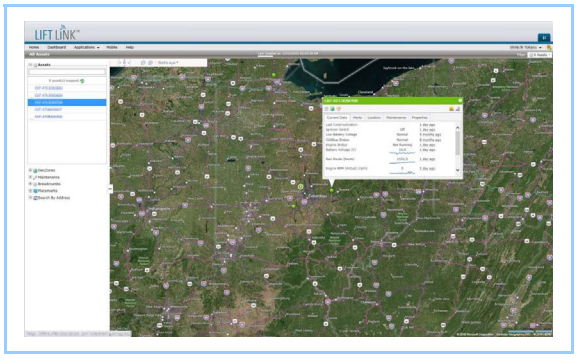


Figure 5 Example of display on Home screen

(3) Alert Management

Currently occurring errors and the error history can be checked in lists. Filtering of errors and notification of errors can be set.

(4) GeoZones

Deviation or entry of forklift trucks from or to a set area can be checked. (**Figure 6**)

(5) Breadcrumbs

The location information history of each forklift can be checked. (**Figure 7**)

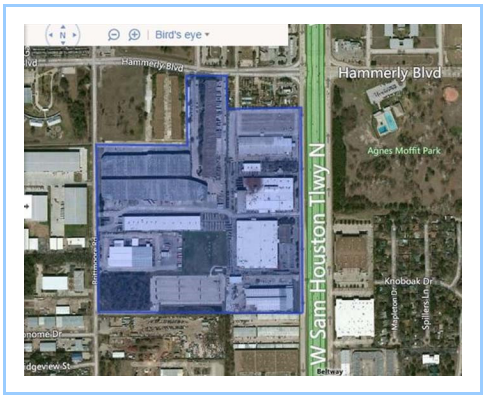


Figure 6 Example of GeoZones display

Figure 7 Example of Breadcrumbs display

(6) Maintenance Planner

The schedule and actual operational records of each forklift can be comprehensively understood and used for service planning. Maintenance proposals can be made based on the actual operational management.

(7) Report Browser

Obtained data is extracted by various conditions and output in CSV. Advanced analysis and graphing can be made, and operations are scheduled, substantially reducing the burden of regular analysis processing.

4. Efforts toward operational management system and challenges

Along with the progress of infrastructure technologies and sensing technologies resulting in the diffusion of Wi-Fi and reduced costs of 3G lines, new products incorporating these technologies are in demand in addition to existing operational management systems.

Therefore, our company has made the following efforts toward competitive commercialization, not only in the domestic market, but also overseas.

<Present efforts>

- Cost reduction of vehicle-installed equipment (improvement of market diffusion rate)
- Extensibility of cloud service including database and charge system according to the form of service
- Application to diversified communication systems (proposal according to the purpose such as acceleration and cost reduction)
- Maintenance of forklift trucks (preventive repairs before the occurrence of failures)
- Positioning of forklift trucks indoors or outdoors

<Future challenges>

- Connection between forklift trucks and other equipment (equipment inside factory, delivery system, etc.) and automation
- Information linkage among different industries. Connection of logistics and information from production to consumer
- Functionalization of expertise of skilled workers
- Forklift trucks that operate autonomously and support operations (providing automatic operation instruction)
- Integration of data of objects to be handled such as products and pallets and actual cargo handling data of forklift trucks (which means that a forklift truck which originally only transports cargo serves as an information transmission base that integrates and manages the logistics information by connecting product information and cargo handling work.)

Forklift solutions have been in a period of change, and should be shifted to a cross-industry solution through efforts toward the establishment of a "cargo handling support system that does not require experienced operators" in the same manner as automated operation technology, the realization of optimum logistics through AI and deep learning technology, as well as operational support and work support systems.

5. Conclusion

Forklift trucks are used in various industries and fields in Japan and overseas, and they are important industrial vehicles on which the logistics which supports our lives is based.

We aim at establishing a leading-edge forklift truck solution that supports logistics around the world through the development of our own technologies and their integration with external technologies.

The origin (or purpose) of a forklift truck is "to transport cargo correctly, quickly, efficiently and safely." We are also going to consider the future image of forklift trucks while placing value on workers' pleasure of working with them.