Creating Value in Data with “OnePackEdge System”

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ABSTRACT

Today, visualization is advanced for the process of each department, such as design, production technology, and a factory, and a large amount of data is collected. However, these data are not fully leveraged due to the lack of efficient coordination between departments and continuity of historical data over different processes. Thus, total optimization is required for cross-department coordination and data continuity through data gathering and analysis. Given this challenge, Fuji Electric has developed “OnePackEdge System” for creating a “value-generating database” to realize a smart factory. An additional data analysis assistant tool is also provided to make analysis more efficient and create value in data.

1. Introduction

As technologies such as the Internet of things (IoT), big data analysis and artificial intelligence (AI) evolve rapidly, we are faced with the challenge of how to specifically use the data for productivity improvement and predictive maintenance of equipment.

This paper describes the creation of value-added data using the “OnePackEdge System” as an example of how to overcome this challenge.

2. Assembly Process Data Collection System[1]

Customers increasingly need to accelerate the development of new technologies to meet the high demands of the market. For example, in the automotive industry autonomous driving, connected cars and electric motorization can be cited.

In many cases today, visualization and the collection of large amounts of data is already advancing in regard to design production technologies and at the departmental level of factories. Up until recently, it had been acceptable to initiate improvement of individual production departments and lines, but since these improvements are limited, a greater number of users are aiming for overall optimization. However, the data collected has not been sufficiently utilized due to inadequate sharing of data between departments and insufficient continuity of historical data across multiple processes. Therefore, it is necessary to carry out overall optimization through data collection and analysis that take into account the coordination and continuity between departments. Figure 1 shows the frameworks that reflect the current state and ideal future state.

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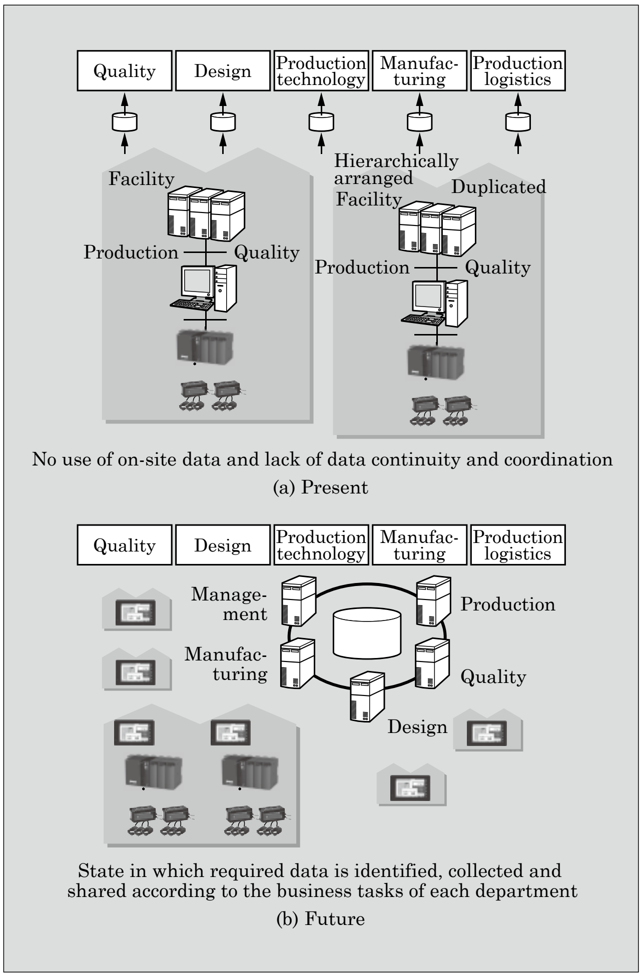

Fig.1 Framework of current state and ideal future state

In order to overcome these challenges and achieve smart factories, Fuji Electric has developed the “OnePackEdge System” as a system for building “profit-generating databases.”

2.1 Quality traceability for the assembly process field

Figure 2 shows an overview of the quality traceability solution provided by Fuji Electric The dashed line shows the scope of the OnePackEdge System. The quality traceability solution consists of a data collection section that collects raw data from sensors and manufacturing facilities connected via LAN and a server section for the databases that stores the data. The system collects the data needed by the user at the required time and makes it easy to carry out searches when it is necessary to trace stored data.

(1) Data collection section

(a) Data collection function

On assembly process lines, quality traceability requires data on the assembling and processing of each machine's work at all stages from start to completion (one cycle). For every process cycle, the OnePackEdge System collects the computer numerical control (CNC) and programmable logic controller (PLC) signals used to control each piece of machinery, as well as various sensor signals such as the pressure, temperature and vibration of each machine. Furthermore, as shown in Fig. 3, the system aggregates collected data within each process cycle (packaged data) to make it meaningful.

By doing this, it can reduce the amount of data collected compared with conventional systems that continuously collect data, because it only collects necessary data at the time it is required. As a result, this greatly reduces the effort required to identify data for analysis, greatly decreasing a user workload.

(b) Camera server connection function

In order to manage changes in 4M (men, machines, materials and methods), there is a need to centrally manage video taken with a camera along with analog inputs such as vibration and current.

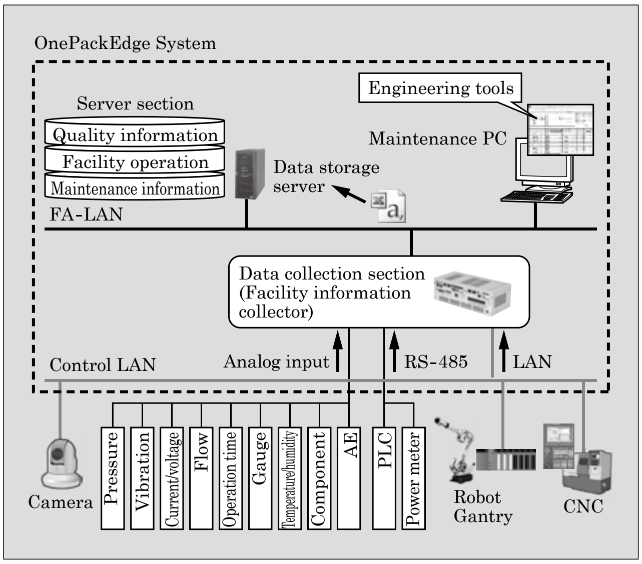

Fig.2 Overview of quality traceability solution

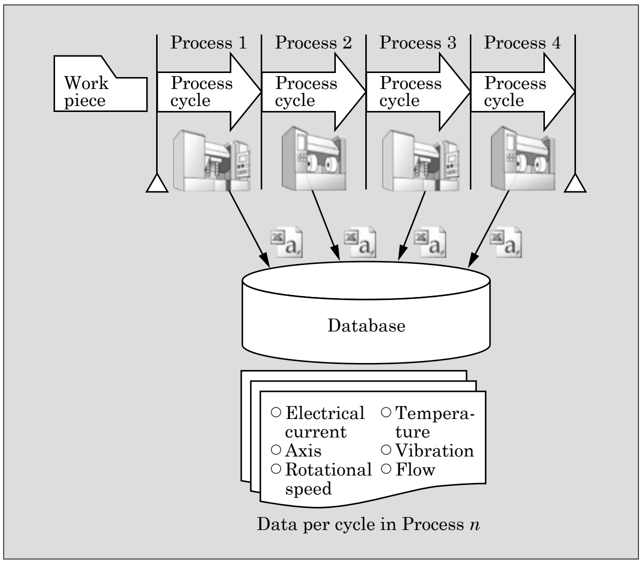

Fig.3 Image of data collection function

However, the camera is mainly managed by a camera system, and because analog data collected from sensors uses a different management system, it has been difficult to achieve centralized management.

As shown in Fig. 4, the system provides a function for monitoring events in the field by synchronizing the camera's recorded video with the analog data transition.

(c) Engineering tool

The engineering tool performs master maintenance of the system, while also adding and deleting data. This solution provides the engineering tool that use Excel*1. Figure 5 shows an overview of the solution. By using the engineering tools prepared on a maintenance dedicated PC, it is possible to specify start and completion signals for each cycle, define field names, data types and storage addresses for the collected data and register such information

Fig.4 Screen example of camera server connection function

*1: Excel is a trademark or registered trademark of Microsoft Corporation

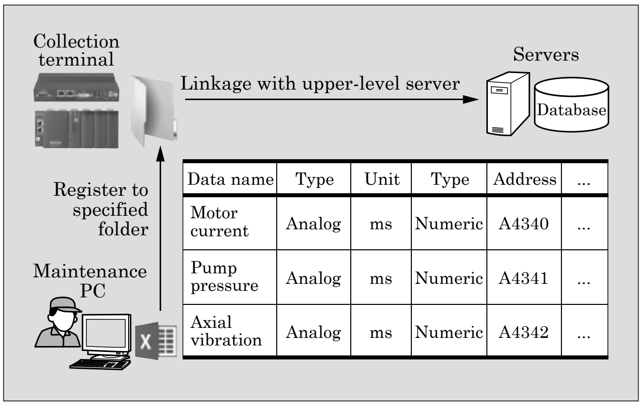

Fig.5 Overview of engineering tools

into the collection terminal's specified folder. As a result, users now can easily add and edit collected data.

(2) Server section

(a) Traceability search function

There is a close relationship between the operation information of manufacturing facilities and the quality information of products. Therefore, users often check operation information and quality information at the same time when problems occur on the production line. However, retrieving such information has been cumbersome because quality information is managed according to product, whereas operation information according to facility. This solution makes it possible to search via both facility axis and work axis, thereby reducing the labor required in user information retrieval.

(b) Data summary function

In order to track factors of abnormality, it is necessary to obtain abnormal values (those exceeding the threshold), maximum values, minimum values, and average values for each item of measurement. However, this takes a lot of effort because the amount of accumulated data is often huge. This solution automatically summarizes and displays these values on the traceability search screen to help reduce the task of checking data by users.

Table 1 Overview of facility information collector specifications

Function classification	Detailed classification	Specifications
Data collection	Collection target	○ PLC or CNC ○ Power meters ○ Various sensors (analog inputs) ○ Contact inputs (digital inputs)
	Collection cycle	○ High speed (1 ms): 16 points (analog inputs) ○ Medium speed (300 ms): 20 points* ○ Low speed (1 s): 128 points*, 24 points (analog inputs)*,**, 16 points (digital inputs)*,** ○ Cycle: 256 points
	Upper-level server transmission	FTP file transfer (supports FTP server and FTP client functions)
Data monitoring	Threshold value monitoring	Threshold monitoring for low-speed data 128-point upper upper limit, upper limit, lower limit and lower lower limit***
I/F	LAN	○ LAN0 (RJ45): 1 Gbits/s (for real-time monitoring) ○ LAN1 (RJ45): 1 Gbits/s (for future expansion) ○ LAN2 (RJ45): 1 Gbits/s (for upper-level PC connection and engineering tool connection) ○ LAN3 (RJ45): 100 Mbits/s (PLC or CNC connection)
	Serial	○ RS-422 (RJ45): For future expansion ○ RS-232C0 (D-SUB 9 pin): For future expansion ○ RS-485 (RJ45): Power meter connection ○ RS-232C1 (RJ45): For future expansion ○ USB0, 1, 2: For maintenance
	I/O	[Standard] ○ Analog inputs: 16 points, 4-20 mA/0-20 mA/±20 mA; Resolution: 14 -bit ○ Digital inputs: 1 point, 24 V DC, 4 mA ○ Digital inputs: 1 point, 24 V DC, Ry output [During I/O expansion] *Connection via expansion I/O (RJ45) ○ Analog inputs: 24 points, 4-20 mA/0-20 mA/±20 mA; Resolution: 14 bit ○ Digital inputs: 16 point, 24 V DC, 4 mA
	Compatible protocols	Mitsubishi MC protocol, FOCAS2 / Modbus RTU

* Only devices with a read response time of 10 ms or less per word
** Only at the time of I/O expansion
*** When monitoring threshold values, a value is judged to be abnormal when it is continuously above the threshold value for a consecutive number of configured times.

2.2 Facility information collector

In order to reduce the size and cost of the data collection section, Fuji Electric has developed a facility information collector that integrates the functions described in Section 2.1. It achieves a 95% reduction in

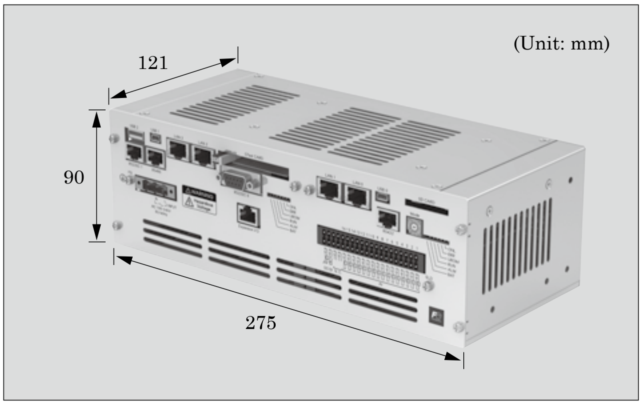

Fig.6 Facility information collector

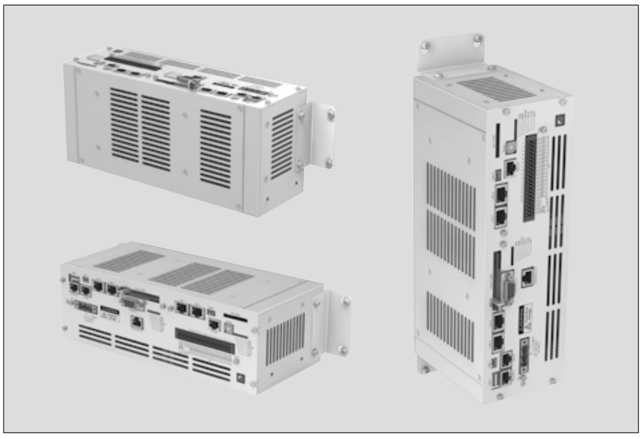

Fig.7 Example of installing facility information collector

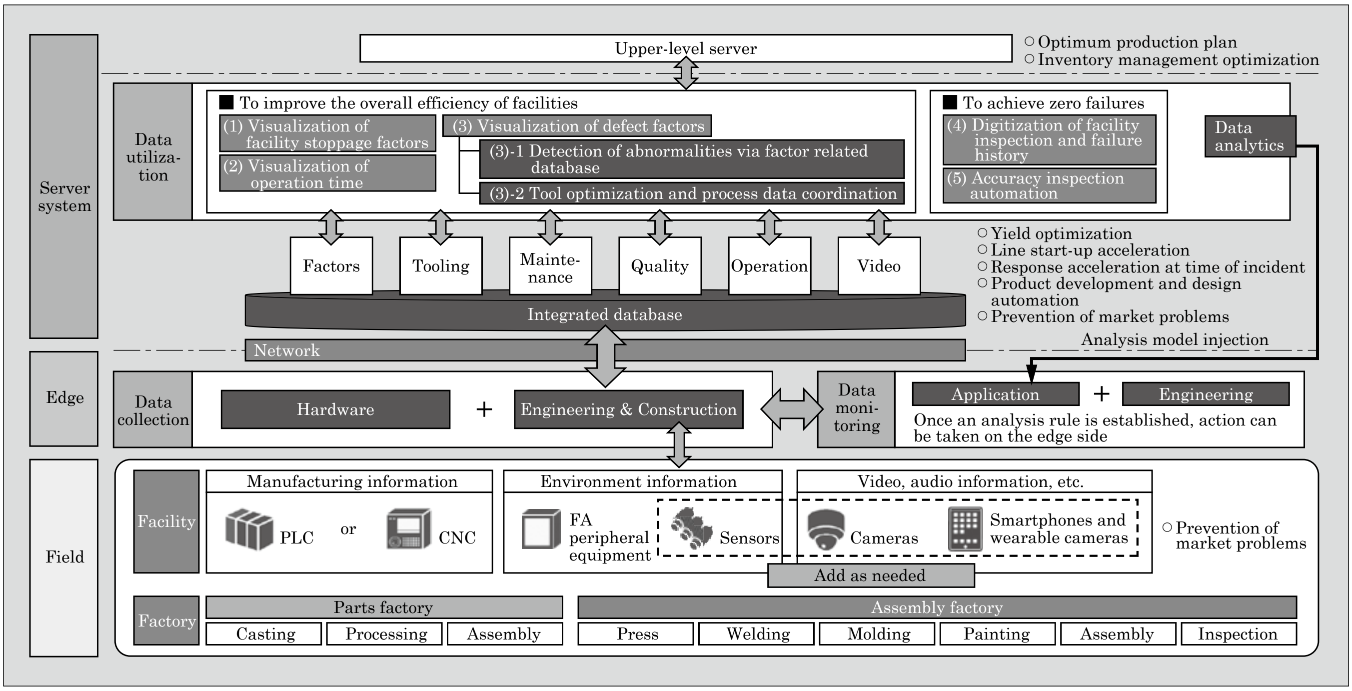

Fig.8 Future vision for the “OnePackEdge System”

volume compared with conventional Fuji Electric collection units. Table 1 shows an overview of the specifications, and Figure 6, the external appearance.

Furthermore, it can be mounted in 3 directions and vertically inverted as shown in Fig. 7 for easy integration into existing control panels.

3. Future Outlook

Figure 8 shows the future vision for the OnePackEdge System. By developing the data collection functions shown in the Figure, we are able to efficiently collect and accumulate meaningful packaged data via various facilities and sensors in the field. In the future, we plan to create new customer value from data by combining the meaningful data with data analytics to use it for applications such as predictive monitoring of production facility failures and product defects. Fuji Electric will continue to actively contribute to this type of data application and promote activities that create additional value from data.

In addition, we will provide a tool for analyzing meaningful packaged data. This tool will not only enable users to search and display the waveforms of accumulated data, but also include other functions such as filter and FFT analysis functions. This tool will also help improve the efficiency of analysis work through its waveform analysis based data distribution function and model waveform comparison function.

4. Postscript

In this paper, we described how the OnePackEdge System can be used to create value from data. Although the need for data collection is increasing due to the spread of IoT, it is way too easy to find oneself drowning in a sea of data that cannot be fully utilized. It is foreseen that valuable data ends up being undiscovered and productivity fails to be maximized. We intend to help customers utilize meaningful data to reduce production loss and management loss.

References

(1) Fujikawa, Y. et al. FA Solution That Applies IoT and Motion Control Technology. FUJI ELECTRIC REVIEW. 2018, vol.64, no.1, p.11-15.

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