A work-site record-keeping service supporting "new normal" ways of working and business transformation

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In July 2020 Azbil released a cloud-based work-site record keeping service. This service digitally replaces the work of recording work results on paper. At various sites work is done by both people and things, and therefore to properly understand what is happening on the site, information on both people and things is necessary. This service provides easy editing and managing of work records without the need for IT skills, supports continuous business improvement, and provides convenient digitization of human work records, with the intention of making the digitized data usable with other data from computer systems and IoT devices. In this paper we discuss the strengths, functions, and technical elements of this service, as well as the possibility of applying it to new methods of working that have arisen as a result of the coronavirus pandemic.

1. Introduction

The novel coronavirus (COVID-19) has been spreading rapidly since February 2020. Companies everywhere have had to be quick to rethink the way they operate and work in order to continue doing business under these circumstances.

One of the new ways of working is remote work, a fact which has prompted many companies to look at the coronavirus pandemic as an opportunity for digital transformation (DX).

DX is a concept advocated by Professor Erik Stolterman at Umeå University in Sweden in 2004. DX was defined as the adoption of evolving technologies that somehow affect, and as a result, improve the life of human beings. In other words, it implies the belief that the penetration of IT will make every aspect of people's lives better. When it concerns business activity, however, DX simply means transforming the company with digital technology.

That is, DX is an approach to value creation that differs from conventional digitization (e.g., conversion of paper records to Excel format, or replacement of human work with robotic process automation[*1]) or digitalization (optimization or productivity improvement using digital technology), which intend to digitize information or automate work.

Leveraging information that people create has been difficult because digitization of that information lagged behind IoT progress related to things.

Records are still manually made on paper at many different work sites. Our work-site record-keeping service is a cloud-based application software service that digitizes this information created by people. This data can be combined with data from other computer systems, IoT devices, and other sources, helping users to understand the real situation at the site and to eliminate the need to rely on assumptions about operations, gut feelings, and having to "get the hang of" a task. As a foundation for true DX, the service can be used by onsite workers to revise the way familiar tasks are done.

2. Development concept

(1) Combatting quality fraud

Azbil started developing this service in response to the many cases of data tampering, inspection by unqualified personnel, and other types of quality fraud by Japanese manufacturers that came to light in 2017 and 2018. By correctly recording the who-what-where-when-why-how of human work, we aimed to prevent fraud in inspection and other processes and help to resolve this serious problem in the manufacturing industry.

(2) Belief in the cloud

Azbil is developing new solutions and new automation products based on our measurement and control technologies and products aimed toward the realization of a sustainable society. Cloud services are one example.

Companies expect that future IT systems will be flexible enough to handle changes in the business environment.

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*1. Robotic process automation (RPA) refers to automation of operations using a software "robot." RPA is effective when applied to routine PC tasks like posting or aggregating data.

Flexibility means the convenience of being able to quickly start when necessary and having no need for hardware assets and internal operators. These are some of the advantages that cloud services offer. The user of a cloud service can, for example, significantly reduce the time, cost, and personnel required for system development and framework building when starting a new DX project. As a result, new projects can be launched more easily.

Recently, the use of the cloud has rapidly spread in core and office automation systems. In the near future, the cloud will probably be adopted for use in production and manufacturing operations systems at factories as well.
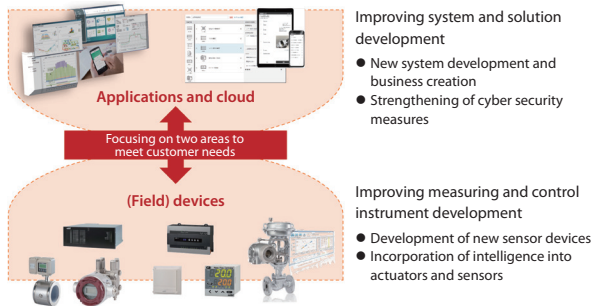

Fig. 1. Focusing on two areas to meet customer needs

Azbil has been advancing a plan to establish a development and implementation platform for native cloud applications, to develop applications that run on the platform, and then to provide them, including also their operation.

(3) A DIY service

Azbil aimed for a system that would allow site workers to build their system by themselves without the help of an IT department or IT vendor. Instead, the system would operate as a service from a company that describes itself as "working together with customers at their site to create value" and that promotes the concept of "human-centered automation." In this context, we developed a service that anyone can use without the need for special IT skills like programming and database design.

This service is also effective as one solution for the small number of IT personnel in Japanese companies mentioned in the "DX Report" issued by the Ministry of Economy, Trade and Industry in September 2018.

(4) Rapid development and continuous improvement

This service provides an application that offers a completely new kind of support. Although we aim to eventually apply this service to various lines of business and operations, we first quickly developed a usable form of the service to make it available as soon as possible, with plans to improve its functionality and usability while users actually use the service.

It is important to continue to release further enhancements rather than stopping after initial provision of a service.

3. Architecture and development environment

This section describes an architecture and development environment conducive to rapid development and continuous improvement of cloud services.

3.1 Architecture

(1) Microservices

We adopted a microservice architecture suitable for a native-cloud environment. One could say that the microservice architecture is the service-oriented architecture (SOA) that spread beginning in the first half of the 2000s, but rebuilt with current technology related to cloud computing, networks, security, and containerization. The microservice architecture makes it easier to link small independent services that are loosely coupled with one another to build an application in comparison with past mainstream monolithic applications, where all functions are developed and operated as one process.

An application created with this structure is called a microservice application.

Monolithic application

Microservice application

Fig. 2. Differences in application structure

Microservice application development allows the developer to design and implement small services for specific parts before all requirements and specifications are determined so that services can be released rapidly. It is also possible to easily update and add services in short cycles after release.

In other words, with microservices the continuous development process, from creation of specifications through release, which takes a long time with monolithic applications, can be done in parallel for each service needed.

Azbil has created a development platform and an operation platform for cloud applications using microservices. We are also continuously making improvements in platform development, as also in application development. Specifically, we review the conventional procedures for all processes including development, security, and operation, to make what is known as DevSecOps[2] a reality.

(2) Containers

We adopted containers to implement the microservices.

The features of containers include:
- OS-independence
- High independence among containers
- Fast startup
- An established version control mechanism
  The features of applications using containers include:
- Multiple instances of the same container (load distribution)
- Redundant configuration
- Easy CPU and memory reallocation
- Easy storage reallocation
- Network settings (security and load balance) with a high degree of freedom
- Application scaling
- Application updates without downtime

This list could be extended, but all features are suited to applications that are expected to run in the cloud.

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*2. A software development method. This method adds security to DevOps, which is a development method where development personnel and operations personnel work together.

These features also facilitate independent design and implementation for each microservice that makes up the application.

Containerized microservices run on the above-mentioned operation platform, linked with one other, achieving high availability, confidentiality, and integrity.

3.2 Development environment

Application development consists of the development of the front end, which the user directly uses through the user interface (UI) and the development of the back end, which is configured as a Web API and executes the business logic (processing specific to the target operation) such as accessing a database or making a calculation in response to a call from the front end application or other service.

Developers ought to be able to pour most of their energy into the UI and business logic specific to the application. This means that they should be able to effortlessly implement standardized UI design or general-purpose processing such as database access, exception processing, and log output.

Therefore, Azbil provides proprietary templates, libraries, an automatic source code creation function, and other features in the development environment to improve development efficiency and standardize quality.

In this way, even if the person in charge changes, we can continue development without lower quality by presenting a common design concept to developers and helping them take over that concept so they can continue to release improvements.
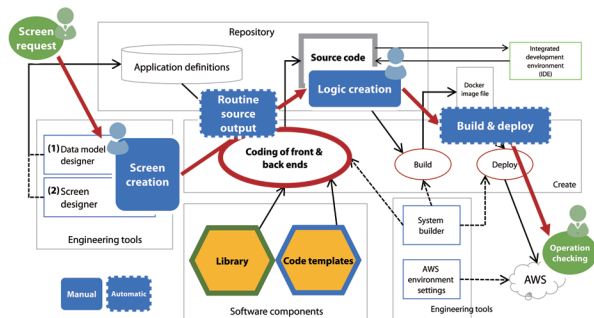

Fig. 3. Overview of development environment

Because the specific service under discussion digitizes "human work" rather than dealing with objects as usual with the IoT, it is important for it to have high usability and easy operation that does not cause confusion or stress.

Even if a service is sophisticated, users will gradually stop using it or become careless when entering information if they have a bad impression of its usability, appearance, or other aspects. This in turn lowers the quality and quantity of the collected data and results in failure to make effective use of it.

In addition to having the necessary functions, an application should be accepted by users and continuously used.

Azbil has created an application that combines functionality and usability with a uniform design by using templates and libraries.

As we increase the number of applications, we intend to apply the software assets and expertise thus gained in order to improve the development environment and with it our development efficiency and application quality.

4. Features of the service (product)

Companies often ask their internal IT department or an IT vendor to develop a system that they want to implement. In this situation, they are greatly dependent on the supplier's schedule. In addition, they may come to desire a more forward-looking system. To build such a system, a project will be established and a thorough implementation plan created. In many cases, the system requirements will also increase, resulting in a large-scale, long-term development.

However, the circumstances in and around companies and departments are constantly changing. By the time the project development is finished, the completed system may be outdated or require modification as a result of changes in the circumstances.

With the features described below, our service allows anyone to easily build a system to record human work. This means that those who have a bit of interest can start building a system on a small scale and site workers can change the system by themselves at their own pace as they want.

The same applies to DX. DX that starts small and can be quickly advanced little by little, even toward a required large transformation, fits the present times with their dramatically changing circumstances.

The features of our service are suitable for achieving these kinds of goals.

4.1 A DIY service

The most important feature of the service is that anyone can use it.

We emphasized this feature, as well as the recording aspect, when building the record system.

(1) No need for programming

A record system (or screen) can be created quickly by simply combining parts recorded with entry methods specific to mobile devices such as reading QR codes or barcodes and recording photos taken with a cell phone camera by dragging & dropping and text entry.

(2) Usability at work sites

The usability of the system results from applying the expertise that Azbil has acquired by interacting with customers at many work sites over a long period of time.

For example, by considering the circumstances of workers and work sites, we developed the recording task screen assuming that it would be used on a tablet or smartphone. This is because tablets and smartphones are easy to install for manufacturing recording and product inspection on production lines. In addition, they are lightweight and highly operable and therefore not a burden on workers who move around for patrols or other reasons. For the operation screen, we attempted to create a simple, intuitive UI that would not confuse first-time users and that could be operated without making errors while working on a site.

4.2 No need for installation

Because our service runs in a web browser, there is no need to install a program if the web browser is already installed.

This means that the device can be selected regardless of whether its operating system (OS) is Windows, iOS, or Android.

The web browser that is required depends on the OS. The Windows and Android platforms require the Chrome browser, and iOS requires Safari.

4.3 The cloud and subscriptions

This cloud service is offered on a subscription basis. Each user pays a monthly fee.

Even a single user can use the service, and the number of users can be freely increased or decreased. Therefore, the service can be used flexibly in line with the organization or business framework.

(1) No startup costs

Because this is a cloud service, there is no need to purchase a dedicated server or prepare an installation location or operators for the server. There is no initial cost if existing devices can be reused, although of course the user must supply the devices.

(2) Safe and dependable service operation

Azbil's Cloud Operation Center[1] operates this service. Because this center has obtained certification for its information security management system (ISMS) based on the international ISO 27001 standard and for its ISMS cloud security based on the ISO 27017 international standard, customers can use this safe service with peace of mind.

5. Functions

The primary role of this service is recording human work. It has the following functions that facilitate continuous work improvement and the management and use of work records.
- Definition of the recording task
- Execution of the recording task and recording of results
- Suspension and resumption of the recording task
- Viewing and editing recorded data
- Outputting recorded data
- User management and task group management

5.1 Definition of the recording task

Here, the recording procedure that the worker follows is defined and saved. The saved procedure is called a definition. Definitions are created by combining multiple records.

The record is the minimum entry unit resulting from the recording task. Records are displayed on a page on the record screen.
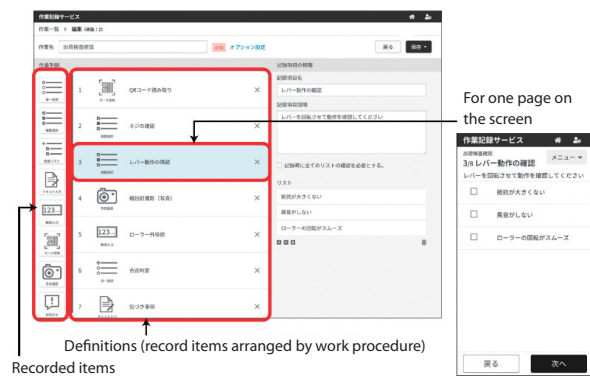

Fig. 4. Definition screen

Knowledge of programming and databases is not required to create definitions. Since the elements required for definition (records) are provided, a screen can be created easily with simple operations such as drag-and-drop or text entry using a keyboard.

5.2 Execution of the recording task and recording of results

As mentioned above, it is assumed that the recording task will be carried out at a work site using a smartphone or tablet (but a PC can also be used).

Fig. 5. Record screens on tablet and smartphone

The results for each element of the work can be recorded with a touch operation that is like turning the pages of a book. After recording all items, the user saves them to the cloud. Because the recorded data is also retained in the device, recording can be done even when the network is not available. (Saving data to the cloud requires a network connection.)

5.3 Suspension and resumption of the recording task

Recording can be suspended and resumed at any time.

For example, a recording task can be carried out during another recording task, and then the first task can be resumed. Or, a different person can take over a suspended recording task on a different device.

Fig. 6. Task suspension screen and resumption screen

5.4   Viewing and editing recorded data

Recorded data that has been saved to the cloud can be viewed and edited. When the edited data is saved to the cloud, the editor and the time when the edits were made are also recorded and stored with the existing data.
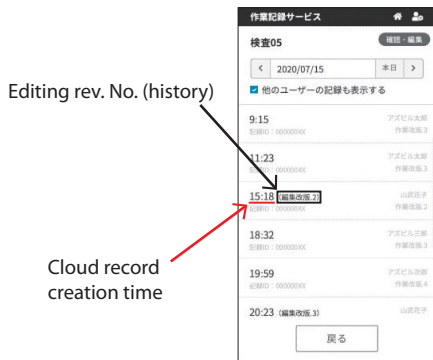
Editing rev. No. (history)

Cloud record creation time

Fig. 7. Record data list (date and time of registration and revision)

5.5   Outputting recorded data

When a date or period and a definition are selected, records that meet the selected criteria are output to a CSV file.

The CSV file can then be imported into commercially available spreadsheet software or business intelligence (BI) tools to fill out forms or visualize data for analysis.

The CSV file includes data on the author and time of record entry as well as the data that was entered on the work record screen.

In addition, the location of record entry in the form of latitude and longitude from the GPS[*3] are also included.

5.6   User management and task group management

5.6.1   User management

A user with administrator rights can easily add and delete users and perform other user management tasks.
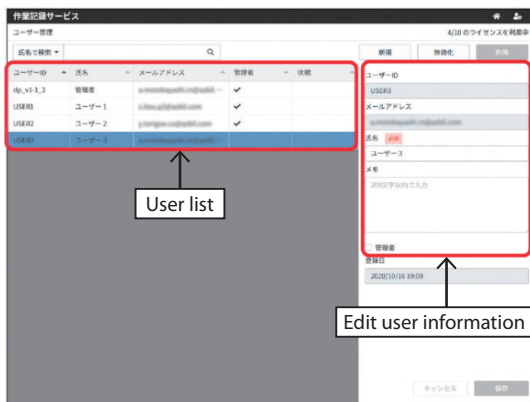
User list

Edit user information

Fig. 8. User management screen

5.6.2   Task group management

With continued use of this service, as the number of definitions increases, it becomes necessary to group and manage them by purpose, operation, organization, or other criteria.

The administrator can create task groups and allocate each user or definition to a group. Afterward, only the definitions in relevant task groups are displayed to the user, which facilitates definition management.
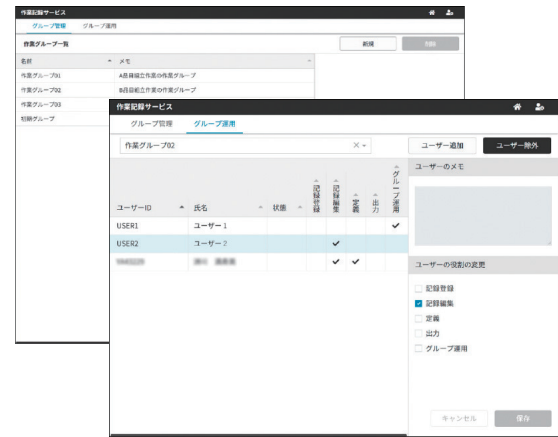
Fig. 9. Task group management screen and group operation screen

Despite the above descriptions of the functions of this service, it may be difficult to understand its actual behavior and usability. More concrete images of the service can be viewed on the website for the service (https://www.azbil.com/jp/rcd/, in Japanese), where a two-month free trial is also available.

6. Business use examples at Azbil

Due to Azbil's corporate image and the product description as a work-site record-keeping service, many users of this service are manufacturers. However, we have also received inquiries from customers in construction, maintenance, and care services, to name a few.

Within the azbil Group, this service is used in multiple departments, including manufacturing, service, and sales.

The Shonan Factory implemented this service in its product inspection process on the flowmeter production line and achieved paperless operation, quality visualization, and process optimization using the recorded data.

For example, by combining this service with a commercially available BI tool, the factory succeeded in reducing the time required to create a quality report from about 40 hours a month to almost zero. Additionally, a better understanding of the situation at the site was gained from information on how the number of quality defects was related to time slots and the quality trends of individual workers. This information was not clearly understood when inspection records were managed on paper.

After these benefits were shared at quality meetings and on other occasions, the service spread to multiple production lines.

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*3. Only when acquisition of GPS data is permitted in the web browser settings on the device.

7. Contribution to "new normal" ways of working

The presence of COVID-19 was confirmed in Japan a year and several months ago. As we are all well aware, the spread of this infectious disease changed our lives in a major way.

Still, many people have no choice but to go to the office even though they would rather stay at home to prevent the spread of the disease.

Although site work must be done on location, work planning and instruction as well as verification and approval can often be done remotely. It is also important to find ways to avoid close contact with people.

This service is very effective for these purposes.

The use of a cloud service eliminates the need to go to the office for server maintenance, and web applications that do not even require installation allow the user to work anywhere with any device.

Digitizing handwritten records eliminates the face-to-face interactions that occur when exchanging or filing handwritten paper records and enables remote sharing of recorded results.

This service digitizes record-keeping at various sites, its applications are not limited to inspection record-keeping at manufacturing sites and equipment inspection record-keeping. For example, our department uses this service to track and check the percentage of work done by teleworking and to record the body temperature, destination, route, and other details of employees who go out for unavoidable reasons during the pandemic.

We hope to find even more company-internal applications of the service that are related to the new ways of working.

8. Future enhancements

Beyond the scope of the present service, which is dedicated to recording, Azbil is currently (at the time of writing) developing a plan management service for related tasks such as planning and giving instructions for recording tasks or approval of recording results.

This new service will facilitate planning, tracking progress, and approving work anywhere, in order to further progress toward paperless work that does not require affixing of seals.

Additionally, we plan to expand services for peripheral and related operations.

9. Conclusions

Looking back to the time when we planned this service, positive opinions about cloud services have increased partly because more companies have begun to use them.

The coronavirus pandemic suddenly accelerated the shift to new ways of working and DX. Against this background, attention to and expectations from our service for digitizing human work and paper records are increasing.

The work-site record-keeping service is a promising service which we will continue to rapidly but carefully improve by leveraging its cloud-specific features to satisfy customer needs.

References
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