Work-site DX with Connected Worker: Attracting attention around the world in the new COVID-19 era

Jun Kuchii
Chief Operating Officer/ Futurist
Fairy Devices Inc.

1. What is Connected Worker and how is it advancing work-site DX?

Even though the level of skill required and workload are increasing, most manufacturers and infrastructure industries continue to face the challenge of workforce shortages. On the other hand, automation using robotics is not progressing fast enough. Robots are skilled at handling fixed tasks, but they cannot work with the flexibility that people can. For some tasks, such as bulk materials handling that people can do easily, even as a part-time job, most attempts to implement them with robots have not been practical.

Robots are also expensive, so it is difficult for all but the largest companies, such as automobile manufacturers, to adopt them. Under these conditions, digital technologies that are able to reduce the workload for on-site workers and multiply the added value created by several times have begun to attract attention.

An example of such technology, which uses digital devices that on-site workers can wear to receive AI and IT support, improve their skills and implement DX, is a solution that we call "Connected Worker."

Connected Worker can improve the standard of on-site work to that of an experienced technician through use of various digital supports including: (1) remote support from an experienced technician, (2) automatic collection of data during work (automatic creation of reports, etc.), (3) collection of work-site data, generation of hazard alerts, (4) training and manual updates based on past work data, and (5) work support using data and AI.

Connected Worker is starting to be introduced to achieve complex goals such as "improving work productivity," "managing worker health and safety," and "preventing work errors and omissions," for on-site work that is intolerant of error, such as in high-tech materials facilities, chemical plants, oil refineries, and electrical power plants.

Figure 1: Value provided by Connected Worker

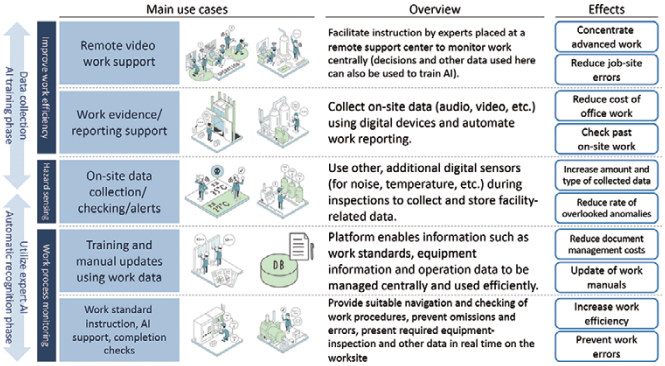
2. Work-site DX achievable with Connected Worker

Currently, particular benefits from implementing Connected Worker are: more efficient business travel, because the on-site worker can receive remote help working together with an experienced technician on technical tasks; and more efficient completion of non-core tasks during daily work, such as decision-making, creation of reports, and collection of evidence and other on-site data.

I expect many readers have had the difficult experience, as I have, of introducing DX or AI, such as information in real documents that are not converted to digital data, or huge amounts of data which require a tremendous workload to cleanse.

Introducing Connected Worker enables you to improve business travel and non-core work efficiencies, while also collecting data.

Figure 2: Connected Worker use cases and effects



Figures 3, 4 and 5 show use cases of DX in on-site operation of a factory, a construction site and for maintenance, respectively. We have found that it can also be effective in logistics, warehousing and transport domains. For example, by assigning a speech recognition digital device to long-distance truck drivers, they can interact with the fleet management system while driving, within the scope of what is permitted legally.

Figure 3: Connected Worker use case in a factory

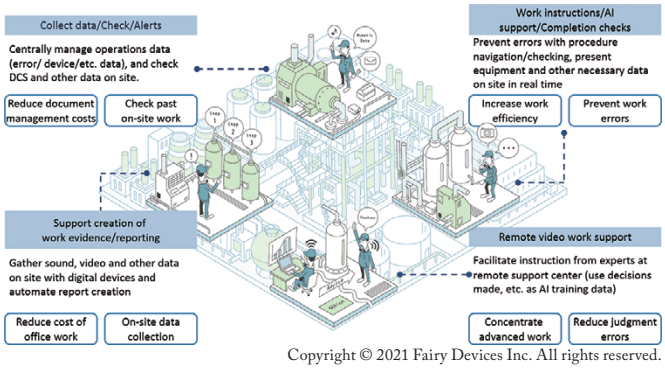


Figure 4: Connected Worker use case on a construction site

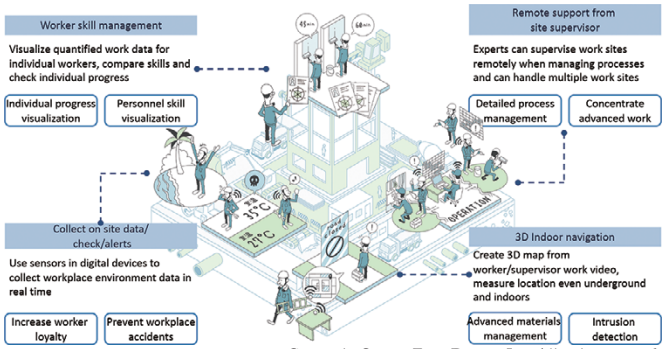
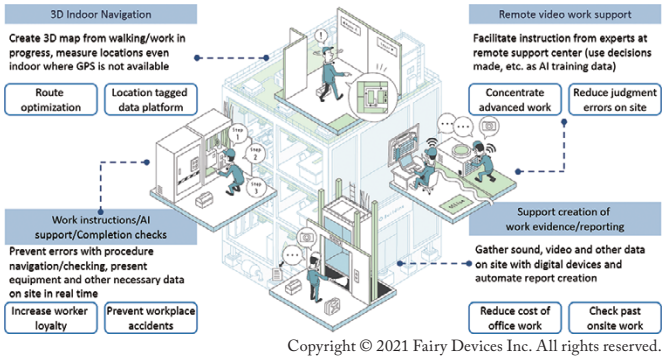


Figure 5: Connected Worker use case for maintenance



* Refer to the following for use case details.
https://fairydevices.jp/connectedworker

3. Why is Digital Transformation (DX) needed in the first place?

I admit that for most readers I am preaching to the choir, but in recent years, the declining population has resulted in labor shortages. In the 2020s in particular, more skilled technicians are retiring each year, and the shortage of personnel is expected to make it increasingly difficult to maintain operations in factories and other infrastructure. This is one of the major reasons why DX is needed in the workplace.

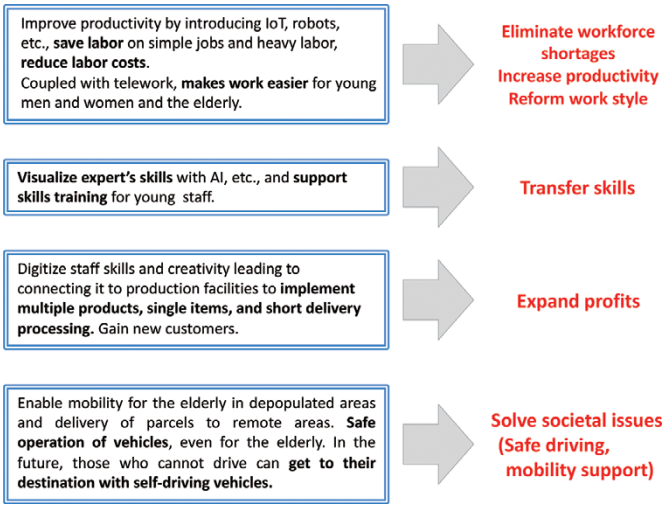
A shortage of workers is emerging in over 90% of enterprises in manufacturing industries and for more than 30%, this has already affected their business*1. In infrastructure industries requiring qualified technicians, such as electrical power, a shortage of electrical safety workforce numbering in the thousands is expected by around 2030*2.

On the other hand, factories and infrastructure are getting more complex and advanced, so it is expected that technologists working in the field will require even more advanced judgment and knowledge in the future than they do now.

In other words, to maintain its GDP and highly developed infrastructure, Japan will need to increase both the quality and the number of technologists in the workforce.

The government has advocated a "Connected Industries," approach to address this situation, promoting DX in all industries. IoT and Digitalization have been promoted for several years, and Connected Industries expands these ideas, using digital technologies to create better working environments, to pass on techniques, skills and knowledge, to increase productivity and even to try to solve societal issues*3.

Figure 6: Examples of the benefits of Connected Industries (*3 from P19 of the METI document)



*1 METI, "The shortage of personnel in manufacturing industries and the utilization of foreign personnel," (July 12, 2018).
https://www.meti.go.jp/press/2018/07/20180712005/20180712005-2.pdf
*2 METI, "Electrical Safety Personnel/Technology WG," (November 25, 2019).
https://www.meti.go.jp/shingikai/sankoshin/hoan_shohi/denryoku_anzen/hoan_jinzai/pdf/20191125_report.pdf (in Japanese)
*3 METI, "Kanto Bureau of Economy, Trade and Industry IoT and Robot Project and FY2019 Policies," (February 2019)
http://kantou.mof.go.jp/content/000226631.pdf (in Japanese)

4. Why is Connected Worker attracting attention for implementation of DX?

To implement DX requires building a "digital twin," optimizing in a digital virtual space, and then feeding it back into execution in real space.

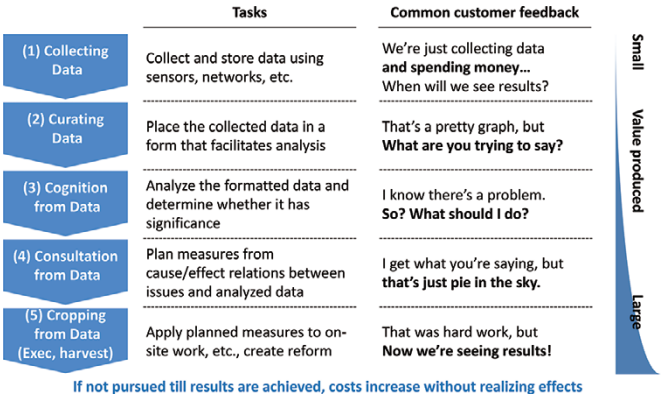
However, this path to implementation is not an easy one.

To achieve valuable DX with a digital twin requires a long process involving the following activities: (1) "Collecting" data, (2) "Curating" data into a shape that can be used, (3) "Cognition" analyzing data and deriving inferences, (4) "Consultation" to derive measures to optimize for efficiency from the obtained inferences, and (5) "Cropping," to finally implement the measures and reap the benefits of more efficient work.

To reach the final execution phase requires the worksite to bear the burden of collecting data, and costs for the enterprise continue. For ICT vendors like us, who are handling the effort, maintaining the system infrastructure is a 24-hour-a-day task, which amounts to rebuilding a society.

We have conducted earlier DX initiatives using IoT and other devices and found that there was not enough data created by human activity to achieve efficiencies through digitalization. Achieving such efficiencies requires DX of the whole business and without doing so, it will not be possible to reap much value for management. For this reason, we have now begun to focus on using Connected Worker in various places, to digitalize the people involved as well.

Figure 7: The 5 C's of DX implementation



5. Rapidly increasing demand for Connected Worker due to COVID-19

In the midst of the great confusion caused by COVID-19 around the world, Connected Worker has begun to attract global attention. A significant reason is that, due to COVID-19, it has become more difficult to send skilled technicians for operation or maintenance of advanced machinery that requires hands-on work.

In particular, companies in developed countries often operate special facilities or factories in developing countries overseas, and such operation requires many skilled technicians. Originally, skilled technicians would be dispatched from Japan to the location to provide technical support, but this has become difficult due to entry restrictions and measures to maintain safety. As such, methods to achieve DX while providing support in the developing country from the developed country have become necessary.

The demand for digitalization measures using the "1.(1) "Remote support from an experienced technician" with Connected Worker have increased due to COVID-19. This is the idea of enabling skilled technicians to telework.

Figure 8: Digitalization of devices and of people

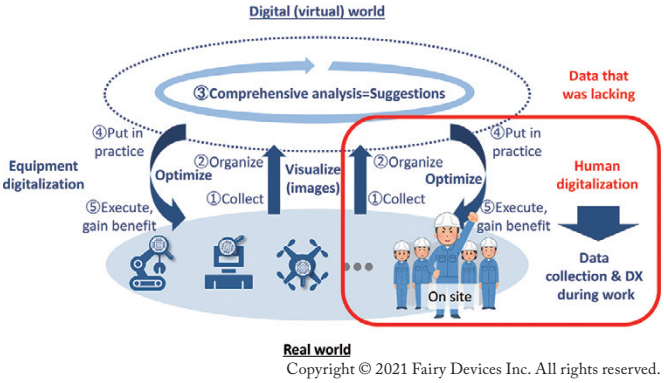
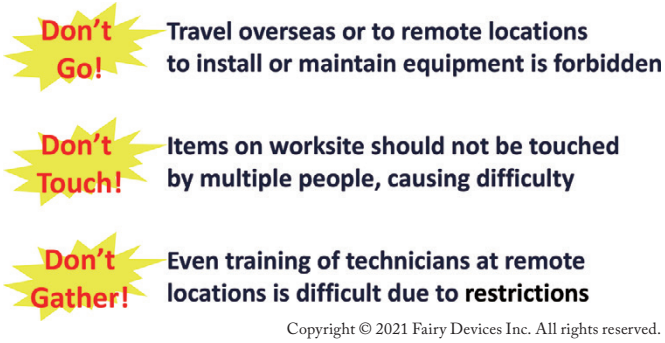


Figure 9: Three workplace issues caused by COVID-19



6. Our initiatives related to Connected Worker

At Fairy Devices, where I am COO, we had requests to implement speech recognition in a factory, which prompted us to focus on this type of issue in on-site work, and continue testing on work-sites.

However, most wearable devices are made based on consumer oriented use cases, for entertainment such as games and other indoor uses, so it has been very difficult to introduce them into real work sites.

In particular, we often encountered issues with head-mounted devices such as fatigue or physical strain due to the weight, or the screen not functioning as required outdoors.

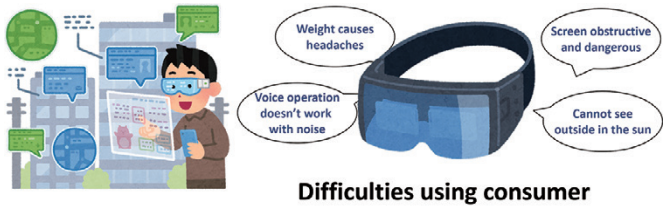
For these reasons, we decided to commit to developing our own hardware. The "THINKLET®" device that we developed is designed to be worn on the shoulders which is different from

prior Connected Worker devices that were in a glasses format. We selected this design because wearing a glasses-type digital device weighing several hundred grams on one's head can result in headaches and other physical strain, while even a small person can carry weight on their shoulders easily, even up to 5 kg. Humans feel less bodily strain when they carry objects on their pelvis or trunk through their shoulders.

We also designed the device with special attention to hands-free operation and a simple UX, comparable to operating a TV remote control.

As a result, we were able to realize a shape that enables digitalization of work without significant burden on on-site workers, either physically or from changes in work practices.

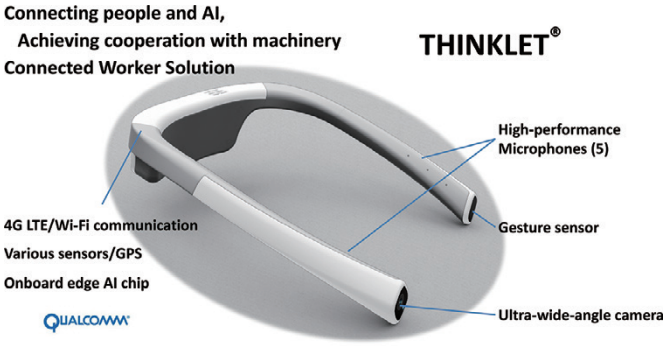
Figure 10: Issues with head-mounted devices for the C's



7. "THINKLET®" features that accelerate Connected Worker adoption

"THINKLET®" has four particular features.

Figure 11: Introducing the Fairy Devices Ltd. "THINKLET®"



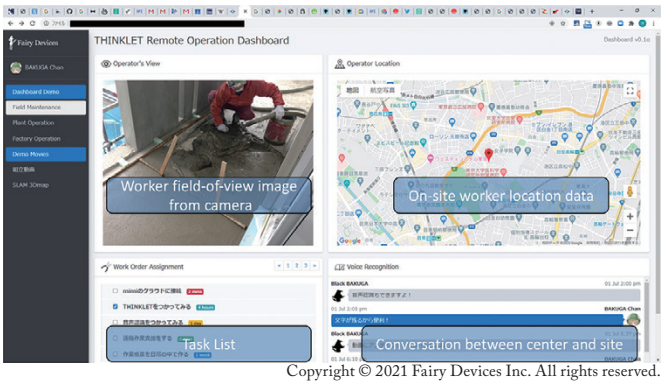
(1) THINKLET® is basically an ordinary Android smartphone inside, but it has no display and is in a form to be worn on the shoulders. Since it has no display, it is extremely lightweight and we were able to keep power consumption very low. As we mentioned earlier, since it is worn on the shoulders, the physical strain on the neck is greatly reduced compared with head-mounted and glasses-type devices.

(2) It uses high-performance microphones, so even in a factory it can be used with speech recognition and AI, or for creating work records.
In fact, devices such as transceivers and pagers have been in sites such as factories before. However, for most sites it has not been possible to use speech recognition because the sound quality was poor, and it was difficult to hear what was said, even for a human. THINKLET® uses several high-performance microphones, onboard edge-AI processing and beam forming. This enables speech to be heard clearly in the workplace. We have also implemented speech recognition for noisy environments, which was difficult in the past. This speech recognition works in environments with noise of 80 db and greater, so AI can be used in factory environments.
By enabling speech recognition with noise, work records that were previously only done after returning to the office can be created, and detailed evidence can be collected and delivered while still on site.

(3) Use of an ultra-wide-angle camera enables the experienced technician to provide remote support, as if they were on-site.
In the past, when the on-site worker needed help, experienced technicians used a two-way radio or similar device to provide support, but this had difficulties. If the on-site person said "The green lamp is flashing," for example, there could be more than one green light in many cases. The THINKLET® has an ultra-wide angle camera mounted on the front, which can capture the on-site worker's field of view and working area. With this camera, the remote expert can evaluate the situation, as if they were there, and give appropriate instructions.
The images captured by this camera also can be used for FairySLAM technology, which creates a 3D map from the video taken by the camera. This enables it to obtain location data even inside a facility where other location information such as GPS cannot be used.

(4) Speech recognition and gesture sensors enable it to be operated with both hands free.

Figure 12: THINKLET® Solution screen concept



In contrast with office work, on-site work often requires holding tools with both hands or wearing gloves for protection, making it difficult to operate a keyboard or touch panel with the finger tips. This is another reason it has been difficult to popularize digital devices for work sites.
THINKLET® has been designed to be operated while using both hands for work, and is equipped with speech recognition and gesture sensors. A worker can operate a drill with both hands and ask the AI to read out from a manual, take a picture or double check the work.

(5) Hardware configuration is customizable for the usage and requirements of the site.
The description above is of the basic configuration. THINKLET® has also been designed to be customizable for the desired use and requirements, with optional features such as converting to a stereo camera by substituting the gesture sensor for a second camera, or adding lights or MR goggles that are linked to the main unit (which we developed in-house). This allows it to support various on-site needs.

8. Implementing "Second Brain," for realizing workplace DX

As mentioned earlier, in the past DX proceeded based on data from on-site facilities and equipment. However, factories and other worksites do not operate with just machines, and generally there was a shortage of data regarding the non-regular work done by people.

THINKLET® is a wearable AI that stays close to the user on their shoulders, with accurate speech recognition and first-person-view video data recording through an ultra-wide-angle camera. Thus, it is able to collect "human Big Data" to an extent which is not possible with fixed microphones and cameras.

It can also use LTE and other high-speed communication, so beyond providing remote work support with video, it can be used to implement "on-site support solutions based on analyzed data," and "skills transfer by an AI expert technician for worker support."

We have defined four levels of DX that can be implemented for such solutions.

DX Level 1: BPR and data acquisition through work digitalization

The costs incurred are not only for collecting data, the digital devices can also be used for useful work support functions such as providing remote support with video, and automating creation of work reports using speech recognition, by which work can be digitalized to reduce the on-site workload.

Thus, while performing regular work as usual, work efficiencies are increased and at the same time non-routine data created by workers at the site will be collected automatically and naturally.

DX Level 2: Digital work support (using data)

Using the human-created non-routine data collected in DX Level 1, including detailed work evidence with the conditions and

Figure 13: THINKLET® customization options

We developed MR goggles that can be used outdoors in collaboration with Hitachi-LG Data Storage

judgments or tacit knowledge that has been revealed, processes that were difficult previously become possible, such as skills transfer, improved training, evidence-based status evaluation, and knowledge management.

Examples include proposing possible causes in a situation where the pressure in a pump is lower than normal, or deriving techniques that skilled workers do subconsciously by comparing videos of their work with that of average workers and then using them to update work manuals.

DX Level 3: Digital work operation reform (using AI)

To build excellent AI, it is essential to train it with an appropriate amount of fresh, precise and accurate training data, but generally it is difficult to obtain enough such data.

It has previously been difficult to gather work data from regular day-to-day work, surrounding conditions, judgments by skilled technicians, and so on, but if we could make this possible and use the data for training, it should be possible to build an AI suitable for that work.

The result would enable some of the work to be automated or optimized by the AI, such as checking completion of work or recommending responses to inquiries from on-site and personnel could concentrate on work that can only be done by a person.

DX Level 4: Digitalization and work integration (collaboration with AI and machinery)

This is the level that most players in the AI market aspire to in the future, and would create a world with people getting help from AIs through digital devices, like having your own personal fairy; like Tinkerbell in Peter Pan or Vivien in the Knights of the Round Table.

We recommend trying not to reach Level 4 or Level 3 in one leap, but to achieve DX in small areas with Level 1 or Level 2.

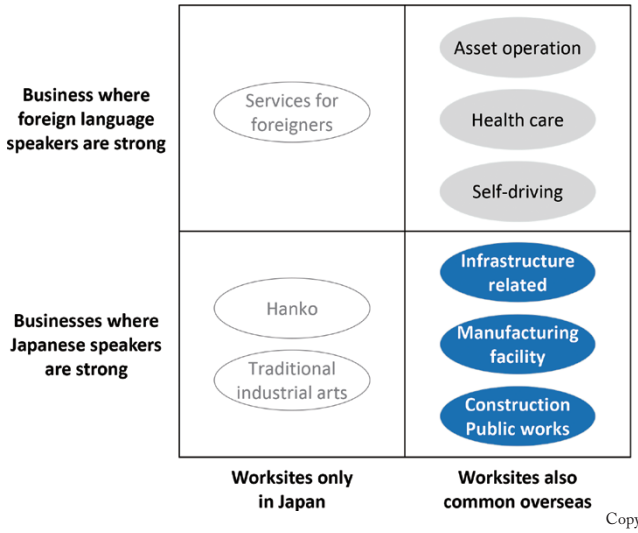
9. Creating a bright future for Japan with DX of workplace knowledge (OT)

Even with the remarkable progress in technology, it is still people who are making the decisions in the workplace.

Japan has many excellent people with much workplace knowledge and this is the basis for quality. I originally worked at an American enterprise, and we often had inquiries about exporting the advanced social infrastructure operations in Japan. There were some cases for which we realized the export to foreign countries, but the operational knowledge was usually confined to the Japanese language and not digitalized, so in most cases it could not be exported.

If an "expert technician AI" can be built using such worksite knowledge, it would clearly be useful for increasing added value for Japanese enterprises, facilitating efforts such as rapid setup of overseas factories and acquiring foreign currency by creating solutions from in-house technologies or maintenance practices. We believe, with such knowledge confined to Japan which is helpful for similar workplaces in foreign countries, that by pursuing DX in areas that are difficult to access by major foreign players, we can build a future in which even Japan, with its declining population, can make earnings in other countries. Fairy Devices is working continuously to develop technologies and realize workplace support AI for on-site workers

Figure 14: Areas that Japanese venture companies can target using AI



Domains where GAFA are strong

- ✓ Global players (majors/promising startups) have already entered
- ✓ Players compete using investment as their ammunition, so it is difficult to oppose global players who have liquid, large-scale capital

Domains where Japanese enterprises have a better chance

- ✓ Domains that cannot operate without people; value of Japanes z e quality maintained by effort on the floor.
- ✓ There is a language gap to access this business, so Japanese enterprises have an advantage over global enterprises in accessing these markets