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Resolving Labour Shortage? The Digital Transformation of Working Practices in the Japanese Service Sector

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1. Introduction

Many advanced democracies, including Japan, face a shift toward an ageing society and a labour shortage. The Japanese Ministry of Labour, Health and Welfare (MHLW) reports in its Labour Economy Survey that on average roughly 55 % of firms in the hospitality industry (hotels, restaurants and cafes) face a labour shortage of part-time workers in 2018 (MHLW 2018:7).

Many restaurants in Japan were already forced to end 24-hour opening due to labour shortages (Harding 2017). It has progressed automation in restaurants. For instance, an increasing number of restaurants and cafes started introducing automation and robotisation, increasing labour productivity, improving advertisement, requiring a smaller number of workers and reducing labour costs. Some restaurants integrated registered customers' smartphones and send advertising messages to their smartphones when they are near to restaurants. This can contribute to the reduction of advertisement costs and effectively increase customers. IBM Japan invented a system named "Chef Watson", which creates a large number of menus for restaurants with just a little input of some food ingredients (Nakata 2014). A large fast-food chain *Yoshinoya* introduced a system in which an automatic conveyor washer does the dishes, and an arm robot puts the bowls up on the shelves, resulting in the increase of labour productivity by 1.3 times (JARA 2017: 75). A restaurant in the theme park, Huis Ten Bosch, also introduced robots to serve customers at the tables, cook Japanese pancakes, and make cocktails. These examples of automation and robotisation appear to have the potential to improve the working environment and labour productivity.

While there are a number of technologies which can contribute to resolving the problem of a labour shortage in the hospitality industry and which can potentially present a partial solution to the problem of a labour shortage, we may also see the negative aspects of those technologies. Some challenges in introducing technologies have started being identified. For instance, some sushi restaurants started adding self-tracking devices to monitor workers. These tracking devices may increase the surveillance on workers and may intensify working practices. Some studies identified these negative consequences of surveillance in other advanced economies (Lupton 2016, Moore 2018). The former CEO of McDonald's announced that the increase in wages would enhance robotisation and automation, and franchise food industries have already started furthering automation (Asano and Gohara-Galileo 2016). This kind of automation can

create downward pressure on wages in Japan as well, where unions and workers have frequently voiced the increase of minimum wage to 1,000 yen.

We are also witnessing an increasing number of news headlines, including robots stealing our jobs, ‘robots: enemy or foe?’. The big question remains whether Japan’s demographic challenge, an increasing rate of the ageing population and a resultant acute labour shortage, can be mitigated by the emergence of robots and automation. This project explores the degree to which the so-called ‘digital economy’ including automation and robotisation can resolve problems associated with the shortage of labour in the Japanese service sector (food and transportation/logistics). Japan is particularly well-suited for such a study due to its combination of being one of the advanced industrial democracies that has experienced the ageing population and the labour shortage issue most acutely, and also due to it having an advantage in terms of the relatively advanced development of its digital economy. The service sector is particularly relevant in this context, as it tends to be labour-intensive. In 2012, over 75 % of the Japanese workforce was employed in the service sector (Cabinet Office 2014a:1), generating nearly 70 % of the country’s GDP (Cabinet Office 2014a:1). The previous year the GDP of the service sector recently surpassed the GDP of the manufacturing industry (Mitsubishi UFJ Research and Consulting 2017: 5).

The main aim of the project is to demonstrate what technologies have been adopted in the Japanese hospitality industry and examine how the progress of the digital economy in the service sector has changed working practices and the working environment. It further seeks to identify whether the advancement of the digital economy will propose a solution to the challenge of labour shortage, or whether it will create new problems and concerns, including employment relations.

2. Background

The government views the integration of robotisation and automation into the service sectors as crucial under the declining population and an acute shortage of labour. The headquarters for Japan’s economic revitalization issued a ‘New Robot Strategy: Vision, Strategy, Action Plan’ in 2015. In this strategy, the government highlights the importance of Japan’s potential for becoming a robotics superpower in the world. The robotisation in the service sectors is considered necessary since it holds roughly 75 % of Japan’s employees. The service sectors tend to have relatively lower labour productivity in comparison to the US. The labour

productivity in the service sector in Japan is only 60% of the productivity in the US (The Headquarters for Japan's Economic Revitalisation 2015:58). In particular, the labour productivity in the Japanese restaurant and hotel industries is 34 % of the labour productivity of the US counterparts (*Kinki Kezai Sangyo Kyoku* 2017:6). The government problematises this low productivity in the service sectors, which withhold the majority of employees in Japan, and the service sectors are increasingly facing a labour shortage. The level of automation in the service sectors is low as they still heavily rely on workforce. The manufacturing sectors in Japan increased labour productivity once they adopted automation. The Japanese government has become eager to develop automation in the service sector to improve labour productivity in the same way as the manufacturing sectors increased labour productivity.

Despite the fact that there is an increasing necessity to automate the service sectors, the service sectors have rarely used robots and have not developed automation, therefore, there is a lack of expertise in making the use of robots as well as manufacturers who find the needs for robots in these sectors (The Headquarters for Japan's economic Revitalisation, 2015:58). The government claims that in order to enhance the use of robots, the service sectors require players who can mediate robot/automation users and manufacturers and match the demand for and supply of robots (2015:58). The priority in the service sectors is placed on the automation in the kitchen and storage room of restaurant and hotel businesses including operations such as washing plates and cleaning so that human can focus on the customer services or high value-added services (The Headquarters for Japan's Economic Revitalisation, 2015:59, 61).

3. Automation in the hospitality industry in Japan

This section introduces the various tasks and processes that introduce new technologies in the hospitality industry in Japan. Table 3.1 demonstrates a list of tasks automated in the Japanese hotel and the food service industry by interviewing practitioners and desk research.

Table 3.1 The elements of digitisation in the food service sector

Areas of automation and digitisation in the food service sector	Advertising/Promotion
	Booking
	Bringing customer to the table
	Ordering
	Cooking
	Serving food
	Kitchen and storage room
	Payment
	Training
	Inventory management
	Accounting
	Monitoring
	Job interview

(Source: Author's own compilation)

3.1. Advertising/promotion

A part of the important tasks for the hospitality industry is probably advertisement and promotion of their restaurants and hotels. The Internet of Things (IoT) and automation are potentially useful tools for advertising tasks. There has been a collaboration between the department store and the train company that owns the train station in Yokohama for the promotion of restaurants and cafes in their joint building. The device is called ‘Signage’, which is a digital vacancy notification board that shows the vacancies of each restaurant in real-time. Signage uses the IoT and AI to gather real-time information of the availability of each shop. Uekubo, a sales planning manager at the department store Takashimaya, explained that the introduction of this device is to revitalise the area of Yokohama Station. This is a new initiative jointly implemented with the manufacturer of the device and Takashimaya. Uekubo points out the challenge in terms of introducing this device is whether this new initiative will function or not, how to improve the accuracy of the provision of real-time vacancies, and how to make the system suitable for the building where they installed it (Answered through an email by Uekubo, Takashimaya, 6 July 2018).

The main benefit of this new system has been the improvement in notifying customers where the vacant restaurants/cafes are, which contributed to the higher satisfaction level among customers who do not waste their time by waiting for a long time for their tables. Customers found the on-the-spot digital panel very informative and convenient. Waiters and waitresses also benefit from knowing more accurate information on how long customers have to wait until they get served to a table.

The hospitality industry also requires not only the on-the-spot device but also a systematic and automated notification system for the promotion of the restaurants and cafes. There is a new automation system for business promotion and advertisement provided by NEC Platforms. The continuous email promotion, birthday special invitations, and discount vouchers have been automatically sent to registered customers to encourage them to visit the restaurants again. For instance, NEC Platforms provides the system that enables restaurant owners to send further invitations to previous customers so that they will visit again (NEC Platforms 2019).

3.2. Booking

The systematic booking system may benefit the hospitality industry by improving the efficiency of business. The new simple device called *Toreta* can digitize booking and customer files, aggregate data and analyse customer data (*Toreta* 2019). This device enables restaurant owners to reduce the hours spent on managing bookings, sorting customer files, and helps to avoid mistakes possibly made in the process of booking and revising booking. In particular, it simplified the process of booking and maintaining the booking system. Customers can check the level of availability of the restaurants easily on the screen and reserve online 24/7 with their PC or smartphone. The device is easy to use for anyone. The owner of one of the restaurants that adopted this device said that it took about two months until all staff got used to the new digital booking system.

By connecting the booking system that files customer information with Point of Sale (POS), this enables restaurant owners to analyse the profits as well as customer preferences in depth. This has increased the profits and improved customer-focused services. Further, restaurants can reduce the time spent in sorting out bookings, reducing human labour by 15%. By improving the booking system, customers whom restaurants would have lost due to the ambiguous availability estimates, the efficiency of the allocation of empty seats to customers improved, leading to an increase in profit of 30% (*Toreta* 2019). This device has been used by a small restaurant with 33 seats, a medium one with 100 seats, a large one with 300 seats, and with large bar-restaurants with 80 chain restaurants. Over 12,000 restaurants have introduced this device and system.

NEC Platforms (2019) provides a similar service as *Toreta* in terms of automating bookings by providing a platform that receives bookings 24/7, confirms bookings, and avoids mistakes over bookings. NEC platforms enables customers to book a table 24/7 and smartphone bookings incur zero cost on bookings.

Small hotel owners also introduced a coherent and comprehensive booking homepage, which combined all booking systems, enabled easier management of hotel bookings and increased the time for customers and more frequent updates of the homepage. This new booking system also enabled more variety of hotel plans (Earthroof 2017).

3.3. Bringing customer to a table

The emotional robot ‘Pepper’ welcomes customers in *Hamazushi*. 498 restaurants of the chain restaurant *Hamazushi* introduced emotional robot Pepper in December 2017, which performs the registration of the number of customers and their preferred seating (counter or tables), and gives the table number to the customers. The tablet Pepper holds has three languages (Japanese, English and Chinese). This was introduced so that the floor staff can focus on other jobs including face-to-face service at the table (SoftBank 2018).



An emotional robot, Pepper, at the Hamazushi restaurant (Source: Softbank 2018)

Kurazushi corporation, the chain sushi restaurant, uses AI for inputting the number of customers, age, the time of their seating at the reception area before a floor staff takes customers to a table. The input of those data on the number of customers, what time they sat at tables, approximate age range of customers, and aggregated data from these inputs provides the estimate of the types of sushi required on the conveyor belt for the first 20 minutes, the next 20 minutes, and the last 20 minutes (Interview with Tsuji, 8 June 2018). This reduced the food waste from over 10% to 3%.

NEC Platforms service (2019) can integrate a robot to smoothen the process of entertaining customers by using a face recognition system for customers who registered themselves. This system stores information of individual customers, their taste preferences, where they prefer to sit, enabling the provision of customised services.

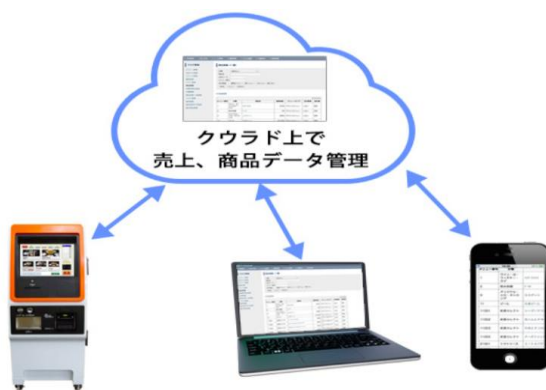
3.4. Ordering

The ticket vending machine, VALTEC, is invented and used in order to directly address the problem of labor shortage. With this system, restaurants and food retail shops can reduce the number of staff who take orders as well as handle payments. This system allows foreign customers to order easily since it has English and Chinese language options.



The vending machine, VALTEC, the touch panel screen of English page (Source: Valtec 2019)

By using this vending machine, data on customers and sales of food are all digitized and managed on the cloud platform. This enables the reduction of labour, labour costs, and time spent on the operation of a cash register since staff do not need to handle ordering nor receiving payments with cash. This also reduces mistakes in counting change and can eliminate mistakes in terms of closing cash register. This also enables the restaurant owners to use accumulated data to improve services.



Managing data on products, profits and customers (Source: Valtec 2019)

Tablet-based self-ordering has become very common, not only among sushi chain restaurants, but also among other types of restaurants, including the restaurant Ootoya (Aoyagi, 2017), the pub/restaurant *Torikizoku* (Nabeko 2018), Hilman Restaurant Japan (Kinki Keizai Sangyo Kyoku 2017), and the chain pub-restaurants of *Uotami*.

Some of the *Izakaya* (pub-restaurant) started integrating a more advanced ordering tablet with *FoodFrontia*, which takes orders on the tablets which display pictures of each piece of food and ingredients of each menu with allergy information in 5 languages. This tablet can take more specific orders of drinks such as with ice, with hot water, and with tonic water (NEC Platforms 2019) or can take orders of meats with specific levels of doneness (medium, rare, etc.).



The advanced touch panel that allows customers to input their preferred strength and temperature of drinks (Source: Valtec 2019)

FoodFrontia can notify customers at the table about the last order. It can also demonstrate how to eat specific Japanese food for foreign tourists.



Visually guiding how to eat Japanese food (Source: Addd-link 2017)

There are many system providers for the restaurants/café industry. Some tablets have a multi-language function, which makes it easier for staff to welcome foreign tourists rather than training staff to speak English (Add-link 2017). BBQ restaurant group Heijyoen, pub-restaurant chain *Uotami*, sushi chain restaurant *Hamazushi* introduced these advanced tablets.

There is a new system for automated ordering and payment by using your smartphone. *Putmenu*, a software downloadable on smartphones, allows each customer to order food at the table in the restaurant by using an app on your smartphone and finish payment with your smartphone (Compass Online 2017). Once you put down your phone on the table, ordering is complete. You can even order food before you arrive at the restaurants (Koizumi 2017, OrangeTablet 2017).

3.5. Cooking

Cooking is a special skill for chef, there is therefore a limited level of automation introduced in the process of cooking. For instance, *RoboChef* is invented to contribute to the cooking of fried rice and noodle to reduce the burden of frying with a heavy frying pan.



RoboChef for fried rice cooking (Source: ITmedia NEWS 2017)

Many sushi chain restaurants introduced sushi rice making robots and sushi-making robots to compensate for a shortage of staff and cope with the ageing staff in the dining room. They have also introduced robotisation so that foreign workers can also work in the kitchen (Interview with Maruyama, 15 January 2019).



Sushi rice robots at Komazsushi (Source: own)

On the other hand, *Huis Ten Bosch* introduced a number of cooking robots including Japanese pancake robots, doughnut making robots, and cocktail robots in a series of *Henna Restaurants*. Hayasaka, the manager of business development of Huis Ten Bosch, commented that Huis Ten Bosch introduced robotisation to make this Holland-themed amusement park as a hybrid of future technologies and history. The introduction of new technologies is also a promotion of their business rather than merely handling the problem of a labour shortage.

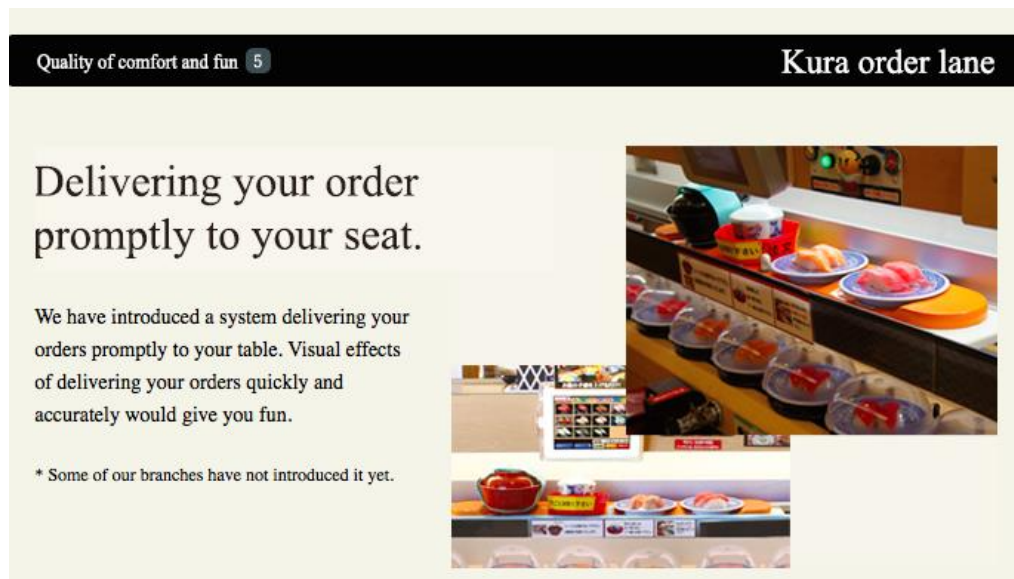


Cooking robot at Huis Ten Bosch (Source: Huis Ten Bosch 2019)

3.6. Serving food

Robotisation in the food service has been developing in some restaurants in Japan. Sushi restaurants have been most proactive in terms of integrating automation for serving food. Kura Corporation has been one of the largest sushi chain restaurants in Japan, which aggressively implemented automation. The conveyor belt and on-demand speedy conveyor belt are

integrated in the majority of its restaurants. By reducing time spend on serving food, the conveyor belt automated the entire process of serving sushi and other plates of food.



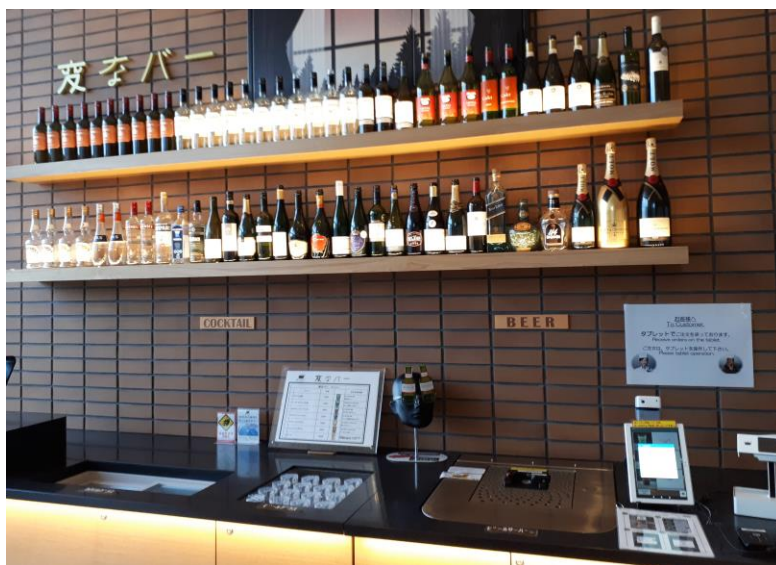
Fully automated sushi serving in Kurazushi (Kura Co. Ltd. 2019)

Ganko Food and *QCafe* in Tokyo Hibiya Midtown have introduced the food serving robot. This robot can carry heavy dishes and reduce the burden of floor staff. Ooura at *Ganko Food* mentions that this robot has decreased the time spent on serving food by staff, but increased the time spent on customers, therefore, improved the level of hospitality which this restaurant views it as the most important in the restaurant business (Interview with Ooura at *Ganko Food*: 15 August 2018).



Serving robot introduced at *QCafe* (Source: Business+IT 2019)

In the Henna Hotel, there is a fully automated bar near the hotel reception, where no human serves customers. Customers pay at the automated cashier, pick up a plastic cup, set it up on the digitised tray, and press the button of chosen drink, and drink is served automatically into the cup on the tray. You hardly see any staff working in the hotel's reception area, although there are some staff working behind the hotel reception. Similarly, in Shibuya, travel agency H.I.S. has introduced a robot café, where a robot makes your drink. From time to time, staff comes to fill up the milk and coffee that robots make drinks from and check the inventory. Again, we see hardly anyone in the café. It is a fully automated café and we order, pay and take drink by using a machine and pressing buttons.



Henna Bar: Human-less and fully automated bar (Source: own)



Human-less café: Henna Café in Shibuya (Source: own)

3.7. Kitchen and storage room

Automation behind the dining room includes robotisation and automation of cooking, dish washing, plate picking, and sorting. *Yoshinoya* introduced automated dishwashing at *Yoshinoya* (JARA 2017:75).



Robot Coro picking dishes (Source: JARA 2017)



Robot Coro sorting plates depending on types of plates (Source: JARA 2017)

By introducing automated washing and robotisation of sorting plates, *Yoshinoya* improved labour productivity by 1.3 times, intending to improve it by 4.6 times with an integrated upgraded version of robots. It not only improved productivity, but also improved working conditions for staff who had to do simple but heavy tasks.

Another important type of work is to maintain the right temperature and record the temperature in the room, fridge, freezer, etc., which is regulated by the government's health authority. 99% of restaurants and cafes in Japan have recorded the temperatures inside the fridge manually and recording these temperatures every day is a cumbersome task for all restaurants' owners (Interview with Hibiki, 18 August 2018). *Hibiki Ltd.*, chain's yakitori restaurants have therefore integrated the sensor systems with IoT for automating the maintenance of temperatures of fridges, cooling devices, and the dining room, and recording temperatures, which used to be done by staff manually. This system allows staff to handle any detected abnormality. With this sensor system, *Hibiki* increased labour productivity by 10%. *Hibiki* mentions that 'we do not manually record temperatures anymore, do not need to check with staff or with each other whether we have been recording temperatures or not, and managed to abolish filing all records of temperature (since we have digitised the records) (Interview with Hibiki, 18 August 2018).

The large sushi chain restaurants, *Kura Co. Ltd.* installed the plate collection system at each customer table. This automates the collection of plates from the 'Plate Slot' which is set at each table. This system also realized calculating the number of digitised plates customer have taken at each table and enabled smooth check out process (*Kura Co. Ltd.* 2019).



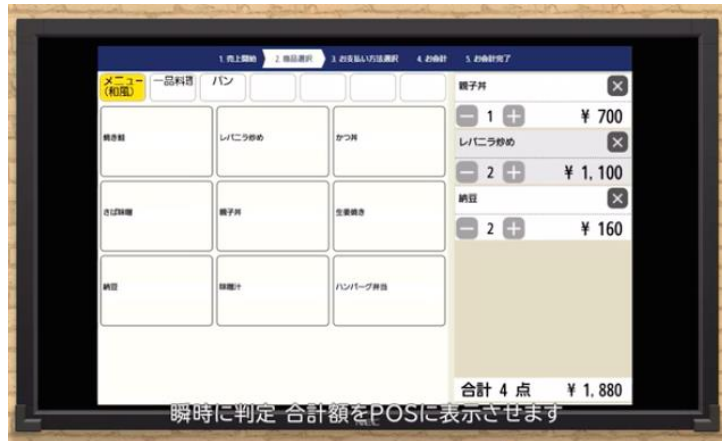
Plate Slot at Kura sushi restaurants (Kura Co. Ltd. 2019)

3.8. Payment

NEC Platforms has introduced various ways of automated payment systems. When you order food with the tablet on the table, the small machine provides a slip with electric code. When you pay, you just need to go to the POS machine and pay by yourself with cash or card. This does not require restaurants staff to come to handle payment. Another system is face recognition and automated payment. If a customer chooses to pay by registering him/herself, NEC Platforms has a system for canteen-style restaurants and cafes, where customers place their own choice of foods on the tray and pay at the cashier. Instead of the cashier with human, the dish on the tray are digitally recognised and customers can see on the screen how much they need to pay (NEC Platforms 2019). Again, this does not require staff, but further, digital screen can be translated into foreign languages, allowing foreign customers to use the system easily.



Chosen dish on the tray digitally recognised (Source: NEC Platforms 2019)



Price of chosen foods are shown on the screen (Source: NEC Platforms 2019)

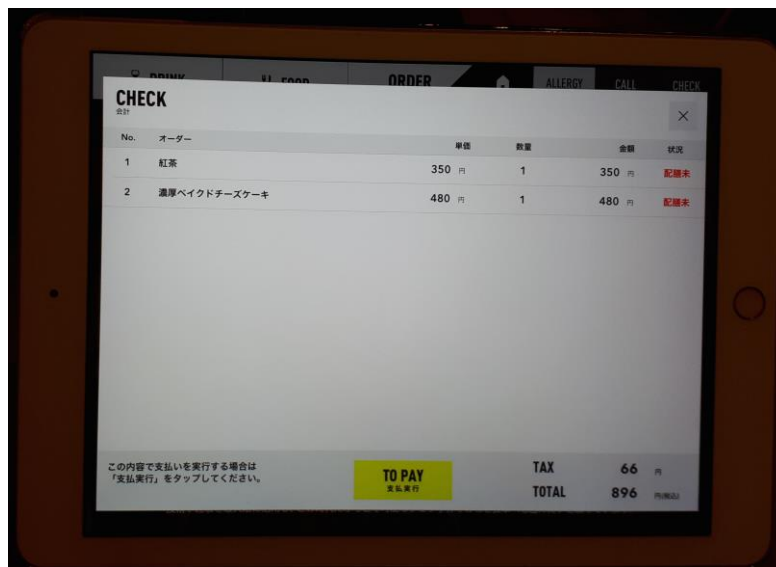
The scan system for a bakery also enable customers to finish payment for their purchase (OrangeTablet 2016). Once you put your breads, cakes, etc. on the tray and locate it at the automatic cashier counter, the system automatically calculates the total price of your purchases, and the cashier only needs to take money from customers (*Kinki Keizai Sangyou Kyoku* 2016:17).



The digital tray scanning the products in one of the bakeries in Tokyo (Source: OrangeTablet 2016)

Gathering Table Pantry in Tokyo first introduced cashless payment as the only payment method in order to reduce workload of staff. This is an unusual measure in Japan since it is well known that Japanese people have preferred cash over credit card and other cashless payment measures. No cash acceptance is a new attempt made by Royal Group, which owns

this café, and the group has been proactive in terms of introducing new technologies in their food service facilities.



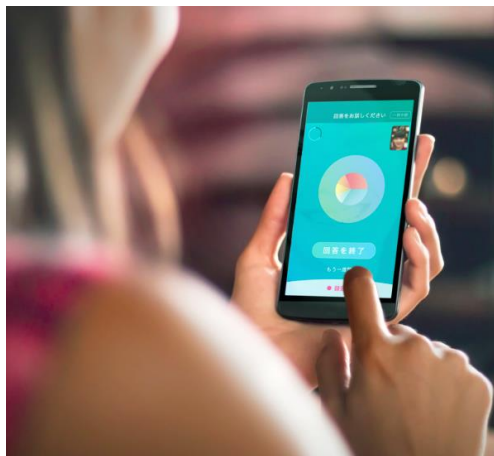
Touch panel ordering and cashless payment at Gathering Table Pantry (Source: own)

3.9. Training

Yoshinoya, a beef bowl chain restaurant, introduced a communication platform ClipLine, (Omise Lab 2017). This platform provides video clips that includes instructions to new staff and information on *Yoshinoya*'s dishes. *Yoshinoya* used to use paper-based training including manuals, new menus, cleaning procedures of the restaurants, and how to serve customers. As running a restaurant is full-on busy work, it is difficult to obtain enough time to train new staff. New staff found it hard to read through a thick manual book and difficult to find key points from such a book. The ClipLine digitised a training system into a simple video, enabling a paperless and efficient training system. *Yoshinoya* chain restaurants, which run 24 hours, already integrated foreign workers and this new training system has made the entire training system more efficient and effective. *Yoshinoya* is proactive in terms of replacing manual work with technologies as much as possible, whereas it focuses on manual cooking and human-to-human services with customers. 'Improved customer services and high quality cooking are the key for *Yoshinoya*'s success' (Uzawa, General Manager of Planning Division, in *Omise Lab* 2017, author's translation).

3.10. Job interviews

Yoshinoya has just started trialling AI-based job interviews for contract workers (Ledg.ai 2019). This AI interview system is called ‘SHaiN’ and *Yoshinoya* decided to use this system so that it will reduce time wasted by sudden cancellations, avoid conducting interviews with whom *Yoshinoya* is not planning to employ, and obtain suitable people for contract workers. SHaiN saves managers time for arrange interviews, which used to take time. Instead, SHaiN allows candidates to take AI interviews 24/7 (SHaiN 2019). By providing this 24/7 interview opportunity, *Yoshinoya* has better opportunities to secure potential candidates more competitively than other similar restaurants. By introducing this system, *Yoshinoya* reduced the time between the submission of applications and the first day of work, speeding up the entire process of hiring short-term contract workers. Another key reasons for this system to be introduced is the fact that food service sectors are seeking short-term contract workers due to the labour shortage problem in Japan (Nihon Keizai Shinbun, 15 November 2018). Candidates have to use their smartphone and answer set questions audibly. This AI-based interview system creates a report and managers considers whether candidates can be hired or not. This system reduced the burden of restaurant managers by making it easy to schedule interviews. AI-based interviews are supposed to eliminate any bias and subjective views toward candidates (SHaiN 2019). SHaiN *Yoshinoya* started this system at 74 restaurants in Kanagawa and will see how it goes.



AI-led job interview (Source: SHaiN 2019)

AI-based interviews have a mixed result. It is still early stage for *Yoshinoya* to evaluate the outcome of this system, but other cases show that AI system still has a bias. (Artificial Unintelligence).

3.11. Inventory management

Due to a labour shortage, the restaurant and hotel managers started adopting Smart Mat, ‘a versatile and powerful automatic inventory machine that you can put any product on and place it anywhere’ (Smart Shopping 2019a). The Smart Mat has Wi-Fi connection, uses low energy with 4 AAA batteries that can last for one year. The A3-sized Smart Mat can hold up to 100 kg and the A4-sized mat can carry 30 kg. You can place them under the stock. Smart Mat can visualise inventory, send an alert of replenishment, and order automatically (email, fax, web).



Smart Mat (Source: Smart Shopping 2019c)

Smart Mat can be used to measure the amount of stock of each product, ingredients, and other miscellaneous by holding them on top of mat in restaurants and hotels. It can even be used to manage a garbage bin with increasing rather than diminishing contents. Users can check stocks with tablets, PCs, and smartphones and can set to send email reports every day. Users can set the stock monitoring frequency with Smart Mat depending on products they want to measure. The measuring frequency can be four times a day to every minute. Restaurants and hotels use Smart mat in the fridge, on the shelves in inventory shed, or in the kitchen, washing-up area, warehouse, storage room, *Hibiya Daishokudo* introduced this smart mat for the inventory control and ordering of ingredients and dishes (Smart Shopping 2019b).



Smart mat in use to check the inventory (Source: Smart Shopping 2019d)

One of the effects of Smart Mat creates are that staff can focus on customer services since they do not need to check and order inventory. Smart Mat can manage and monitor fresh food and reduce the rate of food waste. This device also reduced the number of mistakes made by human workers, avoided miscalculation of stocks, efficiently enabled reordering products on time, thereby making inventory management easier (Smart Shopping 2019a). As restaurant industries tend to use low-waged and low-skilled workers, the Smart Mat can reduce the burden of heavy work in restaurants and contribute to the work-style reform the government promotes. Smart Mat simplified inventory-management related tasks, reducing overtime work for staff.



Smart mat for managing the amount of buffet (Source: Smart Shopping 2019b)

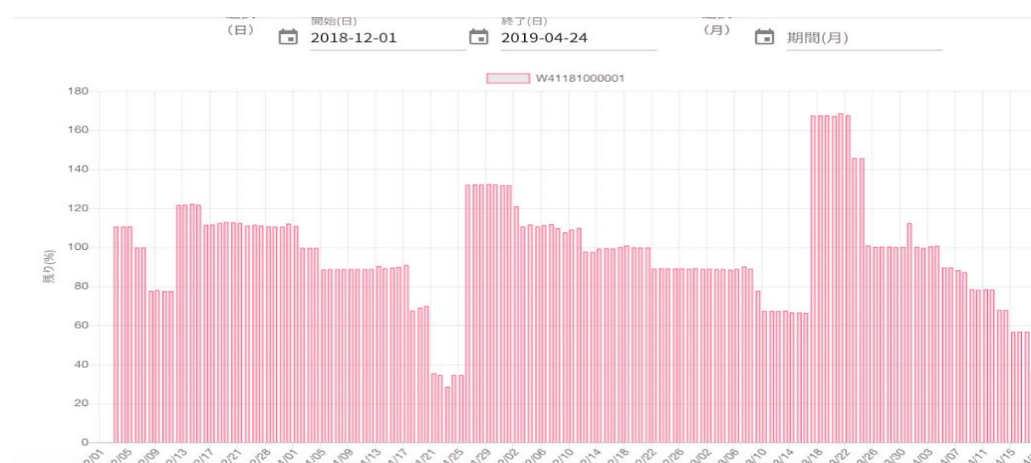
Chain hotels used Smart Mat to measure the amount of buffet food to improve the customer services. Before this was introduced, hotel managers faced frequent problems of running out of popular foods. Considering buffet style food normally have lids on top of each container, it is cumbersome for staff to check a number of containers and monitor how much food left in each container. Smart Mat, which measures the food amount in each container every few minutes, enabled staff to focus on customer service whilst smoothening communication between dining staff and kitchen staff.

Smart Mat is not only for food but also for other inventories in hotels. including bottles of shampoo, conditioner and body soap that are placed in each customer bathroom. Cleaners do not need to check the leftover liquid amount anymore, but Smart Mat will notify when staff needs to refill products. The Smart Mat system reduced workload for cleaners and improved the efficiency of cleaning. Not only liquid but also towels, toothbrushes, leaflets and other amenities in hotels can be measures and monitored by Smart Mat, simplifying inventory management.



Smart mat used to measure bottles, drink packages, and packages of paper in the hotel (Source: Smart Shopping 2019e).

Data can be accumulated on a day-to-day basis and used as a monthly or yearly record of how much of each product was consumed or purchased. These data can be analysed for further improvement of business (Smart Shopping 2019c).



Smart Mat data of daily sales figures for analysis (Source: Smart Shopping 2019c)

3.12. Accounting

A fish-based dish restaurant introduced an IT tool to improve its accounting system, which is designed for small business. This new tool reduced the workload for staff by smoothly organising daily workload for employees, and enabled to cope with a recent labour shortage (IT-Hojo 2019).

The cashless payment system is introduced by Royal Group Co. Ltd. in one of its cafés, Gathering Table Pantry in Tokyo. The reason for this introduction is to smoothen the accounting at the end of each business day. Finishing off the day's business at a restaurant involves checking the total sales, which takes time and is a cumbersome task at the end of the day. Without taking any cash for the payment, this system has simplified the task of every day

accounting. Staff working in Gathering Table Pantry mentioned that this system has made it floor staff job's much simpler.



Tablet-ordering and cashless payment at Gathering Table Pantry (Source: IT-Hojo 2019)

3.13. Monitoring

Some restaurants and hotels started introducing wearable devices to improve efficiency of staff and avoid staff slacking. *Hill Hotel Sanpia* introduced a 'vein authentication system' to simplify the management of staff who work in a various employment status including staff work at the reception desk, restaurants, staff work without shift, and part-time workers. Managing these various employees with various status and calculating their wages has been complicated. The time recording system, which was used to check working time of each staff, involved mistakes, affecting wages. Sometimes staff recorded other staff's time card to claim for false working time. The vein authentication device enabled to eliminate false claims by staff (Mie Prefectural Government 2017:38). This system made it possible for the hotel owners to manage staff more easily.



The vein authentication system introduced at *Hill Hotel Sanpia* (Source: Mie Prefectural Government 2017)

A pub-restaurant introduced this vein authentication system to manage shift of staff. The vein authentication device recognises staff individually accurately, and avoids others using the ID card/password inappropriately. This restaurant used to use time-cards for over 200 staff members and excel sheets to calculate wages. By introducing this vein authentication system and linking this system to sales analysis, order systems, and profit-and-loss management, the restaurant increased sales by 35 % and reduced labour of accounting management from 3 personnel to 2.



(全国にて居酒屋事業を展開)



(静脈認証による勤怠管理)

A pub-restaurant introduced vein authentication system (Source: *Kinki Keizai Sangyou Kyoku* 2017)

Another example of staff monitoring is the sensor device attached to the floor staff's belt (Kinki Keizai Sangyou Kyoku 2017). According to the report by *Ganko Food*, this monitoring device enabled the owner of the restaurant to understand how the layout of the restaurant was preventing staff from serving customers. This led to the change of the structure of the restaurant and improved the efficiency of staff's customer service. Furthermore, this system reduced the wasted time, improved the customer service, increased the time spent on customers, and increased the profitability.

3.14 Automation in the hotel companies

The majority of technologies introduced above are relevant to the hotel business. There are some unique technologies introduced in the hotel industry. It is not unusual for hotels to have integrated the automatic check-in/check-out machine. Shinjuku Washington Hotel in Tokyo has many check-in/check-out machines in its spacious reception. This machine can accept cash as well as card for the payment at the check-out time.



Check-in/check-out machine at Shinjuku Washington Hotel (Source: own)

Huis Ten Bosch group, Henna Hotel has integrated 100% human-less reception. A humanoid robot, two dinosaur robots talk to customers in front of the check-in/check-out counters.

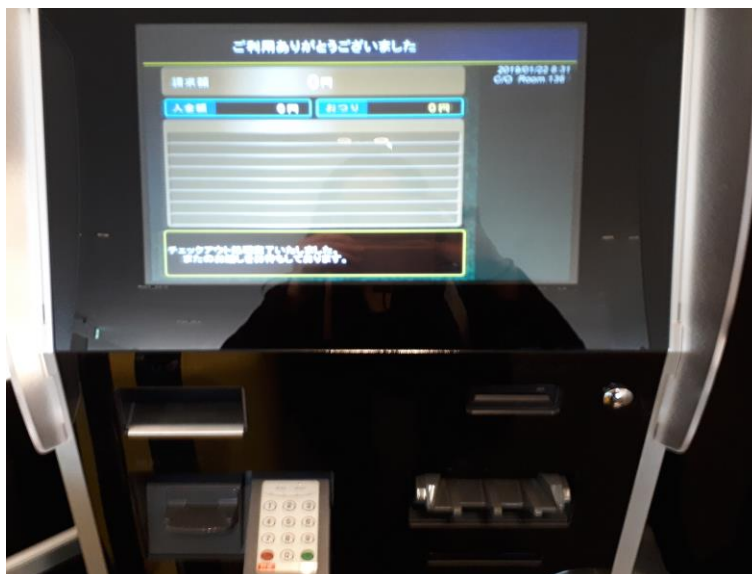
The manager of Huis Ten Bosch business development, Hayasaka has mentioned that

Technically, we do not need robots in front of check-in counters. We introduced robots to soften the shock of customers who use automated check-in counters for the first time. It is too shocking for customers to check-in without seeing any staff. This is why we introduced robots in front of the desks (Interview with Hayasaka at Huis Ten Bosch, 21 January 2019).



Robots at the check-in counter: Reception at Henna Hotel (Source: own)

Moreover, one of the check-in desks has a transparent check-in/check-out screen. Huis Ten Bosch is an amusement park, so robots, new technologies and even dinosaur robots can be acceptable and customers enjoy this as a part of the entertainment in Huis Ten Bosch (Interview with Hayasaka at Huis Ten Bosch, 21 January 2019).



A transparent check-in screen at Henna Hotel (Source:own)

4. Why introduced? From employers' perspectives

4.1 labour shortage

Many interviewed in this study responded that they have a serious labour shortage in their workplace and this was the precise reason to introduce automation and digitization. According

to sushi restaurant owners, it has become extremely hard to employ sushi chef as well as floor staff. The difficulty to find part-time workers leads to heavy workload for daytime staff and they leave. *Recruit*, a job advertising company in Japan, posts job vacancies, which cost over 8,000 euros per week. Yet, this costly job vacancy advertising does not attract enough people to work for restaurants (interview with Tajiri, December 19, 2018). Because of this difficulty in finding enough staff on the dining floor as well as in the kitchen, many large-scale sushi chain restaurants introduced digitisation and robotisation.

The general manager of business development office at Huis Ten Bosch Co. Ltd., Masahiko Hayasaka, who also started the project of Henna Hotel in Huis Ren Bosch, comments that he considered

the automation as the most important strategy in the rural economy to survive in the era of a labour shortage. The rural economy was facing a more severe labour shortage than in the big cities. In order to maintain the large-scale businesses, such as Huis Ten Bosch in Nagasaki, which is a remote rural area from the central economic part of Japan, automation became the necessary measure and strategy (Interview with Hayasaka, 21 January 2019, author's translation).

Similarly, Ooura, at *Ganko Food*, which introduced the monitoring sensor on staff's belt as well as a serving robot, explains the background why his company has introduced these technologies in the workplace:

The food service industry has been characterised by its low labour productivity due to its particular nature of work which requires specific skills, cooking techniques, and face-to-face high quality customer services. Furthermore, due to a declining number of workforce and ageing workforce, on top of the fact that the food industry has not been a popular industry among workers, we decided to do something to improve labour productivity and replace some work which do not require humans with robots and digitisation (Interview with Ooura at Ganko Food, 15 August, 2018).

Both cases clearly show that the food industry is facing acute labour shortage. This is not the story which will happen shortly, but it is happening now. This acute labour shortage led some managers to implement technologies to replace humans.

4.2 For the simplification of work for workers

The hospitality industry introduces automation to simplify tasks for workers, reduce heavy workloads including carrying heavy plates, putting away heavy dishes, and carrying heavy baskets of prewashed dishes. Restaurants install robots and automation in the dining room and the kitchen. For instance, *Ganko Food* introduced the serving robot in the dining space so that staff do not need to carry heavy dishes since it works well when staff serve customers on the big table (Interview with Ooura, 15 August 2018). *Yoshinoya*'s plate-sorting arm robot and washing-supporting arm robot in the kitchen reduce the burden on staff. One of the interviewees reveals that he has introduced the automation to simplify the ordering mechanism for the elderly workers in particular, even though he is not fully in support of automation in the dining room. Kourai comments that

there has been a limit for the elderly workers in terms of taking orders. Some elderly workers found it hard to remember all orders they take from customers. In a sushi restaurant, there are so many different menus. ... when it is really busy, workers who are not capable of taking many orders tend to accumulate too many orders to handle This leads to frustrated customers calling for waiters. ... If workers are around 70 years old, sometimes they do not hear customers' call. By introducing the touch panel tablet on each table, we resolved this problem. (Interview with Kourai at *Komazushi*, 28 December 2018)

Kourai also said the sushi restaurant service industry does not seem to attract young workers, this requires them to adapt themselves to the aging workforce in the workplace.

The simplified process in the hospitality industry also implies the simplification of the training system for newly hired employees and foreign workers. The new technologies introduced above, including the automated ordering system, the easier accounting system enabled by cashless payment, the automated control and recording of facilities' temperatures, all contribute to the simplification of cumbersome tasks for workers.

4.3 Automation for the efficiency

Many owners in the hospitality industry introduced automation to improve efficiency. Considering the fact that the food industry tends to be associated with low labour productivity

in Japan, it is understandable to consider the improvement of efficiency. Tajiri, Cross Dream Co. told us that automation in the sushi restaurants is mainly introduced for efficiency. To achieve this, robotisation has become the key measure. *Kaitenzushi* industry (Conveyor-belt sushi restaurant chain industry) has sought for efficiency by introducing a touch panel for automated ordering, an express lane for ordered food, AI to reduce food waste on the conveyor belt and IC chip for counting the plates and calculating the bill (Interview with Tajiri 2018, 19 December 2018). The most efficient sushi conveyor belt does not circulate sushi, but circulate a plate of sushi which has been ordered. This is to reduce food waste drastically.

An Italian restaurant chain, *Saizeriya*, implemented a test run of AI-based customer estimates with a Japanese Telecom Company, NTT. This AI system integrates data on the population around their targeted restaurant, which is estimated by NTT's smartphone network, weather, events around their restaurant, and sales updates of their restaurant. Based on this data, it calculates and estimates the number of visitors to the concerned restaurant in the next few hours. This estimate is further integrated to create staff shifts for the next day or the next few weeks. Tablets that receive the estimate on customer also send a warning if the estimate was not correct so that staff can prepare beforehand to reduce the possible loss of opportunity and reduce waiting time for customers who visit their restaurant (Saizeriya and Docomo 2018).

Toba Coffee has introduced a device called '*Noodoe*', which digitally connects customers' requests to the serving staff through the cuboid-shaped devices and wearable devices. The floor staff inputs the number of customers and their table number in the wearable device and start serving customers. Anonymous interviewee at Toba Coffee explains the benefit of this device:

When we are busy in peak time, it is hard to notice signboard's notice of the table number, where customers are calling for us, but this (wearable device) gives us the direct sign on our wrist, we can now go directly to customer's table within 10 and 20 seconds. ... We increased the profitability of this café by twice over the last few years without increasing the number of staff, so it is the efficiency (Interview with anonymous interviewee at Toba Coffee, March 2019).



Noodoe: the cuboid-shaped request device and wearable devices for staff at Toba Coffee
(Source: own)

Noodoe also shows the time (length) of customers' stay at each table, this helps staff to guess the potential tables that will become available, and let waiting customers know the approximate waiting time more clearly (Interview with Toba Coffee March 2019).

The automated check-in system and human-less bar at the Henna Hotel in Huis Ten Bosch, was not only introduced to cope with the labour shortage but also to improve the efficiency of the hotel business.



Hennna Hotel reception with a humanoid robot and dinosaur robots (Source: own)

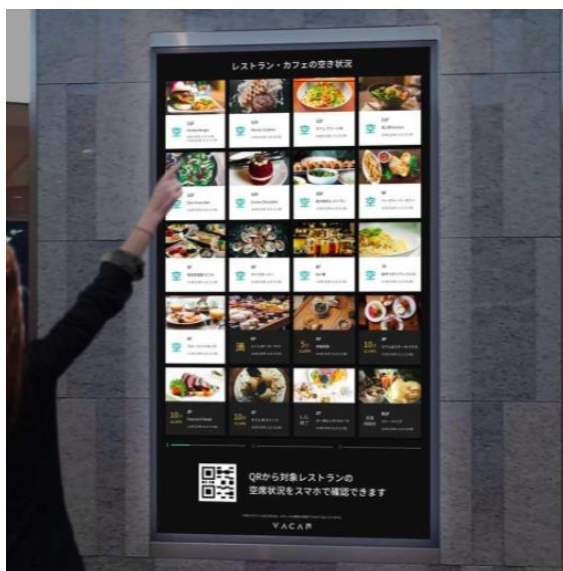
The tablet-based ordering system is also introduced for enhancing efficiency by reducing mistakes made by waiters/waitressed or resolving potential conflict and tension between the

floor staff who take orders and customers who order food. Some work is potentially better done by digitisation than human.

The cases introduced above, namely AI-based estimates of customer number, wearable devices that show customers' demand more efficiently and speedily, the human-less hotel, bar and café show the instances in which digitisation may outperform human work and improve efficiency and labour productivity significantly, which is increasingly required in the era of the labour shortage in Japan.

4.4 Improvement of the quality of the customer service

Some hospitality businesses introduce automation to improve the quality of customer service. According to Toba Coffee, which launched the digital device 'Noodoe' for allowing a quicker response to customers, customers have appreciated this new device, and the popularity of the café has also increased (Interview with Toba Coffee, March 2019). Digital signage in the shopping mall in Yokohama has been introduced to improve the customer service by highlighting the vacant restaurants and enabling the floor staff to estimate the waiting time for customers.



Digital signage shows the availability of each restaurant (VACAN 2019)

When it comes to IoT, the survey conducted by *Kinki Keizai Sangyou Kyoku* demonstrates 17.4% of companies which reside in the Kansai region have already introduced it, and 40 % of them would like to adopt IoT but not have done so (*Kinki Keizai Sangyo Kyoku* 2017, p.14, 18). According to this survey, roughly about 25 % of companies hope to increase sales and

customer satisfaction by introducing IoT, and 19.1 % expects the integration of IoT can improve the customer service (*Kinki Keizai Sangyo Kyoku* 2017: 14). By introducing IoT, the key goals of companies in the foodservice industry are to maintain the regular customers (13.9%), attract new customers (13.9%), and visualise the goals (13%), and supply (12.2%). This survey shows that the majority of restaurants that adopted technologies explained that they introduced them to improve customer services and their satisfaction.

5. Challenge and limitation in automation

Some may argue that the development of digital technologies has reached a new stage in which we are witnessing ‘entirely new qualities of application that are not structurally comparable to those of previous decades’ (Hirsch-Kreinsen 2016:2). Automation introduced in the hospitality industry in Japan demonstrates a new level of technologies that improved the efficiency of the hospitality business and customer services, reduced the time spent on taking orders and closing accounts of the day. It reduced the workload of staff by simplifying the tasks, making the system more efficient, replacing human labour with robotisation, digitisation and AI. New technologies have enabled owners to increase the productivity of their employees. Nevertheless, whether the introduction of new technologies can solve a labour shortage and improve working conditions or not need to be further examined by taking into consideration their limitations and challenges in more detail.

This section seeks to analyse challenges to and limitations of new technologies, including automation, IoT and robotisation generate in the hospitality industry in Japan. This paper claims that it is not straightforward and simple to introduce new technologies even though they have, as we saw above, contributed to, and will have significant potentials to contribute to the solution of a labour shortage in Japan. Newly introduced technologies can pose a new challenge to the hospitality industry. There is a strong possibility that automation does not necessarily improve customer service and working conditions of employees.

5.1 Slow and uneven process

As Moody (2018) rightly points out, the introduction of robotisation and automation is highly uneven and also slow (Moody 2018:8-9), and this applies to the hospitality industry in Japan. Even though many restaurants and hotels have started integrating various technologies in their workplace, they tend to be large corporations that have many chain stores and can invest

relatively large amounts of capital into automation. Many small- or medium-sized business found it hard to invest in such technologies.

Technology does not spread rapidly and evenly since not all firms can afford to adopt new and expensive technologies. For instance, in the food service industries, the major sushi chain restaurants introduced automation such as touch panel ordering system almost ten years ago. In comparison, the medium-sized sushi chain restaurants started introducing over the last three years or so (Interview with Maruyama at *Gattenzushi*, 15 January 2019), let alone other restaurants and cafes, the majority of which have not introduced any digital ordering system. Brynjolfsson et al. (2017) point out that it takes time to see a sufficient level of an aggregate effect of new technology (Brynjolfsson et al. 2017:10). This tendency further delays the investment and implementation of technologies by other followers. As Brynjolfsson et al. claim, even though the benefit of new technology was evident at the outset unless business owners can see the discernible effects brought about by newly introduced technologies, it takes time for those business owners to initiate investing in technologies.

It is also the case that not all business owners in the hospitality industry recognised the necessity of new technologies. According to the survey on Internet of Things (IoT) conducted by the local authority of Ministry of Economy, Trade and Industry, 17.4% of companies in the Kansai region answered that they have already introduced it, whereas 30% of companies have not found any necessity to introduce IoT (*Kinki Keizai Sangyo Kyoku* 2017, p.14, 18, 41). The food service industry, in general, tends to have lower IT literacy, as well as tends to be the case for many small businesses. These factors make it challenging to integrate IoT, and hence, we see slow progress in terms of the integration of new technologies. Moreover, many companies in the foodservice industry have not realized the potential benefits of IoT, leading to a low rate of IoT integration. Besides, many companies tend to prioritise the increase in sales and have not paid enough attention to the potential growth of productivity that can be enabled by IoT. Some businesses are keen on introducing the new technology but are not sure how to start. Furthermore, small companies in local areas lack information on what is available and how to introduce digitisation and automation (*Kinki Keizai Sangyou Kyoku* 2017:41, 44).

The sushi chain industry that has many restaurants in broad areas can invest a large amount of capital into robotisation of sushi making and food serving. For instance, large sushi chain restaurants have installed a rice robot which costs nearly 1,800,000 yen (15,000 euros), a

dishwasher robot of 2 million yen (16,500 euros), a sushi lane of which costs over 10 million yen (82,000 euros), and a sushi rice-shaping robot which costs 2 million yen (16,500 euros) (Interview with Tajiri, 19 December 2018).

Companies will not introduce new technologies unless they can expect an increase in profitability and sufficient profits. Big businesses in sushi restaurant chains could invest a large amount of capital in automation since they can expect cost-effectiveness in their large dining room with many tables. They have a particular style of dining floor, which is built to accommodate a specific arrangement of tables and conveyor belts (Interview with Tajiri, 19 December 2018). *Gattenzushi*'s CEO Maruyama comments as follows.

We introduced a tablet-ordering system since we were 100% sure that it will reduce the time spent on ordering and increase productivity. Otherwise, our medium-sized sushi chain restaurants cannot afford to invest in automation. We have to be sure that automation can reduce costs (Interview, 15 January 2019).

The majority of interviewees have invested in automation on their own without any public funding because there is no public funding for automation. Sushi chain restaurants appeared to be most advanced in terms of automation in the hospitality industry, but this was possible because of the cost-effectiveness stemming from the size and scale of their restaurants. Automation has proved to be very costly and has been integrated unevenly and slowly.

5.2 De-skilling workers?

Technological development is sometimes associated with the polarization of jobs and skills while demanding highly-qualified workers. This polarisation is due to the development of automation for the medium-skill level jobs over the last two decades, and it is expected that we will continue to see this trend to progress in future. What we will see in future is the polarization of jobs, in which we see on the one hand the highly professional demanding jobs (management, consulting, financial services) and on the other hand simple low-wage jobs including monitoring and simple manipulation which are but in high demand (Hirsch-Kreinsen 2016:6-7). Some call this division of employment as “Lousy and Lovely Jobs” (Goo and Manning 2007, cited in Hirsch-Kreinsen 2016:7). The trend of employment in the hospitality industry, based on interviews and observation of the Japanese service industry, appears to be a potential creation and increase in the number of low-skilled jobs.

Similarly, some point out the potentially widening gap between skilled and unskilled workers. In Frey and Osborne's pivotal study (2013) on the impact of automation upon the US labour market, they report that 47% of employees in the US will be replaced or threatened by automation over the next two to three decades. With a similar tone, Nomura and Oxford Martin School's study estimates that the share of Japan's workforce at risk is 49% (Nomura 2016; Mitsuhashi 2016:16). Some knowledge-based high skilled workers may benefit from the process of automation and digitisation, whereas others may suffer from this same process. Due to a lack of skill sets that are required in the digitized workplace, as Brynjolfsson and McAfee rightly point out, we might see the widening gap between the new demand of technologies and the slow pace of adaptability to the newly digitizing socio-economic context and 'implicated opportunities for employees and institutions' (2014, p. 177, cited in Hirsch-Kreinsen 2016:4). They highlight the potential situation of people being unable to catch up with the pace of new technologies.

This trend may be apparent from one of the chef's comments made. For instance, one of the sushi chefs raised his concerns about de-skilling of traditional sushi-making (Interview with Kourai at *Komazushi*, 28 December 2018). Deskilling is sometimes associated with 'Digital Taylorism', in which the digital technologies and automation simplified and optimized the principles of work and work control for complicated tasks (Economist 2015, cited in Hirsch-Kreinsen 2016:7). Moody claims that Taylorism, lean production methods over the last three decades and the reduction of break time and a resultant simple work intensification made industrial production jobs basic and low (2018:11). Digital Taylorism, which we may be witnessing in the digital era, potentially creates another layer of low-skilled and low-paid workers.

5.3 Robots or foreign workers?

When we consider the de-skilling of workers and low-skilled and low-paid work, it is crucial to take into consideration the foreign workers in the hospitality industry in Japan. In the case of restaurants/café industries, automation such as the introduction of digitalised food ordering enabled a greater variety of workers to be employable, including foreign workers (Interview with Maruyama at *Gattenzushi*, 15 January 2019). The increased opportunity for employers to hire foreign workers may mean that automation does not replace workers dramatically since employers may employ foreign workers rather than new technologies. In this case, robotisation

or digitisation is not the factor that replaces human labour, but rather enables a greater variety of workers to be employed. This trend may be further accelerated due to the new immigration policy that allows more foreign workers to stay in Japan for longer term. The food service industry is expected to make most of this new policy since it benefits from employing more foreign workers. For instance, some managers in sushi restaurants that advanced various automation and digitisation clearly mentioned that

this newly revised immigration policy allows us to employ more foreign workers. With the advancement of digitisation and ICT, foreign workers who are not fluent in Japanese can learn how to make sushi graphically on the computer and also digitisation enables the translation easier. This new policy enables us to employ a broader range of workers including foreigners (Interview with Maruyama, 15 January 2019).

The food service industry tends to provide low-paid jobs and there are many small-scale companies. These small-scale companies in the foodservice sector find it difficult to adopt expensive new technologies. If there is an ample supply of cheap labour, the Japanese food service industry tends to resort to low-paid foreign workers rather than invest in costly new technologies. This integration of low-paid foreign workers may create a tension between employers and employees in the food service industry in Japan. This will further contribute to uneven and slow progress in terms of automation and robotisation. Technological determinism, the view adopted by techno-futurists, may remain questionable and uncertain in Japan.

5.4 Robot-inclusive facility/environment and automation accommodating human capacity?

The introduction of new technologies requires a material challenge in its implementation in the workplace in the hospitality industry. Tan, Mohan and Watanabe develop a theoretical framework for robot-inclusive environments including level of autonomy of a mobile robot and robot-inclusiveness of the environment (Tan et al. 2016, cited in Ivanov and Webster 2017:4). Robot-inclusiveness includes how much the design of the environment takes into account the robot, whether the design of the premises provide clean, tidy space for robots, ‘signage, lighting, noise, physical barriers, presence of people and dynamic of the environment, presence/lack of predetermined routes for robot movements, presence/lack of landmarks and sensors to help robot navigation’, etc. are robot-friendly or not can ‘determine the degree to which the environment assists the robot fulfil its tasks’ (Tan et al. 2016, cited in Ivanov and Webster 2017:5).

According to Ivanov and Webster, ‘out of the robot-friendliness of some facilities may emerge a new competitive advantage and unique selling proposition of hospitality companies’ (Ivanov and Webster 2017:3). For instance, whether hotels or restaurants have physical accessibility to accommodate robots including a wide space for machine/robots to dock, wide corridors, suitable floor surface that do not prevent robot cleaners need to be seriously taken into consideration (Ivanov and Webster 2017:5). Repair and insurance policies for the maintenance of robots/machine/technologies also need to be considered as well for the long term business. The hospitality industry, such as hotels, introduced various tools of automation in the past, including ATM machines in the hotel and the cashing of foreign currencies, which used to require people to do for guests. Robots, however, require different treatment and maintenance as well as embody different types of risks (Ivanov and Webster 2017), which also need to be anticipated by business owners before introducing technologies. Hospitality facilities need to design and provide robot-inclusive or robot-friendly environment to enable robots to work efficiently. This may require a change in terms of design of facilities including corridors, kitchens, and dining areas. ‘Humans generally work around what they must to get a task done while more thinking will likely have to be put into the design of the materials and shapes of those things that humans reasonably demand to be spotlessly clean for hygiene purposes’ (Ivanov and Webster 2017:8-9). This implies the complicated process associated with robotisation and automation. As we saw in the case of Japanese sushi restaurants, restaurants that have large amounts of space could integrate automated conveyor belts or had to design specific dinning floor to accommodate robots and automation. Whether this can be done by other small-scale restaurants or not depends on each case.

Training and re-training of employees to accommodate robotics and automation is another factor to be considered (Webster and Ivanov 2019). Many hospitality companies will be required to adapt themselves to the change technologies bring about as well as to ‘be relevant and consistent with the needs of a society that has an increasingly automated productive base’ (Webster and Ivanov 2019:12). The hospitality business needs to be flexibly adjustable to the new demands and change stemming from the integration of robotics and automation.

5.5 Continuous maintenance and upgrading

Machines requires maintenance. This requirement will continue for as long as you have machine. Broussard, in her book titled *Artificial Unintelligence*, points out the continuous

requirement of upgrading and maintenance of technologies, which are sometimes not worth installing. We need to be aware that people misjudge how suitable a computer is, otherwise social problems may occur (Broussard 2018:64, 87). For instance, Roomba-like cleaner robots may cause more damage to restaurants' dining floors. This kind of thing is not intelligence. She further points out that it may be difficult to see algorithmic impacts since tech projects take long time (Broussard 2018: 65,92). She even claims that 'blind optimism about technology and an abundant lack of caution about how new technologies will be used are the hallmarks of technochauvinism', based on her observation of how tech creators ended up with a reckless disregard for public safety (Broussard 2018: 69).

Hibiki, CEO at grilled chicken chain restaurant *Hibiki*, predicts that many tasks in restaurants' industry will be replaced or supported by automation and digitisation, whereas he also raises his awareness over the limitation of automation. For instance, he explains that

the digitisation faces its limits when there is no Wi-Fi. The disruption of Wi-Fi is nothing unusual in his many chain restaurants, the software company from which *Hibiki* installed the devices does not respond to the problem of the devices if its problem is related to the Wi-Fi system, while the telecommunication company from which *Hibiki* has an internet contract says that there is no problem in Wi-Fi. This makes a frustrating situation, where nobody helps out. Even though the software company agrees to come to check, then they cannot come in the restaurant's opening hours since they have 9 to 5 office work. This small thing can cause stress for staff since they have to come early to handle the new problem due to the digitisation. ... When we have a test run of a new device, we have to combine the old system and the new system at the same time, which is cumbersome. This makes staff want to go back to the old manual system. Things do not go smoothly accordingly to the plan or theory (Interview with Hibiki, 18 August 2018).

The maintenance of the digitisation can cause a new problem in the workplace, which also leads to stress for staff. *Hibiki* further stresses the difficulty of communication with software companies. *Hibiki* has been running a test period of new devices with three different software companies, finding it difficult to negotiate with them. A large software company tends to ask *Hibiki* to introduce a new fridge deliberately for the instalment of temperature measuring devices. Software companies that see the opportunities to sell their devices seek to make more

money from selling extras (Interview with Hibiki, 18 August 2018). The owners of restaurants appear to be required to know and make a clear judgement on what is necessary and what is not.

Not only the instalment of the new digital devices and automation, but also the maintenance is a large part of digitisation. Maruyama, CEO at *Gattenzushi*, remarked on the continuous upgrading and abolishment of technologies. In *Gattenzushi*, they once integrated the IC (integrated circuit) chip on the plate and used the machine to count the plate and calculate bill. This system became obsolete once the touch panel ordering system was introduced.

We do not keep using the same technologies. If one technology becomes obsolete, we just abolish it or upgrade to a new version. It is not like once you introduced, you can use it forever (Interview with Maruyama, 15 January 2019).

In a similar tone, Hayasaka at Huis Ten Bosh also commented on the necessity of upgrading. He said that

Henna Hotel introduced the robots at the hotel reception 5 years ago, they do become old and they started looking out of fashion. We are thinking of changing to something new (Interview with Hayasaka, 21 January 2019).

Similar to this, another interesting example here is the case of emotional robot, Pepper, introduced in *Hamazushi*. *NikkeiTeECH* survey revealed that only 15% of companies that introduced Pepper would like to continue to use Pepper at their store after three-year-contract. The newness of Pepper may be dying gradually. Robots such as Pepper cost more than apps, which can have similar function as navigating customers with much lower costs (Tanaka 2018). We are still not sure what will happen to Pepper yet, but it is the question of the long-term maintenance and upgrading that needs to be taken into consideration with the integration of automation.

Once you introduce the technology, it is required to maintain it, upgrade it, and decide whether this technology is necessary or will become obsolete. Technology is exciting when it is new, but this new technology will become old technology eventually. The maintenance cost can be expensive. Whether it is worth or not depends on managers' judgement.

5.6 Dilemma between human service and automation

Some employers and union members are sceptical about the capacity of technologies in the service industry. Some professional chefs find it a dilemma between the necessity for automation and the mediocre-level of food. There is a divide between people who value human-based service and who are more proactive in terms of introducing technologies. Some report that there is no point of automation in the food service industry when we are supposed to provide ‘human service’, automation is the opposite of something we aim (union interview claim). Automation deteriorates customer services.

Moreover, Kourai mentions that his sushi restaurants introduced the touch panel tablet for ordering foods, but he said he did not want to introduce it at all. The reason for this is that it is inevitable to create a distance between the waiters/chefs and customers. Unless you make efforts to talk to customers, the technology of the tablet ordering creates an absolute distance from customers. Sometimes there are no professional sushi chefs in the sushi restaurants since automation, including sushi rice makers and touch panel ordering, simplifies the sushi making process and taking orders (authors’ translation). Kourai further comments on the difference between human-made sushi rice and robot-made sushi rice:

Human-made sushi rice tastes much better than robot-made sushi. This is because human hand temperature can have an impact upon the texture of sushi rice. Even though the capacity of robots can also imitate human-hand temperature, it is still human’s sushi that tastes better. ... But we still have to use robots since there is no alternative (Interview with Kourai at Komazushi, 28 December 2018).

Some hospitality companies’ owners report that if customers do not like touch panel-ordering, they will go to the different restaurants to have more human-based customer services. That is inevitable (Interview with Maruyama at *Gattenzushi*, 15 January 2019). Similarly, Huis Ten Bosh-based *Hennna Hotel*’s manager also views that

some customers may leave due to an absence of human customer service in the hotel. He said that it is inevitable to lose some customers due to the automation and robotisation. But in the hotel/restaurant service industries located in rural areas, a labour

shortage is a serious issue for long-term. Automation is a ‘must’ (Interview with Hayasaka at Huis Ten Bosch, 21 January 2019).

Henna hotel in Huis Ten Bosch fully automated its hotel customer service. Staff is hardly visible. It has a fully automated check in service in front of a humanoid robot or dinosaur robots, fully automated convenience store in the hotel lounge area with face recognition and automated cashier mechanism, fully automated bar, and fully automated check-out system. Whether this level of automation will become a common scene in the hotel industry in the future may pose a question to us. It may give the impression of a detached and cold service, and a sense of isolation, emotionless; literally ‘robotic’. Human-less hotel may be not everyone’s cup of tea. One of the union’s officials in the food service industry also pointed out that

the lack of human customer service defeats the purpose of dining out. People come to restaurants for the better and specific services than home. If we automate the customer services, what is the point for people to visit restaurants? (In the answer to one of the questionnaires by Ringer Hut Group Union)

Based on the interviews in the hospitality industry, respondents on the introduction of automation appear to be divided into three types: one who is proactive in terms of introducing automation, one who is passively introducing since there is no alternative, and the one who is not keen on introducing automation in the customer services since they think customer services should be provided by human workers. This division in opinion in the hospitality industry may further generate a polarisation in terms of the degree of automation in this industry.

5.7 ‘Artificial Unintelligence’ and limitation to automation

Broussard (2018) argues that although ‘technochauvinists’ like to believe that computers do a better job than people at most tasks, computers are better at calculating than humans, ‘there are limits to what a computer can do in certain situations’ (Broussard 2018:29). She sheds a light on the importance of the validity of technology. For instance, she suggests that we need to question whether algorithms designed by people and people who are designing these algorithms are making the world better or worse. Algorithms are designed by people, so if people are biased, algorithms will be biased. Wacky ideas dominated public dialogue in tech to the point that important topics such as gender politics or social issues have been dismissed (Broussard 2018:80). ‘(A)lgorithms don't work fairly because people embed their unconscious

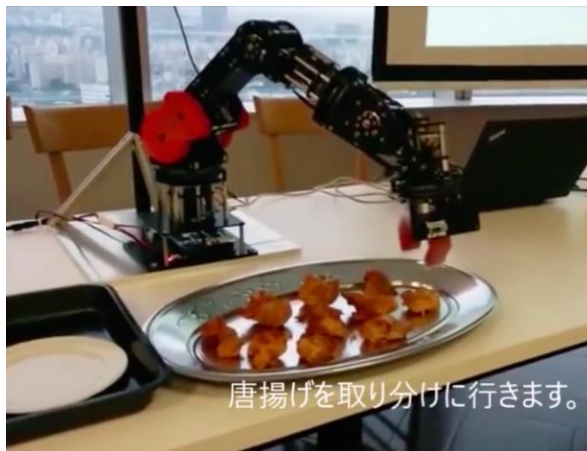
biases into algorithms. Technochauvinism leads people to assume that mathematical formulas embedded in code are somehow better or more just for solving social problems – but that isn't the case' (Broussard 2018: 156). Whether *Yoshinoya's* newly introduced AI-based job interviews can be free from prejudice and discrimination in terms of gender, low-skilled workers, and foreign workers remains to be studied further.

Broussard further highlights that we need to remember that data does not present immutable truth since data and data-collection systems are created by people (p.57). She argues that 'no statistical prediction can or will ever be 100 percent accurate – because human beings are not and never will be statistics' and what we should know is that there are some things machines will never learn and that 'human judgement, reinforcement, and interpretation is always necessary' (Broussard 2018: 118-119).

Moreover, human capacity tends to be often superior than automation in some areas, not all technologies are useful. Sometimes technologies are even abolished due to an arrival of new technology or human work is more efficient. A computer is good at some things, but not at everything (Broussard 2018). Similarly, Moody points out the importance of distinguishing 'the information and communication technology (ICT) that allows faster tracking and guidance of goods or monitoring and measuring ICT', and on the other hand, 'automation such as robots that directly replaces human labour' (2018:14). Some lines of work are better suited for humans than robots. Robots and automation cannot replace all human jobs and human labour needs to adjust herself to the automated working environment.

Furthermore, small cafés and restaurants that can only have 10 customers at the counter table may not benefit from automation. The food service industry in Japan tend to have a small-scale business, leading to a low rate of IoT integration. From our fieldwork in Japan, it is evident that there are some inefficiencies surrounding robots and automation. For instance, *QCafe* in Tokyo Hibiya Midtown, a high brand shopping mall, integrated a food serving robot, but it is only used on weekdays and not on busy weekends. It was stationary in the corner of the restaurant and being idly charged all day. A fried chicken serving robot appears to take too long time to pick up a piece of fried chicken from the big dish and move it to the serving plate (YouTube 2016). This may explain the reason why any restaurant has not introduced it. As Broussard (2018) claims that we should stop fetishizing technologies, become aware of the

limits of technologies and their potential biased embedded in algorithms and data-collection systems. Automation may not be for all tasks involved in the hospitality industry.



A fried chicken picker arm robot (YouTube 2016)

6. Conclusion

This research seeks to examine the level of automation in the Japanese hospitality industry and whether the newly introduced technologies are contributing to resolving the problem of a labour shortage in Japan. The hospitality industry is one of the Japanese industries in which a labour shortage is most acutely felt by workers. This has been evident in the interviews conducted in Japan between June 2018 and February 2019. Many restaurants, cafés, and hotels have started integrating new technologies including IoT, automation, AI, robotisation, and new machines. The sushi industry is one of the most proactive industries that have integrated new technologies on a large scale, including arranging the layout of the restaurants to accommodate machines and automation. Nevertheless, small cafes and restaurants also integrated various technologies including automated accounting system, automated ordering machines, wearable devices to simplify the workload.

Reasons behind the introduction of new technologies vary in the hospitality industry. Nevertheless, many employers or managers explain that they have introduced technologies in order to handle the acute labour shortage which they have been facing in their companies. Some introduced new technologies for the improvement of efficiency, labour productivity, the simplification of tasks for employees, and on some occasions for the ageing employees. Some technologies have been introduced to improve customer services and improve hospitality, which is one of the essential services in the hospitality industry. In many cases, there has been

a significant improvement in service, labour productivity, and a shortening of time spent on certain services. It is not far-fetched to conclude that new the technologies which enabled the simplification of tasks, the increased efficiency, the improvement of the quality of customer services have started contributing to resolving the problem of a labour shortage in Japan.

Nevertheless, it is also important that we are aware of the limitations and challenges new technologies create to workplace and employment relations. Not all tasks are replaceable with technologies nor suited for automation. New technologies tend to be costly, leading to a situation where the minority of hospitality firms can invest in technologies. New technologies require long-term maintenance since they tend to break and stop working temporarily. They also tend to get obsolete, requiring upgrading, updating and replacing. They also require change in the layout of the dining floor and kitchen to accommodate automation and robotisation. Having new devices and machines implies a different training method to adapt employees to new technologies. Technologies can also change employment relations in the digital era. Technologies do not necessarily improve working conditions, but instead, have potential capacities to strengthen a monitoring mechanism over employees. The speed and efficiency technologies bring about in the workplace may require further agility on the side of workers as well. Introducing technologies also implies the suppressing wages for low-skilled workers since simple tasks can be replaced by automation and digitisation. New technologies can de-skill low-paid workers even more.

Furthermore, new technologies are not perfect and sometimes they are not used fully because they can be inconvenient rather than convenient, or because the old system is more reliable or easier, because a human is better than robots or because humans can outsmart automation. It is up to managers' and employers' judgement what types of technologies are required in their workplace, to what extent automation should be integrated, what level of change they expect in terms of employment relations, and what tasks are suited for humans rather than robots. We should not promote technologies without considering these questions and should not be misguided by technological determinism which make us believe that technologies are the most important and will solve problems.

New technologies can contribute to resolving the problem of a labour shortage as we saw in this study. Nevertheless, what we need to be aware in the digital era is to go beyond technological determinism and should not overly fetishize technologies. We have to make an

appropriate judgement over the necessity of technologies and change they generate in the workplace and employment relations. We also need to know the limitations to the technologies and challenges they create, as well as the tensions they can generate to the employment relations.

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Appendix 1

A list of interviewees (including survey)

Restaurant/café/associations for the foodservice industry

Kura Corporation
Komazushi (Conveyor belt sushi chain restaurants)
Gattenzushi (Conveyor belt sushi chain restaurants)
Ganko Food (Japanese food restaurant)
Noodoe SQbism (Noodoe maker)
Nihon Kaitenzushi Kyoukai (Association for Japan Conveyor Belt Sushi Restaurants)
Toba Coffee (café)
Yakitoriya Hibiki (grilled chicken restaurants)
Kagaya (Japanese food restaurant)
Vacan (Signage) - Yokohama Takashimaya
Komazushi (Conveyor belt sushi chain restaurants)
Neo.Emotion (Japanese food and conveyor belt sushi restaurant)

Hotel

Huis Ten Bosch Henna Hotel

Union/NPO

Convenience Store Member Union
Service Rengo Union (Service Sector Union)
UA Zensen and its 10 member unions
Haken Union (Temp Workers' Union)
Zenkoku Union (National Union)
Zenrokyo (National Trade Union Council)
NPO POSSE

Appendix 2

A list of questions to employers

1. Why have you introduced new technology?
2. Have you received any funding from the government or other institutions/authorities?
3. What are the changes you identified once robots/automation are introduced?
4. What do you think the most beneficial aspect the new technology generates?
5. Are there any inconveniences with the new technology (robotisation/automation)?
6. What are the challenges/problems in terms of working with the new technology?
7. Who benefitted most from the introduction of technology?
8. To what extent has the new technology improved productivity?
9. Has the introduction of the new technology reduced employees' working hours?
10. Do you think technology can contribute to the improvement of working conditions and employment relations? If so, tell us an example.
11. Will you continue to incorporate new technology in the future?
12. Will you increase the level of automation/robotisation in the office?
13. What are the problems/challenge in terms of introducing/increasing technology?
14. What regulation/deregulation do you think necessary in terms of advancing technology?
15. What policies do you expect the government to implement?
16. Is there any other technology adopted in this workplace?
17. Are there any other plans of introducing new technology (automation, robotisation)?