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# Study on Women Job at a Time of Digital Transformation ( I ): Women Job and its Future

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Korean Women's Development Institute

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Transformation ( I ): Women Job and its  
Future**



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## I . Introduction

### 1. Research needs and objectives

The gender gap and the discrimination in the Korean labor market stand out in terms of wages and representation of female managers. Although there is a social consensus on the need for women's workforce as a remedy to fight low-birth-caused population cliff, the gender sensitivity of social members related to women's labor has not changed significantly.

Changes in the new industrial ecosystem of digital transformation are taking place across industries. Digitalization, in which digital technology is variously applied throughout society, is already in our daily lives as well as in public areas, including education, labor, economy, and national defense. The impact on labor depends on changes in the industrial

ecosystem; whether the direction of this change will unfold in a similar way as the existing labor market has done or in a gender-equal manner, led by the reformation of gender-sensitive institution, is dependent on how the system develops institutions from the beginning through social consensus.

The impact of digital transformation on jobs is expected to bring significant changes to the amount and quality of jobs through innovation in the "market transaction system and industrial ecosystem" as well as the content, method and skill of work. Examples of an enterprise's digital transformation include the creation of AI through big data and machine learning, where repetitive works can be replaced by machines. Yet, comprehensive analysis and creative activity will remain under the responsibility of humans. The way in which digital transformation works can vary depending on industry. The advent of new Internet-based economies, such as O2O services, on-demand economies, and gig economy, is bringing new forms of jobs to the existing employment patterns. They offer great opportunities for job creation. In the meantime, ways of working that do not match with existing laboring and employment practices demand new models, including social protection system and capacity enhancement.

Positive prospects for the digital transformation economy are new growth engines, new jobs<sup>1)</sup> and work efficiency increase; negative ones are jobless growth intensification, job reduction in existing industries, disappearance of algorithm-vulnerable jobs driven by automation and functionalization, smaller influence of unions caused by fragmented labor, dissolution of the existing employment relation triggered by job flexibility and absence of the new order that is made by job-flexibility.

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1) Smart factory, job segmentation and specialization, platform jobs, etc.

This study was designed to shed light on the followings: the impact that this type of change in the industrial ecosystem can make; whether ways of working in the existing labor market, both actively and inactively participated industries, can worsen or better job segregation by work. The Korean government and workers, alike, need to make a preemptive effort for a new labor market combined with digital technology to develop in a gender-equal manner.

The purpose of this study is to suggest what influence the way of working by industry can leave on the quantity and quality of women employment, which will be caused by the digitalization of industry, and what solution we should have in the face of it in the future. Seen from this perspective, this study is to propose women employment change and future policy task in a preemptive way by way of forecasting women employment in accordance with the digitalization of trends.

## 2. Research information and methods

### 1) Contents of research

- Analysis of the internal and external environment and the trend of female employment according to digital transformation
- Changes in female employment in the traditional manufacturing industry triggered by digital transformation
- Changes in female employment in the health and medical service industry, which is overwhelmingly participated by women, in accordance with digital transformation
- Direction of female employment in the new artificial intelligence industry

- State of gender segregation in the on-demand platform industry shaped by network innovation and the future of female employment

## 2) Research methods

- Analysis on previous studies from home and abroad: Materials of World Economic Forum, the ILO and materials of international organizations, and domestic policies
- Microdata Integrated Service of the Statistics Korea: Raw data of the Census on Establishments (2008-2018) for analyzing the trends of employment over the last decade and the change in women employment by industry.
- FGI and Survey in consideration of related topics to the manufacturing, the health/medical service, the artificial intelligence industry, the platform industry, and others.
- Consultative meetings with figures from related companies, policy officials, and scholar and experts
- Sharing of research findings, outcomes and expert's opinion through policy seminar

Phase 1	<b>Setting the direction of study</b>	<ul style="list-style-type: none"> <li>• Review study details</li> <li>• Review study method–survey design</li> </ul>	<ul style="list-style-type: none"> <li>• Consultative meetings</li> </ul>
Phase 2	<b>Review on relevant literature</b>	<ul style="list-style-type: none"> <li>• International and domestic studies in relation to women’s job in the manufacturing, the health and medical service, the artificial intelligence, and the on-demand platform industry.</li> <li>• Trends of related policy in Korea and overseas countries</li> </ul>	<ul style="list-style-type: none"> <li>• Relevant literature</li> </ul>
Phase 3	<b>Microdata analysis</b>	<ul style="list-style-type: none"> <li>• Employment trends in the labor market and gender trends of economically active population</li> <li>• Trends on gender by employment type</li> <li>• State of establishment’s scale, employees and trade</li> <li>• State of employees and business by turnover</li> </ul>	<ul style="list-style-type: none"> <li>• Additional survey on economically active population (2008-2019)</li> <li>• Census on Establishments (2008-2018)</li> <li>• Relevant literature and data</li> </ul>
Phase 4	<b>Questionnaire survey on corporations and employees by industry</b>	<ul style="list-style-type: none"> <li>• Consultative meeting to come up with questionnaires of corporations and employees in diverse industries</li> <li>• Perform and analyze questionnaires <ul style="list-style-type: none"> <li>– 400 manufacturers</li> <li>– 402 nurses in the health and medical service industry</li> <li>– 105 AI startups and 259 entities from the public sector</li> <li>– 190 deliverers and 170 household service providers, both of which belong to the on-demand platform industry.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Use different questionnaires and sampling methods by industry</li> </ul>
Phase 5	<b>FGI</b>	<ul style="list-style-type: none"> <li>• FGI and in-depth individual interview with workers and corporate HR personnel in different industries</li> </ul>	<ul style="list-style-type: none"> <li>• FGI</li> <li>• In-depth individual interview</li> </ul>
Phase 6	<b>Analysis on the findings and conclusion</b>	<ul style="list-style-type: none"> <li>• Draw policy implication and develop policy task</li> </ul>	<ul style="list-style-type: none"> <li>• Consultative meeting on chosen policies</li> <li>• Policy seminar</li> </ul>

[Figure 1] Procedure of study

## II . Findings and Implications

### 1. Changes in women's jobs due to the introduction of robots into the manufacturing industry

This study conducted a survey on 400 manufacturers<sup>2)</sup>, which hire 300 or more and introduced robots, in order to examine the impact of it on women employment. As the definition of robots varies according to study fields, this investigation used the International Robotics International Robot's definition of industrial robots for this study's purpose.

Looking into the details of the respondents, female workers took up for 23.9%. Among them, 64.4% was engaged in simple, menial works, and those in their 50s and older made up for 33.1% - the biggest age pack. In other words, female workers are relatively old and tasked with simple missions. These facts partly explain that women consist of only 7.5% of team managers and 2.2% of directors and executives. In addition, the average length of service for male workers was 6.9 years, with that of female being 3.1 years. This is in part the reason for the wide wage gap between genders. Overall, female employment is smaller than male one in the first place. In addition, the employment status of employed women is not good because they are in charge of simple and menial jobs, rather than professional, and they are relatively old aged and showing shorter service periods. In all, the work environment for women does not seem desirable.

Respondents said that they introduced an average of 53 robots, with 32.4% of robots connected to online networks. In other words, more than

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2) Electricity equipment manufacturing, electronic components, computers, video, audio and telecommunication equipment manufacturers, automobile and trailer manufacturers.

half said they adopted robots in the processing process, mainly to improve the working environment(45.3%), and reduce working hours(35.0%). 75.5% of companies said that their per capita workload was reduced due to robot introduction. Regarding the amounts of reduced workload, they were 29.7% and 19.5% with men and women, respectively. This is seemingly due to smaller women employment and job difference by gender. Concerning the reduced workloads, about a third of respondents said that they cut staff size. Not a few of the rest answered that they maintained employment headcount by carrying out job transfer, training and education, investment, and others.

Although the introduction of robots replaces human labors to some degree, there can be additional job creation resulting from it. This study found that 21.3% of the surveyed hired staff related to robots. Looking into the additional employment, the number of males hired was on average 5.15, while that of females was 1.0. However, 41.2% of companies said that they did not employ even one single woman. In other words, only about a fifth of the respondents hired additional workers with the introduction of robots, and most of the new addition were males. The reason for this difference can be explained through the characteristics of robot-related staffers, who are mostly field production managers. Moreover, they utilized exiting employees rather than making new hires, and this made women's employment is not likely to happen.

Robot introduction made robot management personnel most needed (for repair and maintenance). Almost half of the respondents said that they found themselves short-staffed in terms of training, repair and maintenance, and engineering staff. Based on this, it can be said for sure that there is a demand of more personnel derived from robot introduction. In light of this, more than half of the surveyed said female workers

were suitable for quality control, operation monitoring, correction and improvement (efficiency improvement, defect reduction, among others), and data-related tasks. On the other hand, only 38.0% of them said that female workers were suitable for maintenance/preservation tasks, which is the most demanded one, while only 16.3% said that women are appropriate for fixing and repair. In other words, there exist jobs that women can do well for sure. Yet, job creation at this point was hardly feasible.

The most positive aspect of robot introduction is working hour reduction and overall working environment improvement. These are expected to give good influence to keeping and increasing female employment in the future. In particular, 60.5% of the respondents said that the introduction of robots makes it easier for women to work, indicating that more women need to be fostered for skilled robot management.

Further analysis on companies that expected positive effects from the introduction of robots in terms of the amount and quality of female employment showed that their work characteristics, organizational culture levels and CEO's level of awareness bring about statistically significant difference. In other words, in terms of the characteristics of existing businesses, the more standardized a job is and the better job cycle is performed, the more likely they will have a positive impact on women employment. In particular, organizational culture and CEO's recognition level were found to have the greatest significant statistical impact. Robot introduction would bring more positive impact to women employment if met with the following conditions: the shorter overtime is; the freer company dining gathering atmosphere is; the better work and life balance is; the longer workers' average tenure is. The beneficial influence was

also available with the followings are fulfilled: the more CEOs respect and trust their employees; the more they emphasize the importance of female workforce; the more frequently they communicate with employees. These results confirm that not only physical changes such as robot adoption but also the environment in which they are introduced and utilized can have a different impact on female employment. Thus policy alternatives should reflect them to increase the effectiveness of robot adoption.

Although, there have been not a few robot-related support projects, most respondents had such a low level of policy utilization. On the other hand, regarding policy demand, the second most request after financial support was about the support for work site improvement, including for work process, floor/work line, shift reorganization, etc.). Therefore, policies related to this area should be reinforced, and this is expected to benefit women employment.

## **2. Changes in women jobs due to the digitalization of the health and medical service industry**

While the demand for the health and medical service industry on the constant rise, partly because of the Korean population growing super aged, the nursing sector, which is overwhelmingly occupied by women, is found with work intensity, poor working conditions, and chronic shortage of workers. Put simply, there are a number of nurses who voluntarily chose not to work in this sector.

Driven by the rapid development of artificial intelligence, big data, and the Internet of Things, technological changes in the health and medical service industry have been progressing at an unprecedented rate; however,

those changes are mainly about the introduction of treatment-oriented technologies. Although the systemization of information has a significant impact on nursing staff, the nursing industry has failed to receive such benefits as the primary objective of the systemization is to easily retrieve data from patients for a better healthcare. Given that, this study defined 10 different skill sets<sup>3)</sup> in the sector, including those which are currently, or can be in use, and those which are in need. Then, it examined digital technology's impact on labor changes among nursing workforce, by investigating 402 nurses working in hospitals and higher medical facilities.

The key findings of the study exhibited that the level of technology introduction and the job replacement of it considerably vary depending on the type of technology. In the nursing sector, technologies other than Electronic Health Records, Automated IV pumps, and electronic monitoring were more varying depending on working department than on hospital scales, including general hospitals and advanced hospitals. In addition, once technology is introduced into the nursing sector, the level of work replacement occurs at 70 to 80%, which has a positive effect on work specialization and improvement. In particular, such departments that require intensive care, such as emergency room, intensive care unit, operating room and recovery room, and comprehensive care service showed a higher level of such replacement. A survey that looked into the degree of technology replacement by

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3) ① Electronic Health Records, ② Automated IV pumps and electronic monitoring, ③ Portable IT devices (patients' condition check-up, monitoring, warning, and others), ④ Patient management using wearable devices or IoT, ⑤ Medication management (inventory system, bar code, injection equipment and others), ⑥ Robot utilization (motion and body-support robot, patient transportation, companion robot, and others), ⑦ Logistics (medication and others), ⑧ Smart beds (anti-fall, patient's activity monitoring, and so on), ⑨ Information service using kiosk and others (questionnaires of nursing information, patient transportation information, explanation to guardians, caution of COVID-19, and others), ⑩ Telehealth monitoring

details of work showed that administrative works, such as inspection tool management, medication and logistics management, and item rearrangement, are easily replaced by technology, whereas face-to-face works and cure treatments, including patient's information sharing, medication and guide, anti-fall and self-injury, are not likely to be so. These results were similar in both general hospitals and advanced hospitals, and were no difference in responses from surveyed service departments.

As a result of investigating how much technological change plays a supplementary role for nursing works, this change is believed to significantly reduce work loads of administration, recording, and supplies management, particularly in the comprehensive nursing service. On the other hand, most of the respondents replied that the change brought marginal reduction to their work to the question that the change lessened their works related to patient treatment, which was different from the aforementioned response. While technology can serve a supplemental role to ways of working, it is not likely to be an alternative to systemic issues. Overall labor intensity, labor time, and exposure to accident have been reduced, but positive changes have been weak in problems arising from structural problems. These responses can be identified with other responses. While a majority of the respondents said technology would not improve in the three-shift working system, almost all said that the comprehensive nursing system would advance working conditions. This can be understood that structural problems play a more important role than the adoption of technology in terms of nursing works.

Given that technological changes do not tackle the biggest problem of nursing work and the main reason for that is manpower shortage, the first starting point of addressing structural problems seems to increase

staff size. In a survey that asked whether or not technological development will replace the workforce in the future, most respondents said that workforce demand will increase, citing it as evidence that even with more technological advancement than in those times when they entered in their business, they saw that there has been such an increase in workforce demands. This can be seen as a reflection of the recognition that technological introduction can reduce employment size in certain sectors of the nursing industry, which is chronically short-staffed, yet, in overall, there would be no such reduction as a whole. If staff size is big enough, introduction of and development of technology can influence employment size. But, we have not seen such discussions sufficiently enough at present. In addition, a survey that questioned if a loosened labor intensity or an improved working environment through technology introduction and development would help solve issues of turnover and retirement in the nursing sector showed a high percentage of positive responses. This offers an implication that labor intensity needs to lower lead by technological change.

Around 80% of the respondents said that technological introduction into the nursing industry has gained less attention from hospitals, or has been slow or has not been made in the first place. About them, 63% of the answers said such passive, delayed response was because of economic reasons – no use in making hospitals profitable. As medical service charges are low, they argue that hospitals focus on treatments that are relatively beneficial to hospital's profits. In other words, the introduction of technology in nursing was slow due to economic reasons associated with hospital revenues.

The decision-making structure related to the introduction of technology also showed little reflection of opinions of related nursing parties. An

overwhelming 71.1% of the respondents said that hospitals unilaterally made decisions in hospitals. About 25% of them said that decisions are shaped through unions or associations. All of these exhibits that it is hard for nurses to make their voices heard. A structure that reflects the governance of nurses seems to be needed in determining the introduction and change of technologies that are applied directly to sites, patients and nurses. Above all, introduction of new technologies will influence the details and methods of work. But also, it will impact employment size. It seems necessary to hear ideas of related parties with regard to training and education scheduled after working hours. It is needed to think about a decision-making structure in which the parties can reflect their opinions on the changing labor process after the introduction of technology.

### **3. The expansion of the artificial intelligence industry and women's jobs.**

Considering that the artificial intelligence sector, or labors related to it, will be an area where continuous change and development are about to take place, researchers took an approach that presents policy alternatives for a comprehensive understanding of the overall discussion of artificial intelligence, technology and industry, rather than women job itself at present. Artificial intelligence was defined as "software and systems that perform intellectual activities similar to those of humans" (Heetae Yang et al., 2018:ii), and this term, artificial intelligence, which first appeared in 1995, has gained much attention in recent years due to its rapid development. As can be found in many recent predictions, the artificial intelligence industry is expected to grow dramatically in the future. For their parts, global IT companies have continued to make large investments in recent years in a wish to dominate this new industry. In

particular, many US IT companies are taking the lead in the race to the artificial intelligence leader. Governments are also announcing various AI industry development policies to preemptively occupy the artificial intelligence industry. To classify artificial intelligence according to the object of recognition and analysis and the technology necessary to realize artificial intelligence, it can be divided into image and video recognition/analysis, signal recognition/analysis, text and language recognition/analysis, data retention/processing technology, and computing technology (Heetae Yang et al., 2018). One of the things that are likely to be overlooked in the AI discussion is data and computing technologies, though these are equally important with the recognition/analysis technologies directly related to algorithm. In particular, data retention/processing technology is believed to experience significant changes and expansion as the artificial intelligence industry continues to grow. This area of data retention/processing technology is considered not only to play a key role in the rapid development of smart artificial intelligence but also to be an important area in terms of job creation.

When it comes to jobs, it seems clear that if artificial intelligence, which has human-like thinking and behavior, is utilized in more areas, many of the previous tasks, especially simple ones, are likely to be replaced by artificial intelligence, and, at the same time, demand more related personnel. In particular, data-related jobs will see dramatic increases in demand of not only high-skilled AI programmers but also large numbers of low-skilled laborers. If the artificial intelligence industry is advanced, diverse new jobs, such as those which link to or integrate with AI technology, are likely to be created. Regarding female jobs, it was confirmed that the proportion of women playing in the artificial intelligence area was small. In addition, in the context

mentioned above, simple tasks performed by women are likely to be replaced by artificial intelligence, which thus makes gender inequality in jobs worsen, if there is a proper response.

This study found that the level of artificial intelligence technology in Korea is less developed than that in advanced countries; Korea's IT giants are relatively left behind in the global competition to dominate the artificial intelligence industry. Some recent cases showed that AI technologies are being applied to several industrial areas, and it was large companies that led such movements. The fact is that small companies or startups that are in hold of very competitive AI technology are just a few. In this regard, large companies take a leader role in leading the AI industry. This investigation conducted survey on 105 AI-related IT startups which have developed AI algorithms or programs. Looking at the overall corporate profiles, CEOs were mostly in their 40s, and more than 60% of the respondents had master's degree or higher. Most of the representatives majored in engineering, especially software-related studies which accounted for 43.7% of the total. When asked about the growth stage, most respondents said that they were currently at the founding, or the early growth stage. For those stages, many of respondents said that they are making big profits at this moment. Regarding AI-related sales, most of them expected that it will be likely to grow, showing similar forecasts that can be identified in the aforementioned very early stages of business. Next, many companies had specialized technologies in image and video recognition/analysis rather than in text and language recognition/analysis or in signal recognition/analysis with regard to artificial intelligence technology. In addition, it was confirmed that data processing is an important part of artificial intelligence development.

The number of workers averaged 23.4, a gradual increase from 18.8

at the end of 2018 and 21.6 at the end of 2019. These numbers show that jobs at artificial intelligence IT companies are also increasing as the artificial intelligence industry expands. In the case of gender, it was confirmed that the proportion of women was relatively low, with an average of 17.1 male and 6.4 female respondents, which also showed gender gaps in the workforce composition. By age, men in their 30s and women in their 20s and 30s show the largest proportion of workers, and it is believed that the composition of young workers reflects the characteristics of early stages in industries and startups.

In terms of working hours, a significant number of men and women worked 40 hours a week, but some worked more than 40 hours. Most of workers, both men and women, were covered by social insurance as well as additional benefits, such as severance pay and paid leave. However, it was confirmed that fewer workers received profit sharing bonuses than other additional benefits. In the case of additional benefits, there was no significant difference between men and women. In addition, an average of 8.2 full-time workers were found to be key employees. Other workers than them participate in other projects other than artificial intelligence. In addition, 1.7 were found to be involved in corporate/organizational management; 1.5 in general administrative; 1.3 in AI support. Although not in large numbers, non-professional workers were also employed to help key artificial intelligence development personnel. Among key technology workers related to artificial intelligence were an average of 6.7 men and 1.6 women, and this displayed that there is gender bias. If you look at the core workforce by age, most of the men and women were in their 20s or 30s, mainly college or master's degree holders. They mostly studies engineering, especially software. Most respondents said that the average work period was 5 to 10 years, with

annual salary averaging KRW 31.65 million for new employees and KRW 49.7 million for those with five-year work experience. Overall average salary was KRW 44.75 million.

Regarding the demand for human resources, most respondents recognized the need to hire key AI technology personnel, while many finding it difficult to secure human resources. In details, 69.3% said they experienced the need of workforce, and 70.3% perceived the difficulty of securing them. The two top reasons why they found it hard were that the lack of experienced personnel and the lack of specialized one in related fields. If this result represents the overall situation of the artificial intelligence labor market, it can be interpreted as the absolute lack of professional and skilled manpower related to artificial intelligence development in the artificial intelligence labor market. With regard to company's difficulty and government support policy, funding issue (including investment attraction) and the lack of professionals were 30.5% for each of the two. 14.3% said that the biggest difficulty is the overall economic recession caused by the COVID-19. As government policies for facilitating the AI industry, direct corporate support was most demanded at 67.6%, while 15.2% for comprehensive policy enhancement to expand artificial intelligence demand and 5.7% for training reinforcement.

Researchers also checked the application and utilization state of artificial intelligence technology in the public sector, which has great policy potential for the development of the artificial intelligence industry. A total of 259 local governments and public institutions responded, with only 6.6% of all respondents currently were in use of AI technology. This showed that not many public organization have practically applied artificial intelligence technology to public administration or social activities, despite the wide social interest in AI technology.

When asked about details and fields of use of artificial intelligence technology, multiple institutions responded that artificial intelligence technology is being applied to safety monitoring, such as in transportation and industry, chatbots for responding to complaints, and forecast on specific projects. In addition, the intelligence technology was being used in areas, including valuation and automatic translation. Though artificial intelligence utilization by institution is low, institutions that have introduced artificial intelligence products or technologies often utilize more of its kind. In other words, only 29.4% of the respondents said they were using artificial intelligence, 70.6% of which were using multiple artificial intelligence technologies. These results can be interpreted as this: institutions with experience in using artificial intelligence are using artificial intelligence in various fields, which demonstrates the use of artificial intelligence has a ripple effect within an institution. As artificial intelligence development and maintenance are often carried out through external private companies, expanding the use of artificial intelligence in the public sector has a potential to contribute to expanding the private sector's artificial intelligence industry. The study also checked the usefulness of the major artificial intelligence technologies in use. 29.4% said they were very useful, and 47.1% said they were useful, both of which mean that they were useful as a whole. As the respondents said that the lack of budget and ideas for applying artificial intelligence were biggest hurdles, it is needed to secure related support.

#### **4. Change in Women's Jobs as the on-demand platform industry going digital**

At this section, this report looks into changes in women's jobs in gig

labor, a locally based on-demand labor platform, which has recently grown fast. Gig labor is a newly emerged one by the digitalization of online network. The locally-based new form of labor is expanding through changes in call services, and, particularly in recent pandemic situations, has grown dramatically. The emergence and growth of gig labor, a new change in the existing labor market, is an important inflection point that can be helpful in predicting new changes in the future women's labor market.

Platforms and gig economy can be defined as 'all types of markets that connect users and suppliers through on-demand commerce on the gig basis' (presentation materials, Oh Eun-jin, 2019). In particular, the platform market, or O2O (Online to Offline), is an economic activity that allows online orders and payments to be made offline and has been growing further with the participation of startups and large companies since 2010 (Korea Internet & Security Agency, 2017:42). Currently, the O2O market stretches throughout life, from commodities to daily services, such as food, real estate, accommodation, finance, laundry, and others.

The delivery industry is rapidly increasing with the increase of single-person household, more delivery apps and delivery agencies. This growing industry, dominantly participated by men, has invited more women. As the delivery food market grows, the demand for delivery workers also increase. Easier access to becoming a delivery service person through delivery agencies brought more women to the industry, which is different from the landscape of the past. On the other hand, female workers in their 30s and 40s who are familiar with using smartphones and apps began to enter the traditional household service market by way of apps as the O2O market grew (Kim Jae-min, 2018:32).

Users also use apps rather than existing placement services increases, and household service workers in the traditional household labor market head towards the online platform market. As a result, both demand and supply of jobs in the traditional household arrangement are decreasing gradually. Due to the special environment of online platform, the provision of household services is also being subdivided (Kim Jae-min, 2018:33). Domestic labor is becoming more fragmented and specialized as app users who need household service choose time and type of work, and other app users who provide the service can check their availability for service provision. In conclusion, the online platform market is rapidly growing in size with the development of technology. As a result, the number of service providers using online platform is also increasing, so it is important to check the types of service they provide and whether they follow the gender segregation in the existing labor market. In particular, studies suggest that gender preferences may cause job segregation in the online platform as users become more inclined to choose service workers they want. Because of this possibility, online platform should be cautious of gender division.

In this context, a survey was conducted on a total of 360 people, 170 household app service workers and 190 delivery app service workers. In the case of domestic app service, all of the surveyed were females. Regarding delivery app services, the proportion of women was 6.3%, a very small compared with that of men. By age, those in their 50s and older took up the highest percentage in the household app service, whereas in their 30s and younger in the delivery app one. By education level, those who have college degree accounted for the biggest portion in the household app services, while and the percentage of workers who graduated from high school was the largest in delivery app services. In

the case of household app services, 77.1% were in marriage were the highest, while 68.9% were unmarried in the case of delivery app services. Both in household and delivery app services, those who work full-time were greater than those who work part-time in numbers. The income earned from those services to their total income is more than 80%. Concerning type of employment, household and delivery app service workers received their paycheck directly from app companies at the rate of 35.3% and 29.5%, respectively. These numbers show that most workers in both industries were not regular employees.

In the case of household app services, the way they work has changed compared with that they did in the past, but their income has not changed significantly. In the meantime, those who engaged in delivery experienced a sea change in their pay, and this brought a whopping number of gig workers to the delivery app industry. As the compensation system is applied still more flexibly to delivery service providers, this industry is going in a way that they can generate high income. Looking at the difference between the two apps, the domestic service needs to develop a high-end market strategy centered on specialization and advancement of services, if it wants to grow in the future. It is difficult to expect explosive growth, like the delivery industry. Not only AI home appliances but also delivery apps and ready-to-cook meals ease housework. Given this, household apps should evolve in a drastic way; otherwise, the household service industry would not grow.

Regarding the work system, household app services are more established than delivery apps, and most work-related guidelines are also in place. While both household and delivery apps have a system through which customers can evaluate workers, the other way around is not mostly possible.

More household service providers experienced unfair treatment than delivery app service workers did. Most unfair treatments were “Details of work are different from what originally talked about” for household workers and “Ignored” for deliverers. There seems no practical countermeasure for them. More than a majority of the domestic service respondents said that human rights protection and legal services were not needed, whereas over 60% of the delivery ones said they were in need of such protection.

Considerable opinions among household and delivery app service workers were that they needed mandatory education and qualifications for them to conduct more professionally and that social insurance should be available for occupational safety. The affirmative response of delivery app service workers was higher than that of household app service ones on the need for qualification restrictions. To the question of “Wage difference depending on performance”, deliverers again replied positively. In particular, regarding the question whether or not they can make enough income, the positive response ratio of the delivery service doubled that of the domestic service, confirming individuals' performance matters in generating income. In this regard, an FGI found that proficiency in using apps plays a critical role in making bigger incomes, indicating that younger people would benefit well from the job.

Currently, the delivery app service is male-dominant. Regarding its future, for the question of how much women participation can expand, more than half of the respondent deliverers said that women can participate in. This indicates that gender gap in the delivery service can narrow down. In addition, if future delivery is performed by equipment, such as drones other than motorcycles, bicycles, and kickboards, gender bias is likely to be drastically reduced. Given this, it is necessary to

ensure that there is no gender gap in relation to the ability to handle those machines.

In terms of fair trade in app services, both household and delivery app service workers had a similar percentage of employment insurance. Household service workers had a higher percentage in terms of national pension plan, while deliverers showed a higher percentage of industrial accident insurance. Both household and delivery app service providers had similar perceptions about the need for employment and industrial insurance, but national pension and health insurance was more strongly demanded among delivery service workers. Half of the household app service workers agreed to the terms and conditions, while half of the delivery providers signed standard contracts. Delivery workers responded more positively than household service providers did to the question whether their relationship with app companies was fair. Regarding the reasons for unfairness, those engaged in household services named asymmetry of information, such as evaluation and income determinants, while those in delivery put the poor compensation system ahead of anything else.

For job satisfaction, both household workers and delivery ones through apps were mostly satisfied with work autonomy and working hour control. As for the willingness to continue the app-based gig labor, more than half of the both were willing to continue, with household workers replying in a more affirmative way than delivery. This can be interpreted as this: even if they have complaints about their practice, they are relatively old and feel limited to move their career. In the case of delivery service workers, as confirmed with the focus group interview, there is no reason for them to change what they currently do, which brings them decent incomes, if they do not find an opportunity that

promises a better job or job security. Yet, they could be understood that when they reach a certain level of assets they could find a job in a different field.

For improving service quality, both household and delivery app service workers collectively said that appropriate fees for their services and to app companies should be paid. In addition, household app service workers said their work intensity should be lessened, while delivery ones replied that social awareness on their service should be improved.

Regarding what app companies have to do, both groups commonly said that those firms should make an pricing standard in a concrete manner and actively mediate in the event of conflicts with customers. On the other hand, workers engaged in delivery had high demands for insurance, training, and employment control.

More than 60% of the respondents said that they need to voice their voices. Yet, about 20% of the delivery respondents recognized that they have unions and other interest groups, while only 8.2% of the household did so. Based on this difference, they have a different level of recognition. All of these findings exhibit that household and delivery service providers wanted to see gig labor settle itself as a formal labor in the Korean society. They also confirm that unlike in the past, they hoped that they can formally get the benefit of social insurance, job training opportunity, quality of service through qualification, and an organizational system that protects their interests. These needs seem more specific among delivery service workers than among household. In particular, the demand for job training and qualifications by delivery app workers can be construed that deliverers see what they currently do a sustainable job, not a temporary one taken prior to a better one.

### III. Policy Tasks

Based on the findings, this study suggests two integrated policy tasks designed for women's jobs at a time of digital transformation period. First, it found that employment changes related to women's workforce can vary widely by individual industry. In the case of manufacturing, universal introduction of robots are expected to reduce employment size. But if robots change working environments, those women whose qualification backgrounds are very different from those working in existing industries can enter the newly shaping industries. Nurses in the health and medical service sector were heavily influenced by the digital transformation, but it is not expected that they will see their staff size reduce. Rather, they anticipated that the digital transformation would make their working environment improved. For that to happen, those practicing on the fields require that policies be made in consideration of such directions. The government has to come up with a detailed blueprint for addressing issues ranging from a human resources nurturing system to the labor market in order for the artificial intelligence and the platform industries do not to see the gender segregation in the labor market of the past.

Therefore, this study proposes to establish a systematic policy plan for the prediction of changes in the labor market and the fostering and utilization of women human resources caused by digital transformation. In addition, the Korean society is faced with the impending issue of population cliff, so it is time for the government to have a preemptive plan for women workforce in preparation of the transition. Given this, this research suggests that the Ministry of Economy and Finance and the Ministry of Gender Equality and Family establish comprehensive plans

as follows:

The plan that will transform women into core future talents should be implemented along with policy support that will trigger changes in the labor market. From this point of view, collaborations should be made for women to grow as such workforce in the future labor market through the following ministry-level efforts:

Ministry of Science and ICT for Basic Plan for Fostering and Basic Plan for Fostering and Supporting of Women Scientists and Engineers; Ministry of Agriculture, Food and Rural Affairs for Basic Plan for Nurturing Female Farmers; Ministry of Employment and Labor for Act on Equal Employment and Support for Work-Family Reconciliation; Ministry of Gender Equality and Family for Basic Plan for Promoting Efforts for Those Who Experience Career Interruption.

The "Comprehensive Plan for Nurturing Women Talents for the Future"(tentative name) should be drafted in a way that diagnoses key areas related to the utilization of women workforce and renews itself every three years so that it can make the plan stay effective for a given period. This structure is a departure from the past where such plans were of life cycle-based ones. The future plan may seem like another program that is to be designed to nurture women talents in the science field; however it is different from the program since it will set up diverse basic plans first and then include all of them for coming up with the new comprehensive plan. It is necessary to concretize basic plans in a detailed manner while centered on relevant master plans; at the same time, those master plans should check the performance of the specified plans.

Secondly, digital transformation means a change in the way of working. This is based on the premise that a person can be a wage earner

and freelance worker or special type of working at the same time. Meanwhile, labor data and relevant statistics are largely produced on wage earners, like on factory workers of the past. This means that those jobs providing services before our eyes could be over- or under-represented in the statistics in our hands. This is in part the reason that the way of producing statistics should be changed. Rather than simply checking whether or not they are employed, surveys should be carried out in a way that asks about ways they work, jobs that pay well, job security they have, particularly compared with wage-earners, and others. To this end, much of the research design currently pursued by the Statistics Korea or the Ministry of Employment and Labor needs to be modified. First of all, regarding those engaged in the platform business, statistics of scales by job is in need. Yet, such specific data has not been produced. It is difficult to identify the population because the definition of platform labor has not been agreed upon in the economically active population survey, and, for this reason, estimating the population's size is never easy. Therefore, reliable statistics should be put forth through substantial agreement between experts and interest groups with regard to the definition of platform labor and the scope of the industry concerned. The same is true for corporate surveys that are inaccurate or not conducted on new industries. For example, platform companies have decent levels of turnover and profits, but employment size is very small. Such companies are often omitted from the actual survey process. This is because platform companies have a very different nature according to the standards of establishment survey. In addition, companies entering in diverse new industries have different characteristics from those of the past. If these realities are not properly reflected, even a large-scale survey will show limitations in predicting

the employment structure of future industries. This study also proposes a large-scale systematic and continued investigation that can produce gender-segregated statistics and identify future industry trends to be resulted from digital transformation.

In addition, it also presents specialized policy for women jobs that reflects the results of surveys by industry.

〈Table 1〉 Women's Job Specialization Policy by Industry

Industry	Policy details
Manufacturing	<ul style="list-style-type: none"> <li>① Additional beneficiary points in selecting robot support companies               <ul style="list-style-type: none"> <li>- Add more points or favorable treat to those which improved on women employment indicators (including new women hirings, women portion, and others)</li> </ul> </li> <li>② Design a training system needed for women workers at a time of adopting robot automation</li> <li>③ Provide robot support consultation and incentives to companies that increased women employment and improved on occupation segregation by gender</li> </ul>
Health and medical service	<ul style="list-style-type: none"> <li>① Strengthen penalty in relation to mandatory nursing staff size               <ul style="list-style-type: none"> <li>- The 25 members of the Health Insurance Policy Review Committee established in the Ministry of Health and Welfare shall consist of the chairperson (Vice Minister of Health and Welfare), eight representatives of subscribers, eight representatives of the health and medical community, and eight representatives of the public interest.</li> <li>※ The health and medical community representative consists of two members of the Korean Medical Association, one member of the Korean Dental Association, one member of the Association of Korean Medicine, one member of the Hospital Association, one member of the Korean Nurses Association, and two members of the Korean Pharmaceutical Association and the Korea Pharmaceutical and Bio-Pharma Manufacturers Association. Currently, the president of the Korean Nurses Association participated in the health and medical industry</li> <li>- Currently one committee member representing the public sector together with other seven ones</li> </ul> </li> </ul>

Industry	Policy details
	<p>② Make it mandatory to put certain number of nurses in the decision making structure</p> <ul style="list-style-type: none"> <li>- The biggest reason behind hospitals being with short-staffed nurses is they do not comply with nurse staff size guidelines</li> <li>※ 43.0% failed to be in compliance. But punishment was a slap on the wrist: administrative orders were just 119 over the past five years.</li> <li>- Fulfilling nurse staff size compliance is not only for working conditions for nurses but for patients' security</li> <li>- Necessary to monitor strictly and enhance legal punishment</li> </ul>
Artificial intelligence	<p>① Need to draft short- and long-term policies for expanding women participation in hopes to address the male-dominant landscape in core AI talents, engineers and data analysis.</p> <p>② Identify diverse jobs with the artificial intelligence industry and build a systemic job creation strategy that helps women participate in diverse relevant jobs</p> <p>③ Review different employment policies that can practically lower a barrier that hinders those females who used to work but not now or older women from learning AI-learning Big Data processing and participating in labeling.</p>
On-demand platform	<p>① Make government policy related to the household service industry more practical: Prepare legislations that reflect the reality faced by household service providers.</p> <ul style="list-style-type: none"> <li>- Revise social security and related institutions that provide workers and consumers alike through household labor act</li> <li>• Four major insurances and vocational training should be available for them, and other measures related to occupational safety are also in need.</li> <li>※ Need to make industrial accident compensation insurance mandatory, like in the delivery service.</li> <li>※ Provide vocational training opportunity through employment insurance so that they can move from household services to other jobs</li> <li>※ Prepare supplementary policy for maternity leave and child care leave when making employment insurance mandatory</li> <li>• Introduce household service providers who have expertise and credibility to users through certified organizations</li> <li>※ Job training is needed because there are a growing number of appliances, equipment, and diverse medications within a house</li> <li>• Prepare legal measures so that certified organizations can screen identities of household service providers in relation to user protection.</li> <li>• Reinforce organizations that advocate household service providers' interest and promote their participation in them</li> </ul>

Industry	Policy details
	<ul style="list-style-type: none"> <li>• Expand the scope of services that are needed in local communities through the support to household service-related social enterprises and co-ops.</li> <li>- Make it general to use a standard contract for fair trade agreement with platform companies               <ul style="list-style-type: none"> <li>• Offer government's guidelines for proper fees</li> <li>• Establish guidelines related to fair trade contract</li> <li>• Encourage platform companies to clearly share contractual terms and labor agreement (tax benefits, social insurance, and others).</li> </ul> </li> </ul>
	<p>② Identify gender segregation in the labor market resulting from digital transformation and develop gender-sensitive policies</p> <ul style="list-style-type: none"> <li>- Design specific plans of maternity leave and child care leave for gig labor women after social insurance makes them mandatory</li> <li>- Strengthen job training, including about application usage.</li> <li>- Reinforce vocational training, mostly at Saeil Center, for easing gender segregation               <ul style="list-style-type: none"> <li>※ Design new programs, including of training for delivery modes</li> </ul> </li> <li>- Introduce the evaluation of policy for on-demand platform business and workers by gender and continuously monitor it</li> <li>- Produce statistical data about platform workers by job and gender</li> </ul>

Source: Documentation of researchers

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