

Understanding Career Interruption among Women Software Developers and How to Help their Entry into Artificial Intelligence Industry

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- With intensifying competition over the leadership in AI(artificial intelligence) industry, one of the pressing policy tasks is to quickly prepare a system to help women software developers, who are at risk of career interruption or are experiencing career interruption, achieve work-life balance and acquire new AI programming techniques. Such a system has more meaning than just a social policy supporting individuals, as it could facilitate development of national science industries and strengthen the national competitiveness.
- Women software programmers with career interruption or with risk of career interruption are highly likely to experience difficulties in adapting to the rapid transition of software skills towards AI programming skills. This study aims to seek ways to help such women software programmers retain their career through capacity building and social protection programs.
- To this end, this study conducted quantitative and qualitative surveys to analyze the current situation of women software developers who are undergoing career interruption or are at risk of career interruption as well as their transition to AI programmers, and to suggest policy alternatives.

- Faced with the necessity to design new policies focused on women software developers, the government needs to consider the followings: 1) Adopt an integrated case management system that provides women software developers, who are at risk of career interruption or are experiencing career interruption, with systematic support including social protection and AI education, 2) Increase multi-faceted content for AI algorithm education, 3) Complement or implement the existing policy measures to protect women software programmers, who have in fact been excluded from work-life balance arrangements, in a more comprehensive and delicate manner, 4) Prepare various measures to address chronic problems in the software industry such as excessive workload, night overtime, and work intensification, etc. 5) Provide intensive support for the growth of AI sub-sectors where women could play the leading role.

Reference for this Brief is as follows. Please refer to Chapter 6 of the original text.

Seon-Mee Shin · Sung Jung Park · Taek-Meon Lee · Jooyoung Lee · Kyung-ju Kang · Hyokyung Kim · Hyeong-Jong Kil · Hanna Jung (2021). *Study on Women Job at a Time of Digital Transformation (II): Career development and social protection System*. Seoul: Korean Women's Development Institute

Why is the focus on career-interrupted software developers?

- Unlike the first-year study on Women's Jobs in the Transition to the Digital Era which focused on presenting mid-to-long-term comprehensive policies, the second-year study focusing on women's jobs in the artificial intelligence industry aims to propose concrete policy alternatives that are urgently needed for the current situation.
- Artificial intelligence industry can be largely divided into algorithm sector that recognizes/analyzes image, signal and text based on technology components, data holding and processing sector, and computing sector. Considering the research intention and practical constraints, this study decided to focus the discussion on women AI developers' jobs in the area of algorithm, which is the core of AI, instead of dealing with all AI sectors.
- Unlike when the first-year study was conducted, experts advised that the perception on AI algorithm skills changed. They explained that AI algorithm skills are no longer perceived as skills that can be mastered only by certain developers but that the existing developers can and must acquire AI algorithm skills thanks to the openness of the AI developers' community. Therefore, this study decided to focus on the existing women software developers' acquisition of AI skills or their transition to AI developers, considering the impact of AI industry.
- Career-interrupted women developers often find it difficult to continue learning technical skills or re-entering the relevant field, due to the practices that commonly exist in the software development industry such as intensive high-time work or heavy workload. Considering the current situation where artificial intelligence industry is being reshaped and talents are required to learn new technologies and make a transition, women with career interruption are highly likely to experience multifaceted challenges.
- In this regard, this study aims to seek ways to help women software programmers, who are experiencing or at risk of career interruption, retain their career through capacity building and social protection systems because they are relatively vulnerable in adapting to the rapid transition of software skills towards AI programming skills.

Current status and perception of software developers with career interruption(or with risk of career interruption)

- This study checked the current status and perception of women software developers by conducting a questionnaire survey of 337 women software developers with actual or potential career interruption, along with a qualitative interview with career-interrupted women in the software sector.
- In the survey, a majority of the respondents were aware of the specific atmosphere or characteristics related to software development jobs. They mentioned: 1)difficulties in achieving work-life balance due to long working hours or excessive workload, 2)lack of senior women software developers who might serve as a role model, due to career interruption, and 3)a certain extent of sexual discrimination in terms of HR(human resources) management.
- The survey respondents said that efforts are needed to eliminate sexual discrimination in HR management and to reduce long working hours and heavy workload. In particular, the survey showed that: 1)it is necessary to relieve the anxiety of non-permanent workers such as temporary/daily/freelance workers over potential termination of their employment contract, and that 2)such non-permanent workers might currently be experiencing discrimination regarding the use of work-life balance arrangements that are available at the company.

<Table 1> Changes needed to help women work for a longer period of time in software programming areas

(Unit: persons, %)

Classification		Efforts to eliminate gender discrimination in HR management	Job insecurity such as termination of employment contract	Anxiety over job stability	Discrepancy between major/ career and job	Discrepancy between aptitude and job	Commute distance and company location	Dissatisfaction with wage level	Long working hours and workload	Gender discrimination in HR management (job allocation, promotion, etc.)	Dissatisfaction with in-house welfare benefits	Others
Total		83 (24.6)	28 (8.3)	35 (10.4)	8 (2.4)	7 (2.1)	10 (3.0)	26 (7.7)	80 (23.7)	34 (10.1)	21 (6.2)	5 (1.5)
Age groups	20s	40 (33.9)	5 (4.2)	14 (11.9)	1 (0.8)	2 (1.7)	1 (0.8)	15 (12.7)	15 (12.7)	16 (13.6)	8 (6.8)	1 (0.8)
	30s	31 (22.8)	11 (8.1)	18 (13.2)	4 (2.9)	3 (2.2)	4 (2.9)	8 (5.9)	31 (22.8)	13 (9.6)	11 (8.1)	2 (1.5)
	40s or older	12 (14.5)	12 (14.5)	3 (3.6)	3 (3.6)	2 (2.4)	5 (6.0)	3 (3.6)	34 (41.0)	5 (6.0)	2 (2.4)	2 (2.4)
Education	2-year college or below	9 (14.8)	7 (11.5)	5 (8.2)	1 (1.6)	3 (4.9)	3 (4.9)	8 (13.1)	15 (24.6)	6 (9.8)	4 (6.6)	0 (0.0)
	4-year university or higher	74 (26.8)	21 (7.6)	30 (10.9)	7 (2.5)	4 (1.4)	7 (2.5)	18 (6.5)	65 (23.6)	28 (10.1)	17 (6.2)	5 (1.8)
Employment status	Permanent employees	72 (26.6)	10 (3.7)	29 (10.7)	6 (2.2)	6 (2.2)	7 (2.6)	25 (9.2)	63 (23.2)	28 (10.3)	20 (7.4)	5 (1.8)
	Non-permanent employees	11 (16.7)	18 (27.3)	6 (9.1)	2 (3.0)	1 (1.5)	3 (4.5)	1 (1.5)	17 (25.8)	6 (9.1)	1 (1.5)	0 (0.0)
Size of business	Less than 100 employees	54 (23.2)	21 (9.0)	25 (10.7)	5 (2.1)	4 (1.7)	6 (2.6)	21 (9.0)	55 (23.6)	19 (8.2)	21 (9.0)	2 (0.9)
	100 employees or more	29 (27.9)	7 (6.7)	10 (9.6)	3 (2.9)	3 (2.9)	4 (3.8)	5 (4.8)	25 (24.0)	15 (14.4)	0 (0.0)	3 (2.9)
Career interruption	Incumbent workers	78 (25.7)	26 (8.6)	34 (11.2)	7 (2.3)	7 (2.3)	9 (3.0)	25 (8.2)	63 (20.7)	31 (10.2)	20 (6.6)	4 (1.3)
	Career-interrupted people	5 (15.2)	2 (6.1)	1 (3.0)	1 (3.0)	0 (0.0)	1 (3.0)	1 (3.0)	17 (51.5)	3 (9.1)	1 (3.0)	1 (3.0)

<Table 2> Implementation & experience of using pregnancy/childbirth-related welfare benefits at work

(Unit: persons, %)

Classification		Implementation			Experience	
		Yes, at present/ in the past.	No, at present/ in the past.	I don't know	Used the benefit	Not used the benefit
Total		184 (61.7)	39 (13.1)	75 (25.2)	47 (25.5)	137 (74.5)
Age groups	20s	62 (54.9)	14 (12.4)	37 (32.7)	1 (1.6)	61 (98.4)
	30s	80 (63.0)	22 (17.3)	25 (19.7)	28 (35.0)	52 (65.0)
	40s or older	42 (72.4)	3 (5.2)	13 (22.4)	18 (42.9)	24 (57.1)
Education	2-year college or below	27 (48.2)	11 (19.6)	18 (32.1)	8 (29.6)	19 (70.4)
	4-year university or higher	157 (64.9)	28 (11.6)	57 (23.6)	39 (24.8)	118 (75.2)
Employment status	Permanent employees	174 (64.2)	32 (11.8)	65 (24.0)	46 (26.4)	128 (73.6)
	Non-permanent employees	10 (37.0)	7 (25.9)	10 (37.0)	1 (10.0)	9 (90.0)
Size of business	Less than 100 employees	110 (53.9)	33 (16.2)	61 (29.9)	28 (25.5)	82 (74.5)
	100 employees or more	74 (78.7)	6 (6.4)	14 (14.9)	19 (25.7)	55 (74.3)
Career interruption	Incumbent workers	167 (61.2)	32 (11.7)	74 (27.1)	37 (22.2)	130 (77.8)
	Career- interrupted people	17 (68.0)	7 (28.0)	1 (4.0)	10 (58.8)	7 (41.2)

- The survey respondents mentioned that it is important to keep enhancing their job capabilities in the relevant field: 1) They answered that the key to competitiveness is to continuously learn new skills. 2) They were concerned that they might lose competitiveness if they don't acquire such skills.

<Table3> I am highly likely to lose competitiveness if I don't receive continuous job trainings.

(Unit: persons, %, points)

Classification		⑤ Strongly agree	④ Agree	③ Neither agree, nor disagree	② Disagree	① Totally disagree	Mean (SD)
Total		147 (43.6)	160 (47.5)	26 (7.7)	3 (0.9)	1 (0.3)	4.33 (0.683)
Age groups	20s	68 (57.6)	45 (38.1)	2 (1.7)	2 (1.7)	1 (0.8)	4.50 (0.701)
	30s	48 (35.3)	68 (50.0)	19 (14.0)	1 (0.7)	0 (0.0)	4.20 (0.697)
	40s or older	31 (37.3)	47 (56.6)	5 (6.0)	0 (0.0)	0 (0.0)	4.31 (0.583)
Education	2-year college or below	25 (41.0)	28 (45.9)	8 (13.1)	0 (0.0)	0 (0.0)	4.28 (0.686)
	4-year university or higher	122 (44.2)	132 (47.8)	18 (6.5)	3 (1.1)	1 (0.4)	4.34 (0.683)
Employment status	Permanent employees	122 (45.0)	129 (47.6)	16 (5.9)	3 (1.1)	1 (0.4)	4.36 (0.678)
	Non-permanent employees	25 (37.9)	31 (47.0)	10 (15.2)	0 (0.0)	0 (0.0)	4.23 (0.697)
Size of business	Less than 100 employees	100 (42.9)	114 (48.9)	15 (6.4)	3 (1.3)	1 (0.4)	4.33 (0.692)
	100 employees or more	47 (45.2)	46 (44.2)	11 (10.6)	0 (0.0)	0 (0.0)	4.35 (0.665)
Career interruption	Incumbent workers	130 (42.8)	147 (48.4)	23 (7.6)	3 (1.0)	1 (0.3)	4.32 (0.686)
	Career- interrupted people	17 (51.5)	13 (39.4)	3 (9.1)	0 (0.0)	0 (0.0)	4.42 (0.663)

- Many of the survey respondents were aware of the importance of learning AI algorithm skills: 1)The respondents generally agreed that AI programming will become a critical area in the future. 2)They also recognized that they are highly likely to lose competitiveness unless they acquire AI programming skills.

<Table 4> I am highly likely to lose competitiveness in my job-related area unless I acquire AI programming skills

(Unit: persons, %, points)

Classification		⑤ Strongly agree	④ Agree	③ Neither agree, nor disagree	② Disagree	① Totally disagree	Mean (SD)
Total		54 (16.0)	162 (48.1)	85 (25.2)	35 (10.4)	1 (0.3)	3.69 (0.873)
Age groups	20s	15 (12.7)	61 (51.7)	27 (22.9)	14 (11.9)	1 (0.8)	3.64 (0.884)
	30s	21 (15.4)	63 (46.3)	37 (27.2)	15 (11.0)	0 (0.0)	3.66 (0.871)
	40s or older	18 (21.7)	38 (45.8)	21 (25.3)	6 (7.2)	0 (0.0)	3.82 (0.857)
Education	2-year college or below	7 (11.5)	35 (57.4)	15 (24.6)	3 (4.9)	1 (1.6)	3.72 (0.799)
	4-year university or higher	47 (17.0)	127 (46.0)	70 (25.4)	32 (11.6)	0 (0.0)	3.68 (0.889)
Employment status	Permanent employees	41 (15.1)	130 (48.0)	71 (26.2)	28 (10.3)	1 (0.4)	3.67 (0.869)
	Non-permanent employees	13 (19.7)	32 (48.5)	14 (21.2)	7 (10.6)	0 (0.0)	3.77 (0.891)
Size of business	Less than 100 employees	32 (13.7)	119 (51.1)	60 (25.8)	21 (9.0)	1 (0.4)	3.69 (0.836)
	100 employees or more	22 (21.2)	43 (41.3)	25 (24.0)	14 (13.5)	0 (0.0)	3.70 (0.954)
Career interruption	Incumbent workers	45 (14.8)	145 (47.7)	81 (26.6)	32 (10.5)	1 (0.3)	3.66 (0.868)
	Career- interrupted people	9 (27.3)	17 (51.5)	4 (12.1)	3 (9.1)	0 (0.0)	3.97 (0.883)

- The survey respondents also pointed out the lack of access to AI-related education: They mentioned that it is necessary to increase artificial intelligence-related education/training programs, along with financial support for those who need such education/trainings. They also said that companies need to expand multi-dimensional AI education programs including financial resources to open AI training programs at work.

**<Table 5> Opinions from (incumbent) AI developers:
I think that there are enough education/training programs related to AI development in Korea.**

(Unit: persons, %, points)

Classification		⑤ Strongly agree	④ Agree	③ Neither agree, nor disagree	② Disagree	① Totally disagree	Mean (SD)
Total		13 (4.3)	51 (16.8)	116 (38.2)	107 (35.2)	17 (5.6)	2.79 (0.934)
Age groups	20s	3 (2.5)	20 (16.9)	43 (36.4)	45 (38.1)	7 (5.9)	2.72 (0.905)
	30s	7 (5.9)	19 (16.1)	48 (40.7)	38 (32.2)	6 (5.1)	2.86 (0.954)
	40s or older	3 (4.4)	12 (17.6)	25 (36.8)	24 (35.3)	4 (5.9)	2.79 (0.955)
Education	2-year college or below	3 (5.9)	9 (17.6)	19 (37.3)	15 (29.4)	5 (9.8)	2.80 (1.040)
	4-year university or higher	10 (4.0)	42 (16.6)	97 (38.3)	92 (36.4)	12 (4.7)	2.79 (0.914)
Employment status	Permanent employees	11 (4.4)	44 (17.6)	93 (37.2)	90 (36.0)	12 (4.8)	2.81 (0.933)
	Non-permanent employees	2 (3.7)	7 (13.0)	23 (42.6)	17 (31.5)	5 (9.3)	2.70 (0.944)
Size of business	Less than 100 employees	7 (3.4)	40 (19.2)	77 (37.0)	70 (33.7)	14 (6.7)	2.79 (0.945)
	100 employees or more	6 (6.3)	11 (11.5)	39 (40.6)	37 (38.5)	3 (3.1)	2.79 (0.917)

- According to the survey, women software developers were worried that they might not be able to accumulate job knowledge related to artificial intelligence if their career is interrupted: 1)The incumbent women software developers were concerned about the possibility that they might not be able to acquire sufficient skills if their career is interrupted. 2)Career-interrupted women software developers mentioned that they are currently unable to obtain AI-related skills.

<Table 6> Opinions from (incumbent) women software developers:

I might not be able to accumulate AI programming-related job knowledge if my career is interrupted now

(Unit: persons, %, points)

Classification		⑤ Strongly agree	④ Agree	③ Neither agree, nor disagree	② Disagree	① Totally disagree	Mean (SD)
Total		31 (10.2)	157 (51.6)	73 (24.0)	39 (12.8)	4 (1.3)	3.57 (0.888)
Age groups	20s	9 (7.6)	57 (48.3)	28 (23.7)	22 (18.6)	2 (1.7)	3.42 (0.937)
	30s	16 (13.6)	54 (45.8)	33 (28.0)	13 (11.0)	2 (1.7)	3.58 (0.918)
	40s or older	6 (8.8)	46 (67.6)	12 (17.6)	4 (5.9)	0 (0.0)	3.79 (0.682)
Education	2-year college or below	4 (7.8)	28 (54.9)	8 (15.7)	11 (21.6)	0 (0.0)	3.49 (0.925)
	4-year university or higher	27 (10.7)	129 (51.0)	65 (25.7)	28 (11.1)	4 (1.6)	3.58 (0.881)
Employment status	Permanent employees	27 (10.8)	120 (48.0)	67 (26.8)	32 (12.8)	4 (1.6)	3.54 (0.906)
	Non-permanent employees	4 (7.4)	37 (68.5)	6 (11.1)	7 (13.0)	0 (0.0)	3.70 (0.792)
Size of business	Less than 100 employees	18 (8.7)	112 (53.8)	48 (23.1)	28 (13.5)	2 (1.0)	3.56 (0.866)
	100 employees or more	13 (13.5)	45 (46.9)	25 (26.0)	11 (11.5)	2 (2.1)	3.58 (0.937)

- Software developers usually learn new job skills through online trainings, but the survey shows that there might be certain limits in acquiring AI skills if they learn new skills only through online trainings.

<Table 7> How to acquire new skills related to job - No.1 priority

(Unit: persons, %)

Classification		Internal job trainings at work	Job trainings provided by the government, local municipalities, and universities	Help from others in the same job areas including co-workers	Self-learning through diverse media such as online trainings	Others
Total		67 (19.9)	53 (15.7)	83 (24.6)	132 (39.2)	2 (0.6)
Age groups	20s	21 (17.8)	14 (11.9)	28 (23.7)	54 (45.8)	1 (0.8)
	30s	31 (22.8)	24 (17.6)	35 (25.7)	45 (33.1)	1 (0.7)
	40s or older	15 (18.1)	15 (18.1)	20 (24.1)	33 (39.8)	0 (0.0)
Education	2-year college or below	11 (18.0)	12 (19.7)	14 (23.0)	24 (39.3)	0 (0.0)
	4-year university or higher	56 (20.3)	41 (14.9)	69 (25.0)	108 (39.1)	2 (0.7)
Employment status	Permanent employees	55 (20.3)	42 (15.5)	69 (25.5)	103 (38.0)	2 (0.7)
	Non-permanent employees	12 (18.2)	11 (16.7)	14 (21.2)	29 (43.9)	0 (0.0)
Size of business	Less than 100 employees	37 (15.9)	34 (14.6)	68 (29.2)	92 (39.5)	2 (0.9)
	100 employees or more	30 (28.8)	19 (18.3)	15 (14.4)	40 (38.5)	0 (0.0)
Career interruption	Incumbent workers	61 (20.1)	48 (15.8)	75 (24.7)	118 (38.8)	2 (0.7)
	Career-interrupted people	6 (18.2)	5 (15.2)	8 (24.2)	14 (42.4)	0 (0.0)

<Table 8> Opinions from (incumbent) women software developers:

I think that I can improve my job capabilities related to AI programming by using online training courses without help from others.

(Unit: persons, %, points)

Classification		⑤ Strongly agree	④ Agree	③ Neither agree, nor disagree	② Disagree	① Totally disagree	Mean (SD)
Total		8 (2.6)	67 (22.0)	101 (33.2)	98 (32.2)	30 (9.9)	2.75 (0.993)
Age groups	20s	2 (1.7)	28 (23.7)	37 (31.4)	39 (33.1)	12 (10.2)	2.74 (0.991)
	30s	4 (3.4)	26 (22.0)	42 (35.6)	32 (27.1)	14 (11.9)	2.78 (1.031)
	40s or older	2 (2.9)	13 (19.1)	22 (32.4)	27 (39.7)	4 (5.9)	2.74 (0.940)
Education	2-year college or below	3 (5.9)	10 (19.6)	17 (33.3)	14 (27.5)	7 (13.7)	2.76 (1.106)
	4-year university or higher	5 (2.0)	57 (22.5)	84 (33.2)	84 (33.2)	23 (9.1)	2.75 (0.970)
Employment status	Permanent employees	7 (2.8)	56 (22.4)	83 (33.2)	81 (32.4)	23 (9.2)	2.77 (0.990)
	Non-permanent employees	1 (1.9)	11 (20.4)	18 (33.3)	17 (31.5)	7 (13.0)	2.67 (1.009)
Size of business	Less than 100 employees	5 (2.4)	48 (23.1)	68 (32.7)	69 (33.2)	18 (8.7)	2.77 (0.979)
	100 employees or more	3 (3.1)	19 (19.8)	33 (34.4)	29 (30.2)	12 (12.5)	2.71 (1.025)

Policy tasks for enhancing women software developers' competitiveness and helping them advance into the AI industry

- Both career interruption of women software developers and lower representation of women in software development sector will have a negative impact on individuals, industries, and the nation.
 - Considering the intensifying competition over the leadership in AI(artificial intelligence) industry, the government needs to devise special measures.
- With decades of efforts, women's jobs policy has been implemented in a substantially systematic way, in terms of the number and kinds of jobs for women.
 - Therefore, it is necessary to move from discussing comprehensive women's jobs policy to creating a detailed women's jobs policy by industry/job function.
- In other words, we need to consider the followings while keeping in mind the urgent need to adopt a concrete employment policy that befits the characteristics of women software developers' jobs.
 - ① Temporary or pilot implementation of an integrated case management system that provides women software developers, who are at risk of career interruption or are experiencing career interruption, with systematic support including social protection and AI education
 - Need to consider adopting an integrated support program in the form of an integrated case management system that provides social protection and AI-related education/ training programs for the above group of women.
 - ② Expansion of AI algorithm education for women software developers
 - Need to bring in high-quality experts to reinforce advanced training courses for the incumbent women software developers. In terms of lecture format, it is important to add offline trainings to overcome the limits of online training courses, while also providing more advice from the mentors who are currently working as AI programmers.

- ③ Improvement of blind spots in terms of institutions or rule execution related to social protection of the underprivileged
- Need to reinforce the efforts to reduce institutional and practical blind spots for temporary/daily workers and freelancers. It is also necessary to use a wider range of carrots and sticks such as better consulting services, stricter rules, and labor supervision so that more employees can use the relevant systems/programs at work.
- ④ Alleviation of excessive workload, night overtime, and work intensification that are regarded as one of the fundamental problems in the software development industry.
- Need to strengthen the collaborative efforts among relevant government departments beyond the Ministry of Science and ICT. If necessary, this topic could be included in the agenda of Economic, Social & Labor Council meeting to reach social consensus.
- ⑤ Intensive investment in the AI-related sectors where women play the main role, considering the fact that women are also the key users of diverse products and services with AI applications
- In the above sectors, women software developers' understanding on women users could become a big advantage. If more women software developers make their way to such AI-related sectors, relevant companies might naturally try to create a more stable working environment and improve their HR systems in consideration of women employees.