

Section S1. The Chronological Phases of Work Related to the Stages of the Industrial Revolution.

Work 1.0 refers to the initial industrial society in the late 18th century, in which the first worker's organizations were created. The production methods, organization of work, and social structures changes resulted from the steam engine being invented and mechanical production systems being phased into manufacturing.

Work 2.0 was the birth of the welfare state, which started with mass production in the late 19th century. Despite industrialization bringing about new social problems and raising fundamental social questions, the worse social problems and pressure from organized labor conversely became an important factor contributing to the first forms of social insurance.

Work 3.0 was based on the social market economy, beginning from the early 1970s, while employment was further developed on an equal footing between employers and employees. Subsequently, information technology and electronics were popularly applied to automatic production. Meanwhile, national markets have been opening and the share of the economy by services has rapidly grown due to globalization [2].

Work 4.0 has been developing since the beginning of the 21st century, the characteristics of which include digitalization, flexibilization, globalization, and polarization [2], [14,15].

Section S2. Worker's Preferences Regarding Work and Types of Talent with Recommended Actions

1. *Worker's preferences regarding work*

As for the preferences of workers regarding work, a recent survey “Value Systems in the Context of Work 4.0” [74] has reflected the discrepancy between the real lives of employees and their preferences regarding work through IT-based qualitative interviews of around 1200 workers (see Table S1). This provided discrete insights into work, in order to identify seven typical value systems, which guide people's actions according to their attitudes and positions. The value systems describe the differences in people's perceptions of the status quo, as well as views on shaping a desirable work environment in Work 4.0. People expect Work 4.0 to provide an ideal working life and working environment; however, some regard the desirable future as a threatening scenario [3]. At present, there is neither a homogenous worker's perspective nor a single employer's perspective on such future work.

Table S1. Work's preferences regarding work with the percentage share

Seven value systems	Percentage share
Being able to live comfortably from work	28%
Working hard for prosperity	15%
Finding a work-life balance	14%
Seeking meaning outside work	13%
Achieving peak performance via dedication	11%
Finding fulfillment in work	10%
Working within a strong community of solidarity	9%

Source: [3], [74]

2. Types of talent with recommended actions for TR

According to Collings and Mellahi (2009) [27], TM systems should focus on high potential and high performing talents, instead of all employees in the organization. In this context, we classify talents with two axes—performance and potential—thus separating them into four sections with different roles and recommended actions for TR, as shown in Figure S1.

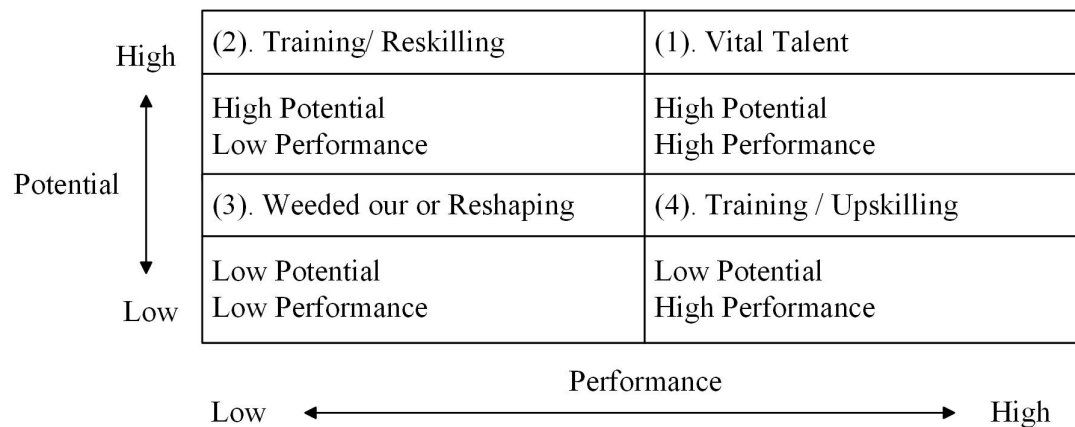


Figure S1. Types of talent with recommended actions for TR

From a competition-based perspective, the upper-right quadrant (1) of Figure S1 consists of employees who have both high potential and high performance and, thus, are the vital talents required by most firms. In the upper-left (2) and lower-right (4) quadrants of Figure S1, in principle, these talents will also be recruited and retained by the organization as target talents. Providing that the organization applies appropriate training and development programs to these talents to improve their competences, they should potentially facilitate TM development [78]. Those in the lower-left quadrant (3) are likely to be weeded out from the organization, due to a lack of value creation. However, many companies constrained the abilities of talents to evolve their business by lacking the pipeline to assign sufficient talents to strategic positions in the organization [79], whatever quadrant the talents belong to.

What if the debate is in a Work 4.0 environment? A significant number of workers do

not have sufficient skills to use such technologies effectively, such as communication, self-direction, and problem solving—so-called soft skills [80]. The low-potential employees in quadrants (3) and (4) may be easily replaced for lacking competition. However, Work 4.0 emphasizes the welfare state and social security; in the case of talents whose skill level is low, they need to be re-shaped or trained by up-skilling (e.g., interdisciplinary) or crowd-work (e.g., self-employed for a high level of self-determination jobs), avoiding being weeded out from talent markets. Likewise, the employment prospects of semi-skilled and unskilled workers are expected to deteriorate further in the future. This trend makes lifelong learning essential, which requires that firms support continuing vocational education for workers, as well as making training imperative [3].

As for the employees who have only high potential but no high performance (quadrant 2), they may possibly move to quadrant (1) later by re-skilling or up-skilling training, as human–machine collaboration will be rapidly evolved in the new era [19]. The talents must increase their value-added and maintain specialized skills, making them difficult-to-replace in a competitive environment [26]. Therefore, the talents engaged in works or activities in Work 4.0 scenarios must show a high degree of flexibility and problem-solving skills, such that they are fit for the future [37].

Section S3. Expert Background (Table S2)

No.	Types of Organization	Number of Employees	Background (or Strength)	Title	Generation belongs to
1	Manufacture	100~500	HR	Supervisor	Gen Y
2	Service	100~500	HR	Director	Baby boomers
3		100~500	IT	Researcher	Gen X
4	Government	Above 1,001	IT	Vice President	Baby boomers
5	Manufacture	Above 1,001	Business Management	Manager	Gen X
6	Service	100~500	Business Management	Consultant	Baby boomers
7	Service	Above 1,001	Business Management	Manager	Gen X
8		Above 1,001	Business Management	Manager	Baby boomers
9	Manufacture	Below 100	Business Management	Consultant	Gen X
10	Service	100~500	Statistics	AVP	Gen X
11	Finance	100~500	Business Management	General Manager	Baby boomers
12	Manufacture	Below 100	HR	Consultant	Gen X
13	Service	100~500	IT	Vice President	Gen X
14	Finance	Below 100	HR	Consultant	Gen X
15	Service	100~500	Incubation Center	Supervisor	Gen X
16	Academic	501~1,000	HR	Manager	Gen X
17	Manufacture	Below 100	HR	Consultant	Gen X
18	Service	Above 1,001	Training & development	Vice President	Gen X

Section S4. The Process of FDM

Step 1. Assume K experts are invited to identify the corresponding relationship between the linguistic terms and triangular fuzzy numbers by using the linguistic variables in Table S3, which determine the importance and the ratings of generations with respect to the various criteria. Accordingly, the fuzzy ratings and their membership functions are delineated in Table S3.

Table S3: Linguistic variables for the importance weight of criteria

Linguistic variable	Code	Fuzzy scale
Not At All Important	NA	(0.0, 0.0, 0.1)
Unimportant	U	(0.0, 0.1, 0.3)
Slightly Unimportant	SU	(0.1, 0.3, 0.5)
Moderately	M	(0.3, 0.5, 0.7)
Slightly Important	SI	(0.5, 0.7, 0.9)
Important	I	(0.7, 0.9, 1.0)
Very Important	VI	(0.9, 1.0, 1.0)

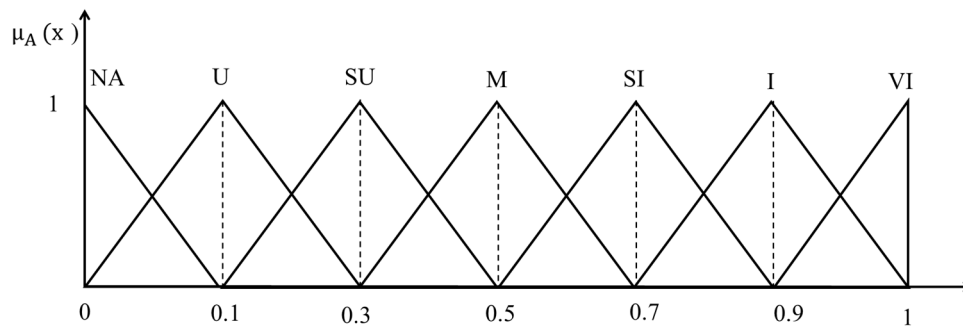


Figure S2. Fuzzy ratings and their membership function

Step 2. Convert the linguistic variables into triangular fuzzy numbers, as suggested in Table S2. Let the fuzzy number \tilde{r}_{ij}^k be the rating of alternative i with respect to criteria j and \tilde{w}_j^k be the j th criteria weight of the k th expert, where $i = 1, 2, \dots, m$; $j = 1, 2, \dots, n$; $k = 1, 2, \dots, K$.

Step 3. For each expert, use the vertex method to compute the distance between the average \tilde{r}_{ij} and \tilde{r}_{ij}^k and the distance between the average \tilde{w}_j and \tilde{w}_j^k , $k = 1, 2, \dots, K$.

The distance between two fuzzy numbers $\tilde{a} = (a_1, a_2, a_3)$ and $\tilde{b} = (b_1, b_2, b_3)$ is computed by Equation (E1):

$$d(\tilde{a}, \tilde{b}) = \sqrt{\frac{1}{3}[(a_1 - b_1)^2 + (a_2 - b_2)^2 + (a_3 - b_3)^2]} \quad (E1)$$

Step 4. If the distance between the average and expert evaluation data is less than the threshold value of 0.2 [81], then all experts are considered to have achieved a consensus. Furthermore, among those $m \times n$ ratings of alternatives and n criteria weights, if the percentage achieving a group consensus is greater than 75% [82], then go to step 5; otherwise, a second round of the survey is required.

Step 5. Aggregate the fuzzy evaluations by Equation (E2):

$$\tilde{A} = \begin{bmatrix} \tilde{A}_1 \\ \tilde{A}_2 \\ \vdots \\ \tilde{A}_m \end{bmatrix} \text{ where } \tilde{A}_i = \tilde{r}_{i1} \otimes \tilde{w}_1 \oplus \tilde{r}_{i2} \otimes \tilde{w}_2 \oplus \dots \tilde{r}_{in} \otimes \tilde{w}_n, \quad (E2)$$

$i = 1, \dots, m$

Step 6. Defuzzification (DF): For each alternative option $\tilde{A}_i = (l_i, m_i, n_i)$, the defuzzification process is performed to derive the crisp values using the Center-Of-Gravity (COG), expressed as Equation (E3):

$$DF = l_i + \frac{(n_i - l_i) + (m_i - l_i)}{3} \quad (E3)$$

The ranking order of alternative options can be determined according to the values of \tilde{A}_i .

Section S5. Expert evaluation by fuzzy set calculation

The fuzzy weights for above 21 TR factors (F1–F21) were converted into fuzzy sets based on the expert's responses on a seven-point Likert scale (Table S4). We estimated the deviation between two fuzzy numbers by calculating the distance between the average fuzzy evaluation data and the expert evaluation data. Providing that the result was less than the threshold value of 0.2, and the percentage of group agreement for each criterion was greater than 75%, then group consensus was considered to be reached. For instance, as expert 1 for criterion F1, the average fuzzy weight was (0.79, 0.94, 0.99) and the original evaluation data Was (0.9, 1.0, 1.0). Hence, the distance between the two fuzzy numbers can be given by

$$\sqrt{\frac{1}{3}[(0.79 - 0.90)^2 + (0.94 - 1.00)^2 + (0.99 - 1.00)^2]} = 0.07.$$
 The value of 0.07 is less than the set threshold value of 0.2; thus, it is acceptable to state that there was group consensus on this criterion. The distances between the averages and expert evaluations are provided in Table S5.

Likewise, we calculated the distances for all 21 criteria, as evaluated by each expert. Each criterion was used to evaluate group consensus, based on the condition that the group agreement was greater than 75%. While calculating the data from all 18 experts and the average fuzzy weights, the results revealed that the criteria F6: "Seeking meaning outside work" and F8: "Coercion" had to be eliminated, as both failed to reach group consensus. The remaining 19 criteria all exceeded the threshold of group consensus. The same rule was applied for the rating of generations later.

The criteria ratings and an example of criteria among R1–R3 for expert #1 are provided in Table S6. The average fuzzy ratings of all experts are provided in Table S7.

Table S4. Assessments of 21 criteria by 18 experts

Label	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	#15	#16	#17	#18
F1	VI	VI	VI	VI	VI	I	VI	VI	VI	SI	I	I	I	I	VI	I	I	I
F2	SI	I	VI	VI	I	VI	I	I	VI	I	I	I	SI	I	VI	SU	I	I
F3	I	I	VI	VI	I	VI	I	I	VI	I	VI	I	VI	VI	VI	I	VI	VI
F4	I	SI	VI	VI	SI	I	I	VI	SI	I	VI	I	I	VI	VI	VI	VI	VI
F5	SI	M	VI	SI	M	I	SI	I	SI	VI	I	I	I	I	M	VI	VI	I
F6	SI	SI	VI	SU	SU	I	I	SI	SI	VI	I	VI	SI	SI	SI	M	I	I
F7	I	I	VI	SI	I	VI	SI	SI	SI	VI	I	VI	I	I	SI	I	SI	I
F8	SI	U	M	I	U	SI	SI	SI	M	SI	SI	I	SU	SI	SU	SU	SI	M
F9	SI	I	VI	SI	SI	I	I	SI	I	VI	I	I	I	VI	I	VI	VI	VI
F10	I	I	VI	I	I	I	I	I	I	I	M	VI	I	VI	M	I	I	I
F11	I	I	I	SI	VI	VI	SI	VI	I	I	VI	I	I	M	SI	I	I	VI
F12	I	SI	VI	I	I	VI	VI	SI	I	I	I	I	VI	VI	VI	SI	SI	SI
F13	SI	VI	VI	VI	SI	VI	I	SI	I	I	VI	I	I	SI	M	SI	I	I
F14	SI	VI	VI	SI	SI	I	I	SI	I	I	SI	I	I	I	SI	VI	SI	I
F15	SI	SI	VI	I	SI	VI	I	SI	SI	I	I	I	SI	SI	SI	I	SI	I
F16	I	I	VI	I	VI	VI	VI	I	I	I	I	I	VI	I	VI	VI	VI	I
F17	I	I	VI	I	I	VI	VI	SI	I	I	I	I	I	I	SI	I	I	I
F18	I	VI	VI	I	I	VI	VI	I	VI	VI	I	I	SI	SI	M	I	SI	SI
F19	SI	I	VI	I	SI	I	VI	SI	SI	I	I	I	SI	SI	I	SI	SI	I
F20	SI	SI	VI	I	SI	VI	I	M	I	SI	I	SI	I	I	SI	VI	SI	VI
F21	SI	I	VI	I	VI	VI	I	SI	I	SI	I	I	SI	I	I	VI	I	VI

Note: Linguistic variables refer to Appendix S4 (Table S3).

Table S5. Distance between average data and expert evaluations

Criteria	Distance between average data and expert evaluations (<0.2)																	
Label	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	#15	#16	#17	#18
F1	0.07	0.07	0.07	0.07	0.07	0.06	0.07	0.07	0.07	0.18	0.06	0.15	0.06	0.06	0.07	0.06	0.06	0.06
F2	0.16	0.03	0.14	0.14	0.03	0.14	0.03	0.03	0.14	0.08	0.03	0.15	0.16	0.03	0.14	0.55	0.03	0.03
F3	0.07	0.07	0.06	0.06	0.07	0.06	0.07	0.07	0.06	0.07	0.06	0.16	0.06	0.06	0.06	0.07	0.06	0.06
F4	0.04	0.20	0.09	0.09	0.20	0.04	0.04	0.09	0.20	0.06	0.09	0.15	0.04	0.09	0.09	0.09	0.09	0.09
F5	0.11	0.30	0.19	0.11	0.30	0.07	0.11	0.07	0.11	0.16	0.07	0.17	0.07	0.19	0.30	0.19	0.19	0.07
F6	0.05	0.05	0.25	0.44	0.44	0.13	0.13	0.05	0.05	0.25	0.13	0.27	0.05	0.05	0.05	0.24	0.13	0.13
F7	0.03	0.03	0.15	0.14	0.03	0.15	0.14	0.14	0.14	0.13	0.03	0.19	0.03	0.03	0.14	0.03	0.14	0.03
F8	0.14	0.42	0.06	0.31	0.42	0.14	0.14	0.14	0.06	0.23	0.14	0.35	0.26	0.14	0.26	0.26	0.14	0.06
F9	0.17	0.02	0.12	0.17	0.17	0.02	0.02	0.17	0.02	0.12	0.02	0.15	0.02	0.12	0.02	0.12	0.12	0.12
F10	0.03	0.03	0.14	0.03	0.03	0.03	0.03	0.03	0.03	0.08	0.35	0.18	0.03	0.14	0.35	0.03	0.03	0.03
F11	0.03	0.03	0.03	0.16	0.14	0.14	0.16	0.14	0.03	0.03	0.14	0.15	0.03	0.35	0.16	0.03	0.03	0.14
F12	0.02	0.16	0.13	0.02	0.02	0.13	0.13	0.16	0.02	0.07	0.02	0.15	0.13	0.13	0.13	0.16	0.16	0.16
F13	0.14	0.16	0.16	0.16	0.14	0.16	0.04	0.14	0.04	0.09	0.16	0.16	0.04	0.14	0.33	0.14	0.04	0.04
F14	0.13	0.17	0.17	0.13	0.13	0.05	0.05	0.13	0.05	0.10	0.13	0.16	0.05	0.05	0.13	0.17	0.13	0.05
F15	0.10	0.10	0.20	0.07	0.10	0.20	0.07	0.10	0.10	0.12	0.07	0.18	0.10	0.10	0.10	0.07	0.10	0.07
F16	0.06	0.06	0.07	0.06	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.16	0.07	0.06	0.07	0.07	0.07	0.06
F17	0.01	0.01	0.12	0.01	0.01	0.12	0.12	0.18	0.01	0.06	0.01	0.16	0.01	0.01	0.01	0.01	0.01	0.01
F18	0.03	0.14	0.14	0.03	0.03	0.14	0.14	0.03	0.14	0.14	0.03	0.15	0.15	0.15	0.35	0.03	0.15	0.15
F19	0.11	0.06	0.19	0.06	0.11	0.06	0.19	0.11	0.11	0.11	0.06	0.17	0.11	0.11	0.06	0.11	0.11	0.06
F20	0.11	0.11	0.18	0.06	0.11	0.18	0.06	0.31	0.06	0.13	0.06	0.19	0.06	0.06	0.11	0.18	0.11	0.18
F21	0.17	0.02	0.13	0.02	0.13	0.13	0.02	0.17	0.02	0.15	0.02	0.15	0.17	0.02	0.02	0.13	0.02	0.13

Table S6. Rating of criteria
(a) The fuzzy scale of impacts

Impacts	Codes (X)	Fuzzy scale		
Very Low	VL	0.0	0.0	0.1
Low	L	0.0	0.1	0.3
Fairly Low	FL	0.1	0.3	0.5
Medium	M	0.3	0.5	0.7
Fairly High	FH	0.5	0.7	0.9
High	H	0.7	0.9	1.0
Very High	VH	0.9	1.0	1.0

(b) Rating of criteria among R1~R3 for expert #1 as an example

#1	C11	C12	C13	C14	C15	C16	C17	C18	C21	C22	C23	C24	C25	C26	C31	C33	C34	C35
R1	H	H	H	H	M	M	FH	FH	FH	FH	FH	FH	FH	FH	M	M	M	M
R2	H	FH	H	FH	FH	FH	FH	FH	H	H	FH	FH	FH	H	H	FH	FH	FH
R3	H	M	H	FH	H	FH	FH	FH	H	H	H	FH	FH	H	H	H	FH	FH
	0.70	0.70	0.70	0.70	0.30	0.30	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.30	0.30	0.30	0.30
R1	0.90	0.90	0.90	0.90	0.50	0.50	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.50	0.50	0.50	0.50
	1.00	1.00	1.00	1.00	0.70	0.70	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.70	0.70	0.70	0.70
	0.70	0.50	0.70	0.50	0.50	0.50	0.50	0.50	0.70	0.70	0.50	0.50	0.50	0.70	0.70	0.50	0.50	0.50
R2	0.90	0.70	0.90	0.70	0.70	0.70	0.70	0.70	0.90	0.90	0.70	0.70	0.70	0.90	0.90	0.70	0.70	0.70
	1.00	0.90	1.00	0.90	0.90	0.90	0.90	0.90	1.00	1.00	0.90	0.90	0.90	1.00	1.00	0.90	0.90	0.90
	0.70	0.30	0.70	0.50	0.70	0.50	0.50	0.50	0.70	0.70	0.70	0.50	0.50	0.70	0.70	0.70	0.50	0.50
R3	0.90	0.50	0.90	0.70	0.90	0.70	0.70	0.70	0.90	0.90	0.90	0.70	0.70	0.90	0.90	0.90	0.70	0.70
	1.00	0.70	1.00	0.90	1.00	0.90	0.90	0.90	1.00	1.00	1.00	0.90	0.90	1.00	1.00	1.00	0.90	0.90

Table S7. Average fuzzy ratings of all experts

AVG	C11	C12	C13	C14	C15	C16	C17	C18	C21	C22	C23	C24	C25	C26	C31	C33	C34	C35
R1	0.70	0.69	0.56	0.63	0.51	0.51	0.51	0.62	0.43	0.50	0.47	0.49	0.44	0.50	0.46	0.17	0.46	0.39
	0.86	0.86	0.74	0.81	0.71	0.69	0.71	0.79	0.64	0.71	0.67	0.69	0.64	0.68	0.65	0.38	0.67	0.60
	0.94	0.96	0.91	0.94	0.89	0.87	0.88	0.94	0.82	0.87	0.83	0.87	0.81	0.87	0.83	0.53	0.83	0.78
R2	0.73	0.70	0.71	0.64	0.58	0.62	0.63	0.64	0.59	0.68	0.64	0.61	0.56	0.70	0.66	0.64	0.62	0.63
	0.91	0.88	0.88	0.84	0.78	0.82	0.82	0.84	0.78	0.88	0.83	0.80	0.75	0.88	0.85	0.83	0.82	0.82
	0.99	0.98	0.97	0.97	0.93	0.95	0.95	0.96	0.93	0.99	0.96	0.94	0.91	0.98	0.97	0.96	0.95	0.95
R3	0.71	0.71	0.82	0.69	0.71	0.72	0.70	0.53	0.83	0.83	0.78	0.68	0.73	0.81	0.81	0.84	0.70	0.73
	0.87	0.86	0.96	0.86	0.88	0.88	0.87	0.71	0.97	0.97	0.93	0.86	0.89	0.94	0.95	0.97	0.87	0.89
	0.96	0.94	0.99	0.96	0.97	0.97	0.97	0.87	1.00	1.00	0.99	0.97	0.96	0.99	0.99	1.00	0.97	0.98