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Psychometric Properties of the Workforce Agility Scale

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Psychometric Properties of the Workforce Agility Scale

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Abstract

Society 5.0 is a concept of society that must humanize humans with technology. If the industrial revolution 4.0 makes humans more modern because they have access to technology, then society 5.0 is a time where technology becomes part of humans. Industrial revolution 5.0 employees are more focused on being prepared to think critically, analytically and creatively to adapt in the future. Therefore, this research aims to test the construct validity of the workforce agility measurement tool. To test the psychometric characteristics of this research, researchers will use an item response theory approach with the Rasch model. In this research, data collection was carried out by distributing instruments or questionnaires to respondents using Likert. This research consisted of 182 respondents. The results of this study show that the validity of the items is quite good with a unidimensional value of 30.2%, there are 24 scale items that are identified as fit or according to the Rasch model reliability coefficient (item = 0.96, respondent = 0.88, Cronbach's alpha = 0.89). The analysis also shows that there are four gender bias items (male, female). From these results, this scale can be used to measure workforce agility of workers in companies or members of organizations.

Keywords

Construction Test, IRT, Workforce Agility

Society 5.0 is a rapidly developing era with extremely fast technological advances. It is a form of improvement from Industry 4.0. The foundation of Society 5.0 is based on the concept of society that must humanize humans with technology. Technology has become a part of human life instead of a mere tool for facilitating human work. Therefore, the existence of the Society 5.0 must be supported by agile human agility in addressing changes. Human agility functions by adapting to a dynamic and competitive industrial environment. According to Hormozi in Alavi & Wahab (2013), a group of researchers put forward ideas about agility at a time when the industry sensed rapid changes in the environment and identify that the traditional style will not promote survival in a volatile environment. Even in an environment that is turbulent due to change, workers in the revolutionary era of Society 5.0 place more emphasis on readiness to think critically, analytically, and creatively, such that they can adapt in the future (Heri et al., 2021).

Workforce agility denotes the ability of employees in an organization to adapt to changes in the work environment. According to Alavi et al. (2014), it is the ability to address and respond to changes as well as to the new conditions introduced by these changes by adapting quickly. However, Society 5.0 is not the only agent of change. For example, the COVID-19 pandemic opened an era of a new normal due to changes in work patterns. The scenario initiated changes in employees by changing their habits in various aspects of the work environment. Previous stud-

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ies discussed the effect of workplace spirituality and workforce agility on innovative work behavior mediated by readiness for change among teachers at XYZ Jakarta schools (Widiyati, 2023), the effect of employee engagement and job satisfaction on workforce agility through talent management in public transportation companies (Azmy, 2021), and the influence of talent management and workforce agility on employee performance at PT. Scholars have widely used prosperous forests in Indonesia (Novriyan et al., 2023) and workforce agility, along with several industrial psychological variables, in Indonesia. However, studies that constructively measured psychometric scale measurements are lacking. Against this background, the current study aimed to examine the psychometric properties of the Workforce Agility Scale (WAS) using the dimensions proposed by Sherehiy & Karwowski (2014). The study expects that the results can be used to determine whether or not company workforces can adapt to dynamic work conditions, environments, or cultures.

Workforce Agility

Workforce agility focuses on the ability of employees to innovate their initial capabilities. Organizations are deemed to need to continuously examine the environment and interpret its dynamics to anticipate future skill-related needs. Furthermore, workforce agility is considered to provide relatively good benefits to companies, because it promotes cooperation within or outside the organization (Breu et al., 2002).

Another definition of workforce agility is the ability of workers to adapt their capacity and capability after which they are intended to undergo training to mastering the required knowledge and skills in a timely manner (Qin & Nembhard, 2010). According to Sherehiy & Karwowski (2014), workforce agility pertains to performance or agile behavior that can be observed in the workplace. Every organization requires an agile workforce, such that one can infer that the workforce of an organization should exhibit agile performance or behavior to predict the benefits of the organization.

A definition of workforce agility can be interpreted as a condition related to the ability of employees to adapt to changes in the work environment (Paul et al., 2020). Sya & Mangundjaya (2020) consider workforce agility as an observable agility of employees at work instead of personality, inclination, or attribute. Moreover, Alavi et al. (2014) suggested that workforce agility refers to the ability of employees to respond to unexpected changes in a quick and precise manner and take advantage of these changes as opportunities.

Sherehiy and Karwowski (2014) proposed the three dimensions of workforce agility, namely, proactivity, adaptivity, and resilience.

a. Proactivity denotes the behavior of employees in anticipating problems related to change and finding solutions to these problems as well as making overall improvement in their work.

b. Adaptivity is related to the professional flexibility of employees. This aspect is related to the ability to undertake multiple responsibilities, move easily from one role to another, and work simultaneously on different tasks in various teams.

c. Resilience refers to the ability of employees to hold a positive attitude toward change, new ideas, and the adoption of new technologies. It includes tolerance for unexpected situations, differences in opinion, and conditions that lead to stress as well as responses to stress.

Wei et al. (2020) provided another definition of adaptivity, that is, it involves the ability of employees to adapt to market changes and quickly collaborate with colleagues across organizational boundaries. Meanwhile, proactivity refers to the ability of employees to find new opportunities and take the necessary actions to overcome problems as well as formulate appropriate solutions. Lastly, resilience denotes the ability of employees to efficiently conduct tasks under stressful environments and possess an attitude of tolerance toward unexpected situations.

Method

This study conducted the evaluation on the basis of item response theory (IRT), which assumes that under test conditions, performance can be predicted by determining individual traits or characteristics of ability. Scores are estimated on the basis of these traits (ability scores),

Table 1. Unidimensionality

	Percentage
Raw variance	30.2%
Unexplained variance in the first contrast	6.8%
Unexplained variance in the second contrast	6.2%
Unexplained variance in the third contrast	5.1%
Unexplained variance in the fourth contrast	4.4%

which are used to predict or explain test items and results (Rosa et al., 2019).

To test the psychometric characteristics of the WAS, the study also used the Rasch model. Toward this end, several assumptions need to be met, namely, unidimensionality, local independence, and item fit; apart from testing the reliability of the scale, the study conducted differential item functioning (DIF).

Participants

The study recruited a total of 182 respondents (men: 77, women: 105). The participants needed to meet the following inclusion criteria: male and female (SD: 0.495), age >18 years (mean: 28.28, SD: 4.579), from various work backgrounds, and willing to fill out an online questionnaire in Google Forms. The sampling technique used was incidental sampling, which selects respondents on the basis of chance. Every subject that the researcher meets by chance can be used as a sample if the researcher perceives that the person they accidentally meet is suitable as a data source (Sugiyono, 2017).

Instruments

Items were adapted from the WAS designed by Sherehiy (2008). The scale classifies the attributes as three dimensions, namely, proactivity, adaptability, and resilience (Wei et al., 2020). The primary data were derived using a questionnaire. Items were rated using a four-point Likert-type scale (1 = *strongly disagree*, 2 = *do not agree*, 3 = *agree*, 4 = *strongly agree*).

Procedure

Data collection was conducted on October 17–24, 2022. We then performed data screening using Microsoft Excel followed by analysis via Winstep 5.1.5.2.

Results

Unidimensionality

Unidimensionality is a condition in which only one attribute or ability can be measured by a set of items in a test (Bond & Fox, 2012). In Rasch modeling, analysis of unidimensionality measures the extent to which the diversity of instruments measure what it intends to measure. This reliability indicates the extent to which repeated measurements will produce the same information, that is, they will not produce meaningful and significant differences in information. The minimum prerequisite for unidimensionality is a raw score data measurement of >20%. In addition, the unexplained variance value of an instrument should be <15% (Sumintono & Widhiarso, 2013).

Table 1 indicates that the raw variance data measurement results are 30.2%. The results demonstrate that the requirements of unidimensionality in WAS have been fulfilled; thus, further analysis can be conducted. Unexplained variance instruments of 6.8%, 6.2%, 5.1%, and 4.4%, which do not exceed 15%, supported this result.

Table 2. Local Independence

Correlation	*Entry Number Item*	*Entry Number Item*
0.33	23 Item 23	24 Item 24
0.32	10 Item 10	15 Item 15
0.31	16 Item 16	17 Item 17
0.31	11 Item 11	12 Item 12

Local Independence

The assumption of local independence denotes the value of the possibility of answering a question that does not depend on other questions. The limit for local independence is a residual correlation value of <0.30 (Christensen et al., 2017; Meijer et al., 1990).

Table 2 suggests that eight items indicate local dependence, namely, items 23, 24, 10, 15, 16, 17,11, and 12. Twenty items are free from local dependence.

Item Fit

Item fit is used to explain whether or not items function normally for measurement. If an item is found unfit, then it is an indication that a misconception exists among respondents about the item in question. According to Boone et al. (2014) and Bond & Fox (2015), the values of outfit means-square, outfit z-standard, and point measure correlation are the criteria used to determine the level of item fit. If the items on the three criteria are unmet, then one can ascertain that the items are insufficient and, thus, need to be rephrased or replaced. According to Boone et al. (2014), the criteria used for checking the suitability of items that are inappropriate (outliers or misfits) are an MNSQ value of 0.5–1.5, a ZSTD value of –2.0 to +2.0, and a PTMEA value of 0.4–0.85.

The results in Table 3 demonstrate that four items are unfit when examined using the MNSQ, ZSTD, and PT when outfit values are measured, such that the items need to be replaced or omitted. Meanwhile, if the other items

Table 3. Item Fit

Item	*Outfit MNSQ*	*Outfit ZSTD*	*PTMEA*	*Description*
I24	2.11	8.21	0.19	Unfit
I4	1.71	4.82	0.39	Unfit
I23	1.47	3.97	0.39	Unfit
I2	1.30	2.32	0.38	Unfit
I6	1.25	1.81	0.49	Fit
I27	1.24	1.71	0.52	Fit
I5	1.19	1.71	0.50	Fit
I12	1.18	1.38	0.40	Fit
I1	1.14	1.05	0.40	Fit
I10	1.13	1.06	0.52	Fit
I11	1.03	0.29	0.47	Fit
I13	1.04	0.35	0.56	Fit
I26	1.03	0.30	0.58	Fit
I25	1.03	0.30	0.55	Fit
I3	1.01	0.12	0.48	Fit
I21	0.97	–0.18	0.43	Fit
I16	0.85	–1.15	0.59	Fit
I7	0.83	–1.36	0.57	Fit
I9	0.75	–2.03	0.54	Fit
I8	0.75	–2.12	0.53	Fit
I14	0.74	–2.18	0.53	Fit
I18	0.66	–2.91	0.59	Fit
I20	0.66	–3.19	0.54	Fit
I15	0.59	–3.69	0.62	Fit
I22	0.60	–3.68	0.55	Fit
I28	0.58	–3.86	0.54	Fit
I19	0.57	–3.82	0.62	Fit
I17	0.54	–4.20	0.60	Fit

Note. MNSQ = Means-Square, ZSTD = Z-Standard, PTMEA = Point Measure

Table 4. Rating Scale

Category Label	*Obsvd Avrge*	*Andrich Threshold*
1	0.13	NONE
2	0.35	−3.16
3	1.65	−0.56
4	3.04	3.72

Note. Obsvd Avrge = Observed Average

do not meet one criterion, then they can still be maintained and do not need to be changed or replaced (Sumintono & Widiarso, 2013).

Rating Scale Testing

The rating scale test is conducted to verify whether or not the rating of options is confusing to the respondents. An example is measurement techniques that use Likert-type ratings or polytomous data. The study conducted this test to determine the distance that, in fact, applies to individuals in answering the existing response categories (Deviana et al., 2020). The Andrich threshold index value is used as reference to determine the effectiveness of the rating option. A value is called ideal if the Andrich threshold index score increases sequentially from negative to positive. This direction indicates that the rating options given are effective, that is, from a low (negative) to a high (positive) logit score. The irregularity of the scores on the two indices indicates that inefficient answer choices, because only a few respondents selected them.

Table 4 depicts that the average observation begins with logit +0.13 for 1 = *strongly disagree* and 2 = *disagree* (+0.35 logit) and increases in choice with 3 = *agree* (+1.65 logit) and 4 = *strongly agree* (+3.04 logit). This increase in logit value indicates that the choice is effective in eliciting responses. Another recommended measure is the Andrich threshold to test whether or not the polytomous value used is correct. The Andrich threshold value moves from NONE to negative and continues to positive, which sequentially indicates that the options given are valid for the respondent.

Reliability

Reliability is a test that will show how consistent the measurement results are if the measurement is carried out many times (Azwar, 2019). In the Rasch model approach, there are two reliability indices, namely: respondent reliability and item reliability. Person reliability and item reliability are considered bad <0.67, enough 0.67–0.80, good 0.81–0.90, very good 0.91–0.94, and special >0.94 (Sumintono & Widhiarso, 2013; Boone et al., 2014). In addition, the results of the summary statistics can also be seen through the Cronbach's Alpha KR-20 coefficient. The criterion value used is <0.5 (poor); 0.5–0.6 (bad); 0.6–0.7 (enough); 0.7–0.8 (good); and >0.8 (very good) (Sumintono & Widhiarso, 2013).

According to Tennant and Conaghan (2007) in addition to using the reliability coefficient (person and item reliability), Rasch modeling also uses an index (person and item separation index). For the separation item and person index criteria used >2.5 is considered sufficient to carry out a comparative analysis at the group level (Deviana et al., 2020).

Table 5 demonstrates an item reliability coefficient of 0.96, Pearson's reliability coefficient of 0.88, and Cronbach's alpha value (reliability coefficient) of 0.89.

Table 5. Reliability

	Separation	*Reliability*	*Description*
Item	5.13	0.96	Special
Person	2.65	0.88	Good
Cronbach's Alpha		0.89	Special

DIF

The DIF depicts the detection of item bias using the Rasch model analysis, which is necessary for determining whether or not items exhibit bias in certain categories of respondents. Bias can be determined by a value below 5% (0.05) in the probability table contained in Winstep (Sumintono & Widhiarso, 2015).

A few items indicated bias in terms of demographic data (gender). In the DIF test based on gender on the WAS with 182 respondents (77 men and 105 women). The DIF results pointed to four items, namely, I2, I14, I23, and I25, which were identified as biased with a probability value of <0.05.

Discussion

This study uses Rasch modeling to reveal the psychometric properties of the WAS. The assumption test was conducted on unidimensionality and local independence. In addition, the study reveals the validity of the tool using item fit, functioning of the rating scale, item reliability, respondents, Cronbach's alpha values, and DIF based on gender.

The first assumption test performed is that for unidimensionality, which was conducted to measure the extent to which the diversity of in-

Table 6. Differential Item Functioning

Item	*Gender*	
	Probability	*Description*
I1	0.68	Unbiased
I2	0.00	Bias
I3	0.79	Unbiased
I4	0.84	Unbiased
I5	0.26	Unbiased
I6	1.00	Unbiased
I7	0.73	Unbiased
I8	0.28	Unbiased
I9	0.30	Unbiased
I10	1.00	Unbiased
I11	0.28	Unbiased
I12	0.10	Unbiased
I13	0.41	Unbiased
I14	0.04	Bias
I15	0.83	Unbiased
I16	0.33	Unbiased
I17	0.42	Unbiased
I18	0.43	Unbiased
I19	0.85	Unbiased
I20	0.42	Unbiased
I21	0.42	Unbiased
I22	0.67	Unbiased
I23	0.00	Bias
I24	0.85	Unbiased
I25	0.04	Bias
I26	0.05	Unbiased
I27	0.51	Unbiased
I28	0.82	Unbiased

struments measures what they intend to measure (Sumintono & Widhiarso, 2015). The minimum prerequisite for unidimensionality is raw score data of >20% (Sumintono & Widhiarso, 2013). Moreover, the assumption of unidimensionality in the 28 items on workforce agility is sufficiently fulfilled with a raw score of 30.2%. In other words, all items are single in measuring the construct of workforce agility.

The second assumption test denotes local independence. The limit for local independence is a residual correlation value of <0.30 (Christensen et al., 2017). On the WAS, several items indicate local independence such as item 23, when paired with item 24, produces a residual value of 0.33. The two items occur in local dependence, because they have an attachment. Simply put, when a respondent achieves a high level of ability to answer item 24, then the estimate is dependent on item 23.

This item illustrates that respondents consider item 24 (I am easily frustrated and stressed if there is a change in the workplace) to be closely related to item 23 (I am reluctant to accommodate and make changes to my habits in doing work at the company). This finding occurs for both items, because the high level of ability to answer the item is dependent on the item pair. Moreover, items that indicate other local independence are item 10 (I communicate well with people who have different backgrounds) when paired with item 15 (I have good relationships with people from different departments) with a residual value of 0.32.

The next item that indicates local independence is item 16 (I can adapt quickly to existing situations, then can switch from one project to another) when paired with item 17 (I can adapt to the requirements of new equipment) with a residual value of 0.31. The last item that indicates local independence is item 11 (I behave in accordance with the customs, norms and values that exist in the workplace) when paired with item 12 (I change my behavior in order to work more effectively with others) with a residual value of 0.31. Several items that indicate local independence could be selected to be used as an item on the scale or corrected one of them, because they were indicated to be similar and related.

After testing the assumptions, the study performs an item fit test to determine the suitability of the data obtained using Rasch modeling. Item fit is measured using several categories including MNSQ, ZSTD, and PT mean correlation value (Sumintono & Widhiarso, 2013). According to Boone et al. (2014), the MNSQ item must be prioritized in evaluating item fit. The reason is that the MNSQ outfit is more sensitive to outliers and produces more familiar calculations. Sensitivity to outliers renders easy the identification and fixing of item conformity problems. Based on the item fit validity test, the study identified four items, namely items 2, 4, 23, and 24, that are unfit or not in accordance with Rasch modeling. Thus, the identified items can be rephased or omitted from the scale.

The next test with Rasch modeling is a rating scale test indicated by the Andrich threshold value for each response option on the WAS. The Andrich threshold value in this study moves from NONE to negative and continues to positively, sequentially indicating that the answer choices given are valid and easily understood by respondents.

This instrument has an item reliability of 0.96. This finding indicates that the items on the scale can provide maximum performance when given to other respondents with comparable levels of ability. The reliability of the scale was 0.88, which suggest that the consistency of the responses is good. In addition to examining item and respondent reliability, this study also investigated Cronbach's alpha value as a reliability measure that is commonly used in classical test measurements. The WAS reached a Cronbach's alpha of 0.89, which suggest that the reliability of Cronbach's alpha value is very good. Although Rasch modeling is more general and uses several item and person reliability estimates, Cronbach's alpha reliability can be considered.

Rasch modeling can display item bias detection with DIF. In this study, item bias was detected for gender, and four items were identified as gender-biased. This tendency may occur, because an item is more in favor of one group with certain characteristics, while individuals with other characteristics are disadvantaged. The items that exhibited bias based on DIF gender analysis are items 2, 14, 23, and 25.

Therefore, the five items identified as biased

can be revised to prevent respondents across certain demographic categories from answering differently (Boone et al., 2014a). Nevertheless, with only three items identified, bias exerted no effect on the validity of item fit and demonstrated that the quality of the items as a whole was less problematic when used in different sample categories.

Conclusions

Based on the results of psychometric analysis with Rasch modeling, the study concluded that the WAS can be used to reveal one psychological construct (unidimensionality) and provide consistent results with an instrument reliability coefficient of 0.89, item reliability coefficient of 0.96, and respondent reliability coefficient of 0.88. In other words, the instrument produces consistent measurement scores and has good item quality. The four response options are very good as evidenced by the regular and increasing Andrich threshold index values, which indicates that the respondents do not experience confusion in ascertaining differences among the response options. The validity of item fit was relatively satisfactory despite four items identified as unfit and another four items identified as gender-biased. These results remain a record for the researcher, such that items can be improved or discarded.

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Appendix. Item Work Force Agility

Dimensions	Indicator	Item
Proactive	• Carry out tasks as requested • Changing behavior at work • Using new work tools	1. I find new ways and leverage resources to help get the job done 2. I fix things, if they don't suit me 3. I design a work procedure in my work area 4. I like to change the old way in the company of doing a job 5. I can do and finish my work without knowing the big picture. 6. I can predict problems that may occur in my work 7. I am able to solve new and complex problems at work 8. I am looking for opportunities to make improvements at work 9. I try to think 'out of the box' to solve problems
Adaptability	• Looking for a more effective way • Up to date with company information • Can adapt	1. I communicate well with people from different backgrounds 2. I behave in accordance with the customs, norms and values that exist in the workplace 3. I change my behavior in order to work more effectively with others. 4. I am an up to date person regarding information in the workplace 5. I can adapt to new work procedures in the company. 6. I have good relations with people from different departments 7. quickly adapt to the situation at hand, then be able to switch from one project to another. 8. I can adapt to new equipment requirements 9. I am able to adapt to work with a team that has different habits 10.I can use the new equipment at work
Resilience	• Have good behavior according to the norm • Adaptability related to changes that occur • Have the ability related to the completion of work	1. I'm looking for more effective ways to help me do my job 2. I do the job as ordered 3. I can accept feedback from colleagues 4. I am reluctant to accommodate and make changes to my habits in doing work in the company. 5. I am easily frustrated and stressed if there is a change in the workplace 6. I stay calm when faced with difficult circumstances 7. I can complete my work efficiently even in difficult or stressful situations 8. I can work well when faced with a narrow workload or work schedule (deadlines) 9. When a difficult situation occurs, I react by trying to manage the problem