Human Resources Development Model For The Industrial Revolution 4.0 Era In Aceh, Indonesia

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Abstract: This study aims to identify the competencies and to develop a human resource development model for industry 4.0 in Aceh. To achieve the objectives, the study used a mixed-method research approach. Qualitative research was conducted through in-depth interviews with human resource development practitioners and experts who were selected purposively. While quantitative research was carried out by surveying 337 respondents who worked in various fields of work in Aceh. The results showed that there are 4 competencies needed to be able to compete and survive in industry 4.0, which are: (1) personal competence, (2) social competence, (3) methodological competence, and (4) technical competence. Of these four, personal competence has the greatest contribution in explaining the variants of competencies needed in the industrial revolution 4.0. For this reason, various elements of this personal competence should be prioritized in the human resource development model, followed by various other competencies, such as social competence, methodological competence, and technical competence. The development of these various competencies is expected to generate and transform Aceh's human capital into better superior human resources, who mastered and advanced in sciences, technology, and innovation as the main pillars of the regional development to achieve the Indonesia Golden Vision 2045.

Keywords: Human capital 4.0. competencies, human capital development, industrial revolution 4.0..

1 Introduction

Technological development, based on history, is the main factor driving the emergence of the industrial revolution, including the Industry 4.0 (Kazancoglu & Ozkan-Ozen, 2018). Cyber-Physical Systems (CPS), the Internet of Things (IoT), automation, big data, and artificial intelligence are the main technologies in this Industrial Revolution 4.0 era. They have completely changed the industrial and manufacturing environment, particularly in the developed countries, and spread throughout the world over the next decade. This transformation process not only has an impact on industrial and manufacturing systems and structures changes, but also affects the changes of works nature, criteria, and qualifications of human resources required by the industry (Dombrowski & Wagner, 2014; Kazancoglu & Ozkan-Ozen, 2018; Motyl *et al.,* 2017). Consequently, these conditions will have a major impact on changes in the education and training system, which will prepare and adjust the various competencies possessed by human resources to accommodate the needs of industry 4.0. This is to ensure that every human being has the competitive advantage, good employability and to prevent the skill-biased, where the supply of skilled labor does not meet the demand for a job (Liu & Grusky, 2013).

The skill-biased phenomenon occurs also in Aceh. Aceh is the only province in Indonesia that obtains special autonomy to implement Sharia Law, has become a special region in the field of Education. Aceh has the flexibility to determine strategies and policies for human resource development. Various efforts and models have been made by the Government and higher education institutions in Aceh, to accommodate the industrial revolution 4.0 era. However, these efforts and models are still not optimal in producing quality human capital needed by Industry 4.0. Based on the publication of Central bureau of statistics of the Republic of Indonesia (2020), Aceh is still the second-highest position of the *Open Unemployment Rate* province in Sumatra, with an unemployment rate of 6.20 %. Ironically, the majority of these unemployed are individuals who have completed higher education.
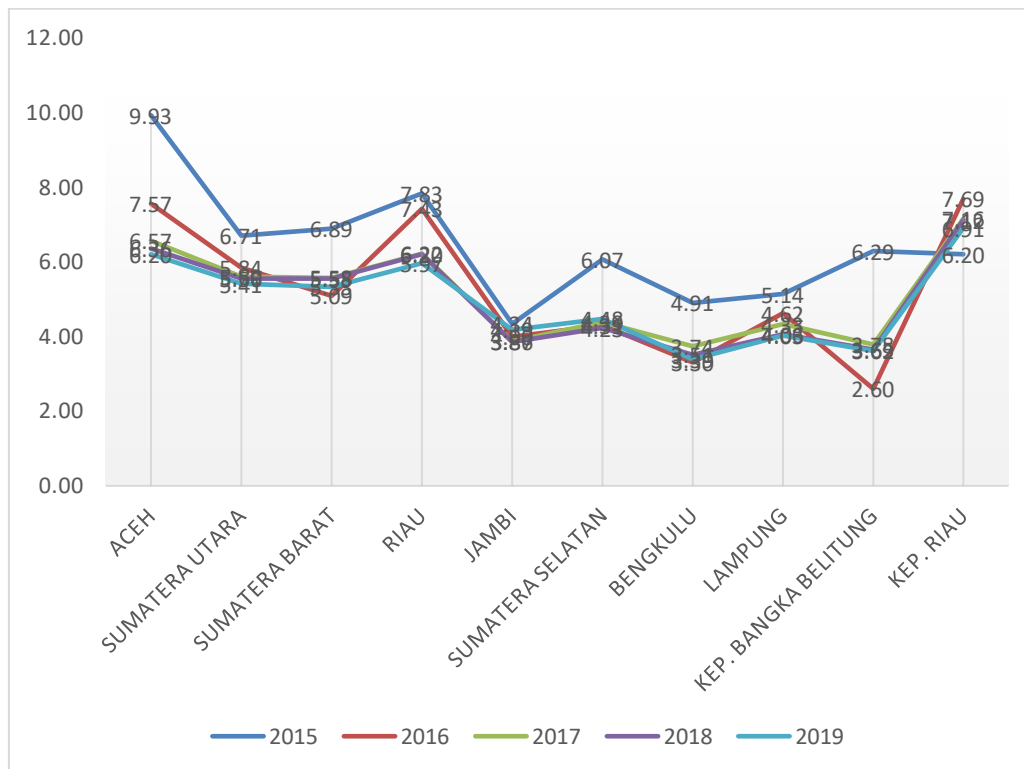
Figure 1 Open Unemployment Rate Province in Sumatra, Indonesia 2015-2019

Source: Central bureau of statistics of the Republic of Indonesia, 2020

The increasing number of unemployed shows that graduates of higher education institutions in Aceh do not have sufficient competency, pieces of knowledge, skills, and abilities to compete in the labor market. Besides, the current HRD model has not been optimized in producing the human capital that have a high employabilitylevel. To understand this phenomenon, 2 questions will be answered, which are:

RQ1. What are the competencies needed in the era of the industrial revolution 4.0 in Aceh?

RQ2. What is the model for developing human capital to meet the needs of the era of the industrial revolution 4.0 in Aceh?

Empirically, the literature shows that there is still a lack of research that identifies the competencies for industry 4.0 in Aceh, that will be used by decision-makers to develop a HRD model in Aceh. This development model is important because the regional development of Aceh and Indonesia cannot be separated from the science, technology, and innovation that is inherent in human resources. Thus, the development of qualified human resources with mastery of science, technology, and innovation is the main pillar of the development for achieving the Golden Indonesia 2045 vision.

2 Literature Review

2.1 Industrial Revolution 4.0

The history notes that technological developments are the main factors causing a shifting paradigm and the emergence of the industrial revolution, including the industrial revolution 4.0 (Lasi *et al.*, 2014; Kazancoglu & Ozkan-Ozen, 2018; Low *et al.,* 2019). The industrial revolution 1.0 focused on the use of new work methods and technology, to replace manual labor with limited work equipment. The industrial revolution 2.0 focused on the use of machines and innovation on the assembly linesin factories. While, the 3rd industrial revolution was marked by the discovery of semiconductors, personal computing, and the internet. Today, we are in the era of the 4th industrial revolution, or Industry 4.0, where computer systems and automation combined in new ways with robots connected to computer systems via machine learning algorithms (Low, *et al.,* 2019). Schwab (2017) stated that the 4th industrial revolution is a continuation of the 3rd industrial revolution, which is characterized by technological disruption which is a combination of physical, digital, and biological domains, in the form of the Internet of Things (IoT), Artificial Intelligence, New Materials, Big Data, Robotics, Augmented Reality, Cloud Computing, Additive Manufacturing 3D Printing, Nanotech & Biotech, and Genetic Editing.In line with Schwab (2017), Hermann, *et al.* (2016) identified four main components of Industry 4.0, namely: Cyberphysical Systems (CPS), Internet of Things (IoT), Internet of Services (IoS), and smart factories. Gates and Bremicker (2017) supported the same idea, who define Industry 4.0 as a combination of CPS, IoT, and IoS to create a

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"smart factory". Geissbauer *et al.,* (2016) then placed all these digital technologies in the "wheel-type framework for Industry 4.0".

In this rapidly changing working environment, each individual must prepare himself to face every challenge, by having the right mindset and being proactive and adaptive to accept the inevitable changes. What the most important is how to ensure that each individual can adapt quickly and equipped them with the right skills to increase their employability (Low *et al.,* 2019). Related to this, Schwab (2017) stated that these various computer and automation technologies will have a disruptive effect, where computer technology and automation will replace the role of humans in workers. This, of course, soon will result in the loss of several working fields. As a result, this condition will force many workers to become unemployed or be forced to change the skills they have. Also, Schwab (2017) said that computer technology and automation have also a capitalization effect, where the need for new goods and services will generate new job opportunities. As well as various jobs that will remain exist, because they cannot be replaced by computers and automation technology, such as social workers who take care of mental health and substance abuse, psychologists, human resource managers, computer system analysts, marketing managers, etc.

2.2 Human Capital

The human capital theory was first popular in the work of Nobel Prize winner Gary Becker. Becker (1964) assumed that an increase in human capital would greatly affect future income, both from a monetary and psychological perspective. The capitals are inherent in humans, such as expertise, knowledge, and level of health. From this definition, Becker (1964) developed a theory of human capital, to explain how the characteristics of human capital will be a good value to individuals, families, institutions, or society, and how individuals make investment decisions that they will make to obtain human capital (Harris*et al.,* 2018).

This theory then developed rapidly and was widely adopted by researchers in many studies and works of literature. In the management literature, human capital is defined as the knowledge, skills, and abilities possessed by an individual that can be utilized to produce an outcome (Hitt *et al.,* 2001). Wright and McMahan (1992) and Wright *et al.* (1994) introduced the concept of the human capital pool, which describes the collection of human capital characteristics of an institution. The results of these researches indicate that various attributes of human capital, such as knowledge, skills, abilities, experience, and educational level of employees, greatly affect the performance achieved by units in an institution.

Other researchers have also proven that human capital is the best predictor to the sustainability of an organizationand offered the best Return on Investment (ROI) (Ployhart *et al.,* 2014; Nyberg *et al.,* 2014; Mawdsley & Somaya, 2016; Delery & Roumpi, 2017; Boon*et al.,*2018). Therefore, executives believe in the importance of human capital, where it should be able to demonstrate the combination of the various elements of human capital can be measured, developed, and utilized with reasonable benefits for long-term survival and organizational growth.

2.3 Human Capital Development in The Industrial Revolution 4.0 Era

In general, the human capital term is understood as the expertise, ability, knowledge, and experience of someone to do his job satisfactorily. Based on this understanding, human capital development can be defined as a process to improve the skills and competencies of people, by developing their competencies through various activities such as providing training, education, and good human resource management (Abdullah, 2012). For this reason, all activities aimed to improve the quality, expertise, and competence of each individual, is the process of developing human resources. Following the opinion of Hamlin and Stewart (2011) quoted by Hecklau*et al.* (2016) states that there are 4 main objectives of the human resource development process, which are (1) increasing the effectiveness & performance of individuals/groups; (2) improve organizational effectiveness & performance; (3) develop knowledge, skills & competencies of human resources; and (4) increasing the potential & personal growth of human resources.

Meanwhile, Islam sees the development of human capital in a more comprehensive manner, which includes of all human elements, both physical, intellectual, psychological, and spiritual development (Abdullah, 2012). Islam does not distinguish between competent and incompetent, as well as skilled and unskilled persons to be considered as part of human capital (Abduhu in Abdullah, 2012). But the most important thing is the extent to which a person has the ability and experience to fulfill his goals and responsibilities on this earth. Thus, the development of human capital in Islam means how to equip someone with the capital and the appropriate means, so that he can functioning to provide better service to the community, following the demands of the environment in whatever era he lives in.

For the needs of the industrial revolution 4.0 era, the World Economic Forum (2016) published research related to "The Future of Jobs Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution". Based on the research, concerning the overall scale of demand for various skills in 2020, more than one-third (36%) of all jobs in all industries required complex problem solving, followed with social skills at 19%, process skills at 18%, and the lowest need are physical ability such as physical strength or agility, at 4%. Hecklau *et al.* (2016,

2017) in his research also emphasized the importance to remap the competence of human resources in the era of the industrial revolution 4.0. Individuals who lives in the era of the 4.0 industrial revolution will face many challenges due to the disruption, such as economic challenges, social challenges, technical challenges, environmental challenges, and political and legal challenges. To deal with this condition, the employer requiring workers who are agile and able to perform various types of tasks and jobs in very different contexts (Gleason, 2018). Soo, the workers must have holistic competencies, such as technical competencies; methodological competence; social competence; and personal competence (Hecklau*et al.,* 2016). For this reason, human resource development must also be directed towards strengthening the various elements of competence needed, such as complex problem-solving skills, critical thinking, creativity, social skills, coordinating with others, emotional intelligence, decision making, service orientation, negotiation skills, and cognitive flexibility.

3 Methodology

This study used a mixed-method research approach, that integrating qualitative and quantitative research results. Qualitative research was conducted by interviewing HR development experts and practitioners in Aceh who were selected purposively. The interview process is carried out in a semi-structured manner, that offers a focused structure for discussion, but not in too strict a manner (Holloway & Galvin, 2017). The results of the interviews are documented, and all the processes of qualitative data analysis are using content analysis (Hsieh & Shannon, 2005; Creswell & Clark, 2011; Lune & Berg, 2017)

All the findings of this qualitative research, especially the elements of the competencies needed to work successfully in Industry 4.0, are then tested in quantitative research. This quantitative research was conducted by surveying 337 respondents who worked in various fields of work in Aceh, such as education, manufacturing, services, public services, health, banking, trade, technology and telecommunications, and others (see table 1). The data collected through this quantitative study were analyzed using Exploratory Factor Analysis (EFA). The main objective of EFA is to define or determine the structural basis of the variables or subjects analyzed (Hair *etal.,* 2019).

Table 1 Characteristics of Respondents

Characteristics		N	(%)
Gender			
a.	Male	150	44.5
b.	Female	187	55.5
Age			
a.	< 25 years old	68	20.2
b.	25 - < 35 years old	159	47.2
c.	35 - < 45 years old	71	21.1
d.	45 - < 55 years old	30	8.9
e.	> 55 years old	9	2.7
Education Level			
a.	Diploma (D1-D4)	40	11.9
b.	Bachelor (S1)	199	59.1
c.	Master (S2)	79	23.4
d.	Doctor (S3)	40	5.6
Field of Work			
a.	Manufacturing	10	3.0
b.	Services	49	14.5
c.	Education	125	37.1
d.	Public Services	50	14.8
e.	Health	36	10.7
f.	Banking	20	5.9
g.	Telecommunication	3	0.9
h.	Technology	1	0.3
i.	Trade	40	11.9
j.	Others	3	0.9
Length of Work			
a.	< 5 years	177	52.5
b.	5 - <10 years	74	22.0
c.	10 - < 15 years	43	12.8
d.	15 - < 20 years	25	7.4
		18	5.3

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e.	> 20 years	

Source: authors own study (2020)

4 Results and Discussions

4.1 Qualitative Results

The content analysis of the interviews' transcripts concluded a consensus that competencies are the main assets for an individual to work in Industry 4.0 in Aceh. This is supported by informant 1 saying that:

"To be ready to face an era that is developing very rapidly and its changes are irregular, there must be a thought that competencies should be a priority in human development in higher education institutions ... someone's success is determined by 80% by his competencies or soft skills, not by his hard skills."

The same thing was conveyed by informant 2 saying that:

"The learning process must be done by equipping individuals to have a competencies or soft skills"

From these two opinions, it shows that the development of competencies or soft skill is a dominant factor that must be prioritized in developing human resources in the era of the industrial revolution 4.0. The results are in line with research conducted by Low *etal.* (2019) stating that hard skills are fundamental, but competencies are equally important. Every individual can show their technical expertise from the qualifications and everything they have. What distinguishes one person from another is their competencies (Low *et al.,* 2019). For this reason, an employer will prefer to hire someone with average grades but has good competencies or soft skills that allow him to thrive in the workplace. It is also following what was presented by the informant 3 saying that:

"For being a successful person, there are several things that integrated and inseparable, which are attitude or behavior, knowledge, skills, and hard work"

The same thing was also conveyed by informant 4 saying that:

"An individual is said to be superior if he is superior in attitude as a person, superior in behavior and intellectually superior."

From the expert's view, competencies are the main factor needed by individuals to work in the era of the industrial revolution 4.0. The question that arises after is, what kind of competencies and soft skills are required. The informants stated that there are several competencies that are the main assets for a person to work in the era of the industrial revolution 4.0. Informant 2 said:

"Building a sense of responsibility, shaping attitudes and behavior, having empathy and contextual sensitivity, having communication skills and the ability to work well together, are important assets for success and work"

Similar to what informant 4 said that:

"Apart from attitudes and behavior, knowledge and skills, hard work, and human relations are very important"

This is also consistent with informant 1 who said that:

"We know that all people or most people want to be with good people, not smart people. Whether it's not more intellectual, but more personal and spiritual. For that reason, we must form believe for them, we have to form personality, have strong interactions, where they can openly accept differences, their individualism becomes less dominant, and their communication is good"

These various opinions in line with Hecklau*et al.* (2016, 2017), who states that there are 4 competencies that individual needs to be able to compete and survive in industry 4.0, which are: technical competence, methodological competence, social competence, and personal competence.

4.4 Quantitative Results

The quantitative results begin with describing the data which represents the respondents' perceptions of all the competencies required to work in Industry 4.0 in Aceh. The descriptive statistics includes the minimum and maximum values, the mean value, and the standard deviation (see table 2).

Table 2 Descriptive Statistics

Competencies	N	Minimum	Maximum	Mean	Std. deviation
Motivation to continue learning	337	2.00	6.00	5.63	0.64
Compliance and being responsible	337	2.00	6.00	5.57	0.66
Ability to cooperate and compromise	337	2.00	6.00	5.54	0.68

Skill to solve problems	337	3.00	6.00	5.52	0.66
Skill to resolve conflicts	337	3.00	6.00	5.48	0.67
Skill to make decisions	337	2.00	6.00	5.48	0.69
State of the art knowledge related to the work	337	2.00	6.00	5.46	0.70
A sustainable mindset	337	2.00	6.00	5.44	0.69
Analytical skills	337	2.00	6.00	5.41	0.81
Technical skills	337	1.00	6.00	5.40	0.76
The process understanding	337	1.00	6.00	5.39	0.77
Skills in developing networking	337	1.00	6.00	5.36	0.91
Has flexibility	337	2.00	6.00	5.35	0.76
Media Skills	337	1.00	6.00	5.25	0.89
Ability to work under pressure	337	1.00	6.00	5.22	0.90
Ambiguity tolerance and accepting change	337	2.00	6.00	5.14	0.88
Understanding of IT and security	337	1.00	6.00	5.12	1.07
Foreign language skills	337	1.00	6.00	5.05	1.09
Digital skills	337	1.00	6.00	5.02	1.14
Intercultural skills	337	1.00	6.00	5.00	1.00

Source: authors own study (2020)

Table 2 shows that motivation to continue learning (m = 5.63 out of 6, where 1 is very insignificant and 6 is very important), compliance and being responsible (m = 5.57), and the ability to cooperate and compromise (m = 5.54) as the 3 most important competencies needed to work successfully in Aceh. Interestingly, respondents also perceive that intercultural skills are the competencies with the lowest level of importance (m = 5.00) compared to other competencies.

Furthermore, factor analysis is used to answer questions and achieve the first research objective, which is to identify and map out the competencies needed to be successful in industry 4.0 in Aceh. In this study, the factor analysis method used is Exploratory Factor Analysis (EFA). The first step in EFA is to assess the overall significance of the correlation matrix with the Bartlett test and the factorability of the overall set of variables and individual variables using the measure of sampling adequacy (MSA). The Bartlett's of Sphericity and the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy was conducted. The table 3 shows the Bartlett's test finds that the correlations, when taken collectively, are significant at the 0.001 level, and indicates that sufficient correlations exist among the variables to proceed. The Kaiser-Meyer-Olkin test also indicated that the overall MSA value falls in the meritorious range (above 0.80) with a value of 0.938 (see tabel 3).

Table 3 Bartlett's of Sphericity and *Kaiser-Meyer-Olkin* Tests

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.938
Bartlett's Test of Sphericity	Approx. Chi-Square	4411.259
	Df	190
	Sig.	0.001

Source: authors own study (2020)

The second step was to extract the factors, and to assess the dimensionality of the competencies needed in Industry 4.0. We used the principal component analysis method to extract the factors (Hair *et al.,* 2019). There are four components retained represent 68.63 percent of the variance of the 20 variables, deemed sufficient in terms of total variance explained (see table 4). Component 1 has an eigenvalue of 9.790 being a factor 1 which can explain 48.95% of the variation in the competency. Furthermore, successively component 2 has an eigenvalue of 1.586 which becomes a factor of 2 which can explain 7.93% of the variance; component 3 has an eigenvalue of 1.343 being a factor of 3 which can explain 6.72% of the variance, and component 4 has an eigenvalue of 1.007 being a factor of 4 which can explain 5.04% of the variance in the competencies needed in Industry 4.0.

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Table 4 Matrix of Total Variance Explained

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.790	48.951	48.951	9.790	48.951	48.951	3.847	19.237	19.237
2	1.586	7.928	56.878	1.586	7.928	56.878	3.692	18.459	37.695
3	1.343	6.716	63.594	1.343	6.716	63.594	3.500	17.499	55.195
4	1.007	5.035	68.629	1.007	5.035	68.629	2.687	13.435	68.629
5	.698	3.492	72.122						
6	.666	3.330	75.451						
7	.619	3.096	78.547						
8	.538	2.692	81.239						
9	.475	2.374	83.613						
10	.453	2.265	85.878						
11	.430	2.149	88.027						
12	.358	1.790	89.817						
13	.350	1.748	91.566						
14	.317	1.584	93.150						
15	.300	1.499	94.649						
16	.278	1.391	96.039						
17	.237	1.183	97.222						
18	.211	1.057	98.279						
19	.178	.888	99.167						
20	.167	.833	100.000						

Extraction Method: Principal Component Analysis.

Source: authors own study (2020)

To identify the structure of the component, we rotated all extracted factors using the varimax rotation. The rotation gives good results in maximizing the amount of variance that can differentiate the factors (Hair *et al.*, 2019). An optimal factor structure, exists when all variables have high loadings (more or equal to ±0.50) only on a single factor and very low loadings on all other factors. While items that have a loading factor below ±0.50 and cross-loadings of a variable be excluded from the analysis. The table 5 shows the factor solution was derived from principal component analysis with a Varimax rotation of 20 competencies needed in industrial 4.0 in Aceh.

Table 5 Matrix of the Rotated Component

Rotated Component Matrix [a]

Competency Items	Component			
	1	2	3	4
A sustainable mindset	0.706			
Has flexibility	0.697			
Ability to work under pressure	0.688			
Ambiguity tolerance and accepting change	0.674			
Compliance and being responsible	0.612			
Motivation to continue learning	0.597			
Ability to cooperate and compromise	0.559			
Digital skills		0.836		

Rotated Component Matrix [a]

Competency Items	Component			
	1	2	3	4
Understanding of IT and security		0.827		
Media Skills		0.671		
Networking Skills		0.598		
Intercultural skills		0.594		
Foreign language skills		0.562		
Skill to solve problems			0.796	
Skill to resolve conflicts			0.788	
Skill to make decisions			0.690	
Analytical skills			0.600	
The process understanding				0.790
State of the art knowledge related to the work				0.785
Technical skills				0.760
Extraction Method: Principal Component Analysis.				
Rotation Method: Varimax with Kaiser Normalization.[a]				
a. Rotation converged in 6 iterations.				

Source: authors own study (2020)

The Matrix of the rotated component clearly shows there are 4 main factors that form the constructs of competency. Factor 1 consists of 7 elements that reflect the various competencies, such as: having a sustainable mindset, having flexibility, the ability to work under pressure, ambiguity tolerance and accepting change, compliance and being a responsible, motivation to continuous learning, and the ability to cooperate and compromise. When viewed from the structure of its constituents, the factor 1 is called personal competence. Personal competence is a competency that includes motivation, attitudes, and social values possessed by an individual (Hecklau*et al.,* 2017). This competency is very personal and inherent in an individual, making this competency difficult to measure and train.

Interestingly, the results showed that the personal competency is the most important. When compared with the other three competency elements, the contribution of this personal competence is the largest. These dimensions can explain 48.95% of variance changes in competency constructs that a person needs to succeed in the labor market. This is very reasonable considering the conditions of industry 4.0, which have forced an individual to live in a work environment that continues to change very quickly, despairing, and full of uncertainty. Besides, individuals must also deal with "human-machine interface challenges" which will replace their roles in work, as a result of the company's business model transition to adapt to the conditions of industry 4.0. This condition will certainly have an impact not only on one's productivity, but also on the dimensions of work, work dynamics, working conditions, the education system, and the demands for skills that a person must have (Liboni *et al.,* 2018), as well as his ability to cope with stress, working fatigue, and balancing life and work that individuals want to achieve (Flores *et al.,* 2020). To adapt to the various demands of change, various dimensions of personal competence, become very important. For example, the increasing of work that is done virtually, has made an individual no longer bound by time and place. So that he can work anywhere and anytime. Besides, frequent rotation in tasks and jobs requires a person to have higher flexibility and accept the changes, ambiguity tolerance, and be able to work together and compromise with the entire work team, to meet job demands and responsibilities properly and effectively (Hecklau*et al.,* 2016; Flores *et al.,* 2020).

The second most important factor in the competency constructs is social competence. The results showed social competence was able to explain 7.93% of the competency profile needed by an individual. This social competence is a competency that includes attitudes, abilities, and skills to form social relationships easily, build cooperation, and communicate with others (Hecklau*et al.,* 2017). This social competence allows a person to achieve common goals fairly in the social interactions where they live in. They will easily take on their social responsibilityand will greatly help the organization to coordinate all its heterogeneous employees, encourage cooperation, and rapid adaptation to a new work environment quickly. The results of this study identified 6 elements of social competence, which are: having digital skills, having an understanding of IT and security, media-related skills, networking skills, cross-cultural skills, and language skills. The results are consistent with Flores *et al*. (2020), said that in disruptive industry 4.0, individuals who are flexible and have social competence will greatly determine the success of their work and organization. Industry 4.0 has created many new opportunities for individuals and organizations, especially by involving and interacting with individuals and institutions from various countries. To synergize these various opportunities, the ability of an individual to build networks, have cross-cultural expertise, and foreign language expertise is very important. With these various

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competencies, a person will easily build interconnections, make adjustments, and centralize the job positions they want in the collaboration and network of their multicultural organizations (Weilkiens, 2015).

Other interesting findings showed that a person's social competence is also shaped by digital expertise, IT understanding and security, and media skills. This digital expertise is a capability that enables individuals to operate digital media, such as computers, devices, networks to search, process and apply data in digital media (Van Dijk & Hacker, 2003 in Flores*et al.,* 2020). This digital capability supports interaction and communication, whether personal, social, and professional (Flores *et al.,* 2020). Almost all activities of the value chain of business are increasingly digitalized, including various activities related to consumers. This condition cannot be separated from the presence of industry 4.0 which encourages the realization of personalization of products and services, which requires reconfiguration of the on-demand production systems, adopting a flexible, adaptable, and efficient manufacturing network, and also enabling the integration and communication between producers and their consumers. The future "*smart factories*" will be empowered by Internet of Things (IoT), and IoT will create the Internet of People (IoP) (Miranda *et al.,* 2015). All of these conditions will change the company's communication structure, and the consumers will become a part of the information exchange network system, in the company's manufacturing process. For this reason, digital expertise, understanding IT and security, and media skills are become apart of individual's social competence, and have a significant impact in building and maintaining these relationships (Liboni *et al.,* 2018).

The third factor of the competency is methodological competence, that can explain 6.72% of competency required by an individual. This methodological competence is all the abilities and skills that a person needs to solve problems and make decisions (Hecklau*et al.,* 2017). This study identified 4 elements of methodological competence, which are: problem-solving skills; conflict resolution skills; decision-making skills; and analytical skills. In the era of the industrial revolution 4.0, an individual will work in an increasingly complex and decentralized environment. He will face many problems and conflicts in his work. Flores *et al.* (2020) said that the 4.0 industrial revolution has changed the company's operational structure in 4 things, which are: (1) company operations will be greatly helped by the existence of a cyber-physical system; (2) decentralization in the decision-making and planning process; (3) continuous integration of processes and cross-functional perspectives will become the norm; and (4) The quality of production and maintenance will become automatic, resulting in increased complexity and expertise to integrate and manage. This condition has changed the patterns of interaction between employees, as well as various work activities that demands to be done in a more coordinated, creative and strategic manner. Besides, Industry 4.0 also demands a higher service orientation and the relationship between companies and consumers. This will have an impact on the amount of data that must be checked, information sources must also be checked on an ongoing basis, and the responsibility for these various processes will be higher. These various demands will become part of the methodological tasks, that requiring qualified methodological competences. With these methodological competencies, individuals will be able to independently solve various new and complex problems, based on the results of the thoughts they have learned and their working methods (Flores *et al.,* 2020).

Finally, the fourth factor of competency construct is technical competence. Technical competence is the knowledge, skills, and abilities needed by an individual to fulfill his job duties and responsibilities which leads to an acceptable level of performance (Hecklau*et al.,* 2016). Robles (2012) defines the technical competence as the ability and knowledge required by a person to perform a variety of jobs, craft, and trade, which requires dexterity, training, and experience. Flores *et al.* (2020) stated that technical competence are specific knowledge and skills required for certain jobs, which are usually specifically trained by companies. These competences are constant and limited for certain work environments, and directly related to the company operations. In the context of this research, 3 elements form the structure of technical competence, which are: the ability to understand process; having the latest state of the art knowledge related to the workand have technical skills. These three elements explained 5.04% of the variance of competency constructs needed in industry 4.0 in Aceh.

At the current time and in the future, the industrial revolution 4.0 will affect all sectors of work and industry, both manufacturing and service systems. Currently, the focus of the industry is on how to develop intelligent and communicative systems to help the production process and other value chain activities, including building a machine-to-machine communication and human-machine interaction. For this reason, most companies will strive to build and develop effective data management, to revolutionize their business using artificial intelligence, robotics, cognitive computing, and the Industrial Internet of Things (Ismail & Hassan, 2019). This business model transformation, of course, will greatly affect the technical competence of employees. The results of this study are also consistent with the results of research conducted by Flores *et al.* (2020) who said that in the era of revolutions 4.0 companies need individuals who are professional and dexterous, especially in digital competencies, understanding the organizational and industry structure, industrial processes, the industrial standard and rules, problem-solving techniques, the use of software, human- machines interaction, setting the digital network, digital security, and digital coding or programming.

Furthermore, this research has also achieved the second research objective, which is to develop a human resource development model needed in the era of the industrial revolution 4.0 in Aceh. In the context of this research, human resource development is a strategic approach to develop effective employment to produce highly committed and qualified individuals who are ready to work and succeed in the era of the industrial revolution 4.0. For the organizations, human resource development focuses on all activities related to professional education, learning, and training for individuals and teams, whose functions greatly affect the development of the organization and its performance, both now and in the future (Hecklau*et al.,* 2016).

Based on the results, figure 2 showed the human resources development model for the industrial revolution 4.0 era in Aceh. The personal competencyis the factor that has the greatest contribution in explaining the variants of competence needed in the era of the industrial revolution 4.0 in Aceh. For this reason, this personal competency must be the priority in the development, which is then also followed by various other competencies, such as social competence, methodological competence, and technical competence. The results of this study are in line with the mandate of the 1945 Constitution of the Republic of Indonesia, which mandates the government to strive for and implement a national education system that enhances faith, devotion to God Almighty, and noble morals to educate the nation's life and advance knowledge and technology for the advancement of civilization and the welfare of mankind. In the context of higher education, Republic of Indonesia Law Number 12/2012 concerning Higher Education, article 4 also mandates higher education institutions to develop human resources that focus on building capabilities and shaping the character and civilization of a nation with dignity to educate the nation's life; develop innovative, responsive, creative, skilled, competitive and cooperative academicians; as well as developing science and technology. From these two laws, it is clear that the development of superior and competitive human resources is more focused on aspects of development that strengthen identity or soft skills as well as other competency elements to make qualified human resources.
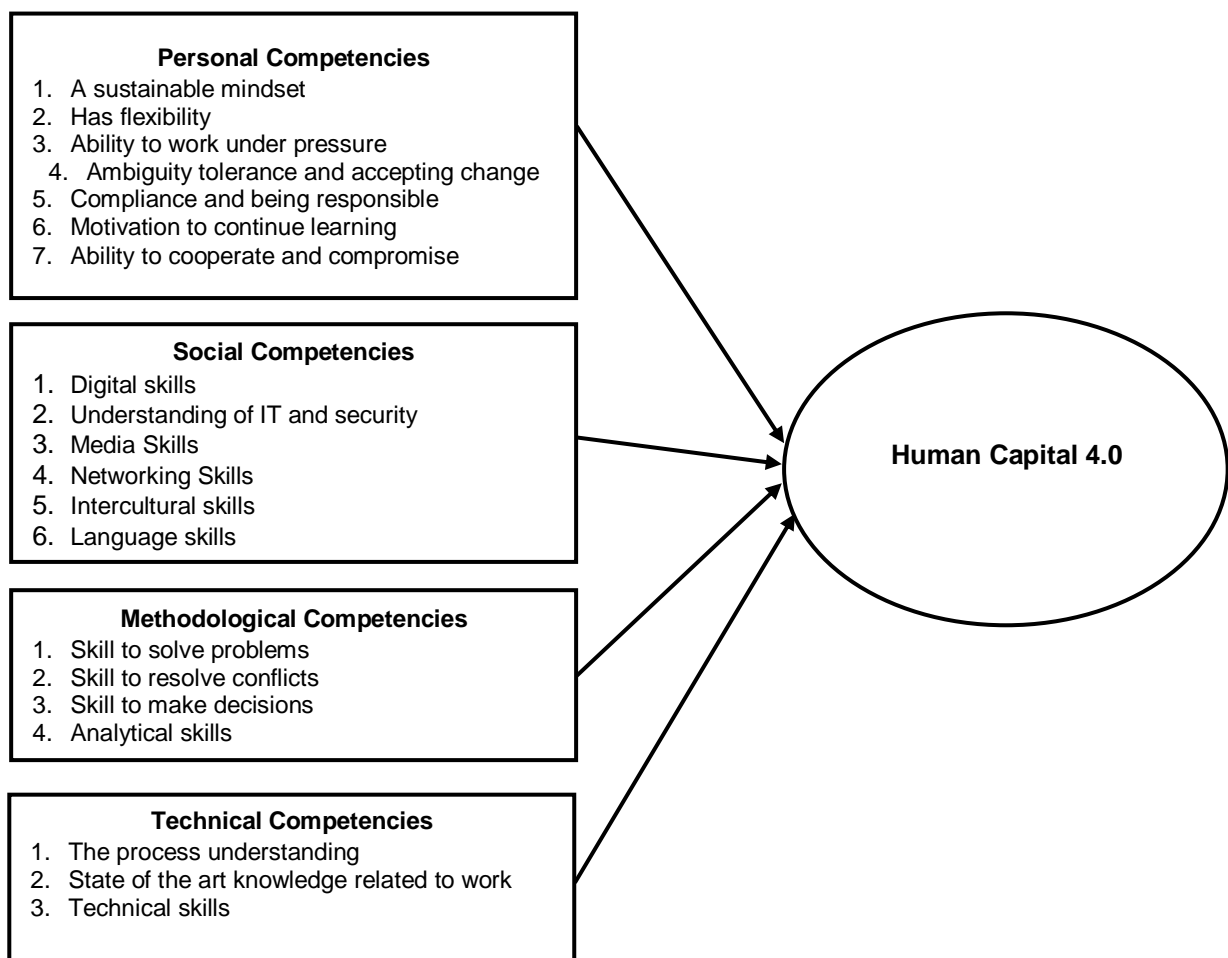
Figure 2. The human resources development model for the industrial revolution 4.0 era in Aceh
Source: authors own study (2020)

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5 Conclusion

Industry Revolution 4.0 era has led to disruption and transformation in daily and working life. Individuals must be prepared to face the challenges of a work that is globalized, automated, virtualized, and world connected network, andtransform these challenges into something useful. For this reason, each individual needs to carry out a self-assessment to identify their strengths and weaknesses, hence it will be easier to identify areas that need to be developed. The results of this study indicate that individuals must develop and strengthen various elements of personal competence, such as having a sustainable mindset; flexibility; ability to work under pressure; ambiguity tolerance and accepting the change; compliance and being responsible; motivation to continue learning; ability to work under pressure, and to cooperate and compromise. Also, individuals must strengthen the elements of their social, methodological, and technical competences.

To support this human capital development process, the government must also involve proactively, by setting a direction for human capital development that focuses on developing and strengthening personal, social, and methodological competencies, to support technical competencies that have been the primary focus of the development. The government can strengthen the quality of each individual through training programs and workshops on the aspects of technical competence, such as operating high-tech machines and software as an effort to adapt to the industrial era 4.0. However, the results of this study indicate that the successful implementation of all new and sophisticated technologies resulting from Industry 4.0 is largely determined by the attitudes and behavior of the people. In the end, these human resources are the drivers of all the changes that are happening today. For this reason, it is very important to pay attention to these personal, social and methodological aspects in the making of regulations and government policies. Furthermore, the government is also expected to provide more grants, financial assistance, and sponsorship for the development of personal, social, and methodological competences, in addition to technical competencies, so that each individual has a greater opportunity to develop themselves and be ready to work successfully in the industrial revolution 4.0.

Finally, higher education institutions must also play an important role in the development of human capital, following the needs of the industrial revolution era 4.0. The universities must actively incorporate the various elements of personal competence identified in this research into their curricula and subjects. Modules, learning plans, and teaching styles must be able to promote the improvement of these various competencies and soft skills. Besides, an internship program with mentors from the industry is also a viable solution. Through this program, individuals can gain technical knowledge and experience directly related to the field of work and can develop personal, emotional, and social competencies that are following the fields and special interests of these students.

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