


# Literature Review On The Role Of Decision-Making System For Indonesian Workforce Recruitment In Industrial Revolution 4.0

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Article Info	ABSTRACT
<p><b>Keywords:</b> Industry 4.0, Human Resource, Workforce, Decision Making System, AHP.</p>	<p>Industry 4.0 is impacting the world of work, increasing efficiency and effectiveness while posing challenges for human resource management in terms of talent acquisition. Automation and technological advancements require new skills for workers to remain competitive. However, surveys show that graduates in Indonesia do not have the skills and knowledge that match industry demands, resulting in a mismatch between labor supply and demand. Human resource professionals must adapt to the rapidly evolving industry by making effective and efficient decisions in the recruitment and selection process. Decision-making systems play an important role in optimizing this process, especially through the use of Analytical Hierarchy Process (AHP) in Industry 4.0 using big data and the internet. Through a systematic literature review, the potential of AHP in supporting decision-making for human resource selection/recruitment in the Indonesian workforce and Industry 4.0 is explored. AHP's ability to consider multiple criteria and weights among alternatives enables flexible and structured decision-making, making it a suitable tool for recruitment and selection processes.</p>
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## INTRODUCTION

We are in the midst of 4th industrial revolution has transformed the way we produce products with advance digitalization together with internet technologies. Interconnection with data/ information sharing is the power of industry 4.0 (Marr, 2018). It offers some applications to identify opportunities as the machines collect and share big data about performance, data analysis, that offers opportunities of optimization for the operation to be more efficient and effective. The companies need to upskill their current workforce to take the new responsibilities and recruit new employees with the right skills. According to Haris Munandar (Kepala Badan Penelitian dan Pengembangan Industri), welcoming the industry 4.0, there are some fields that need to be prepared: automation, machine to machine communication, human to machine communication, continuous technology development. The human resources need to prepare with the high skills requirement.

As increasing automation in industry 4.0, there are huge challenges faced by workforce that the jobs are being replaced by machines and the skills or qualification requirements rapidly changes. There is labor (workforce) supply and demand mismatch especially in Indonesia where the workforce cannot find the right job based on their skillset (Callista et al., 2022; Rahadian, 2019). The big challenge also faced by human resource in organization or companies to find the right talent and person that fit with the job requirement and organization. With the fast pace industry and talent competition, it is essential for the recruitment and selection process take place within short time in most effective and efficient way. However, the recruitment and selection process is still manual by sending resume and the company needs few days (weeks) to process the application and make decision to hire employees. Therefore, decision making system is essential for users or managers to make the right decision regarding recruitment, selection and hiring at the right place and right time with right talents based on job and skills requirements.

Some researches attempt to address the decision making system using AHP in various field and case study. Review by (Dahlan et al., 2023) discuss how far the AHP application as decision making system in sports training which help to design the recruitment of players, coaches, and type of training. Previous research by (Butar et al., 2023) use analytical hierarchy process (AHP) as employee recruitment decision support system in Security Services Companies. The decision support system will automate the recruitment and selection process by choosing the applicants (alternatives) considering criteria and weight that are assessed by companies. Research by (Rachman, 2008b) design the decision making system software based on AHP methods and TOPSIS that can support the users to assess and decide the ideal candidates based on criteria and weight.

This review attempts to address the key issue of decision-making system (in particular by using Analytical Hierarchy Process) role in human resource recruitment and selection process in the context of industry 4.0. With Analytical Hierarchy Process methods that uses criteria, weight, and alternatives, it has promising method for decision making system in human resources recruitment process that also have criteria (skills, experience, education, etc), weight, and alternatives (potential candidates). The criteria can be customized according to the industry & job requirement/ demand, the weight is based on the importance for each criteria and the alternatives can be enhanced based on the potential candidates. The expected result of the research is to propose the use of AHP in decision making system tool provides the flexibility that much needed in industry 4.0 in deciding the right candidate for the job, especially in Indonesia workforce context.

## METHODS

This study used Systematic Literature Review (SLR). Researcher methodology including collecting secondary data, identifying, analyzing, reorganizing and formulating all the information from previous research or study about the research topic, through articles and journals on Google Scholar, digital libraries, websites and browsers using the tools search term and keywords related to the topics of research such as “AHP”, “decision making system” in the scope of industry and human resource. Library research is the research that

is conducted by utilizing data sourced from books, journals, documents and magazines without require field studies (Wohlin et al., 2020). The analysis of data in this research consists of data collection, data selection based on the scope of this research, data reports and conclusion (Luh et al., 2021).

Data collection methods include observation and literature studies. In this research observation with the objective of finding information related to the research related to Data/ statistic/ survey in 2018-2023 by organization and HR companies, such as LinkedIn, Indef, Badan Pusat Statistik, PWC Asia Pacific about the educated and unemployment workforce in Indonesia, skill requirement in globalization and industry 4.0, the use of technology by applicant in finding job. The finding of the data collection will give support the background of this research in relation with Indonesia workforce in context of industry 4.0 and Articles, national and international journal regarding decision making system and analytical hierarchy process (AHP) from 2007-2023. Data selected based on the scope of relation and application of decision making system (in parcticular AHP) in human resource and based on the real case study. Eight articles were selected as shown in table 2. All articles refer to a case study and the object of these articles to evaluate of the real cases where Analytical Hierarchy Process was used and implemented by different criteria, weight and alternatives based on the real case study.

## RESULTS AND DISCUSSION

### Challenges Face by Human Resource for Workforce in Indonesia

Based on Badan Pusat Statistik (BPS), the labor force in Indonesia estimated 144.01 million by February 2022, which is 69.06% of the total working age population in Indonesia (208.54 million). This is huge population that needs to be focused in term of how to match and balance between workforce demand and supply. According to Indef survey (cited in bisnis.com) The decline rate in the number of unemployed people in Indonesia has been slow since 2012 (Rahadian, 2019). The slow rate of decline in the number of unemployed is followed by the increasing number of unemployed labor force with a vocational (SMK) and higher education (PT) background. The increase in unemployed graduates of SMK and PT continued to rise throughout 2012-2018. The increase in the number of unemployed SMK and PT graduates is considered the result of the lack of harmony between the supply and demand sides of labor in Indonesia. INDEF researcher Ahmad Heri Firdaus suspects that there are at least two main reasons for the increase in educated and skilled unemployment. One of them is the possibility that the abilities or skills possessed by SMK and University graduates are not in accordance with current industry needs.

As the workforce have difficulties to find the job, the same challenge also faced by human resource. According to Jobvite survey 67% HR practitioners mentioned that biggest challenge in recruitment is to find the skillful and high-quality talents. The challenge of finding the right person for the job is also faced by the human resource as there is talent gap of the skills required (due to demographic, education, or skills), the employee's market, job posting, and social distancing and technology (Callista et al., 2022). The unbalance of supply and demand in the workforce cause the educated (University graduated) workforce

decides to find the job that are not according to their skills or education background. The mismatch of educational background and the current job is horizontal mismatch (Wolbers, 2003) Horizontal mismatch can cause the low job satisfactory level, the low employees' productivity and the loss to national economy as the skills are underutilized from human capital perspective (Somers et al., 2019) . Furthermore, when the recruitment process is complicated when they have to wait for managers or users to make decision, whether from CV screening or decision to move to the next round recruitment process (Nadia Fernanda, 2021) .

With the increasing use of digital/ online recruitment by company, there are opportunities for data analysis and technology to help in human resource to match between the skills and requirement of the job and increasing the efficiency of recruitment process. According to (Skaggs, 2020), 79% of job seekers say they are likely to use social media in their job search. According to Jobvite Recruiter Nation Report, 60% of recruiters are investing in company career websites, 28% recruiters are investing via job boards (Jobvite Recruiter Nation Report 2016 | Jobvite, n.d.) . According to Zippia, 92% of employers use social media sites to find talent (Flynn, 2023).

**Table 1.** Job Discoveries on Social Media by Generation

Generation	% of people discovered job vacancy on social media
Gen Z	62%
Millenials	56%
Gen X	31%
baby Boomers	12%

Based on the statistics shown in Zippia, there is increasing social media use to discover job from generation baby boomers to gen Z (Flynn, 2023). Moreover, due to globalization and industry 4.0 cause challenges to companies such as increasing customer demands of good quality, more affordable, customized, and fast to obtained products: fast technology development, and fierce competition. As companies need to adapt to these changes and challenges, there are significant changes in the job skills requirement that force the workforce to learn and obtain. According to the PWC Global survey, 44% of the workforce believe that the skills required for their jobs will undergo significant changes within the next five years (PwC Asia Pacific Hopes and Fears 2023: Indonesian Employees Are Bullish about AI's Potential in Their Careers, n.d.) Human skill matters most, with adaptability/ flexibility (69%), collaborative skills (67%), and critical thinking (66%) seen as more important than technical or core business skills (PwC Asia Pacific Hopes and Fears 2023: Indonesian Employees Are Bullish about AI's Potential in Their Careers, n.d.).

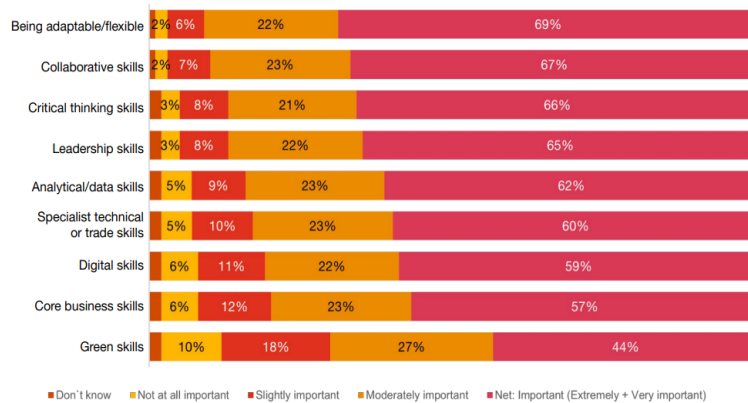


Figure 1. Skills Requirement in Globalization and Industry 4.0

### Overview of Human Resource Management

According to (Richa & Bhar, 2016) primary HR activities as follows Staffing (recruitment and selection), Motivating (salary, benefit, incentive), Training and development, Maintenance. Effective human resource management utilizes the systems and tools to get the right number of people with the right skills and personality (person-job fit) in the right place at the right time.

### Overview of Decision-Making System

The decision-making system is an interactive system which helps the managers in making decisions using data and models to solve the complex (structure, semi structured or unstructured) problems (Rachman, 2008a). According to (Dewi, 2023) decision making steps is shown in the figure 2.



Figure 2. Decision Making Steps

Intelligence phase is the step where the decision maker understands and identifies the problem. Input data is collected to identify the problem. Design phase is the process to understand the problem, find solution, and test the solution validity. The activities in this phase will be finding, developing, and analyzing the alternative. The choice phase purpose is to choose the best alternative that can be implemented in the implementation phase. Decision making system has five characteristics: computer-based system, used to help the decision maker, to solve the complex problem that impossible to use manual calculation, using interactive simulation, and data with analytical model as main components (Sparague & Watson H. J., 1998).

### Analytical Hierarchy Process (AHP)

Model AHP was introduced by Thomas L Saaty in 1980. AHP is the multicriteria methodology by ranking the alternatives of a decision problem by a set of priorities and criteria to achieve a set of goals. The decision is made based on how the alternatives compared according to several criteria and the decision maker will choose the alternative that best meets the decision criteria. The process of AHP (Taylor, 2019)

1. Produce the pairwise comparison matrix for each alternative for each criterion.
2. Mathematical and synthetization steps: sum each column value of pairwise matrices, divide the value in every column by its sum, calculate the average of each row value in the matrices, and combine the vectors of preferences for each criterion.
3. Make the pairwise comparison matrix for the criteria
4. Calculate the normalized matrix
5. Develop the preference vector
6. Calculate the overall score for each alternative
7. Rank the alternatives from highest to lowest
8. Calculate the consistency index (CI) to check the pairwise comparison consistency and validity and divide the CI value with RI (Random Index) value. If  $CI/RI < 0.10$  then the pairwise consistency is satisfactory.

### AHP Applications in Human Resource

There are many AHP applications in Human Resource functions from previous research shown in table below.

**Table 2.** Previous Research Focus on AHP Applications in Human Resource functions.

Author/ Methods	Purpose/ goals	Criteria	Finding/ Results
(Saaty et al., 2007) Use linear programming and AHP to optimize the human resources allocation problems, for example in hiring and filling the position	to determine the number of positions and fill the position with the most suitable applicants for the position that can contribute to the company objectives in BDS located in Pennsylvania	Clinical expansion, meet demand, employee management, product development, product quality, marketing, R&D, manufacturing with each position has different criteria for example: VP of marketing will have criteria such as experience, contact, synergy, education, leadership. The priorities of individuals will be	Results show that to solve the human resource allocation problems with organization objectives, constraints, and optimization tools using AHP and linear programming as the best way to determine which positions and which candidates to hire based on salary and no of people required for each position



Author/ Methods	Purpose/ goals	Criteria	Finding/ Results
		coefficient of objective function in linear programming with constraint of salary and no of people for each position.	
(Rachman, 2008b) Combining AHP and TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) to assess the candidate selection	To propose the application based on AHP and TOPSIS method to help companies in assessing and recommending the ideal candidates.	No criteria given and stated. The criteria, weight and alternatives will be managed by users.	Design the software with the customization concept where criteria, weight, alternatives (candidates) can be uploaded by users that can help to give ideal assessment for candidate selection.
(Abdullah et al., 2013) Use AHP to rank human capital indicators in Malaysia	Propose the analytical pairwise comparison to rank human capital indicators in Malaysia.	With criteria such as talent (T), strategically integration (SI), cultural relevance (CR), knowledge management (KM), and leadership (L) and using indicators as Using knowledge (CRbUK), Employee Skill Index (USI), Sharing and Reporting Knowledge (SaRK) and Succession Rate of Training Program (SRoTP)	Using Knowledge (CRbK) has the first rank which concludes that Using Knowledge is the most important indicator in human resource in Malaysia, followed by SaRK, SRoTP, and ESI.
(Zhang et al., 2014) Use AHP software version 0.5.2. to assess faculty members of school in Tianjin University using	To assess faculty members of school in Tianjin University using performance assessment of teaching, research, and service.	The criteria of teaching (B1) are undergraduate (C1), graduate (C2), rewards on teaching (C3), teaching bases (C4). Criteria for research	The results of the research show that school A has highest score.

Author/ Methods	Purpose/ goals	Criteria	Finding/ Results
performance assessment of teaching, research, and service		(B2) are research fund (C5), patent (C6), publication (C7), rewards on research (C8), key laboratory (C9). There are 17 schools (school A to school Q) to be assessed. The weight is determined using AHP software version 0.5.2.	
(Jurík & Sakál, 2015) using AHP in selection of candidates and evaluation of manager competencies of Industrial Enterprises in Slovakia using AHP classical numerical method and software expert choice (EC).	selection of candidates and evaluation of manager competencies in Industrial Enterprises Slovakia	of and in industrial enterprise no 1 using hierarchical structure of AHP, with alternatives of 6 candidates (A, B, C, D, E, and F) using competencies-qualification requirements (experience, knowledge of English language, university education, knowledge of recruitment methods, high computer literacy, communication ability, flexibility, assertiveness, orientation to detail, perseverance, and patience)	.The result of the model no 1 show that the best alternative is candidate F, followed by candidate A, D, E, C, and B. In the model of evaluating employees (managers) competencies in industrial enterprise 2 with 26 managers (identified as RP1 to RP26) using criteria such as result orientation, cogency of appearance, strategic thinking, coaching, interpersonal sensitivity, identification with process, initiative. The result for model no 2 shows the best alternative is RP 23 followed by RP 6, 9, 16, and 10.
(Özbek et al., 2018a) To determine	To implement AHP web-based application to		The result of the research is AHP web-based application that can be used by decision



Author/ Methods	Purpose/ goals	Criteria	Finding/ Results
personnel selection problem with criteria: educational status, university, experience (in year) and candidate as alternatives	determine personnel selection problem with criteria: educational status, university, experience (in year) and candidate as alternatives		makers who make multiple selections and determine the criteria weight. The screen will show the candidates evaluation and the best candidate recommended.
(Lubis & Amalia, 2021) Assessing employee performance decisions using human resource score card and AHP at PT. PLN (Persero) North Sumatra Generation	To give assessment and evaluation for employee performance decisions at	From Human Resource score card there are 4 KPIs perspectives which are financial (F, 4 KPIs indicators), customer (PK, 3 KPIs indicators), internal business process (PBI, 7 KPIs indicators), and growth and learning (PP, 4 KPIs indicators). From these 4 perspectives there are 18 KPIs indicators. The survey is given to supervisor at PT PLN KITSBU using pairwise comparison and using AHP to know the weight of importance for each indicator. From the AHP score there will be the employee performance assessment.	The results show from financial perspective, the weight is 3.341 (moderate), customers are 3.524 (good), internal business process is 3.357 (moderate) and growth and learning are 3.38 (moderate).
(Butar et al.,	To determine how	The criteria and	The proposed system and

Author/ Methods	Purpose/ goals	Criteria	Finding/ Results
2023) Observation, interview, literature studies. Observation is conducted by observing employee recruitment process in security services companies	to combine AHP method and other techniques to develop employee recruiting decision support system in security services companies	weight are not stated, but managed by HRD to provide in web based AHP	procedure of employee recruitment decision support system using web based AHP is expected to automate the hiring process and simplify the human resource process.

### Opportunities for Human Resource Decision Making Application in Industry 4.0 Using Data and Technology

Although Industry 4.0 gives huge challenges, but it also opens the new opportunities for organization in term of human resource development, labor productivity growth, opportunities of opening new industries, shifting some tasks and responsibilities from human to machines or robots. Globalization creates new opportunities for many countries, for example, the role of labor market constraints (geographical location, underdevelopment, etc.) declines (Adamková, 2020). Using autonomous robots and Internet of Things (IoT) can increase the automation and optimization of production with decreasing reliance on people that can make errors that result in less waste and greater efficiency; therefore, it will help to reduce business operational cost (Ali et al., 2022). The transformation and acceptance of industry 4.0 in personnel is essential and needs to focus on processes and employees themselves (Adamková, 2020). Organizational structure in Industry 4.0 changes in the characteristics due to a changing environment: individuals' empowerment, decentralization, less formal rules, teamwork that more suitable in the full of innovation and changes environment (Lasi et al., 2014).

Human resources are essential for organization as human resources influence efficiency and effectiveness in company to achieve the objective of the business (Rachman, 2008a). Decision making in human resource selection is not easy especially in globalization and competition forcing the companies to be flexible and adapt quickly that results in rapid change of human resources requirements. Thus, the human resource needs to consider of the following (Adamková, 2020):

1. Human resources personnel must have competence to identify the skills needed for the industry and define the new skills that industry 4.0 can bring.
2. HR needs to be more digitally focused and keep up with technology to beat competition.

3. Use of interconnection and integration with focus on new, modern, and efficient communication platform
4. Retraining The decision-making model itself helps to solve the challenges in human resources recruitment by connecting the requirement and selection process with the information technology.

According to (LinkedIn, 2023), convey with the support of technology, large candidate data sets and the application of AHP in decision-making systems in the human resource recruitment process will have a positive impact on human resource performance by eliminating candidates and selecting the best candidates based on organizational goals and personnel selection criteria. (Özbek et al., 2018) with the utilization of AHP method and Application Design will create the possibility to integrate and develop different organizations. This method will help human resources to match between skills and job requirements in a short time and improve the efficiency and effectiveness of the recruitment process with the flexibility to consider, change, and assess multiple criteria of job requirements, especially in the industrial revolution 4.0 where rapid changes are inevitable, organizations must adapt quickly to follow the demands and requirements of the market that impact human resources.

## CONCLUSION

Industry 4.0 has given huge changes for organization and industry. Many companies and workforces must adapt with the rapid change of skills, requirement and demand that has impacted the organization as the whole and also especially the human resource. In Indonesia, although there is increasing University graduates, the human resource in companies or industries face difficulties finding the suitable candidates based on the skills or qualification requirement. As there is increasing change of skill requirement and criteria, it is critical to provide the decision-making application that is suitable for recruitment and selection. Industry 4.0 has given opportunities with technology and big data as the source of tools and data to provide decision making process more effective and efficient. The implications of this research are the application of AHP decision making, technology and interconnection of big data that are provided by industry 4.0 to implement the decision-making tools for human resource. With the implementation of AHP decision making web-based application, the human resource selection and recruitment process can be more effective by finding the suitable candidates based on organization objectives, criteria (skills, requirement, education, experience), the weight of importance and comparison from one candidate to others. The users can put the criteria that they think are important for the selection and candidates' data can be taken from the social media, internet application, or even provide analysis from various resources. It can help to human resource selection process more efficient by algorithm of AHP using technology that can process the data quickly and provide the best candidates accordingly. It will give flexibility as well as the users can alter (add) the criteria that they prefer for the job. Some of the recommendation that the companies or organization human resource to make right decision in term of talent selection and recruitment are (1) using decision making concept and tools/ application,

especially AHP to ensure the criteria that are important can be assessed objectively to select the right persons for the right job (2) using the technology to build decision making web-based application that can link/ connect the candidates' big data (from social media or internet) and have AHP algorithm where the users or managers can include or add the criteria (skill, requirement, experiences) that they need for the job and select the best candidate based on the criteria and the weight to achieve the organization goals. The recommendation for further research is how to combine AHP algorithms with the linear programming based on the constraints of salary, UMR (Upah Minimum Regional), no of people required for the position and build web-based applications accordingly.

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