Journal of Human Resource Development (2026)
Clausius Scientific Press, Canada

DOI: 10.23977/jhrd.2026.080104
ISSN 2616-3357 Vol. 8 Num. 1

Employee Psychology and Behavior in Human-Machine Collaboration, Algorithm Management, and Digital Workforce Scenarios

Yuan Song

School of Economics and Management, Shanghai University of Political Science and Law, Shanghai, 201701, China
songyuan@shupl.edu.cn

Keywords: Human-machine collaboration; Algorithm management; Digital workforce; Employee psychology; Employee behavior

Abstract: There are some factors that can affect the traditional approach of management of the employees including, for instance, the fact that there is no optimum coordination between machines and human beings, the process of algorithm-driven decision-making lacks transparency, and the adaptability of the employee in job-changing. The purpose of this article is to analyze the psychological reactions of the employees in the context of digitalization of the workplace. It analyzes the impact mechanisms of these factors on work engagement, organizational identification, and innovative behavior from the dimensions of technology trust, psychological security, perceived algorithmic fairness, and job security. Simultaneously, a multi-scenario simulation analysis model is constructed to compare the psychological and behavioral characteristics of employees under different digital work environments. The results show that in human-machine collaboration scenarios, employee technology trust increases from 2.45 in the traditional manual model to 4.28, psychological security increases from 3.82 to 4.36, and work engagement and innovative behavior levels reach 4.37 and 4.41 respectively, indicating that intelligent systems can effectively stimulate employee creativity and work enthusiasm after undertaking repetitive tasks.

1. Introduction

With the rapid development of artificial intelligence, big data, cloud computing, and automation technologies, human-machine collaboration, algorithm management, and digital workforce have gradually become important components of organizational digital transformation [1]. Intelligent systems are not only widely used in manufacturing, financial services, healthcare, and platform economy, but also deeply involved in management activities such as task allocation, performance evaluation, business decision-making, and process optimization, driving the transformation of organizational operation models from traditional manual-dominated to human-machine collaborative models [2]. However, while improving operational efficiency and resource allocation capabilities, the widespread application of digital technologies has also brought new challenges to employee psychology and behavior.

Based on this, this paper systematically analyzes the changing characteristics and internal mechanisms of employee psychology and behavior in three typical digital work scenarios: human-machine collaboration, algorithm management, and digital workforce. First, it explores the formation process of employee psychological perception in the digital technology environment from the dimensions of technology trust, psychological security, perception of algorithmic fairness, work pressure, job security, and organizational identity. Second, it analyzes the changing patterns of employee behavior, such as work input, innovative behavior, adaptive behavior, and learning behavior. Finally, by constructing a multi-scenario simulation analysis model, a comparative study on the psychological and behavioral indicators of employees in different digital work environments is conducted. Based on the analysis results, an optimization path for human-machine collaborative management in the context of digital workforce is proposed, aiming to provide theoretical reference and practical inspiration for organizations to achieve synergy between technological efficiency improvement and employee development during digital transformation.

2. Related Works

As the process of digital transformation continues to deepen, scholars have begun to pay attention to the impact of digital technology on the labor force structure, employee capability development and organizational management model, and have carried out extensive research on digital capability building, digital literacy cultivation, human-machine collaboration and talent development. Akter explored the profound impact of digital technology on labor force management and organizational operations, and emphasized the important role of digital transformation (DT) in dealing with complex and ever-changing business environments. The study pointed out that organizations need to build digital capabilities that match the needs of the labor force in order to achieve value creation and value capture [3]. Calvo-Sotomayor and Atutxa proposed that measures such as industrial structure optimization and digital empowerment should be used to alleviate the productivity pressure brought about by aging and promote the transformation of population aging towards a stable and sustainable socio-economic development [4]. Kadhim explored the important role of digital literacy in the modern labor force. The study pointed out that digital literacy covers the ability to effectively use various digital tools, software platforms and online communication tools, which can significantly improve employee work efficiency, collaboration ability and innovation level [5]. Mohiuddin explored the impact of HR technology application on employee development and financial industry development against the background of the rapid development of digital banks. Based on survey data from approximately 200 digital banking professionals, the results showed that the application of HR technology significantly improved employees' digital skills, adaptability, and learning efficiency, and promoted organizational productivity, service quality, and innovation capabilities [6]. Tona et al. used Johnson & Johnson as a case study to explore how enterprises can use artificial intelligence to build a digital-first talent pool. The results showed that successful implementation of AI-enabled talent development requires focusing on future workforce planning, cross-border ethical data governance, and addressing AI blind spots [7]. Rajamanickam et al. focused on analyzing the application of technologies such as the Internet of Things, artificial intelligence, big data, robotics, virtual reality, and augmented reality in job training. The study found that Industry 4.0 technologies help improve learning outcomes, achieve personalized training, and enhance students' digital skills, but there are still imbalances in technology acquisition, resource allocation, and regional development [8]. Oostveen et al. used employees in the UK manufacturing industry as the research subjects and investigated the awareness and acceptance of digital manufacturing technologies (DMTs) among 313 employees. The results showed that employees generally recognized the value of digital technology in

improving productivity, product quality, and corporate competitiveness, but still had concerns about the ease of use of technology, skills training, and human-machine collaboration [9]. Sharma et al. explored the relationship between workforce agility, change readiness, and digital transformation based on dynamic capability theory. Through structural equation model analysis of 161 questionnaires from Indian companies, they found that workforce agility can significantly improve employees' change readiness, and change readiness further promotes the digital transformation of enterprises [10]. Existing research mainly focuses on the role of digital transformation in promoting organizational performance, digital capability building, and talent development, while systematic research on the psychological perception and behavioral response mechanisms of employees in the context of human-machine collaboration, algorithm management, and digital workforce is still relatively insufficient.

3. Employee Psychological and Behavioral Mechanisms in Digital Work Scenarios

3.1 Employee Psychology and Behavior in Human-Machine Collaboration Scenarios

3.1.1 Technological Trust and Psychological Security

Regarding the issue of human-technology cooperation, the staff should cooperate with AI, intelligent decision-making technologies, and machines in order to complete a task. Technological trust can be defined as the overall evaluation of abilities and reliability of intelligent technology systems by the worker and affects his willingness to use them. A belief that an intelligent technology system is able to assist with obtaining precise information, making decisions, and easing the workload of a person creates technological trust and positively affects the feeling of identification during cooperation. However, imperfection of a system, which is caused by faulty decision-making logic and precision of its results, malfunctioning and uncertainty about the results of a work done leads to the decreasing of the level of technological trust of a person, see Figure 1.

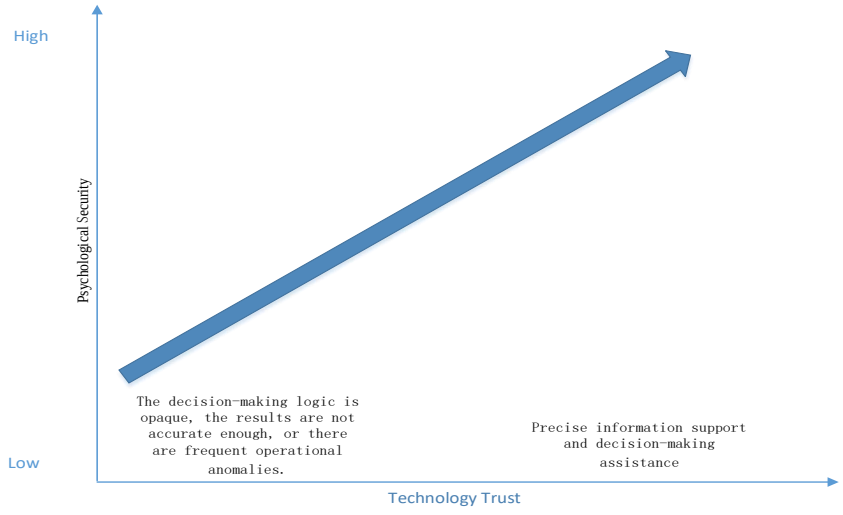

Figure 1. The Synergistic Relationship between Technological Trust and Psychological Security

There are lots of examples where industrial robots and intelligent inspection systems are used during product assembly and inspection in intelligent manufacturing. The point is that in case intelligent machines can perform their tasks accurately and provide necessary data about production, the worker starts to trust the machine as an effective tool for boosting productivity at work. For instance, there is visual recognition in car industries that detects part defects more effectively than any human inspector. However, in case the equipment performs wrong actions or stops functioning,

workers start to doubt its efficiency.

For example, in the medical profession, the AI diagnostic tool helps the physicians to determine features of the images and provide guidance on the way to proceed with diagnosis. If the physician considers the AI to be an assisting agent while making decisions, rather than a replacement of the physician, then there is a high degree of acceptance of such technologies. The physician makes the decisions concerning the diagnosis and treatment of the patients, but at the same time uses the intelligent system to make the process efficient and accurate, hence lowering the workload. In the finance department, the intelligent risk management tool can be used by account managers to find out the risky clients, thereby avoiding the cumbersome process of screening the clients one after the other. When the decision-making process is clear and reliable, the employees tend to accept digital management systems.

Therefore, it is vital to continually raise the level of confidence of employees towards the intelligent system by providing them with technical training and human-machine cooperation. However, the role of the artificial intelligence needs to be clearly outlined to avoid the negative perception of technological replacement by the employees, thus raising their psychological safety and improving human-machine cooperation.

3.1.2 Work Engagement and Innovative Behavior

Definition of work engagement could refer to the amount of vigor, commitment, and dedication by which workers work. In the case of human-machine interaction environment, AI could handle tasks such as data analysis, data processing, searching for information, and carrying out repetitive operations so that the workers do not have to go through monotonous tasks and can focus on adding value and problem-solving. Due to proper structuring of the workload, workers are able to focus on business operations and thus are more engaged and efficient in their work. On the other hand, decision-making from instant data analysis is helpful for workers' performance and accomplishment.

However, in recent years, the application of AI programming assistants has been widely used in writing the code, code debugging and optimization. Thanks to the smart software, developers may easily generate simple code and conduct repeatable tests in order to leave tedious tasks and focus on important activities, such as the system design and product innovation. In financial institutions, due to the application of the intelligent risk management system and data analysis software, it is possible to automatically perform data screening and risk identification procedures and let account managers and analysts devote their attention to critical tasks, such as customers' needs analysis and business development.

An innovative activity is an activity of an employee associated with generating new ideas, developing new ways and implementing the results thereof during work. The human-machine relationship model enables artificial intelligence (AI) to quickly analyze large amounts of information and identify any patterns that exist, providing employees with various information resources and references for decision making. For example, in the field of pharmaceutical research and development, researchers have begun to use AI for drug screening and molecular structure analysis. Traditional drug development requires a significant investment of time in experimental verification, while AI can quickly complete massive data calculations and candidate drug screening, significantly shortening the early research cycle. Based on this, researchers can devote more energy to innovative solution design and key technological breakthroughs, thereby improving the efficiency of R&D innovation. In the manufacturing sector, some intelligent manufacturing enterprises use AI to analyze production data, identify equipment operating patterns and process optimization opportunities, while engineering and technical personnel propose new production organization plans and process improvement measures based on system feedback, achieving

synergistic advancement of technological and management innovation.

3.2 Employee Psychology and Behavior in Algorithm Management Scenarios

3.2.1 Perceived Algorithmic Fairness and Work Pressure

Algorithm management, through real-time monitoring and data tracking, achieves full-process supervision. While it can improve organizational management efficiency, it may also place employees in a high-intensity performance evaluation environment for extended periods. Taking the platform economy as an example, food delivery and ride-hailing services commonly use algorithmic management models for task allocation, route planning, and performance evaluation of employees. In recent years, riders from multiple platforms have reported that the system continuously compresses delivery times and incorporates indicators such as order completion rate, on-time rate, and user reviews into the comprehensive evaluation system. During peak times, to avoid penalties because of being unable to deliver timely or earning less, some drivers may have to accelerate their pace and reduce the break time in order to finish delivery tasks, thereby leading to high mental stress and experiencing fatigue. Such incidents have gained much social attention and therefore have resulted in the rule that forces the platform to improve the algorithm rules and ensure the legal rights of the workers. Such cases are common in the industry of call center and online customer service. The system of smart monitoring is employed to monitor the online time of workers, response time and satisfaction of customers. Though this can be helpful to increase the sophistication of management, many data inspections may subject workers to constant surveillance and therefore cause them tension.

3.2.2 Employee Adaptation Behavior and Organizational Identification

Under algorithmic management, besides being tasked to perform assigned work activities, employees must also learn how to adapt themselves to management digitally and intelligently. The adaptive behavior of employees involves activities of learning and adjusting undertaken by employees in order to meet organizational needs and manage the changes in technology. In relation to algorithmic management system, employees are more adaptable as they learn digital skills, improve techniques of work process, and change behavioral styles. Adaptive behavior has the potential to make it easier for employees to comprehend the rules of algorithm, increase work productivity, and control digital work.

Organizational identification is defined as the degree to which employees know the values of the organization and development goals of the management and is one of the main psychological factors influencing employee behavior. Under the algorithm-based management, organizational identification does not only appear on account of traditional interpersonal relations and organizational culture but is also determined by the attitude of employees toward the algorithm management system. If the attitude of employees to the algorithm management system is positive, then they are going to adopt the philosophy of management of the organization and align personal goals with those of the organization, and, thus, organizational identification becomes higher.

4. Simulation of Employee Psychology and Behavior in Typical Digital Work Scenarios

4.1 Scenario Design

To verify the impact of different digital work scenarios on employee psychology and behavior, this paper adopts a scenario simulation analysis method to construct four typical work environments: traditional manual mode, human-machine collaboration scenario, algorithm management scenario,

and digital labor force scenario. By setting unified work tasks, evaluation indicators, and analysis cycles, the psychological perception and behavioral performance of employees in different scenarios are compared and analyzed.

(1) Human-Machine Collaboration Scenario

Taking the product assembly line of an intelligent manufacturing enterprise as the research object, a human-machine collaborative production scenario is constructed. In the traditional manual mode, employees independently complete tasks such as parts identification, assembly, and quality inspection; in the human-machine collaboration mode, industrial robots are responsible for parts handling, repetitive assembly, and standardized testing, while employees are mainly responsible for production process monitoring, quality judgment, and handling of abnormal problems.

(2) Algorithm Management Scenario

Taking a food delivery platform as the research object, an algorithm management work scenario is constructed. The system automatically completes task dispatch, route planning, and performance evaluation based on order information, delivery distance, and rider status, and implements dynamic management based on indicators such as on-time rate, order acceptance rate, and customer rating. Employees complete delivery tasks according to the platform's algorithm rules. During the simulation, different levels of algorithm transparency and assessment intensity were set to analyze changes in indicators such as employee work pressure, organizational identification, collaborative enthusiasm, and task completion efficiency, in order to assess the impact of algorithm management on employee psychology and behavior.

(3) Digital Labor Scenarios

Based on the intelligent customer service center of the bank, the collaborative service scenario of the digital labor was created. Within the framework of the traditional service scenario, the human customer service is responsible for handling customer queries and business transactions, while within the digital labor service scenario, artificial intelligence customer service is responsible for standard tasks such as account inquiry, business transaction advice, FAQ answering, and information recognition. The human customer service is responsible for complex business transaction handling, relationship building, and personalization. The constant volume of customer business was maintained during the simulation, and such parameters as the job security of the employees, learning motivation, work engagement, and task performance efficiency were measured to detect the characteristics of role transition of the employees with the appearance of digital labor.

4.2 Experimental Procedure

In order to achieve comparable results from the analysis, the experiment was carried out in accordance with the procedure of "scenarios creation – indicator assessment – result analysis".

(1) Four types of work scenarios have been created, which are: traditional manual scenario, human and machine interaction scenario, scenario of algorithmic management and digital workforce scenario.

(2) Consistent setting of task size, work cycle and standard of evaluation is provided for consistent comparative basis in different scenarios.

(3) The indicator system of psychological and behavioral evaluation is created. The psychological indicators include technological trust, psychological safety, work stress, organizational identification and job security, while behavioral indicators include work engagement, innovative behavior level, learning initiative, collaborative enthusiasm and task effectiveness.

(4) With the help of the 5-level assessment method, each indicator is valued and change in the indicators in different scenarios is calculated.

(5) On the basis of the assessment results, the impact mechanism of digital work scenarios on

psychology and behavior of employees can be analyzed and the optimization strategy of human-machine cooperation in digital workforce background can be discussed.

Table 1. Changes in Employee Psychological Indicators under Different Digital Work Scenarios

Indicator	Traditional Manual Mode	Human–Machine Collaboration Scenario	Algorithmic Management Scenario	Digital Labor Scenario
Technology Trust	2.45	4.28	3.71	4.15
Psychological Safety	3.82	4.36	2.95	3.64
Work Stress Level	3.25	2.71	4.42	3.58
Organizational Identification	3.68	4.12	3.37	3.91
Occupational Security	4.15	3.94	3.52	3.21

Note: A 5-point scale is used for evaluation, with higher scores indicating higher indicator levels (excluding work pressure).

It is obvious from Table 1 that the human-machine cooperation scenario is marked by the highest levels of trust in technology and psychological safety, implying that employees are ready to turn to intelligent systems for assistance. Efficiency gains in management can be witnessed in the algorithm management scenario, which, however, is also marked by the highest level of work pressure on employees, being 4.42.

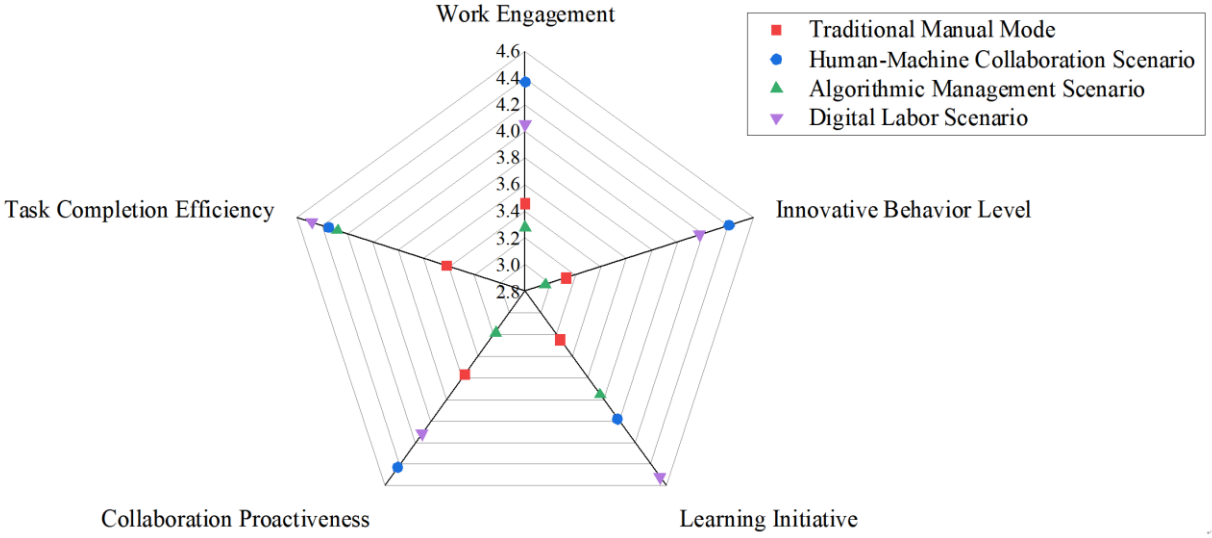

Figure 2. Changes in Employee Behavioral Performance in Different Digital Work Scenarios

As regards the behavioral analysis, it is worth saying that the situation of human-machine collaboration contributes to the largest positive impact on work engagement, innovative actions, and cooperative motivation, namely, 4.37, 4.41, and 4.43, respectively. On the one hand, the situation of algorithm management demonstrates the highest effectiveness of task completion, but the low level of innovative behavior indicates that there may be no time for innovation due to excessive attention to performance management. As far as the situation of digital workforce is concerned, the learning initiative of employees reaches 4.52, which shows that they are eager to take an active part in their own development due to digitalization of work, see Figure 2.

4.3 Discussion on Employee Psychological and Behavioral Optimization in the Digital Workforce Scenarios

4.3.1 Job Security and Role Restructuring

There is now a slow change in the roles of employees from being mere executioners to being decision-makers, innovators, and managers. In order to do this, there should be a shift from the mere execution of tasks to doing more value addition through the use of the digital platform while utilizing their innovative and human ability.

It is very important for any organization to make sure that the job security of its employees is not at all threatened while at the same time creating a digital labor force. This can be achieved by making sure that there is a definition of the supportive function of digital labor and there is an effective transition of the jobs along with career development for the employees. This helps the employees understand the supportive function of technology and not only its replacement function.

4.3.2 Learning Behavior and Ability Improvement

Learning behavior of the employee in the context of digital labor has the characteristics of continuity, digitalization, and independence. In contrast, there is a need for the employees to develop skills related to the functionality of the digital platform, application of data analysis, and use of smart devices so as to make the process of collaboration with the digital workforce more effective.

On the other hand, it is also necessary to cultivate innovative thinking, systematic thinking and cross-disciplinary collaboration capabilities to adapt to complex and changing work needs. Through continuous learning, employees can enhance their understanding and application capabilities of new technologies, reduce the anxiety and uncertainty caused by technological changes, and improve their control over digital work.

Capacity improvement is not only reflected in technical skills, but also includes the overall development of cognitive abilities, communication skills and innovation abilities. As the digital workforce takes on a large number of repetitive tasks, employees can devote more time to high-value work and improve their overall quality by participating in activities such as decision-making analysis, project innovation, and organizational collaboration. Organizations should establish a complete digital training system and lifelong learning mechanism to provide employees with skills training, job practice and knowledge sharing platforms to help employees form continuous learning habits and achieve simultaneous improvement of personal abilities and organizational development needs.

4.3.3 Human-Machine Collaboration Management Strategy

The joint participation of digital labor and employees in organizational operations has become an important characteristic of modern enterprises. Achieving efficient human-machine collaboration requires not only advanced technological support but also scientifically sound management strategies. The core objective of human-machine collaboration management is to fully leverage the data processing advantages of digital labor and the creative advantages of employees to optimize resource allocation and improve organizational performance.

(1) A clear division of responsibilities between humans and machines should be established.

In cases where tasks have clear rules and highly standardized processes, digital labor is responsible for automation; in cases where tasks involve creative design, complex decision-making, and emotional interactions, it is important that the key functions of employees are utilized. Through proper demarcation of work areas, it is possible to avoid overlap and resource wastage, leading to

efficient collaboration.

(2) Transparency and employee participation in the collaboration process needs to be enhanced.

In order to increase their trust in the digital labor process, organizations should increase their employees' understanding of the logical functioning, boundaries, and rationale behind it. At the same time, through effective feedback, it is possible for them to actively participate in optimizing the digital labor process. This would help them feel more involved in the process of digital transformation.

(3) Human-machine collaborative management systems must be developed with a focus on people.

While organizations must emphasize technological efficiency in their efforts towards digitalization, it is also necessary that they take into account the psychological and career development needs of their employees. They should develop better training and career plans and incentives for employees so as to help them fit in the new work environment.

5. Conclusion

As a result of the widespread adoption of artificial intelligence, algorithmic management, and digital workforce, the way in which the workers carry out their tasks is gradually shifting from traditional manual methods to digital human-machine collaboration. In this research paper, the changes in the psychological perception and behavioral performance of the employees in these three digital methods of human-machine collaboration, algorithmic management, and digital workforce can be studied. It is found that in the case of human-machine collaboration, there is an increase in technological trust and psychological safety and therefore the performance and innovative behavior of the employees can be improved. In the case of algorithmic management, although it makes the process of task allocation and organizational management easier, yet it puts some pressure on the employees. This paper conducts simulation analysis based on typical digital work scenarios. The results reflect the overall changing trends of employee psychology and behavior under the background of digital transformation; however, due to the lack of large-scale empirical survey data, individual differences in different industries and organizational environments still need further verification. Future research could combine questionnaire surveys, behavioral experiments, and actual operational data from enterprises to conduct in-depth analysis of the dynamic evolution of employee psychology and behavior in different digital work scenarios, in order to further enhance the universality of research conclusions and their practical guiding value.

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