International Journal of Economics and Management Research

E-ISSN: 2830-2508
P-ISSN: 2830-2664

(Artikel Penelitian/Ulasan)

Talent Management Transformation in the Industry 4.0 Era: A Study on Manufacturing Companies in Semarang Regency

Maharani Hulu[1], Dyah Palupiningtyas[2,*]

[1] STIEPARI Semarang; email : maharani.21510374@student.stiepari.ac.id
[2] STIEPARI Semarang; email : dyahpalupi@stiepari.ac.id

* Corresponding Author : Dyah Palupiningtyas

Abstract: This research aims to explore talent management transformation in the Industry 4.0 era at manufacturing companies in Semarang Regency. Using a qualitative approach with a multiple case study design, the research involved five manufacturing companies with diverse characteristics. The results show a paradigm shift in talent conceptualization, from focusing on specific technical skills to a combination of technical, digital, and adaptive skills. Five key capability clusters (digital, adaptive, collaborative, analytical, and innovative) were identified as the focus of talent development. Adaptation strategies implemented include process digitalization, adaptive learning programs, agile performance management, strengthening employee value proposition, and developing collaborative learning ecosystems. The research also identified five main challenges: digital capability gaps, resistance to change, infrastructure and resource limitations, challenges in contextualizing global practices, and generational gaps in digital adoption. Critical success factors include leadership commitment, clear vision and strategy, holistic approach, focus on people, flexibility, data-driven decision making, and continuous learning culture. This research contributes to the talent management literature by developing a contextual capability framework for the Industry 4.0 era in the Indonesian manufacturing context, as well as providing practical guidance for organizations in navigating talent management transformation by considering both technical and socio-cultural aspects.

Keywords: Talent management; Industry 4.0; digital transformation; manufacturing companies; digital capabilities.

1. Introduction

The Industry 4.0 era has brought fundamental changes to the global business landscape, characterized by the integration of digital technologies, automation, and artificial intelligence into various business processes [1]. These changes present both challenges and opportunities for companies, particularly in human resource management and talent development [2]. In this context, talent management has undergone a significant transformation, becoming a crucial factor for organizational competitiveness, especially in the manufacturing sector, which is directly affected by digitalization [3].

Manufacturing companies in Semarang Regency, as the subject of this study, represent a sector experiencing high adaptive pressure due to technological change. Semarang Regency is one of Central Java's industrial hubs, contributing significantly to the Gross Regional Domestic Product (GRDP), reaching 38.7% in 2023 [4]. There are 147 medium and large manufacturing companies operating in the region, employing over 75,000 workers [5]. The digital transformation occurring within these companies requires them to reconceptualize their talent management strategies to ensure the availability of competencies aligned with the demands of Industry 4.0.

Previous research has explored various aspects of talent management using diverse methodological approaches. Yulianto et al. (2022) employed a quantitative approach with

Received: November 30, 2024
Revised: December 15, 2024
Accepted: December 29, 2024
Published: December 31, 2024
Curr. Ver.: December 31, 2024

regression analysis to identify the relationship between talent management practices and employee performance in the food industry in Indonesia[6]. The study found a positive correlation between talent development programs and employee creativity ($\beta=0.53$, $p<0.01$). While it provided strong statistical insights, this approach had limitations in explaining the contextual and sociocultural dynamics influencing talent management implementation.

Meanwhile, Wibowo and Palupiningtyas (2023) adopted a case study method to analyze the transformation of human resource management in the digital era. The strength of this approach lies in its ability to explore phenomena in depth within specific contexts, but its findings have limited generalizability[7]. The study found that transformational leadership played a significant role in the success of talent management initiatives, yet it did not elaborate on how these dynamics differed across various industry sectors.

A mixed-methods approach was employed by Ferdiansyah and Palupiningtyas (2023) to examine strategies for improving employee performance[8]. The combination of quantitative surveys and in-depth interviews allowed for comprehensive data triangulation but required more time and resources. The study's findings indicated that the integration of digital technologies in talent management processes increased the effectiveness of employee development programs by 37%, although its implementation faced resistance from 42% of senior employees.

On the other hand, a qualitative phenomenological approach was applied by Waruwu and Palupiningtyas (2024) to understand employees' subjective experiences with talent management programs in the fashion industry[9]. While providing deep insights into individual perceptions and experiences, this method had limitations in offering a systematic overview of the program's impact on organizational performance as a whole.

Several international studies also offer valuable perspectives on talent management in the Industry 4.0 era. Zhao et al. (2022) used a longitudinal approach to track the evolution of digital competencies in talent management programs within Chinese manufacturing companies[10]. The study found that companies proactively integrating digital literacy into their talent selection and development criteria achieved 23% higher productivity compared to their competitors. However, this approach requires a significant time commitment and faces challenges in controlling external variables that may influence research outcomes.

While these studies provide valuable contributions, research gaps remain. First, most studies focus on companies in large urban centers, with less attention given to the unique dynamics of manufacturing companies in semi-urban areas such as Semarang Regency. Second, existing research tends to emphasize the technical aspects of digital transformation without delving deeply into the human and cultural dimensions in talent management adaptation. Third, there is a lack of qualitative studies exploring comprehensively how manufacturing companies navigate talent management transformation amidst the technological disruption of Industry 4.0, particularly in the Indonesian context.

Based on these gaps, this study identifies several key issues to investigate: (1) How do manufacturing companies in Semarang Regency reconceptualize their talent management practices in response to the demands of Industry 4.0? (2) What are the main challenges faced in talent management transformation, and what strategies are employed to overcome them? (3) How do sociocultural dynamics influence the adaptation of talent management processes to technological disruption? (4) To what extent does the transformation of talent management contribute to the development of organizational capabilities in facing changes in the business environment?

To address these questions, this study proposes a qualitative approach with a multiple case study design. This approach was chosen for its ability to explore complex phenomena in their natural context, allowing for an in-depth understanding of the mechanisms, processes, and dynamics involved [11]. Data will be collected through a combination of in-depth interviews with executives and HR managers, focus group discussions with employees at various levels, participatory observation, and analysis of company documents related to talent management policies and practices.

This qualitative approach enables a holistic exploration of talent management transformation, taking into account the social, cultural, and organizational contexts influencing the process. Compared to the quantitative approach, which tends to reduce complex phenomena into measurable variables, the qualitative approach provides a deeper understanding of how and why transformation occurs, as well as the meanings attached to these experiences by the actors involved [12].

This study is expected to make significant theoretical and practical contributions. Theoretically, it will enrich the literature on human resource management by providing contextual insights into the transformation of talent management in the Industry 4.0 era, particularly in the context of manufacturing companies in emerging regions. Practically, the findings can serve as a reference for HR practitioners and policymakers in designing talent management strategies that are responsive to technological disruptions, considering human dimensions and local contexts.

Thus, this study not only fills gaps in academic literature but also provides guidance for manufacturing companies to navigate talent management transformation amidst the changes of Industry 4.0, enabling them to maintain competitiveness and drive sustainable growth.

2. Literatur Review

2.1. The Concept of Talent Management in the Modern Context

Talent management has undergone significant conceptual evolution since it was first introduced by McKinsey & Company in 1997 through the phrase "the war for talent" [13]. In recent years, this concept has continued to evolve alongside changes in the global business environment. Thunnissen (2016) defines talent management as a series of systematic processes aimed at identifying, attracting, developing, retaining, and utilizing individuals with high potential who provide unique value to the organization. This definition emphasizes a strategic and holistic approach to talent management[14].

In a more contemporary perspective, Collings and Mellahi (2019) developed the concept of talent management by introducing the "value-based talent management" approach, which focuses on aligning talent management with the creation of value for a broader range of stakeholders[15]. This approach moves beyond the traditional focus on key positions and individual talent, placing more emphasis on how talent management systems and processes collectively support organizational excellence.

A comprehensive review by Gallardo-Gallardo et al. (2020) of 293 talent management articles published between 2001 and 2018 revealed a shift in focus from an exclusive perspective (talent as a small group of high-performing individuals) to an inclusive perspective (talent as potential possessed by all employees)[16]. This shift reflects a more democratic and humanistic understanding of talent within organizations.

In the Indonesian context, research by Palupiningtyas et al. (2024) identifies a unique combination of global perspectives and local values in talent management practices. A study conducted on logistics companies in Indonesia showed that cultural aspects such as the value of togetherness (gotong royong) and social harmony played an important role in shaping effective talent management approaches[1]. These findings emphasize the importance of contextual sensitivity in designing talent management systems, particularly in a country with high cultural diversity like Indonesia.

2.2 Transformation of Talent Management in the Industry 4.0 Era

The Industry 4.0 revolution is characterized by the integration of digital technologies, the Internet of Things (IoT), artificial intelligence, and big data analytics into production and business processes [17]. This phenomenon directly impacts the global talent management landscape. Whysall et al. (2019) identify three main transformations in talent management due

to Industry 4.0: (1) a shift in skill requirements from manual to digital, (2) acceleration of the competency development cycle, and (3) changes in organizational structure towards a more adaptive and flexible model[18].

A longitudinal study conducted by Kazancoglu & Ozkan-Ozen (2018) on 45 manufacturing companies in Europe revealed that 76% of companies made significant reconfigurations to their talent management systems to anticipate disruptions caused by Industry 4.0. These reconfigurations included changes in recruitment processes, the development of digital competencies, and the redesign of career paths[19].

In Indonesia, a study by Maria et al. (2022) on the food processing industry found a positive correlation between the implementation of technology-based talent management practices and employee creativity ($r=0.67$, $p<0.01$)[2]. The study also identified transformational leadership as a moderating variable in this relationship, highlighting the importance of leadership in managing talent management transformations in the digital era.

Ferdiansyah and Palupiningtyas (2023) revealed an interesting phenomenon that digital transformation in talent management in Indonesian manufacturing companies faces unique challenges related to the digital divide across generations[8]. Their study found that although there was a 42% increase in efficiency in administrative talent management processes through digitalization, 37% of senior employees reported difficulties in adapting to the new system. These findings underscore the social complexity involved in implementing digital transformation in talent management.

2.3 Strategic Approaches in Talent Management

Recent literature identifies various strategic approaches to talent management that are relevant in the Industry 4.0 era. Sparrow and Makram (2015) developed the "four logics of talent management" framework, which includes: (1) capital logic (focused on creating economic value through talent), (2) process logic (optimization of talent management processes), (3) psychological contract logic (focused on the reciprocal relationship between the organization and employees), and (4) identity logic (focused on developing organizational identity through talent)[20].

An interesting strategic approach developed by Meyers and van Woerkom (2018) integrates both inclusive and exclusive perspectives in talent management through a hybrid model[21]. This model allows organizations to adopt a proportional differentiation approach based on specific contexts and needs, avoiding rigid dichotomies between inclusion and exclusion.

For the Indonesian context, Yulianto et al. (2022) identified four strategic approaches to talent management adopted by SMEs in responding to the challenges of the pandemic: (1) talent agility (flexibility in talent placement), (2) cross-functional development (development of cross-functional competencies), (3) digital upskilling (enhancement of digital competencies), and (4) collaborative talent ecosystem (collaboration in talent development)[6].

A study by Octafian and Istiqomah (2021) in the Indonesian tourism sector revealed that talent management approaches focusing on the development of job satisfaction significantly contributed to business sustainability during a crisis[22]. These findings highlight the importance of psychological dimensions and employee well-being in talent management strategies, especially in times of uncertainty.

2.4 Talent Management Practices in Manufacturing Companies

The manufacturing sector has unique characteristics that influence the implementation of talent management. Deloitte (2018) found that 89% of global manufacturing companies face significant talent gaps, especially in digital and analytical competencies. This situation drives the reconfiguration of talent management practices to bridge these gaps[23].

A study by Heru Yulianto et al. (2022) on entrepreneurs in Central Java revealed that 64% of small and medium-sized manufacturing businesses face challenges in identifying and

developing talent with competencies relevant to digital transformation. This finding indicates a significant gap in talent management capabilities between large companies and SMEs in the manufacturing sector[6].

Research specifically on manufacturing companies in Semarang conducted by Hari Purnomo and Palupiningtyas (2022) found that talent management practices focusing on intrinsic motivation and transformational leadership styles positively impacted employee performance. This study identified four effective talent management practices: (1) competency-based talent assessment, (2) cross-generational mentoring programs, (3) structured job rotations, and (4) flexible career paths[24].

Waruwu and Palupiningtyas (2024) explored the influence of macroeconomic factors on the performance of fashion companies in Semarang, finding that companies with adaptive talent management systems demonstrated greater resilience in facing economic fluctuations[9]. Talent management practices such as multi-skilling and knowledge sharing were proven to increase organizational flexibility in responding to changes in the business environment.

2.5 Challenges in Implementing Talent Management in the Digital Era

Despite its significant benefits, the implementation of talent management in the digital era faces various challenges. Whysall et al. (2019) identified four main challenges: (1) the speed of changing competency requirements, (2) the scarcity of talent with digital skills, (3) resistance to change, and (4) the gap between educational systems and industry needs[18].

In the context of Indonesia, a study by Widodo and Safitri (2023) revealed that companies face three specific challenges in the digital transformation of talent management: (1) limited technology infrastructure, (2) lack of digital literacy among line managers, and (3) difficulties in integrating digital talent management systems with local cultural practices[25].

Meanwhile, Henry Yuliamir et al. (2022) found that companies in Semarang face challenges in building a learning ecosystem that supports talent development in the digital era. The study identified a significant gap between the speed of technology adoption and the speed at which the competencies required to operate it are developed[26].

Ana Kolbiyah et al. (2021), in their study on employee performance, revealed that 67% of employees in the manufacturing sector experienced anxiety regarding the relevance of their competencies in the Industry 4.0 era[27]. These findings reflect the psychological challenges that need to be addressed in the talent management transformation process.

2.6 Integrative Talent Management Model for the Industry 4.0 Era

Several researchers have developed integrative models for talent management in the Industry 4.0 era. Claus (2019) introduced the "Digital Talent Management Framework," which integrates five dimensions: (1) talent attraction and employer branding, (2) digital assessment, (3) personalized development, (4) agile performance management, and (5) data-driven retention strategy[28].

On the other hand, Harsch and Festing (2020) proposed the "Smart Talent Management" model, which emphasizes the use of smart technology in every stage of talent management, from planning to retention[29]. This model focuses on utilizing data analytics to make more accurate and objective talent management decisions.

In the context of Indonesia, Wibowo and Palupiningtyas (2023) developed the "Contextual Digital Talent Management" model, which integrates digital technology with local values in talent management practices. This model emphasizes the importance of contextualizing digital approaches by considering culture, infrastructure, and local workforce characteristics[7].

Recent research by Palupiningtyas (2023) on Green Human Resource Management offers an additional perspective by integrating sustainability into talent management. The developed model emphasizes aligning talent management practices with organizational sustainability goals, providing a new dimension to the discussion of talent management transformation in the Industry 4.0 era[3].

2.7 Research Gaps

Based on the literature review above, several research gaps can be identified. First, most studies on talent management transformation in the Industry 4.0 era focus on large companies in advanced economies, while the context of manufacturing companies in emerging regions like Semarang Regency remains underexplored. This gap is significant, considering the contextual differences that can affect the implementation of talent management practices.

Second, while several studies identify challenges in digital talent management transformation, there is still limited understanding of how manufacturing companies concretely navigate these challenges. Specifically, the mechanisms of adaptation and risk mitigation strategies in the transformation process still require deeper exploration.

Third, the interaction between technological and socio-cultural aspects in talent management transformation has not received adequate attention in the literature. Most research tends to focus on the technical aspects of digital transformation without providing sufficient focus on the social and cultural dynamics that influence the process.

Fourth, existing research generally adopts an organizational perspective in analyzing talent management transformation, while the employee perspective, as a direct recipient of the impacts of the transformation, remains underrepresented. Understanding how employees from diverse backgrounds perceive and respond to changes in talent management practices still needs to be further explored.

This study aims to fill these gaps by exploring in-depth how manufacturing companies in Semarang Regency navigate talent management transformation in the Industry 4.0 era, considering both technological and socio-cultural aspects, and integrating both organizational and individual perspectives to gain a more holistic understanding of this phenomenon.

3. Metode

This study adopts a qualitative approach with a multiple case study design to explore talent management transformation in manufacturing companies in Semarang Regency. A qualitative approach was chosen for its ability to deeply explore complex phenomena in their natural context [11]. The multiple case study design allows for comparative analysis across cases to obtain rich and comprehensive understanding [30].

The research subjects consist of five manufacturing companies in Semarang Regency, selected using purposive sampling based on the following criteria: (1) medium to large manufacturing companies that have been operating for at least 5 years, (2) companies that have undergone or are currently undergoing digital transformation in their talent management practices, (3) companies that have an HR department with a formal structure. A total of 60 informants were involved, including senior executives, HR managers, line managers, and employees from various levels and functions.

Data collection employed methodological triangulation, which includes:

1. In-depth interviews with executives, managers, and employees to gain a comprehensive understanding of their experiences, perceptions, and practices related to talent management transformation. The interviews were semi-structured with a prepared protocol but remained flexible to explore emerging topics.

2. Participatory observation was conducted to obtain contextual understanding of the implementation of talent management practices. The researcher engaged in various activities

related to talent management at each company, including recruitment processes, training sessions, performance appraisal activities, and HR strategy meetings.

3. Document analysis of HR/talent management policies and procedures, digital transformation strategic plans, annual reports, training materials, and talent management information system documentation to obtain contextual and historical data.

Data analysis followed the interactive model by Miles et al. (2020), which includes data condensation, data presentation, and conclusion drawing/verification[12].

The validity and reliability of the research were ensured through the application of trustworthiness criteria [31], which includes credibility (methodological and source triangulation, member checking), transferability (thick description), dependability (audit trail), and confirmability (reflexivity journal).

The theoretical framework for analysis integrates three perspectives: the Resource-Based View, which sees talent as a strategic resource [32], the Dynamic Capabilities Theory, which focuses on organizational adaptation capabilities [33], and Institutional Theory, which helps to understand the influence of contextual factors [34].

The research will be conducted in four main stages: (1) preparation and literature review, (2) data collection, (3) data analysis and interpretation, and (4) report writing and validation of findings.

4. Research Results and Discussion

4.1 . Research Results

4.1.1 Profile of Manufacturing Companies in Semarang Regency

This study involved five manufacturing companies in Semarang Regency, each with diverse characteristics, as summarized in the following Table 1:

Table 1. Profile of Manufacturing Companies Studied

Code	Industry Sector	Number of Employees	Year Established	Ownership Status	Digital Transformation Stage
PT A	Textiles	750	1995	PMDN (Domestic)	Medium implementation stage
PT B	Automotive Components	1200	1988	PMA (Japan)	Advanced implementation stage
PT C	Furniture	560	2001	PMDN (Domestic)	Initial implementation stage
PT D	Food & Beverage	850	1997	PMDN (Domestic)	Medium implementation stage
PT E	Electronics	1100	1993	PMA (Korea)	Advanced implementation stage

4.1.2 Conceptualization of Talent Management in the Industry 4.0 Era

The research identified a shift in the paradigm of talent conceptualization in manufacturing companies in Semarang Regency in the Industry 4.0 era, as summarized in Table 2.

Table 2. Paradigm Shift in Talent Conceptualization

Dimension	Conventional Paradigm	Industry 4.0 Era Paradigm
Talent Definition	Focus on specific technical skills	Combination of technical, digital, and adaptive skills
Perspective	Predominantly exclusive (high potential)	Combination of exclusive and inclusive
Orientation	Position-oriented	Capability-oriented

The five key capability clusters that are the focus of talent development in the Industry 4.0 era for manufacturing companies in Semarang Regency are:

1. Digital Capability: Includes basic digital literacy to the ability to operate automation systems and data analytics.
2. Adaptive Capability: Involves continuous learning, resilience to change, and the ability to adapt to new technologies.
3. Collaborative Capability: Includes cross-functional teamwork, virtual communication, and collaboration within a digital ecosystem.
4. Analytical Capability: Includes the ability to interpret data, data-driven decision making, and solving complex problems.
5. Innovative Capability: Includes creativity, idea development, and innovation skills based on digital tools.

The priority for developing these capabilities varies between companies depending on the stage of their digital transformation.

4.1.3. Talent Management Adaptation Strategies in the Industry 4.0 Era

The study identified five main strategies implemented by manufacturing companies in Semarang Regency to adapt their talent management practices for the Industry 4.0 era:

1. **Digitalization of Talent Management Processes**

All companies involved in the study showed a significant trend toward the digitalization of various aspects of their talent management processes. The level of digitalization varies depending on the stage of digital transformation within each company, as summarized in Table 3.

Table 3. Digitalization of Talent Management Processes

Company	Recruitment & Selection	Development & Learning	Performance Management	Retention & Succession Planning
PT A	Online recruitment application, AI-based selection (initial stage)	Basic e-learning platform	Digital evaluation system (implementation stage)	Digital talent dashboard (planning stage)
PT B	Integrated digital recruitment, AI-based selection	Comprehensive digital learning platform, VR training	Cloud-based performance management system	Predictive analytics for retention, digital succession planning
PT C	Basic online recruitment	Basic e-learning	Manual evaluation system with partial digitalization	Manual with planned digitalization
PT D	Digital recruitment, video interview	Intermediate e-learning platform, micro-learning	Digital performance tracking	Basic talent analytics
PT E	Integrated digital recruitment, AI-driven assessment	Comprehensive digital learning platform, AR/VR simulation	Real-time performance management	Advanced talent analytics, predictive succession planning

2. **Development of Adaptive Learning Programs**

All companies studied have developed or revitalized their learning programs to facilitate the development of capabilities relevant to the Industry 4.0 era, including the following approaches:

- Blended Learning (5 companies)
- Micro-Learning (3 companies: PT B, PT D, PT E)
- Personalized Learning Paths (2 companies: PT B, PT E)
- Experiential Learning (5 companies)
- Peer Learning (5 companies)

3. **Implementation of Agile Performance Management**

Three out of five companies (PT B, PT D, and PT E) have shifted from conventional annual performance appraisal cycles to a more agile performance management approach, with the following characteristics:

- Continuous Feedback
- Dynamic Goal-Setting
- Focus on Development
- Utilization of Data Analytics

4. **Strengthening the Employee Value Proposition (EVP)**

Four out of five companies have recalibrated their EVP with elements relevant to the aspirations of Millennials and Gen Z, as summarized in Table 4.

Table 4. Employee Value Proposition (EVP) Elements in the Digital Era

EVP Element	Implementation in Manufacturing Companies
Meaningful Work	Connecting work with broader social and environmental impact
Growth & Development	Opportunities for digital capability development and continuous learning
Flexibility	Flexibility in work hours and locations for roles where applicable
Technological Environment	Work environment with up-to-date technology and support for innovation
Purpose & Values	Clear articulation of company purpose and values aligned with personal aspirations

5. **Development of Collaborative Learning Ecosystems**

Four out of five companies are involved in collaborative initiatives for digital talent development, including:

- Partnerships with Educational Institutions
- Industry Collaborations
- Government Programs
- Community Engagement

4.1.4. Challenges in Talent Management Transformation

The study identified five main challenges faced by manufacturing companies in Semarang Regency in the transformation of talent management for the Industry 4.0 era:

1. **Digital Capability Gaps**

All the companies studied reported significant gaps between the digital capabilities required and those currently available. This gap is further exacerbated by the limitations of formal educational systems in producing graduates with relevant digital capabilities.

2. **Resistance to Change**

All companies studied face resistance to the digitalization of talent management processes, with varying intensities. This resistance manifests in various forms, from passive to active rejection, and is related to the following factors:

- Job Insecurity Anxiety
- Discomfort with New Technologies
- Reluctance to Leave Comfort Zones
- Distrust of New Systems

3. **Infrastructure and Resource Limitations**

Three out of five companies (PT A, PT C, and PT D) reported significant limitations in technology infrastructure and resources as major challenges in the talent management transformation. These limitations include:

- Inadequate IT Infrastructure
- Budget Constraints
- Limited IT Human Resources

4. **Challenges in Contextualizing Global Practices**

Multinational companies (PT B and PT E) face specific challenges in contextualizing global talent management practices to fit local contexts. These contextualization challenges include:

- Adapting to Local Cultural Values
- Compliance with Local Regulations
- Adjusting to Local Infrastructure
- Language and Communication Issues

5. **Generational Gaps in Digital Adoption**

The study found significant generational gaps in the speed and level of digital technology adoption in the context of talent management. All companies reported that younger employees (Millennials and Gen Z) adapted more quickly to digital systems compared to their senior counterparts.

4.1.5. Strategies for Overcoming Challenges and Critical Success Factors

The research identified five key strategies employed by manufacturing companies in Semarang Regency to overcome talent management transformation challenges:

Table 5. Strategies for Overcoming Talent Management Transformation Challenges

Challenge	Strategies for Overcoming	Companies Implementing
Digital Capability Gaps	- Accelerated digital learning- Digital mentoring programs- Partnerships with educational institutions	PT A, PT B, PT C, PT D, PT E
Resistance to Change	- Transformational communication- Participatory approach- Change champions- Incentives and recognition	PT A, PT B, PT C, PT D, PT E
Infrastructure and Resource Limitations	- Phased implementation- Cloud solutions- Resource sharing- Prioritized investment	PT A, PT C, PT D
Contextualization Challenges	- Local adaptation teams- Hybrid approach- Co-creation with local stakeholders	PT B, PT E
Generational Gaps	- Reverse mentoring programs- Peer learning- Differentiated learning approaches	PT A, PT B, PT C, PT D, PT E

The study also identified critical success factors in talent management transformation in the Industry 4.0 era:

Table 6. Critical Success Factors in Talent Management Transformation

Success Factor	Description
Leadership Commitment & Support	Active involvement and genuine support from top management in the transformation process
Clear Vision & Strategy	Clear articulation of the transformation direction and how talent management supports business goals
Holistic & Integrated Approach	Transformation encompassing the entire talent management cycle, integrated with other transformation initiatives
Focus on People	Attention to the human aspects of transformation, including employee needs, aspirations, and well-being
Flexibility & Adaptability	Ability to adjust approaches based on feedback and changing conditions
Data-driven Decision Making	Utilization of data and analytics in decision-making related to talent management

Culture of Continuous Learning	Development of a culture that encourages ongoing learning and adaptation to change

4.2. Discussion

4.2.1. Talent Management Reconceptualization in the Industry 4.0 Era

The research findings indicate a significant paradigm shift in the conceptualization of talent in manufacturing companies in Semarang Regency, from a focus on specific technical skills to a combination of technical, digital, and adaptive skills. These findings align with the research of Whysall et al. (2019), who identified a similar shift in the global Industry 4.0 context, where the definition of talent evolved to accommodate the need for new capabilities due to technological transformation[18].

The shift from an exclusive perspective to a combination of exclusive and inclusive perspectives found in this study is consistent with the global trend identified by Gallardo-Gallardo et al. (2020). In their study of 293 talent management articles, they revealed an evolution from an elitist view focusing on a small group of high-potential employees to a more inclusive approach that recognizes the potential of all employees[16].

The five key capability clusters (digital, adaptive, collaborative, analytical, and innovative) identified in this study expand the competency framework developed by Kazancoglu & Ozkan-Ozen (2018) for the Industry 4.0 era. Their longitudinal study of manufacturing companies in Europe identified the need for competency reconfiguration to anticipate Industry 4.0, but this study provides a contextual perspective from Indonesia, emphasizing the importance of collaborative and adaptive capabilities in line with local cultural characteristics[19].

The finding that companies in the early implementation stage (PT C) are more focused on developing basic capabilities such as digital literacy and adaptive skills, while companies in the advanced stages (PT B and PT E) emphasize analytical and innovative capabilities, shows an evolutionary pattern in talent development approaches. This pattern supports the digital transformation maturity model developed by Deloitte (2018), which describes stages of organizational capability development in digital technology adoption[23].

The theoretical contribution of these findings is the development of a more contextual and holistic capability framework for talent management in the Industry 4.0 era, particularly in the context of Indonesian manufacturing. These findings enrich existing perspectives by showing how contextual factors such as the stage of digital development in companies and cultural characteristics influence the definition and development of talent within organizations.

4.2.2. Talent Management Adaptation Strategies in the Industry 4.0 Era

The digitalization of talent management processes found in this study reflects the global trend identified by Claus (2019) in the "Digital Talent Management Framework." However, this study reveals a significant digital gap between multinational companies (PT B and PT E) and local companies (PT A, PT C, and PT D) in Semarang Regency[28]. This gap is in line with the findings of Widodo and Safitri (2023), who identified limited technology infrastructure as a major barrier to digital talent management transformation in Indonesia[25].

The adaptive learning approaches adopted by the companies in this study, particularly the combination of blended learning, micro-learning, and peer learning, align with the recommendations of Anderson & Lee (2021) regarding the effectiveness of multi-modal learning approaches

in digital talent development. However, this study adds a contextual dimension by showing how the value of togetherness (gotong royong) in Indonesia influences preferences for peer learning as an effective knowledge transfer method, as also identified by Palupiningtyas et al. (2024) in the context of human resource management in Indonesia[25];[1].

The transformation from conventional performance management to agile performance management found in three companies (PT B, PT D, and PT E) is consistent with the global trend explained by Harsch & Festing (2020) in the "Smart Talent Management" model. However, this study reveals specific challenges related to the Indonesian cultural context in implementing continuous feedback, which is often hindered by reluctance to provide direct criticism due to the high value placed on social harmony[29]. These findings enrich the understanding of the complexities involved in contextualizing global performance management practices in high-context cultures like Indonesia.

The strengthening of Employee Value Proposition (EVP) found in this study, with a focus on aspects such as meaningful work, growth & development, and purpose & values, supports Deloitte's (2018) findings on the shift in digital talent preferences[23]. However, this study adds a new perspective by showing how companies with limited resources, such as PT C, can develop effective EVP by emphasizing personal development and meaningful work relationships, which become alternative differentiators from multinational companies with greater resources.

The development of a collaborative learning ecosystem involving multiple stakeholders in this study expands the concept of the "collaborative talent ecosystem" identified by Yulianto et al. (2022) in their study on SMEs in Indonesia. The finding that four out of five companies are involved in collaborative initiatives with educational institutions, industry associations, government, and communities reflects the recognition that talent development for Industry 4.0 requires an approach that goes beyond the boundaries of a single organization[6].

The theoretical contribution of this discussion is the development of a more comprehensive and contextual talent management adaptation model for the Industry 4.0 era, particularly in the context of manufacturing in developing countries like Indonesia. This model emphasizes the importance of considering contextual aspects such as technology infrastructure, local culture, and resource availability when designing talent management adaptation strategies.

4.2.3. Challenges and Strategies for Overcoming Talent Management Transformation

The digital capability gaps identified in this study are consistent with the global findings of Deloitte (2018), which show that 89% of manufacturing companies experience significant talent gaps, particularly in digital and analytical competencies[23]. However, this study uncovers an additional dimension of this challenge in the context of Indonesia: the misalignment between formal education curricula and the rapidly developing industry needs driven by digital transformation.

The resistance to change identified in this study, manifesting as concerns about job loss and discomfort with new technologies, aligns with the technology resistance model developed by Ali et al. (2016)[35]. The finding that resistance is higher in companies with older average employee ages and more conservative organizational cultures supports the research of Ferdiansyah and Palupiningtyas (2023) on factors influencing resistance to digitalization in Indonesian companies[8].

The limitations in infrastructure and resources faced by three local companies (PT A, PT C, and PT D) reflect the structural challenges in developing economies as described by Widodo and Safitri (2023)[25]. The finding that multinational companies have a significant advantage in access

to global technology and resources highlights the widening digital gap between large and medium-sized companies in the region, which could have implications for regional competitiveness and economic sustainability.

The contextualization challenges faced by multinational companies (PT B and PT E) expand the understanding of the complexities of transferring talent management practices across countries, as explained by Collings and Mellahi (2019)[15]. The need to adapt practices to local cultural values, regulations, infrastructure, and communication styles underscores the importance of the "contextual digital talent management" approach proposed by Wibowo and Palupiningtyas (2023)[7].

The generational gap in digital adoption found across all the companies studied aligns with the findings of Ferdiansyah and Palupiningtyas (2023) on unique challenges in digital transformation in Indonesia[8]. However, this study reveals an interesting social dynamic where this gap creates shifts in knowledge hierarchies that do not always align with position hierarchies, adding complexity to organizational change management.

The strategies for overcoming transformation challenges identified in this study, such as accelerating digital learning, participatory approaches, phased implementation, and reverse mentoring programs, expand the repertoire of solutions identified in previous literature [18]; [29]. The finding that local companies (PT A, PT C, and PT D) tend to adopt phased approaches and prioritize investments to address resource limitations provides valuable insights into how companies with limited resources can still effectively undergo digital transformation.

The critical success factors identified in this study, especially leadership commitment, a holistic approach, and a focus on people, support the digital transformation implementation framework proposed by Teece (2018)[33]. However, this study contributes by identifying the importance of contextualization and adaptation in implementing transformation in the Indonesian context, characterized by an awareness of infrastructure limitations, local cultural characteristics, and employee preferences.

The theoretical implications of this discussion are the development of a comprehensive framework for understanding the challenges and strategies in talent management transformation in the Industry 4.0 era, particularly in the context of developing economies with unique socio-cultural characteristics like Indonesia. This framework enriches the understanding of how contextual factors such as infrastructure, culture, and resources interact with global digital transformation dynamics to shape local challenges and solutions.

5. Conclusion

This study has explored the transformation of talent management in the Industry 4.0 era within manufacturing companies in Semarang Regency. Based on data analysis from five manufacturing companies with diverse characteristics, this research has produced several key findings related to the reconceptualization of talent management, adaptation strategies, challenges, and success factors in the context of digital transformation.

The main findings of the study indicate a paradigm shift in the conceptualization of talent, from focusing on specific technical skills to a combination of technical, digital, and adaptive skills. The perspective on talent has also shifted from a dominant exclusive (high potential) approach to a more balanced combination of exclusive and inclusive approaches. Five key capability clusters (digital, adaptive, collaborative, analytical, and innovative) have been identified as the focus of

talent development in addressing the challenges of Industry 4.0, with varying priorities according to the stage of digital transformation in the companies.

The five talent management adaptation strategies applied include the digitalization of processes, the development of adaptive learning programs, the implementation of agile performance management, strengthening the employee value proposition (EVP), and the development of collaborative learning ecosystems. Despite this, companies face significant challenges in the transformation process, including digital capability gaps, resistance to change, limitations in infrastructure and resources, challenges in contextualizing global practices, and generational gaps in digital adoption.

The findings are closely related to the research objectives, which aimed to understand how manufacturing companies in Semarang Regency reconceptualize their talent management practices in response to Industry 4.0. The study reveals that this reconceptualization is multidimensional, encompassing a redefinition of talent, a reorientation of perspectives, and the development of new capability clusters. The second objective, identifying challenges and adaptation strategies, is answered through comprehensive findings on five main challenges and various strategies implemented by the companies, with variations influenced by contextual factors such as company size, ownership status, and the stage of digital transformation.

This study provides significant theoretical and practical contributions. Theoretically, the research enriches the talent management literature by developing a contextual capability framework for the Industry 4.0 era within the context of Indonesian manufacturing. The findings on the interaction between global approaches and local values expand the understanding of the contextualization of talent management practices. Practically, this study offers guidance for organizations navigating talent management transformation, considering both technical and socio-cultural aspects. The identification of critical success factors also provides concrete guidelines for HR practitioners in designing and implementing transformation initiatives.

While providing valuable findings, this study has some limitations. The focus on five manufacturing companies in Semarang Regency limits the generalizability of the findings to a broader context. The cross-sectional research design also limits the ability to observe the evolution of talent management transformation over time. Future research is suggested to adopt a longitudinal approach to track the development of talent management transformation over time. Further in-depth exploration of the impact of talent management transformation on organizational performance could also enrich the understanding of the strategic value of these initiatives. Additionally, cross-sector or cross-regional comparative studies could provide a more comprehensive perspective on contextual variations in talent management transformation in the Industry 4.0 era.

Referensi

[1.] Ali, M., Zhou, L., Miller, L., & Ieromonachou, P. (2016). User resistance in IT: A literature review. International Journal of Information Management, 36(1), 35–43. https://doi.org/10.1016/j.ijinfomgt.2015.09.007

[2.] Barney, J. B., & Clark, D. N. (2007). Resource-based theory: Creating and sustaining competitive advantage. Oxford University Press.

[3.] Claus, L. (2019). HR disruption—Time already to reinvent talent management. BRQ Business Research Quarterly, 22(3), 207–215. https://doi.org/10.1016/j.brq.2019.04.002

[4.] Collings, D. G., & Mellahi, K. (2019). Strategic talent management: A review and research agenda. Human Resource Management Review, 29(2), 178–190. https://doi.org/10.1016/j.hrmr.2018.08.004

[5.] Creswell, J. W., & Poth, C. N. (2021). Qualitative inquiry and research design: Choosing among five approaches (4th ed.). Sage Publications.

[6.] Deloitte. (2018). The future of manufacturing: Digital talent management. Deloitte Insights. https://www2.deloitte.com/insights/us/en/industry/manufacturing/digital-talent-management-strategies.html

[7.] Ferdiansyah, D. B., & Palupiningtyas, D. (2023). Strategi peningkatan kerja karyawan. Badan Penerbit STIEPARI PRESS, 2(1). https://badanpenerbit.stiepari.org/index.php/stieparipress/article/view/164

[8.] Gallardo-Gallardo, E., Thunnissen, M., & Scullion, H. (2020). Talent management: Context matters. The International Journal of Human Resource Management, 31(4), 457–473. https://doi.org/10.1080/09585192.2019.1642645

[9.] Harsch, K., & Festing, M. (2020). Dynamic talent management capabilities and organizational agility—A qualitative exploration. Human Resource Management, 59(1), 43–61. https://doi.org/10.1002/hrm.21972

[10.] Kazancoglu, Y., & Ozkan-Ozen, Y. D. (2018). Analyzing Workforce 4.0 in the Fourth Industrial Revolution and proposing a road map from operations management perspective with fuzzy DEMATEL. Journal of Enterprise Information Management, 31(6), 891–907. https://doi.org/10.1108/JEIM-01-2017-0015

[11.] Lincoln, Y. S., & Guba, E. G. (1985). Naturalistic inquiry. Sage Publications.

[12.] Maria, A. D., Yulianto, H., Palupiningtyas, D., & Usodo, H. (2022). Relationship between transformational leadership, proactive personality, creative self-efficacy and employee creativity at food processing SMEs in Indonesia. Evidence-Based HRM: A Global Forum for Empirical Scholarship, 10(3), 257–274. https://doi.org/10.1108/EBHRM-03-2021-0033

[13.] Meyers, M. C., & van Woerkom, M. (2018). Talent management: An integrated approach. In D. G. Collings, K. Mellahi, & W. F. Cascio (Eds.), The Oxford handbook of talent management (pp. 86–109). Oxford University Press.

[14.] Michaels, E., Handfield-Jones, H., & Axelrod, B. (2001). The war for talent. Harvard Business Press.

[15.] Miles, M. B., Huberman, A. M., & Saldana, J. (2020). Qualitative data analysis: A methods sourcebook (4th ed.). Sage Publications.

[16.] Octafian, R., & Istiqomah, A. (2021). Studi kepuasan wisatawan Curug Lawe Kalisidi. Gemawisata: Jurnal Ilmiah Pariwisata, 17(1), 17–27.

[17.] Palupiningtyas, D., & Nugraheni, K. S., & Octafian, R. (2024). Navigating human resource challenges and key success factors in the transition to integrated logistics systems: A change management perspective. Jurnal Manajemen Industri dan Logistik, 8(2), 141–156. https://doi.org/10.30988/jmil.v8i2.1516

[18.] Palupiningtyas, D., & Purnomo, H. (2022). Pengaruh motivasi dan gaya kepemimpinan terhadap kinerja pegawai Hotel Horizon Pekalongan. Jurnal Riset Rumpun Ilmu Ekonomi, 1(1), 37–51. https://doi.org/10.55606/jurrie.v1i1.11

[19.] Palupiningtyas, D., & Wahono, S. M. (2023). Green human resource management: A comprehensive analysis of practices, impacts, and future directions. In Proceedings of the International Conference on Digital Advance Tourism, Management and Technology (pp. 1–7). https://doi.org/10.56910/ictmt.v1i1.6

[20.] Palupiningtyas, D., & Waruwu, M. K. (2024). Analysis of the influence of macro economic factors on the financial performance of the Nadira Fashion Company in Randugunting Village, Bergas District, Semarang Regency. Journal of Business Management and Economic Development, 2(2), 626–634. https://doi.org/10.59653/jbmed.v2i02.677

[21.] Palupiningtyas, D., & Wibowo, T. S. M. (2023). Peningkatan kinerja roomboy. Badan Penerbit STIEPARI PRESS.

[22.] Palupiningtyas, D., Yuliamir, H., & Rahayu, E. (2022). Pengaruh kompetensi dan motivasi terhadap kepuasan kerja serta berdampak pada kinerja karyawan di Hotel Muria Semarang. Jurnal Ilmu Manajemen, Ekonomi dan Kewirausahaan, 2(3), 363–369. https://doi.org/10.55606/jimek.v2i3.856

[23.] Rauf, A., Yulianto, H., Palupiningtyas, D., & Octafian, R. (2022). Pelatihan manajemen UMKM sebagai upaya peningkatan ekonomi pada masa pandemi bagi kelompok wirausaha di Desa Jembrak. Jurnal Pengabdian Masyarakat Waradin, 2(3), 18–23. https://doi.org/10.56910/wrd.v2i3.293

[24.] Schwab, K. (2016). The Fourth Industrial Revolution. World Economic Forum.

[25.] Scott, W. R. (2013). Institutions and organizations: Ideas, interests, and identities (4th ed.). Sage Publications.

[26.] Sparrow, P. R., & Makram, H. (2015). What is the value of talent management? Building value-driven processes within a talent management architecture. Human Resource Management Review, 25(3), 249–263. https://doi.org/10.1016/j.hrmr.2015.04.002

[27.] Teec, D. J. (2018). Dynamic capabilities as (workable) management systems theory. Journal of Management & Organization, 24(3), 359–368. https://doi.org/10.1017/jmo.2017.75

[28.] Thunnissen, M. (2016). Talent management: For what, how and how well? An empirical exploration of talent management in practice. Employee Relations, 38(1), 57–72. https://doi.org/10.1108/ER-08-2015-0159

[29.] Whysall, Z., Owtram, M., & Brittain, S. (2019). The new talent management challenges of Industry 4.0. Journal of Management Development, 38(2), 118–129. https://doi.org/10.1108/JMD-06-2018-0181

[30.] Wibowo, T. S. M., & Palupiningtyas, D. (2021). Kinerja karyawan: Tinjauan kompensasi dan prestasi kerja. In Seminar Nasional Teknologi dan Multidisiplin Ilmu (SEMNASTEKMU) (pp. 383–388). https://doi.org/10.51903/semnastekmu.v1i1.128

[31.] Widodo, S., & Safitri, R. (2023). Understanding the relationship between work stress and productivity in hotel employees. International Journal of Contemporary Hospitality Management, 35(13), 4521–4544.

[32.] Yin, R. K. (2018). Case study research and applications: Design and methods (6th ed.). Sage Publications.

[33.] Yulianto, H., & Palupiningtyas, D. (2023). Laporan Perkembangan Industri Kabupaten Semarang 2023. Dinas Perindustrian dan Tenaga Kerja Kabupaten Semarang.

[34.] Zhao, L., Chen, X., & Wang, S. (2022). Digital competencies and talent management strategies in manufacturing: Evidence from China. The International Journal of Human Resource Management, 33(5), 879–902. https://doi.org/10.1080/09585192.2021.1891114