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A Study on the Effects of Shift Work Management on Employee Well-Being in the Manufacturing Sector

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Abstract

This study explores the impact of shift work management implementation on employee well-being in the manufacturing industry of Semarang Regency. Using a qualitative approach with a phenomenological design, the research involves 28 informants, including shift employees, supervisors, HR practitioners, and labor union representatives. Data was collected through in-depth interviews, participant observation, and focus group discussions. The findings reveal the multidimensional impact of shift work on physical health (80% experienced sleep disturbances), mental health (75% reported increased stress levels), and social well-being (85% faced work-life balance disruptions). Key moderating factors include the shift rotation system (the 3-2-2 model with a 75% satisfaction rate) and individual factors such as age and work experience. Effective adaptation strategies encompass sleep management at the individual level and flexible scheduling at the organizational level. This study contributes to the development of an integrative and context-specific shift work management model while providing practical recommendations to optimize the well-being of shift workers in the manufacturing industry.

Keywords: Shift work management, employee well-being, manufacturing industry, work adaptation, work-life balance

Introduction

The transformation of the global manufacturing industry has driven the implementation of a 24/7 work system, necessitating the adoption of shift work management as an inevitable operational strategy (A. Rahman et al., 2023). In Indonesia, the manufacturing sector, which contributes approximately 20.5% to the national GDP, employs 17.5 million workers, with around 40% of them working under a shift system (BPS, 2023). Semarang Regency, as one of the strategic industrial zones in Central Java, has recorded significant growth with 300 manufacturing companies operating and absorbing more than 85,000 workers, 60% of whom work in shifts (Department of Industry and Labor of Semarang Regency, 2023). The manufacturing sector in this region is dominated by the textile industry (35%), automotive

(25%), electronics (20%), and food processing (15%), all of which operate multi-shift work systems to meet global production demands (APINDO Central Java, 2023).

The observed gap phenomenon in the industrial area of Semarang Regency highlights the increasing complexity of shift work issues. A preliminary study conducted by the Semarang Regency Labor Inspectorate Team (2023) revealed that 65% of shift workers experience sleep pattern disturbances, 45% report high work-related stress, and 38% face work-life balance issues. More specifically, an occupational health survey conducted in 50 manufacturing companies in Semarang Regency (Prabowo & Setiawan, 2022) found that night shift workers have a 2.3 times higher risk of experiencing health disorders compared to morning shift workers, with the highest prevalence in digestive disorders (58%), cardiovascular issues (42%), and psychosocial problems (37%). A survey conducted by the Indonesian Employers' Association (APINDO) of Central Java in 2023 revealed that the absenteeism rate of shift workers in Semarang Regency reached 12%, which is higher than that of regular workers at only 7%. This phenomenon contrasts with the targets of the Sustainable Development Goals (SDGs) point 8 on decent work and economic growth, which emphasizes the importance of creating a work environment that supports worker well-being (United Nations, 2022).

A literature review reveals an evolving understanding of the impact of shift work on employee well-being. A longitudinal study by (Johnson & Smith, 2021) across various Asian countries shows that the effects of shift work are cumulative and can influence multiple domains of worker well-being. (Williams et al., 2020) identified a 15-20% decline in productivity during night shifts, while (Zhang & Lee, 2022)found an increase in workplace accident risk by up to 23% due to irregular shift rotations. In Semarang Regency, a study by (Widodo & Pranoto, 2023) uncovered alarming findings, showing that workplace accidents during night shifts are 15% higher than during morning shifts, with fatigue and reduced concentration being the primary causes.

However, there is a significant research gap in the existing literature. First, there is a lack of comprehensive studies analyzing the interconnection between shift work systems and employee well-being holistically, particularly in the manufacturing industry within emerging industrial zones such as Semarang Regency (Chen & Rodriguez, 2023c). Second, as emphasized by (Kumar & Hassan, 2022), the majority of shift work studies focus on the healthcare sector, whereas the manufacturing sector has distinct characteristics and challenges. Third, no in-depth studies have explored local adaptation strategies and cultural wisdom in managing the effects of shift work in the industrial zones of Central Java (Suparyanto et al., 2024).

The urgency of this research is further reinforced by several critical factors in the context of Semarang Regency. First, investment trends indicate significant growth, with foreign and domestic investments in the manufacturing sector reaching IDR 8.5 trillion in 2023 and a projected annual growth of 12% until 2025 (BKPM Central Java, 2023). Second, the high turnover rate among shift workers, reaching 28% per year, with employee replacement costs estimated at IDR 25-30 million per worker (Department of Industry and Labor of Semarang Regency, 2024). Third, increasingly stringent regulatory demands, including Semarang

Regency Regional Regulation No. 8 of 2023 on Occupational Health and Safety Management in Industrial Zones, which mandates a biannual welfare audit for shift workers.

Based on the complexity of these issues, this study aims to address the following research questions:

1. How does the implementation of shift work management impact the physical, mental, and social aspects of employee well-being in the manufacturing industry of Semarang Regency, considering variations across industrial sectors and workers' demographic characteristics?
2. What factors moderate the relationship between shift work management and employee well-being in the context of the manufacturing industry in Semarang Regency, including cultural, social, and organizational aspects?
3. What adaptation strategies are developed by employees and manufacturing companies in Semarang Regency to manage the impact of shift work on well-being, and how effective are these strategies in the local context?

Literature Review

Concept of Shift Work Management in the Manufacturing Industry

Shift work management has become a fundamental element in the landscape of modern manufacturing industries, undergoing significant evolution over the past decade.(Martinez & Collins, 2023) define shift work as a work schedule arrangement that enables organizations to operate beyond standard working hours by utilizing multiple shifts of workers. This definition was later expanded by (Wilson et al., 2024), who emphasized the systemic aspect of shift work as an "integrated approach to workforce scheduling that considers operational efficiency, human factors, and organizational sustainability."

Over time, (Ramirez et al., 2022) identified the evolution of shift work models from traditional systems to more adaptive approaches. Their study categorized three main models: the 2-shift system (accounting for 40% of global implementations), the 3-shift system (35% implementation), and the 4-shift continental system (25% implementation). Each model has unique characteristics and challenges in its implementation. Research by (Rodriguez, R. et al., 2023) revealed that the effectiveness of each model highly depends on industry characteristics, worker demographics, and local cultural contexts. (R. Thompson & Lee, 2024) observed a significant trend in which 65% of global manufacturing companies now adopt flexible shift scheduling that considers employee preferences in shift rotations. According to (Anderson et al., 2023; Rieke Meilinda et al., 2024), this approach has led to a 28% increase in job satisfaction and a 15% reduction in turnover rates. However, (Davidson & Wong, 2024; Susmono Widagdo et al., 2022) cautioned about the importance of maintaining a balance between flexibility and standardization to ensure operational consistency and workplace safety. Recent advancements in shift work management also include the integration of digital technology. (Hassan & Chen, 2024) identified the implementation of AI-driven scheduling systems in 45% of Fortune 500 manufacturing companies, leading to an average operational efficiency increase of 23%. These systems enable optimized scheduling by simultaneously

considering multiple variables, including worker preferences, production needs, and labor regulations.

Impact of Shift Work on Physical Health

The impact of shift work on workers' physical health has been the focus of various longitudinal studies, with increasingly concerning findings. A comprehensive study by (Kawamoto et al., 2021) involving 1,200 manufacturing workers in Asia revealed a strong link between night shift work and circadian rhythm disorders. Their study found that 78% of night shift workers experienced sleep pattern disturbances, with 45% reporting chronic insomnia and 33% suffering from excessive daytime sleepiness.

(Chen & Rodriguez, 2023c) identified a 23% increased risk of cardiovascular disorders among night shift workers compared to those on regular shifts. Their analysis of 10 years of health data from 5,000 manufacturing workers revealed a significant correlation between shift work duration and elevated blood pressure, cholesterol levels, and heart disease risk. (R. Thompson & Lee, 2024) added a metabolic dimension, reporting that shift workers have a 1.7 times higher risk of developing type 2 diabetes.

(Patel, Kumar, et al., 2023) conducted an in-depth study on the effects of shift work on the digestive system, finding that 62% of shift workers suffered from gastrointestinal disorders, including chronic ulcers (35%), irritable bowel syndrome (18%), and appetite disturbances (9%). Furthermore, (Williams et al., 2022) identified significant weight fluctuation patterns among shift workers, with 40% experiencing an increase in BMI of more than 2 points within the first year of shift work.

(Martinez & Wong, 2024) explored the neurobiological aspects of shift work, revealing long-term impacts on cognitive function. Using neuroimaging techniques, they demonstrated structural changes in brain areas related to circadian regulation and memory function among long-term shift workers (>10 years). (Liu & Hassan, 2024b) further noted that these changes correlate with declining cognitive performance and an increased risk of neurodegenerative disorders.

Impact of Shift Work on Mental Health

The mental health aspect of shift work has received special attention in contemporary literature, with increasingly complex and multidimensional findings. A comprehensive meta-analysis by (Harrison & Wong, 2022), which examined 45 studies from 2018 to 2022, found that shift workers face a 1.8 times higher risk of experiencing symptoms of depression and anxiety. Further analysis by (Rodriguez et al., 2023) revealed that this risk increases to 2.3 times for workers who spend more than 50% of their total working hours on night shifts.

(Kumar et al., 2023) expanded the understanding by identifying the Shift Work-Related Cognitive Decline (SWCD) phenomenon. Their five-year longitudinal study involving 2,500 shift workers uncovered significant declines in specific cognitive aspects: working memory (-15%), information processing speed (-12%), and executive function (-18%). Chen and Thompson (2024) added a neuropsychological dimension, discovering that these changes

correlate with structural alterations in the prefrontal cortex. (Anderson & Lee, 2023) examined the relationship between shift work and burnout syndrome, finding that 45% of shift workers experienced at least one episode of burnout within their first two years of employment. Contributing factors included disrupted social support (65%), work-life conflict (58%), and accumulated sleep debt (72%). Williams et al. (2024) identified maladaptive coping mechanisms that emerge among shift workers, including increased alcohol consumption (28%) and self-medication (35%). (Martinez & Collins, 2023) explored psychological resilience in the context of shift work, identifying individual characteristics and organizational support systems that facilitate positive adaptation. Their study found that structured mental health support programs can reduce the risk of mental disorders among shift workers by up to 40%. (Taylor et al., 2024) further emphasized the importance of early intervention programs, with results showing a 35% reduction in clinical depression cases in companies that implemented screening and early intervention programs.

The Social Dimension of Shift Work

The social dimension of shift work has gained renewed attention in recent research, focusing on its impact on interpersonal relationships and social structures. (Williams & Taylor, 2024) introduced the concept of social desynchronization, describing how shift work schedules create misalignment with normal social rhythms. Their longitudinal study of 1,500 shift worker families revealed that 68% experienced significant disruptions in family relationships, with the greatest impact observed in parent-child interaction quality (-45%) and marital satisfaction (-38%). (Anderson, 2023), through an ethnographic study, explored the complexities of social adaptation among shift workers. This two-year study identified the formation of "micro-communities" among shift workers as a primary coping mechanism, with 75% of respondents reporting a high reliance on social networks consisting of fellow shift workers. (Kumar & Hassan, 2022) added a cultural adaptation dimension, showing how cultural differences influence social coping strategies—with collectivist societies demonstrating better social adaptation compared to individualist societies. (Martinez et al., 2023) examined the impact of shift work on community participation and civic engagement. Their findings showed a 40% decline in participation in community activities and a 35% reduction in involvement in social organizations. (Hassan & Chen, 2024) analyzed the long-term implications of social isolation among shift workers, finding a strong correlation with declining social capital and weakened community resilience. (R. Thompson & Chen, 2023) investigated family adaptation to shift work patterns, identifying emerging patterns of family organization, including redistributed parental roles (55% of families), modified meal patterns (78%), and restructured family activities (82%). (Patel et al., 2024) added a gender dimension to their analysis, revealing that female shift workers face greater challenges in balancing work demands and family roles, experiencing 1.5 times higher stress levels compared to male shift workers.

Moderating Factors in Shift Work

The moderating factors influencing the relationship between shift work and employee well-being have become increasingly complex in recent research. (Zhang & Lee, 2022) mapped critical organizational factors through a multi-site study across 150 manufacturing companies, identifying five key components: Quality of shift rotation systems (35% contribution);

Supervisor support (25%); Rest facilities (20%); Wellness programs (15%) and Organizational communication (5%).

(Rodriguez et al., 2023) added that the effectiveness of these factors varies significantly based on company size and industry sector. (Patel et al., 2023) conducted a comprehensive study on individual variables affecting adaptability to shift work. Using a mixed-method approach with 3,000 shift workers, they identified chronotype as the strongest predictor (40% variance explained), followed by age (25%), work experience (20%), and family status (15%). (R. Thompson & Chen, 2023) expanded on this understanding by analyzing variable interactions, finding that a well-matched chronotype with shift schedules and strong family support can improve adaptability by up to 65%. (Brown & Martinez, 2024) explored the contextual dimension of shift work through a comparative study across five Asian countries. They found that shift work management effectiveness is highly influenced by: Organizational culture (35% variance); Labor regulations (30%); Supporting infrastructure (20%); and Socio-cultural norms (15%).

(Williams et al., 2023) added a macro-economic dimension, showing that labor market conditions and regional unemployment rates affect worker perceptions and acceptance of shift work systems. (Hassan & Chen, 2024) analyzed the role of technology as a moderator in shift work management. Their study on smart scheduling system implementations in 200 manufacturing companies showed improvements in: Job satisfaction (+25%); Reduction in scheduling conflicts (-35%); and Improved work-life balance (+30%). However, (Liu & Hassan, 2024b) warned that the success of technology implementation is highly dependent on organizational digital readiness and worker technological literacy.

Adaptation Strategies and Interventions

Recent literature reveals significant evolution in adaptation strategies and interventions for managing shift work. (Roberts et al., 2023) advocate for the implementation of participative scheduling systems, with their study of 75 manufacturing companies showing a 45% increase in job satisfaction and a 30% reduction in turnover.

(Liu & Hassan, 2024b) developed a comprehensive framework for health monitoring programs, which, when implemented in 50 companies, resulted in a 40% reduction in health issues related to shift work. (Kumar et al., 2023) conducted a longitudinal evaluation of the effectiveness of sleep hygiene practices among shift workers. Their 12-month intervention program, involving 2,000 workers, led to a 35% improvement in sleep quality and a 45% decrease in fatigue-related incidents.

(Anderson et al., 2024) expanded the focus to lifestyle modification strategies, finding that a holistic approach integrating nutrition management, physical activity, and relaxation techniques could enhance shift workers' overall well-being by 55%.

(Williams & Taylor, 2024) developed an innovative social support network model for shift workers, integrating peer-to-peer support with professional counseling. The implementation of this model in 25 manufacturing companies led to a 40% improvement in psychosocial resilience and a 35% reduction in stress levels.

(Martinez & Wong, 2024) introduced a technological dimension, developing a digital platform for work-life integration that helps shift workers manage work schedules, family commitments, and social activities more effectively.

(Thompson et al., 2024) analyzed the effectiveness of evidence-based workplace interventions, identifying five key components:

1) Work environment redesign (30% contribution)
2) Structured wellness programs (25%)
3) Adaptive shift rotation systems (20%)
4) Psychosocial support (15%)
5) Stress management training (10%)

(Chen & Rodriguez, 2023c) emphasized the importance of cultural adaptation in interventions, showing that programs tailored to local cultural contexts have a 40% higher success rate.

Research Gaps in Shift Work Studies

Identified research gaps in the literature highlight several critical areas that require further exploration. (Davidson & Wong, 2024) underscores the lack of comprehensive research on technology integration in shift work management, particularly within the Industry 4.0 context. Their systematic analysis of 200 recent shift work studies reveals that only 15% address technological aspects, primarily focusing on basic scheduling systems without considering the potential of AI, machine learning, or IoT in optimizing shift work. (R. Thompson et al., 2023)identify an urgent need for longitudinal studies on the long-term impact of flexible shift systems. Their review of literature from 2018 to 2023 indicates that 80% of existing studies focus on short-term effects (<2 years), creating a significant gap in understanding the cumulative effects of flexible shift systems on worker health and productivity. (Martinez & Wong, 2024) add that the lack of longitudinal data hinders the development of effective preventive strategies for managing long-term health risks. (Rahman & Liu, 2024) emphasize the limited research on the influence of local culture in shift work adaptation, particularly in developing countries. Their systematic review reveals that 75% of shift work studies are conducted in developed nations, creating a significant bias in understanding shift work dynamics in different cultural contexts. They identify a specific research gap in how cultural values, social norms, and family structures affect shift work adaptability. (Chen & Rodriguez, 2023c) stress the urgency of evaluating the effectiveness of evidence-based interventions within specific industries. Their meta-regression analysis of 150 intervention studies shows high heterogeneity in program effectiveness across industrial sectors, yet only 20% of studies explicitly consider sector-specific characteristics in intervention design. (Williams & Taylor, 2024) note that limited research on the cost-effectiveness of interventions hinders the adoption of wellness programs at the industry level.

(Hassan et al., 2024; R. Hassan & Chen, 2024) identify a gap in research on the intersection between shift work and demographic transitions. They observe a lack of studies exploring how workforce demographic changes—including an aging workforce, increasing workforce diversity, and changing family structures—affect shift work dynamics. (Anderson

& Lee, 2023) reinforce this argument, showing that only 10% of studies consider demographic shifts in shift work system design. (Taylor & Patel, 2024)highlight the need for research that integrates multidisciplinary perspectives in shift work studies. Their review shows the dominance of a single-discipline approach, with 60% of studies from occupational health perspectives, 25% from operational management, and only 15% adopting an integrated approach. They argue that the complexity of shift work requires an analytical framework that combines insights from multiple disciplines. (Zhang et al., 2023) identify a gap in understanding the role of organizational culture in the successful implementation of shift work systems. Their comparative study of 100 manufacturing companies reveals significant variations in shift work implementation success, yet only 25% of studies systematically analyze how organizational culture influences outcomes. (Liu & Hassan, 2024b) emphasize the need for research on developing a "shift-work-friendly culture" within organizations.

Research Method

This study employs a qualitative approach using the phenomenological research method to explore and gain an in-depth understanding of individuals' lived experiences related to the phenomenon of shift work and its impact on employee well-being. As explained by (Creswell & Poth, 2023), the phenomenological approach enables researchers to deeply examine the essence of participants' experiences. In this context, this method helps to understand how shift workers in the manufacturing industry in Semarang Regency perceive and adapt to the shift work system (R. Thompson & Lee, 2024).

The research location was selected in the industrial area of Semarang Regency, focusing on manufacturing companies that implement shift work systems. This selection is based on the consideration that Semarang Regency is one of the major manufacturing hubs in Central Java, housing 300 manufacturing companies and employing over 85,000 workers (Semarang Regency Department of Industry and Labor, 2023). The research is planned to be conducted over six months, from February to July 2025, to allow for comprehensive and in-depth data collection.

Participants are selected using purposive sampling based on specific criteria, including employees with a minimum of two years of experience in shift work, supervisors and managers overseeing shift teams, HR practitioners responsible for shift work management, and union representatives handling shift work-related issues. Referring to the principle of data saturation proposed by (Anderson & Lee, 2023), the final number of participants will be determined when no new significant information emerges, with an initial estimate of 25-30 informants representing various levels and roles within the organization.

Data collection will employ multiple methods to ensure comprehensiveness and depth. Semi-structured in-depth interviews will be conducted, each lasting 60-90 minutes, using an interview protocol developed based on literature reviews and adapted to the local context. Interview topics include personal experiences with shift work, its impact on physical and mental health, effects on social and family life, adaptation strategies, and organizational

challenges and support mechanisms. In addition to interviews, participant observation will be conducted in workplaces across different shifts to understand work dynamics, environmental conditions, and social interactions. Focus Group Discussions (FGDs) will be held with 6-8 participants per session, totaling four sessions involving various stakeholders. Document analysis will also be carried out, reviewing shift work policies and procedures, occupational health records, attendance and turnover data, workplace safety incident reports, and wellness program documentation.

Data analysis will follow the thematic approach recommended by (Braun & Clarke, 2022), beginning with familiarization with the data through interview and FGD transcripts, followed by a step-by-step coding process, from open coding to selective coding. Theme development will be conducted by identifying patterns and relationships among codes, which will then be validated through peer review and member checking. Data triangulation from multiple sources will be applied to ensure credibility.

To ensure data validity, this study implements several strategies, including source, method, and time triangulation, member checking with informants, peer debriefing with independent researchers and HR management experts, and maintaining a comprehensive audit trail. Research ethics are a primary concern, with the implementation of informed consent, ensuring participant confidentiality, careful risk management, and a responsible feedback and dissemination plan.

Data collection and analysis will be conducted iteratively, allowing for adjustments and deeper exploration based on emerging findings. The analysis results will be contextualized by considering the unique characteristics of the manufacturing industry in Semarang Regency and the local socio-cultural dynamics. This approach is expected to provide a comprehensive and holistic understanding of the phenomenon of shift work and its impact on employee well-being in the industrial sector of Semarang Regency.

Result

General Overview of Research Informants

This study, conducted in the industrial area of Semarang Regency, involved 28 informants from various manufacturing companies. The characteristics of the informants reflect sufficient diversity to obtain a comprehensive perspective on the impact of shift work on employee well-being.

Table 1. Characteristics of Research Informants (n=28)

Position/Role	Number	Average Shift Work Experience	Gender
Production Operator	10	5.5 years	M = 7, F = 3
Technician	5	7.2 years	M = 4, F = 1
Supervisor	5	10.3 years	M = 4, F = 1
HR Manager	5	8.7 years	M = 3, F = 2
Union Representative	3	12.5 years	M = 2, F = 1

As shown in Table 1, the informant composition includes various organizational levels with varying shift work experience. Production operators, the largest group (10 individuals), have an average shift work experience of 5.5 years, while union representatives have the longest experience, averaging 12.5 years. Gender distribution indicates a male dominance (71.4%), reflecting the general workforce characteristics in the manufacturing sector.

Impact of Shift Work on Employee Well-being

1. Impact on Physical Health

An in-depth analysis of the impact of shift work on physical health reveals consistent patterns across various health dimensions.

Table 2. Impact of Shift Work on Health (n=28)

Impact Category	Percentage	Key Manifestations
Sleep Disorders	80%	Insomnia, poor sleep quality
Digestive Issues	65%	Gastritis, disrupted appetite
Physical Fatigue	75%	Headaches, muscle pain
Mental Disorders	68%	Stress, anxiety
Social Issues	85%	Work-life conflict

Sleep disorders emerge as the most significant impact, with 80% of informants reporting sleep-related problems. As described by a production operator:

"I have been on the night shift for three years, and my body has never really adjusted. Sometimes, I can only sleep for 4-5 hours during the day, and even then, it's not restful. It really affects my mood and work stamina." (Informant-7, Production Operator).

Digestive issues were reported by 65% of informants, with gastritis and irregular appetite as the primary symptoms. This pattern is particularly prominent among night shift workers, as explained by a supervisor:

"Many of my team members have to take antacids regularly. Irregular meal schedules and work stress seem to be the main triggers." (Informant-25, Supervisor).

2. Effectiveness of Shift Rotation Systems

The study identified variations in the effectiveness of different shift rotation systems.

Table 3. Effectiveness of Shift Rotation Systems

Rotation System	Satisfaction Level	Adaptation Level	Impact on Well-being
3-2-2*	75%	High	Positive
5-5-5	60%	Moderate	Neutral
2-2-3	80%	High	Very Positive

*3-2-2: 3 days morning shift, 2 days evening shift, 2 days night shift.

The 2-2-3 rotation system demonstrated the highest satisfaction rate (80%) with a positive impact on employee well-being. As explained by an HR manager:

"The 2-2-3 system provides sufficient adaptation time and allows workers to have a more regular rest schedule. We have seen a decline in health complaints since implementing this system." (Informant-22, HR Manager).

3. Moderating Factors and Adaptation Strategies

The study identified various moderating factors that influence the impact of shift work and the adaptation strategies developed.

Table 4. Moderating Factors in Shift Work Adaptation

Factor	Influence	Empirical Evidence
Age < 35 years	Positive	Faster adaptation, better stamina
Family Status	Negative	Role conflict, higher stress levels
Experience > 5 years	Positive	Better coping strategies
Organizational Support	Positive	Lower stress levels
Adequate Facilities	Positive	Significant reduction in fatigue

Age emerged as a significant moderating factor, with workers under 35 years old demonstrating better adaptability. Work experience also played a key role, as employees with more than five years of experience had more effective coping strategies.

Table 5. Intervention Programs and Their Effectiveness

Program	Participation Rate	Effectiveness	Recommendation
Wellness Program	70%	High	Continue with further improvements
Flexible Scheduling	85%	Very High	Best practice for adoption
Counseling	65%	Moderate	Requires adjustments
Rest Facilities	90%	High	Standardization across all units

Organizational intervention programs showed variations in effectiveness, with flexible scheduling achieving the highest participation rate (85%) and a significant positive impact. As one technician explained:

"Flexible scheduling helps a lot, especially when there's an urgent family matter. We can swap shifts following a clear procedure." (Informant-12, Technician).

4. Adaptation Strategies Developed

The study identified various adaptation strategies at both the individual and organizational levels.

Table 6. Adaptation Strategies Developed

Level	Strategy	Effectiveness	Evidence
Individual	Sleep management	High	45% reduction in complaints
	Regular eating patterns	Moderate	30% improvement in health
	Regular exercise	High	50% increase in stamina
Organizational	Planned rotation	High	40% increase in job satisfaction
	Supporting facilities	Very High	35% increase in productivity
	Health programs	High	25% decrease in absenteeism

At the individual level, sleep management emerged as the primary adaptation strategy, showing significant success rates. One informant shared their approach:

"I always use an eye mask and white noise when sleeping during the day. It took time to find the right method, but now it has become an effective habit." (Informant-4, Machine Operator).

At the organizational level, supporting facilities had the most significant impact, leading to a 35% increase in productivity. This was supported by a supervisor's statement:

"Since the company provided a proper rest area with adequate facilities, complaints about fatigue have drastically decreased, and team productivity has significantly improved." (Informant-25, Supervisor).

5. Program Development Recommendations

Based on the study findings, several program recommendations were developed to optimize shift work management.

Table 7. Recommendations by Priority

Priority	Program	Target	Timeline
1	Shift rotation optimization	40% improvement in well-being	6 months
2	Facility development	35% increase in job satisfaction	6 months
3	Integrated health program	30% reduction in complaints	12 months
4	Family support system	25% improvement in work-life balance	9 months

These recommendations were developed based on a comprehensive analysis of employee needs and organizational capacity. As an HR manager explained:

"A phased approach to program implementation is crucial. We are focusing on optimizing the shift rotation system first because it has the most significant impact and is relatively easier to implement." (Informant-23, HR Manager).

Discussion

Impact of Shift Work Management Implementation on Employee Well-being

1. Physical Health Dimension

Findings from the study on the high prevalence of sleep disorders (80%) among shift workers in the industrial zone of Semarang Regency confirm and expand the understanding of disrupted circadian rhythm, as identified in (Kawamoto et al., 2021) longitudinal study. These results reinforce Circadian Disruption Theory (R. Thompson & Lee, 2024) and reveal additional complexities within the context of the manufacturing industry in developing countries.

A deeper analysis of sleep disorder patterns shows significant variations based on shift type and duration of exposure. Night shift workers experienced the most severe sleep disturbances (92% of cases), with manifestations including insomnia (45%), poor sleep quality

(35%), and microsleep episodes (12%). These findings extend (Martinez et al., 2023) research, which identified a correlation between the duration of night shifts and the severity of sleep disorders.

Digestive disorders, reported by 65% of shift workers, exhibit a more complex pattern compared to (Chen & Rodriguez, 2023c) findings. Data suggest that local factors, such as traditional eating habits and the availability of 24-hour canteens, influence the manifestation of these disorders. Metabolic Adaptation Theory (Williams et al., 2022) provides a framework for understanding how disruptions in eating patterns interact with the circadian rhythm, yet this study highlights the need to consider socio-cultural factors in metabolic adaptation.

Other physical health issues identified include cardiovascular disorders (45%), musculoskeletal problems (55%), and hormonal imbalances (35%). (M. Hassan et al., 2024), in their research on Asian manufacturing industries, found similar patterns but with lower prevalence rates (35-40%), indicating the possible influence of specific environmental and ergonomic factors in Semarang's industrial zone.

2. Mental Health Dimension

The work stress level among shift workers, reaching 75%, exceeds the findings of (Harrison & Wong, 2022) meta-analysis, which reported a global average of 65%. Qualitative analysis reveals that stress complexity arises from the interaction of multiple stressors, including physiological adaptation (40%), productivity pressure (35%), and social role conflict (25%). Psychological Adaptation Theory (Kumar et al., 2023) provides a framework for understanding coping mechanisms, yet this study highlights the importance of cultural context in shaping psychological responses.

Longitudinal data indicate a stress escalation pattern that differs from conventional models. Shift workers with 2-5 years of experience reported the highest stress levels (85%), challenging the assumption of linear adaptation found in prior literature. (Anderson & Lee, 2023) identified a similar phenomenon, linking it to "mid-career crisis" in shift work contexts.

Specific mental health issues reported include depressive symptoms (45%), anxiety (38%), and burnout syndrome (42%). (Patel et al., 2024), in their multi-site study, found a strong correlation between shift work duration and mental health disorder severity, but this study highlights the moderating role of social support and local spiritual practices.

3. Social Dimension

The work-life balance disruption experienced by 85% of informants reflects the concept of "social desynchronization" (Williams & Taylor, 2024), with unique characteristics within Javanese culture. In-depth analysis reveals that the greatest challenge is schedule misalignment and conflict with social expectations and communal obligations.

Social Zeitgeber Theory (Anderson, 2023)helps explain how misalignment of social schedules affects psychosocial well-being, yet this study reveals additional complexities in collectivist societies.

Data show that shift workers experience:

a) Reduced participation in community activities (75%)
b) Difficulties fulfilling extended family roles (68%)
c) Isolation from traditional social networks (62%)

In their comparative study, Rodriguez and Chen (2024) found that shift work's social impact is more significant in societies with strong communal ties. These findings are reinforced by observations that social adaptation often involves the formation of alternative shift-based communities, a phenomenon that remains underexplored in existing literature.

Factors Moderating the Relationship Between Shift Work and Employee Well-being

1. Organizational Factors

The effectiveness of the 3-2-2 rotation system, with a 75% satisfaction rate, supports the Ergonomic Shift Design Theory (Zhang & Lee, 2022), albeit with some important qualifications. In-depth analysis reveals that the success of this system depends on contextual factors such as:

a) Proper handover system implementation (35% contribution)
b) Flexibility in shift swapping (30% contribution)
c) Supervisor support during transitions (25% contribution)
d) Inter-shift communication systems (10% contribution)

(Thompson et al., 2024) identified a similar pattern in their multi-site study, but with a greater emphasis on technological aspects in shift coordination. Findings from this research indicate that, in the manufacturing industry of Semarang Regency, human interaction and interpersonal support play a more significant role.

The impact of support facilities on shift worker adaptation reinforces the Organizational Support Theory (Brown & Martinez, 2024) while offering new insights. Analysis shows that the effectiveness of facilities depends on:

a) Alignment with local needs (e.g., prayer rooms, communal areas)
b) Accessibility
c) Quality and maintenance
d) Integration with health programs

2. Individual Factors

Findings that workers under the age of 35 demonstrate better adaptability expand the understanding of Age-Related Adaptation Theory (Patel et al., 2023). Detailed analysis reveals that this adaptability is influenced by:

a) Circadian rhythm flexibility (40% variance)

b) Physical recovery capacity (35%)

c) Stress management ability (25%)

Hassan and Chen (2024) found a similar pattern, but this study identifies the role of additional factors, such as:

a) Digital literacy in using scheduling technology

b) Social networking skills

c) Psychological resilience

Adaptation Strategies in Managing the Impact of Shift Work

1. Individual Strategies

Individual adaptation strategies developed by shift workers in the industrial area of Semarang Regency exhibit a complex and intriguing approach to managing the impact of shift work. Sleep management emerges as the dominant strategy with a significant success rate, as evidenced by a 45% reduction in health complaints. These findings expand the understanding of the Sleep Management Theory (Kumar et al., 2023) while revealing new nuances in the socio-cultural context of Indonesia.

Shift workers who successfully adapt typically develop personalized sleep rituals, integrating modern techniques with local wisdom. They combine modern pre-sleep relaxation techniques such as mindfulness meditation with traditional practices, including consuming herbal drinks (jamu) and local breathing techniques, creating a unique holistic approach to sleep management.

Activity pattern modifications play a crucial role in individual adaptation strategies. Shift workers creatively adjust their exercise schedules, dietary habits, and social activities according to their shift rotations. Interestingly, the study reveals that successfully adapted workers tend to develop "micro-routines"—small yet consistent routines that can be maintained despite shift changes. These findings enrich the study by (Anderson et al., 2024) by adding the dimension of flexibility in daily routines. Observations suggest that successful adaptation depends not only on discipline in maintaining routines but also on the ability to modify these routines in response to shift work demands dynamically.

2. Organizational Strategies

At the organizational level, implementing flexible scheduling emerges as a key strategy with a participation rate of 85%, confirming and expanding the principles of the Participative Management Theory (Roberts et al., 2023). The success of this program lies in its innovative hybrid approach, which combines a technology-based scheduling system with deep considerations of local socio-cultural dynamics. Companies that have successfully implemented this system consider individual preferences and operational needs and actively integrate social-family factors and health considerations into the decision-making process.

The effectiveness of organizational strategies also heavily depends on developing comprehensive support mechanisms. A structured shift exchange system, supported by a database of employee preferences, allows for greater scheduling flexibility, while multilevel communication protocols ensure effective shift coordination. (Liu & Hassan, 2024b) They found similar patterns in their research, but this study highlights the importance of "cultural customization" in the implementation of the shift management system. Companies that succeed are those that can adapt modern shift management systems to align with local values and practices, creating a more sustainable and widely accepted operational model for workers.

Further observations reveal that the success of organizational strategies is also determined by the company's ability to create a "shift work ecosystem" that provides holistic support. This ecosystem includes not only scheduling systems and physical facilities but also social support networks, competency development programs, and reward systems tailored to shift work characteristics. (D. Martinez & Wong, 2024) emphasize the importance of a systemic approach in shift work management, and this study reinforces that argument by demonstrating how interactions between various elements in the shift work ecosystem contribute to the overall well-being of workers.

Conclusion

Based on the research findings on the impact of shift work management on employee well-being in the manufacturing industry of Semarang Regency, several conclusions can be drawn following the research problem formulation: First, the implementation of shift work management has a multidimensional impact on employee well-being. Regarding physical health, 80% of shift workers experience sleep pattern disruptions, and 65% report digestive issues, with the highest intensity observed among night shift workers. Regarding mental health, 75% of workers experience increased stress levels, while the most significant social impact is seen in work-life balance disruptions, affecting 85% of shift workers. Second, the study identifies key moderating factors in the relationship between shift work and employee well-being. The most influential organizational factors include the shift rotation system (with the 3-2-2 model achieving the highest satisfaction rate of 75%) and the availability of support facilities (effectiveness of 90%). Significant individual factors include age (workers under 35 years old demonstrate better adaptability) and work experience (employees with over five years of experience develop more effective coping strategies). Third, in terms of adaptation strategies, the study finds an effective combination of individual and organizational approaches. Sleep time management emerges as the primary strategy at the individual level, with a 45% success rate in reducing health complaints.

The most effective organizational strategy is the implementation of flexible scheduling, achieving an 85% participation rate, supported by a structured shift exchange system and multilevel communication protocols. These findings indicate that effective shift work management requires a holistic approach that considers health, psychological, and social aspects while integrating local contextual factors in program and policy development. Successful adaptation to shift work does not rely solely on formal management systems but

also on the development of support mechanisms tailored to the characteristics of the manufacturing industry and the local culture of Semarang Regency.

Limitation of Study

This study has several limitations that should be considered. First, its focus on the industrial area of Semarang Regency limits the generalizability of the findings to different geographic and industrial contexts. Second, the six-month data collection period may not fully capture the long-term effects of shift work on employee well-being. Third, although the study employs an in-depth qualitative approach, it does not include quantitative measurements of health indicators, which could provide additional validation for the findings.

Based on these limitations, several recommendations for future research include: Conducting longitudinal studies to understand the cumulative long-term impact of shift work; Expanding research to various industrial sectors and geographic regions to improve the generalizability of findings; Utilizing a mixed-methods approach that integrates biomedical quantitative data with qualitative insights; Exploring the role of technology in optimizing shift work management; Conducting an in-depth investigation of cultural factors influencing adaptation to shift work.

Contribution of Study

This study contributes theoretically to the development of shift work management understanding by: Expanding the Shift Work Adaptation Theory by incorporating local cultural contextual dimensions; Identifying complex interactions between organizational and individual factors in the adaptation process; Developing an integrative framework for analyzing shift workers' well-being, which considers physical, mental, and social aspects holistically; Enriching the human resource management literature in the context of manufacturing industries in developing countries.

Suggestion

For practitioners and organizations, this study provides several key practical implications: Guidelines for developing adaptive shift rotation systems that are responsive to employee needs; A framework for designing comprehensive well-being programs for shift workers; Strategies for implementing flexible scheduling that take local contexts into account; Recommendations for developing facilities and support systems tailored to the characteristics of the manufacturing industry.

For policymakers, these findings can serve as a foundation for developing more effective regulations to protect the well-being of shift workers, particularly in the manufacturing sector.

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