





“Working hours of the future: AI technologies, collective synergy, and biorhythms as the foundation for productive work”

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WORKING HOURS OF THE FUTURE: AI TECHNOLOGIES, COLLECTIVE SYNERGY, AND BIORHYTHMS AS THE FOUNDATION FOR PRODUCTIVE WORK

Abstract

This article explores the potential of integrating biological rhythms, artificial intelligence (AI), and collective synergy to create adaptive work schedules that meet both individual needs and organizational objectives. The paper emphasizes the misalignment of traditional static schedules with natural circadian rhythms, highlighting the negative effects on productivity, well-being, and stress levels. The study aims to demonstrate how AI-driven technologies, combined with biometric data from wearable devices, can optimize work schedules to improve cognitive performance by 20-30%, as evidenced by recent studies.

The proposed methodology leverages AI to process physiological and cognitive data, tailoring individual work schedules while ensuring team synchronization through collective synergy. By creating «synchronization windows» for collaborative tasks, AI mitigates the loss of collective efficiency often associated with flexible schedules. The article provides a framework for implementing this model, emphasizing the balance between flexibility and team interaction, supported by technologies such as fitness trackers and machine learning algorithms.

The findings underscore the practical value of integrating AI in workforce management, offering organizations a pathway to enhance productivity by 15-20% and reduce employee turnover. This study contributes to the discourse on modern work optimization by bridging individual productivity, technological advancements, and collective efficiency, presenting a dynamic, future-oriented approach to work scheduling.

Keywords

artificial intelligence in workplace, work-life integration,
workplace productivity, employee well-being, biological
rhythms, work hours, collective synergy, AI scheduling

JEL Classification

J22, O30

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РОБОЧИЙ ЧАС МАЙБУТНЬОГО: АІ-ТЕХНОЛОГІЇ, КОЛЕКТИВНА СИНЕРГІЯ ТА БІОРИТМИ ЯК ОСНОВА ДЛЯ ПРОДУКТИВНОЇ РОБОТИ

Анотація

У статті досліджується потенціал інтеграції біологічних ритмів, штучного інтелекту (ШІ) та колективної синергії для створення адаптивних графіків роботи, які відповідають як індивідуальним потребам, так і цілям організації. Наголошується на неузгодженості традиційних статичних графіків із природними циркадними ритмами, підкреслюючи негативний вплив на продуктивність, самопочуття та рівень стресу. Дослідження має на меті продемонструвати, як технології, керовані штучним інтелектом, у поєднанні з біометричними даними з носимих пристроїв можуть оптимізувати робочі графіки для покращення когнітивних здібностей на 20-30%, про що свідчать останні дослідження.

Запропонована методологія використовує штучний інтелект для обробки фізіологічних і когнітивних даних, адаптації індивідуальних графіків роботи, забезпечуючи синхронізацію команди через колективну синергію. Створюючи «вікна синхронізації» для спільних завдань, ШІ зменшує втрату колективної ефективності, яка часто пов'язана з гнучкими

графіками. У дослідженні наводиться основа для реалізації цієї моделі, наголошується на балансі між гнучкістю та командною взаємодією, що підтримується такими технологіями, як фітнес-трекери та алгоритми машинного навчання.

Отримані результати підкреслюють практичну цінність інтеграції ШІ в управління персоналом, пропонуючи організаціям шлях до підвищення продуктивності на 15-20% і зменшення плинності кадрів. Дане дослідження робить внесок у дискурс про сучасну оптимізацію роботи шляхом поєднання індивідуальної продуктивності, технологічного прогресу та колективної ефективності, представляючи динамічний, орієнтований на майбутнє підхід до планування роботи.

Ключові слова

штучний інтелект на робочому місці, інтеграція між роботою та особистим життям, продуктивність на робочому місці, благополуччя співробітників, біологічні ритми, години роботи, колективна синергія, планування ШІ

Класифікація JEL

J22, O30

INTRODUCTION

The traditional five-day workweek, introduced under the influence of the Industrial Revolution, no longer meets the needs of modern society. Changes in the nature of work, the growing role of technology, and increased awareness of employee well-being are driving the search for new approaches to organizing working hours. New models of the workweek are becoming important tools for enhancing social capital, balancing work and life, and increasing overall productivity.

The traditional approach to structuring work schedules has long relied on uniformity, favoring standardized working hours over individual needs and preferences. This approach often overlooks the natural biological rhythms and cognitive cycles that dictate human productivity and well-being. With the growing awareness of these rhythms, supported by advancements in biometric tracking technologies, organizations are beginning to explore the potential of personalized work schedules to maximize efficiency and employee satisfaction.

Simultaneously, the rise of artificial intelligence (AI) has introduced unprecedented opportunities to analyze complex data and design adaptive systems that can optimize both individual and collective work dynamics. The ability of AI to process large volumes of data, including physiological, cognitive, and behavioral metrics has positioned it as a transformative tool in rethinking workplace management.

However, the challenge of balancing individual flexibility with organizational objectives remains unresolved. The dichotomy between personal productivity and team synergy often leads to suboptimal outcomes, either for individuals or the collective workforce. Current models of flexible work often sacrifice one for the other, highlighting the need for innovative solutions that harmonize these priorities.

Modern workplaces lost the connection to natural rhythms. But integrating AI with biorhythms isn't about inventing new patterns – it's about rediscovering and systematically implementing these eternal principles.

The traditional guild system balanced individual mastery with collective knowledge transfer. Similarly, AI systems should facilitate natural hierarchies of competence while preserving essential human relationships.

Working hours are often viewed as a point of contention between employers and employees: employers aim to maximize profit, while employees also seek to conserve their energy. However, the underlying contradiction runs much deeper, stemming from a misalignment with natural biological rhythms. This misalignment is exacerbated by the rigid use of mechanical, clock-based schedules, the nature of work itself, and the ongoing struggle to balance individual and collective efforts effectively.

1. LITERATURE REVIEW

The misalignment between traditional work schedules and human biological rhythms has been a critical subject of study in the field of productivity and workforce management. Walker (2018) provides foundational research into circadian rhythms, revealing significant variations in human cognitive and physical performance throughout the day. Studies by Bottenheft et al. (2020) have demonstrated that fixed work schedules often lead to reduced cognitive efficiency and heightened stress by disregarding individual variations. Early research into circadian rhythms revealed significant variations in human cognitive and physical performance throughout the day, identifying chronotypes such as “early birds” and “night owls” with distinct peaks of productivity.

The integration of wearable technologies into workforce optimization opens new avenues for collecting real-time physiological and cognitive data. As documented by Hyysalo et al. (2017), these devices capture metrics providing a foundation for understanding individual productivity cycles. The effectiveness of biometric data in guiding adaptive scheduling systems has been validated through several empirical studies (Newport, 2016; Walker, 2018).

Recent advancements in artificial intelligence enhance the ability to design dynamic work schedules. Glaveski (2018) reported increase in productivity in organizations adopting AI-driven solutions. This is further supported by McParlane’s (2023) analysis of Microsoft’s implementation of flexible scheduling, which demonstrated significant organizational benefits.

The challenge of balancing individual flexibility with collective synergy remains prominent. Yang et al. (2021) examined how remote work affects collaboration, while Bernstein and Turban (2018) analyzed the impact of workspace design on human collaboration. Clopton (2011) emphasizes the importance of social capital in team performance, suggesting that any scheduling system must account for team dynamics.

Global workplace trends support the need for innovative scheduling approaches. The Gallup State

of the Global Workplace Report (2024) and OECD Compendium of Productivity Indicators (2024) highlight declining engagement and productivity under traditional work models. Research by Pencavel (2015) demonstrates diminishing returns in productivity from extended working hours, while Haraldsson and Kellam (2021) document successful implementations of shorter working weeks.

Building upon existing research from Vise and Malseed (2006) to recent studies by Rungta (2024), this study proposes a comprehensive model integrating biological rhythms, AI-driven personalization, and collective synergy to optimize work schedules effectively.

2. DISCUSSION

The integration of biological rhythms into workplace scheduling represents a fundamental shift in how we conceptualize productivity and organizational effectiveness. While traditional work structures have long prioritized standardization over individual differences, emerging research suggests that aligning work schedules with natural biological patterns could unlock previously untapped potential in both personal and team performance. The relationship between individual chronotypes and collective productivity presents a complex challenge that requires careful consideration of multiple factors.

The desire to work less can be explained by a variety of psychological, social, economic, and cultural factors that reflect changes in society and human nature. Key explanations for this phenomenon include the following.

The desire to work less is the result of a complex interplay of factors: the evolution of values, the necessity to maintain health, technological progress, and the aspiration for a higher quality of life. Scientific research supports this trend, demonstrating that fewer working hours not only enhance well-being but often improve productivity.

Reducing working hours is also associated with addressing social issues such as demographic crises and the restoration of family values. In European

Table 1. Reasons behind the motivation to reduce working hours

Source: Based on (Bernstein & Turban, 2018; Haraldsson & Kellam, 2021; Newport, 2016; Pencavel, 2015).

Reasons	Explanations
Evolution of Values and Priorities	<ol style="list-style-type: none"> 1. As material well-being and living standards improve, people begin to prioritize quality of life over mere financial success. Studies show that people value free time for family, hobbies, and self-development more than additional work hours for extra income. 2. Modern society increasingly seeks a balance between work and personal life (work-life balance) as a response to the exhausting work schedules of past generations.
Psychological Burnout and Stress	<ol style="list-style-type: none"> 1. Working at a high pace leads to professional burnout, recognized by the World Health Organization (WHO) as a global issue. 2. People aim to reduce stress caused by task overload, multitasking, and constant availability in the digital age.
Technological Progress and Automation	<ol style="list-style-type: none"> 1. Thanks to automation and the use of technology, people can accomplish more tasks in less time. 2. Psychologists argue that reducing working hours helps improve mental health and overall productivity. 3. Reduction in working hours without loss of productivity. 4. Redistribution of time towards innovation, creativity, or relaxation.
Biological and psychological need for rest	<ol style="list-style-type: none"> 1. The human body and brain have limited capacity for productive work. The desire to work less is a natural mechanism of self-preservation. Biological rhythms and neuropsychological studies confirm that after 8 hours of mental or physical work, productivity sharply declines.
Increased social welfare	<ol style="list-style-type: none"> 1. People feel the need to replenish their energy, which is spent on rest, sports, or creative activities. In most developed countries, increased labor productivity enables people to work less. 2. Reduction of the workweek in developed economies following the Industrial Revolution. 3. Studies demonstrate that people experience greater happiness and satisfaction when they have more free time for self-realization and social connections.
Changing role of work in human life	<ol style="list-style-type: none"> 1. The traditional role of work as the primary purpose of life is evolving. Desire to devote more attention to family, travel, and hobbies. 2. Desire to engage in meaningful and fulfilling work.

countries, low birth rates are partially attributed to the modern labor market leaving insufficient time for family, child-rearing, and personal development. In this context, a shorter workweek allows employees to harmoniously balance professional life with family obligations. The experiences of countries like Finland and Norway show that flexible working conditions positively impact social well-being.

Flexible work models and reduced working hours are becoming essential tools for harmonizing professional and personal life in the modern world.

The 4-day, 10-hour workweek seeks to combine the advantages of a shortened workday while maintaining the output of a typical 40-hour workweek. On the one hand, employees gain an additional day off, potentially improving work-life balance

Table 2. Comparison of different work-week models

Source: Author based on (Clopton, 2011; Haraldsson & Kellam, 2021).

Parameter	40-hour week (5 days)	Shortened week (30-32 hours over 4-5 days)	4-day week of 10 hours
Total working hours	40 hours	30-32 hours + overtime (4-6 hours)	40 hours
Daily work duration	8 hours	6-8 hours	10 hours
Average productivity per hour	Moderate (100%)	Higher (+15-20%)	Initially high, declines by day's end (~90%)
End-of-week productivity	Declines to ~80%	Declines with overtime to ~70%	Declines daily (~85%)
Cognitive load	High	Moderate, increases with overtime	High due to extended workdays
Risk of Burnout	High	Moderate, rises with overtime	High due to prolonged stress
Team synergy	High	Moderate, disrupted with overtime	Moderate due to fatigue
Work-life balance	Low	High, moderate with overtime	Moderate; more days off but fatigue on workdays
Overtime costs	Low	High	None

and facilitating recovery. Overtime is avoided, reducing costs and mitigating the negative psychological effects of extended work hours. Ultimately, the total working hours (40) remain unchanged, preserving the scope of tasks.

However, certain drawbacks not only remain but also intensify:

1. A long working day (10 hours) leads to significant cognitive overload and fatigue towards the end of the day. This results in decreased productivity during the last hours of work.
2. Team synergy suffers due to fatigue, especially in the afternoon.
3. Flexibility in balancing work and personal matters during working days is reduced.

As a result, during the first 6-7 hours, productivity remains high, but by the 9th-10th hour of the workday, there is a sharp decline (to ~85-90% of initial productivity). This is due to exhaustion and the decrease in cognitive abilities.

To maximize effectiveness, it is worth experimenting with flexible schedules, productivity monitoring (using AI), and considering biological rhythms, which would help optimize working hours based on the characteristics of each profession and employee.

The implementation of a 4-day workweek increases the additional time available for participation in social life, volunteering, and family relationship development. Specifically, studies show that reducing the workweek by 20% increases the number of interpersonal interactions outside of work by 30%.

Furthermore, the level of trust and interaction between colleagues increases. In a flexible schedule environment, employees are more likely to choose collaboration over competition, as free time reduces the feeling of burnout and social pressure.

Paradoxically, reducing the length of the workweek can enhance productivity. This idea is based on the concept of “reducing costs through focus”. Limited time conditions encourage employees to work more focused, cutting down on unproductive tasks.

The experience of companies like Microsoft Japan demonstrates that a four-day workweek can increase productivity by 40% through reducing time spent on meetings and focusing on key tasks.

Moreover, a flexible schedule reduces stress levels and improves employees’ overall health, which positively impacts their performance.

Employee well-being depends not only on their salary but also on their quality of life, which is determined by physical, emotional, and social comfort levels. Prolonged work without sufficient rest leads to burnout, increased depression, and chronic illnesses.

Flexible workweek models allow employees to focus more on physical activity, hobbies, and spending time with loved ones. Additionally, reducing transportation loads through remote work improves the environmental situation and lowers stress levels.

The integration of flexible schedules not only changes approaches to work but also stimulates innovation. In companies with flexible work models, there is an observed increase in the number of creative ideas. For example, the introduction of “innovation time” at Google led to the creation of Gmail and Google Maps.

On the other hand, there are drawbacks and hidden risks associated with this model. These issues are especially relevant today due to various influencing factors.

The paradox of flexible scheduling lies in its dual nature as both catalyst and potential inhibitor of innovation. While designated “innovation time” has proven transformative in tech giants like Google, as evidenced by products like Gmail and Google Maps, the underlying mechanism extends beyond mere time allocation. Companies implementing flexible schedules must balance the benefits of individual creative freedom against the challenges of maintaining organizational cohesion. Research during the pandemic period has highlighted this complexity – while digital tools can bridge physical gaps, they may filter out the spontaneous interactions that historically contributed to innovation. This creates what we might term a “flexibility-innovation paradox”, where the

Source: Developed by the author.

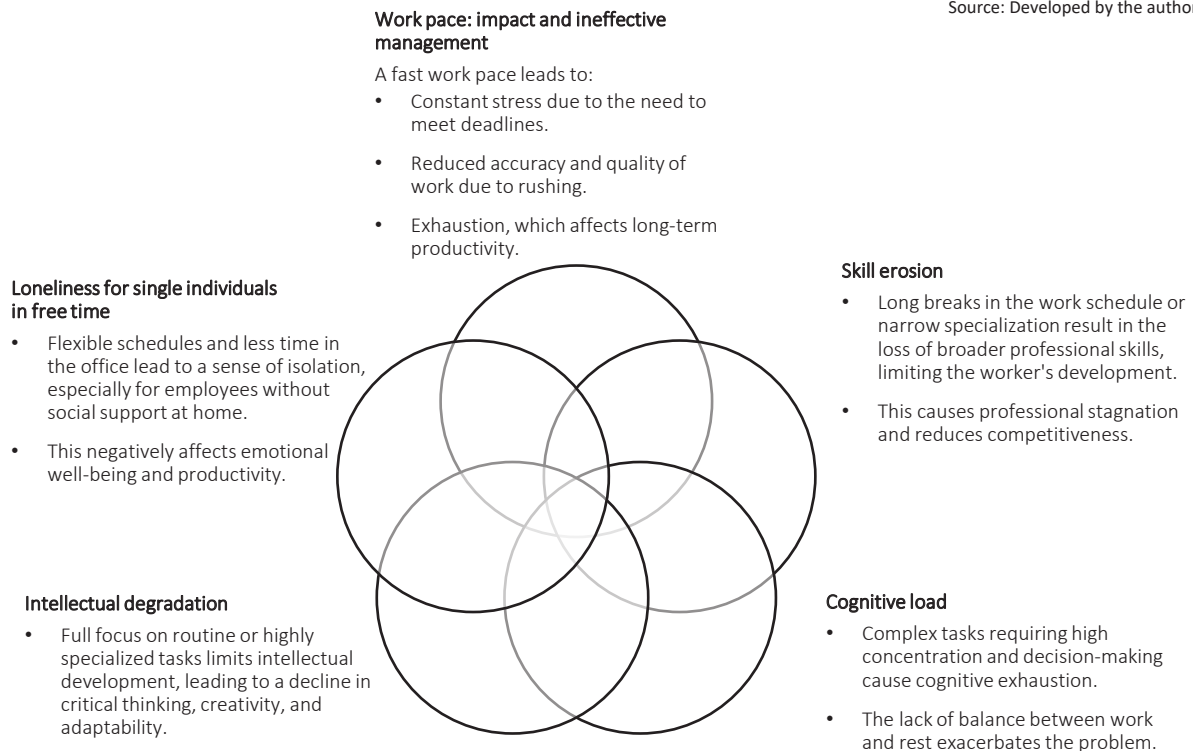


Figure 1. Disadvantages and threats of reducing working hours

very policies intended to boost creativity could potentially disrupt the social fabric that facilitates idea exchange.

However, this does not mean that reducing working schedules is unreasonable. Technological progress enables the individualization of work schedules, but few jobs can be performed entirely independently or generate benefits in large organizations. Alongside technological advancements, there is a trend toward collective work, responsibility, and security.

Although technology allows for the customization of work schedules, no employee can work in complete isolation:

- 1) most tasks in large organizations are interdependent, where the work of one specialist affects the work of others;
- 2) projects that require collective effort (engineering, research, or creative) cannot fully rely on asynchronous individualization.

Technological progress not only increases productivity but also presents new challenges concerning social and economic well-being:

- 1) collective work provides psychological support, promotes the distribution of responsibility, and reduces the stress of individual isolation;
- 2) in large organizations, teamwork creates accountability and reliability, which are often lacking in fully individualized processes.

Collective work plays an important social role in a society increasingly immersed in technological detachment. Another contradiction lies between the static nature and flexibility of work schedules.

3. The transition from static schedules is necessary due to the following reasons:
 1. Inefficiency of a fixed approach with regard to biological rhythms.
 2. The need to enhance productivity and reduce stress.
 3. Modern technological capabilities to adapt schedules.

A static schedule ignores individual biological rhythms (circadian rhythms) that dictate a person's

Source: Developed by the author.

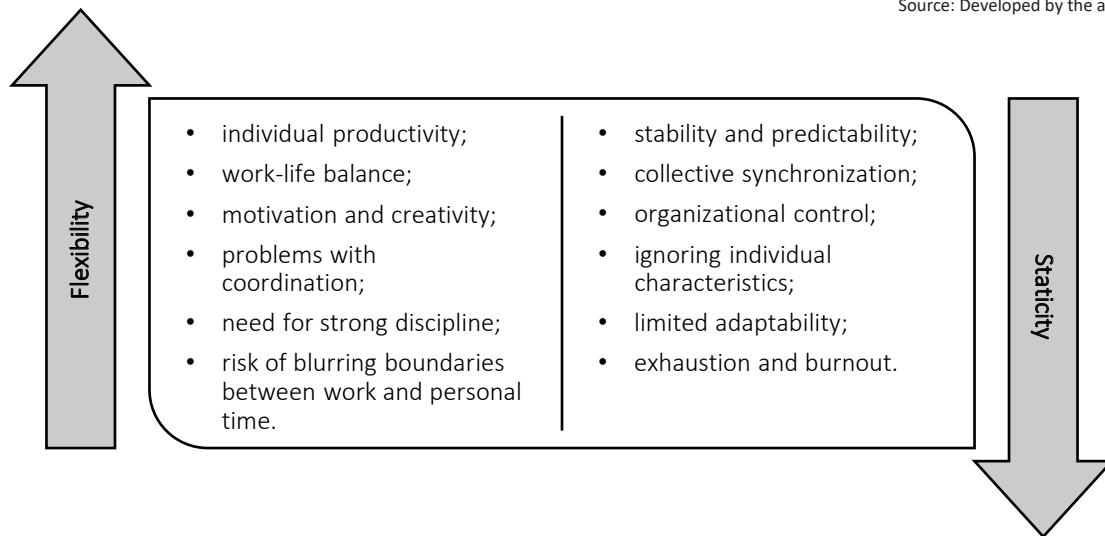


Figure 2. Advantages and disadvantages of static and flexible schedules

productivity and energy levels throughout the day. People are conventionally categorized into “larks” and “owls”, whose peak activity times differ:

- 1) larks are more productive in the morning;
- 2) owls are more active in the evening.

According to research, adherence to fixed schedules reduces productivity and causes chronic stress and burnout, as work occurs during periods of physiological energy decline.

A flexible schedule, adapted to the physiological and cognitive characteristics of an employee or student, allows work to be done during moments of peak concentration and motivation:

- 1) for instance, individual intervals of “cognitive peak” (the time when the brain processes information most effectively) can be utilized for complex tasks;
- 2) conversely, routine tasks can be performed during periods of reduced activity.

A study by Harvard Business Review indicates that organizations with flexible work schedules observe a 15–20% increase in productivity and a significant reduction in employee turnover. Biological rhythms determine individual productivity peaks at different times of the day. To achieve team synergy, however, it is crucial to synchronize

key collaborative activities (e.g., meetings, team-based tasks) with periods of optimal activity for each employee:

- 1) using AI tools to synchronize the circadian rhythms of different team members enhances team synergy, as individuals work together during their “cognitive peaks”;
- 2) conversely, poor synchronization can reduce team productivity by misaligning activity peaks and diminishing focus during critical moments.

Circadian rhythms, team synergy, and AI form a cohesive ecosystem where optimizing one element strengthens the others. Artificial intelligence plays a pivotal role in ensuring the flexibility, precision, and adaptability of this model. To implement such a system, technological advancements like fitness trackers, smartwatches, and similar devices should be leveraged to measure biological rhythms. AI-driven algorithms can then reformat work schedules based on the following principles:

- 1) incorporating biological rhythms to maximize individual productivity;
- 2) preserving and enhancing team collaboration through synchronized activities;
- 3) wide-scale integration of AI to ensure dynamic and flexible scheduling.

Source: Developed by the author.

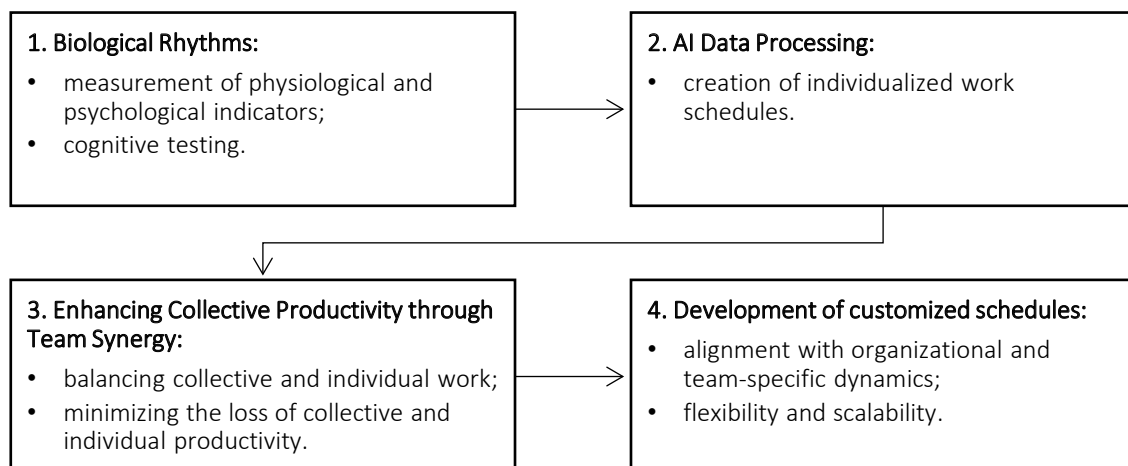


Figure 3. Scheme for implementing biological indicators, artificial intelligence technologies, and the concept of collective synergy in creating a work schedule

Analysis of data from wearable devices measuring heart rate variability, cortisol levels, and cognitive alertness reveals distinct patterns of peak performance that vary significantly among individuals. When AI algorithms process this biometric data alongside team collaboration metrics, they can identify optimal “synchronization windows” - periods where individual peak performance times naturally overlap, creating opportunities for enhanced collective output. The key innovation lies in AI’s ability to continuously adapt schedules based on real-time physiological data while maintaining what organizational psychologists call “collaborative momentum” - the state where individual circadian optimization actually strengthens rather than fragments team cohesion. This creates a self-reinforcing cycle where improved individual performance enhances team dynamics, which in turn supports better personal productivity patterns.

This scheme describes the integration of biorhythms, artificial intelligence, and collective synergy to form an adaptive work schedule that satisfies both individual employee needs and organizational needs.

1. Biorhythms determine physiological and psychological states of a person throughout the day. They include circadian rhythms (changes in body activity over 24 hours) and cognitive peaks (periods of maximum brain productivity). Using fitness trackers and cognitive test-

ing, data can be collected about optimal performance times and physiological states (for example, heart rate, stress level).

2. Artificial intelligence analyzes collected biometric and cognitive data and forms individual work schedules. Machine learning and big data are used to build productivity models. Optimized schedules take into account employee characteristics (cognitive peaks, energy levels) and organizational tasks (time for collective and individual work).
3. Collective energy is the synchronization of work schedules to maximize collective work efficiency. Team interaction often suffers in flexible schedules. AI should minimize the loss of collective advantages. AI combines workers into groups with similar biorhythms and provides “synchronization windows” for joint work.
4. Creating an optimized schedule involves balancing flexibility and collective interaction. The schedule must correspond to employee characteristics, take into account organizational goals, and maintain collective effectiveness through synergy.

The revolutionary concept lies in treating the workplace as a living organism with its own consciousness, where AI acts not just as a scheduling tool but as a collective neural network of the organization. By introducing AI to the workplace

ecosystem, we can visualize and quantify how individual biorhythms, team dynamics, and organizational goals create a unified field of productivity - similar to how neurons form consciousness in the brain. This biological-organizational parallel allows us to apply neuroscience principles to workplace optimization, where AI serves as the organizational limbic system, constantly balancing individual needs (like neurons) with collective goals (like brain functions), ultimately creating a self-aware, self-optimizing workplace ecosystem.

To form a new work week, it's important to consider the balance between productivity, biorhythms, and demographic challenges. The development of artificial intelligence will allow flexible integration of individual work schedules according to each employee's biological rhythm while maintaining a collective rhythm. For example, AI can analyze productivity data, cognitive load, and tasks to optimize working hours.

The specifics of different industries are taken into account through a modular approach: critical sectors operate on a mixed model, while creative or office professions implement shortened or flexible weeks. The example of Iceland and Canada demonstrates the effectiveness of a four-day week, however maintaining effective communication requires additional technological solutions.

Technologies will also help maintain work rhythm and hybrid schedules, contributing to solving the demographic crisis through better work-life balance. AI can create a platform that adapts to company-specific tasks, personal characteristics of employees, and global trends.

This model combines productivity with flexibility and aims to preserve synergy in teams, eliminating excessive cognitive load and allowing humanity to adapt to the future labor market.

CONCLUSION

Changing the traditional approach to working time allows for achieving a better work-life balance. Research confirms that adapting schedules to employees' biorhythms increases productivity while reducing stress and professional burnout. Technological progress, particularly AI tools and biometric devices, allows for creating individualized and adaptive work schedules. This increases the efficiency of both individual and collective work. AI helps optimize "synchronization windows" for team collaboration, minimizing the negative consequences of flexible schedules. Despite the individualization of work schedules, collective work remains an important factor in organizational success. The integration of biorhythms and technologies helps preserve team synergy, ensuring support, distribution of responsibilities, and effective communication. The introduction of adaptive work models using AI harmonizes individual employee needs with organizational objectives, creating conditions for economic development and well-being.

AUTHOR CONTRIBUTIONS

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Visualization: Denys Ovsianynkov.

Writing – original draft: Denys Ovsianynkov.

Writing – review & editing: Taras Kytsak, Denys Ovsianynkov.

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