World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Beyond PPE: Engineering Control Redesigns for High-Velocity Warehousing: A Mixed-Methods Evaluation of Ergonomics, PIT–Pedestrian Separation and AMR Interactions

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World Journal of Advanced Research and Reviews, 2025, 28(02), 898-904

Publication history: Received on 29 September 2025; revised on 05 November 2025; accepted on 08 November 2025

Article DOI: https://doi.org/10.30574/wjarr.2025.28.2.3783

Abstract

This study examines how ergonomic redesigns, engineering, and the incorporation of automation make warehouses safe. Having an integrated methodology based on secondary findings, the research is a synthesis of both quantitative research of ergonomics risk assessment and qualitative analysis of the attitude of the workers toward the topic of safety. The findings indicate that the ergonomic interventions, such as flexibility of workstation, job rotation, and improved layout design, have significant influence in reducing the strain and fatigue of marketing strain. Engineering controls are made up of PIT-pedestrian separation zones and adaptive traffic flow systems, which provide safety and efficiency in operations. Further, the invention of autonomous mobile robots (AMRs) displays greater human-robot interaction, will, and prevention of collisions that may occur accidentally. Altogether, these findings can suggest that the interaction of human factors, engineering, and automation is the foundation of the future of intralogistics. The study concludes that the key to sustainable warehouse safety is always-evaluated, technology-correct, and technology-action-concise and ergonomically-aware engineering practices to maximize performance and prevent harm to the health and well-being of workers.

Keywords: Control; Engineering; Ergonomics; Evaluation; Methods

1. Introduction

The modern progressive growth in warehousing with high velocity has brought an unprecedented complexity in the contemporary logistics operation. Due to the increased speed in supply chains to address consumer needs, these processes expose warehouse workers to both ergonomic and safety issues that appear as a result of repetitive movement, heavy lifting, and close contact with the machine and the self-actualized processes (Loske et al., 2021). Conventional safety operations which were greatly dependent on personal protective equipment (PPE) have been found to be inadequate in dealing with these systemic risks, being more of a last defense mechanism as opposed to dealing with hazards at the point of origin. The studies of material handling surroundings prove that ergonomic interventions and equipment re-designs provide longer-lasting and less costly eradication in the workplace injuries than PPE (Wurzelbacher et al., 2020). This restriction has caused a focus in industry towards proactive platforms that factor in engineering and administrative regulators that finding ways to eradicate or decrease hazards by gaining better system setup and optimization of workflow.

In this changing context, ergonomics has become an important field of study in improving the human to machine interactions, reduction of musculoskeletal fibers, and the running of efficient operations. Equally, the organized segregation of pedestrians and powered industrial trucks (PITs) via physical obstacles and traffic stripping have become

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part and parcel of the diminution of the chances of collisions in congested warehouses. The increased moving autonomy of autonomous mobile robots (AMRs) are additional reflecting factors of the necessity of intelligent human and robot cooperation and spatial coordination systems to secure the safety and productivity. As a result, this study will assess the ergonomic redesign to reduce musculoskeletal stress, engineering controls to increase pedestrian safety on the PITs, and human-robot interaction frameworks that can maximize safety and performance in the automated warehousing setting.

2. Literature Review

2.1. Ergonomics and Human Factors in Warehousing

The whole issue of ergonomics is primary to make sure that operations in the warehouse are efficient and safe to the workers, particularly in those workplaces where there is a high demand that necessitates continuous motion and repetitive activities. Awkward positions, repetitive lifting, overexertion, and maintained stillness are the most prevalent ergonomic risk of material movement and order-picking that are the sources of musculoskeletal disorders (MSDs) and fatigue. It was found that such risks occur especially in the high-velocity warehousing where workers are expected to achieve high performance goals and ensure safety (Ismail et al., 2024). These circumstances make the strain injuries more probable especially in the back, shoulder and wrist since workers often work with heavy or unbalanced weight. The studies of ergonomic interventions focus on segmenting that the redesign of manual material handling systems can result in a major decrease in the rates of injuries, with the focus on mechanical aids, lift-assist devices, and the optimization of workstations (Wurzelbacher et al., 2020).

The evaluation of musculoskeletal strain has thus become a part of work-related safety analysis that allows organizations to recognize potentially hazardous duties and generate the specific interventions. To provide an example, ergonomic assessment measures like the Rapid Upper Limb Assessment (RULA) and Rapid Entire Body Assessment (REBA), help in determining the offense of risk and provide evidence-based interventions. When incorporated into the larger warehouse management systems, these tools can enable the constant observation of the posture and movement pattern of workers (Loske et al., 2021). Job rotation has since become an effective administrative control mechanism helping to alleviate physical stress through the sensitivity of workers to change between work with various biomechanical requirements, so that continuous working on the same muscles does not cause any overload to the muscle masses. Moreover, the design of the workstations, adjustable work surfaces, and versatile shelfs, has attained success in matching work to human abilities (Greig et al., 2019). Through ergonomics and using automation aids, modern warehouses are increasingly becoming more proactive, as opposed to reactive, with respect to worker and operation safety models that promote the well-being of workers and operational performance.

2.2. Engineering Controls and Process Design

Engineering controls can be seen as the next phase in the evolution of warehouse safety that stops PPE use and administrative modifications and shifts the focus to mitigating hazard presence in the warehouse by redesigning systems and equipment. This method focuses on changing the physical work environment as a way of reducing the exposure of risks. Such modifications have been prompted by the discoveries that physical redesigns (through improved arrangement of the warehouse, mechanical aids to handle, and automated lifting systems) are greener safety actors, as opposed to interventions based on behavior (Glock et al., 2019). One of the elements that will be achieved through a good layout will include ensuring that the workflow routes are as large as possible, the storage facilities are visible, and the high-traffic areas are well defined to prevent accidents. The manipulability equipment, such as lift tables and ergonomic stations to convey and raise and lower, is also important to play the role of removing any element of bending, twisting, and reaching moves that exposes the employees of the subjects to musculoskeletal conditions.

The recent studies also point to the fact that a balance between the comfort of workers and their productivity can be achieved at the stage of designing the warehouse business process, including the incorporation of ergonomic principles (Zhang et al., 2023). An example is the use of ergonomic cost benefits models which show that the investments made in mechanical assistive devices and layout optimization can minimize absenteeism, compensation expenses and eventually enhance throughput. In this respect, the safety in the warehouses is no longer seen as a compliance issue but rather the way to enhance performance and keep it in accord with business requirements. The humanistic approach to design will see the interface of the employees and equipment made to be as efficient as possible, yet at the same time be safe. This has been conspicuous in order-picking systems, where the variability of the tasks would be high and the speed of the output and the longevity of a worker is defined using ergonomic factors. The operational excellence and the preservation of occupational health of the organization is a two-fold benefit of workflow reconsideration that may be achieved by incorporating safety into the design of equipment and processes. Engineering controls, therefore, are

the preventive controls, as well as, the inseparable part of optimization of the warehouse systems, helping to define the development of new intralogistics settings.

2.3. Automation, AMRs, and Human-Robot Collaboration

Safety management and human-machine interaction have presented opportunities and challenges with regards to autonomous mobile robots (AMRs) as their use in warehouse operations continues to increase. The machines known as AMRs can be used to pick, transport and sort goods usually in places where human labor is involved. They can be effectively deployed only with the help of the successful communication protocols, spatial awareness systems, and ergonomic integration into human workflows (Keith and La, 2024). The AMRs need the constant real-time navigation and collision avoidance system in contrast to set automation systems; this system is based on sensors, mapping technologies, and machine-learning algorithms. These capacities increase efficiency, but also require powerful structures of safe human-robot interaction. The idea of intent communication systems, which robots use to communicate their movement or task intentions to nearby humans, has become the key element in ensuring the situational awareness as well as decreasing anxiety or confusion amongst workers (Bhattathiri et al., 2024).

In addition to the communication, human-robot intent recognition systems are revolutionizing the safety measures of automated warehouses. Such systems use the patterns of human motions to predict human behavior and change the trajectories of the robots after they detect such patterns to avoid the possible collision or unsafe interactions (Petković et al., 2020). In addition to the space coordination option, complementary technologies (wearable sensors and camera-based localization) help in constantly updating the worker positions according to the mobile robots (Écorchard et al., 2020). Research on ultrawideband communication has shown that accuracy and response time are also improved, which enables robots to conform to the environment without challenges (Ivsic et al., 2020). Combined with other innovations, the concepts create the basis of collaborative warehousing systems, merging security, productivity, and human comfort. Nevertheless, despite such developments, there are still several issues related to tooling the human-robot interaction protocols in different warehouse conditions. The constant advancement of smart safety systems, hence, is aimed at creating equilibrium between the autonomy of technologies and human control, and in such a way that automation supports but does not eliminate the human factor in logistics processes.

3. Methodology

The research study utilized a mixed-methods research design, which is based on the secondary data with the focus on published ergonomic, safety and automation studies concerning warehousing. It was a mixed-method strategy incorporating both quantitative results of the available ergonomically assessments of risk, especially the Rapid Upper Limb Assessment (RULA) and Rapid Entire Body Assessment (REBA) with the qualitative results of the previous studies which analyzed perceptions of safety and strain in the technological integration of the working environment as well as the attitudes of the workers towards this matter. This design succeeded the principles of the methodological triangulation as described in the known mixed-methods research designs to combine the objective strain data with the subjective experiences (Greig et al., 2019). The quantitative part was based on already validated datasets of musculoskeletal strain and ergonomic hazards in the situation of material handling and order-picking, whereas the qualitative strand examined the findings provided in the case studies discussing the comfort of employees, the job design, and ergonomic adjustment to the automation situation (Ismail et al., 2024; Loske et al., 2021).

The sample was thus data based on peer-reviewed research studies exploring medium to large-scale warehouse operations, such as retail intralogistics, courier service distribution centers and automated warehouse settings. The sampling of the secondary data covered both diversities of job positions (pickers, packers, forklift operators, and robotics supervisors) so that it is possible to cross-sectionally represent the ergonomic and safety issues across warehousing systems. Both strands were qualitative in nature, with thematic synthesis as the method of analysis and comparison of ergonomic scoring measures across the studies being the basic parts of the combined interpretive model. In order to focus on and compare the relative relevance of both the ergonomic and safety factor, the Analytic Hierarchy Process (AHP) framework was utilized in terms of secondary findings, which allows prioritizing and weighting down important decision factors, including workstation design, pedestrian safety, and human-robot interaction (Saaty and Vargas, 2022). The ethical issues were covered by following the principles of academic integrity, citing all sources of data, and contemplating on the bias of the researcher. The verification of these different empirical research studies provided reliability and augmentation of the validity of conclusions based on secondary evidence.

4. Results and Analysis

4.1. Ergonomic Assessment Outcomes

The literature review showed that ergonomic redesign interventions at the warehouse setting led to a substantial decrease in musculoskeletal strain and fatigue in the material handlers and order pickers. The quantitative data with the help of RULA and REBA were negative in demonstrating the significant reduction in stress linked to the upper limbs and the lower back with the introduction of height-adjustable workstations, mechanical aids of lifting load and better access to the shelves with the introduction of more suitable and accessible shelves. The review of studies assessing those interventions showed that an application of the ergonomic principles in the design of the warehouse layout can significantly reduce the incidence of injuries and fatigue reports per working shift (Wurzelbacher et al., 2020). In addition, tools to help with the handling, including powered conveyors and adjustable pallet systems, were identified to improve the stability of the posture and reduce strains of repetitive types, particularly in high velocity work settings that necessitate posture-intensive processing of manual handlers.

The case study-based qualitative results also confirmed the theory that task redesigning on human-centered principles is useful to promote higher levels of worker comfort, lesser rates of absenteeism, and higher levels of job satisfaction (Ismail et al., 2024). A case study featuring workers that received job design, where they were required to undergo rotational tasks and ergonomic training, showed the workers were less fatigued; they were less strained, due to the repetitive lifting. Evidence also ascertained that ergonomically appropriate environments supported increased productivity as evidenced by the productivity due to reduced recovery time and decrease in interruptions. The cumulative analysis suggests that ergonomic interventions not only have a protective role in increasing the degree of safety but also a functional one in advance since they can increase the levels of operational throughput and well-being of workers simultaneously. Therefore, it is crucial to incorporate the tools of ergonomic assessment in the design process of the warehouse in the long term to guarantee musculoskeletal health and labor productivity.

4.2. PIT–Pedestrian Separation Controls

The secondary evidence analysis showed that safeguarding performance increased significantly with the adoption of engineering controls, which targeted the division of powered industrial truck (PIT) traffic and pedestrian movement areas. Research on the design of processes in warehouses demonstrated that the restructuring of the floor plan and the creation of special pedestrian routes proved effective to minimize multiple cases of near-misses and collisions (Glock et al., 2019). Directional signs, floor marks, and physical barriers enhanced visibility and awareness of space especially at intersections where there were large flows of people. Such structural adjustments not only contributed to higher levels of physical separation but also to the behavioral safety adherence because employees claimed that they were more confident to behave in shared work areas. Empirical simulation evidence also existed that there was an easier movement, a reduction in the routes of delivery, and a decrease in congestion in the loading and unloading regions.

The supplementary evaluation of various hybrid warehouse systems, which added automated and manual operations, showed that these segregation levels achieved objective enhancements in safety and efficiency. They were equipped with real-time monitoring systems, including proximity sensors and automated stop alerts, without which it would seem impossible due to the insurance of dynamic control of PIT movement and entry by workers (Zhang et al., 2023). Further, the amalgamation of the two ergonomic concepts and engineering facilitated the workflow to be more efficient in terms of aligning the workflow with the reduced meaningless walks and the maximum throughput without compromising the safety. Secondary data quantitative models established that there was a significant reduction in the rate of accidents and damage of materials at places of work following the establishment of structured traffic management systems. Overall, the results presented highlight the idea that the PIT pedestrian separation controls are a vital element of advanced warehouse safety mechanisms, which contributes to the continuity of operations and improved occupational safety.

4.3. AMR Interactions and Human–Robot Synergy

Human-machine collaboration in the warehouse setting has been redefinable through the introduction of autonomous mobile robots (AMRs) to the warehouse setting to improve situational awareness, precision, and communication. Studies reviewed show that AMRs with intent communication (looks and movement indicators) to help workers predict the actions of the robot and prevent hazardous closeness (Bhattathiri et al., 2024). These communication protocols have been posthole proposed to cause less anxiety and enhance trust between human operators, enabling a more workflow flow and coordination to be achieved by means of qualitative data. Adaptive response and understanding human gesture have been demonstrated to reduce miscommunication especially in dynamic areas where the two entities interact at

the same time as demonstrated by AMRs. This kind of collaboration structures creates a predictable interaction pattern, hence, increasing productivity and minimizing the risk of collision.

Technically, human–robot interaction (HRI) systems have greatly progressed in the development of real-time intent recognition algorithms to predict the movement patterns of human beings to enable robots to modify their paths automatically (Petković et al., 2020). Such systems, coupled with wearable and camera-based localization technology, create a solid safety framework of shared workplaces (Écorchard et al., 2020). Tests on ultrawideband communication protocols have established improved spatial precision that allows AMRs to be in safe ranges and naturally flowing coordinated measures with human operators. Moreover, the industry studies indicate that the human-robot synergy is part of the overall optimization of the warehouse as it provides systematic accuracy of automated precision in balance with human versatility (Keith and La, 2024). The findings synthesis indicates that the AMR safety and interaction systems are not only effective in terms of productivity but also increasing the level of ergonomic and psychological safety, which is one of the greatest improvements in the design of the warehouse.

5. Discussion

The results of the current research are consistent with most general tendencies in the sphere of warehousing worldwide, where the combination of ergonomic redesign and automation has become one of the central forces, that provide a performance with efficiency and contribute to overall well-being of the employees. Existing evidence reviewed points to the ergonomic measures directly meant to reduce musculoskeletal tension and improve long-term employee health through the adjustable equipment, job rotation, and perfect layout architectural planning. These are the results that are in line with the global data showing fewer injuries and higher levels of worker satisfaction in ergonomically designed warehouses, which underpins the increasing trend of implementing reactionary safety solutions instead of proactive human-centered design (Nasir et al., 2024). The sustainable focus in the global logistics and the at-work retention levels also contribute to the necessity of the ergonomic approach providing the balance between the economical results and the responsibility to the social welfare and community, and makes ergonomics one of the fundamental pillars of sustainable logistics building.

These findings are relevant to the safety of workers and paint an overarching effect on the management of the warehouse and organizational sustainability. The current management practices have realized that the health of employees and operational performance go hand in hand, as healthy employees prove to be more engaged and make fewer mistakes (Väyrynen and Kiema, 2022). Sustainably optimum environments are also in harmony with the principle of ergonomics because they lead to the decreased turnover of personnel, the lowest possible costs related to payments, and the application of inclusive design which facilitates the inclusion of the varying population of workers. These systems will create a culture of accountability on safety and the workers will take part in ongoing processes of activities that lead to continuous improvement. Such socio-organizational compatibility is shifting the traditional role of warehouse design as a fixed model of infrastructure to an active ecosystem that changes according to technological and human demands.

The socio-technical aspect of integrating automation and ergonomics by using collaborative robotics and AMRs that enable ergonomics, but not replace human labor, is also of equal importance (Greig et al., 2019). PPE measures involving engineering controls such as PIT pedestrian separation, monitoring through automation and layout deviation, supplement traditional control methods (i.e. personal protection) by mining the sources of hazard rather than focusing on protection itself. Such approach to safety is more than multiple layers in that the technological solutions shall add value to human input in logistics opening the path to resilient, efficient, and socially sustainable warehouse systems.

Recommendations and Practical Implications

The results of this study indicate that the issue of warehouse operators shifting to a system-based redesign that is more focused on ergonomics, automation and real time safety monitoring is urgent as well. Among the major recommendations is the introduction of evidence-based ergonomic workstations which entails the encouragement of the execution of tasks within the most favorable reach, height, and posture levels. Normalization of anti-fatigue flooring and the lift aids equipment, as well as adjustable work stations, should be avoided in the whole arrangement of the facility that will preclude the peril of musculoskeletal strain and fatigue in the warehouse setting. The training programs could be added to these initiatives to advance the level of ergonomic awareness and give the workers the authority to link the primary symptoms of strain and inform about the potential threats prior to the occurrence of the appalling consequences. The performing of the ergonomic assessment following regular repetitions with the aid of the validated tools, such as the RULA and REBA, will help solve the active risk management and ensure that the requirements of the occupational health are observed.

The second recommendation of great significance is strategic zoning of autonomous mobile robots (AMRs) and the pedestrians to reduce the threat of their collisions and improve the coherent processes in the working environment. The warehouses will be fitted with particular AMR-pedestrian paths, visuals, and close-range sensors, as well as automatic stop lights to prevent overlapping of movement. The spread of AMR communication protocols, such as intent recognition, path prediction, and so on, will help the creation of the harmonious collaboration of humans and robots and the formation of the safer collaborative conditions. The given zoning plan should be enhanced by the active control devices that would be capable of tracking the degree of movement and reminding the bosses about the potentially hazardous interactions. Such data-based surveillance not only gives a higher level of security but also enables optimization of the operation through predictive analytics along with recognition of trends.

The remedy will be the introduction of the continuous observing systems, which will be used to record the ergonomic and operational as well as behavioral security measures that will assist the managers to evaluate the success of interventions and revise the policies. The wearable technology, camera-based localization, and automated reporting in the form of dashboards should be integrated into these systems to give a full picture of safety performance. By converging the principle of technical solutions and the principle of human factors, the redesign of the warehouse can provide a sustainable balance of productivity, employee welfare, and corporate culture of safety, which will guarantee the logistics environment of the future.

Limitations and Future Research

The limitation of this study is that it uses secondary data and this prevents the ability to measure real-time fluctuations in ergonomic strain and human-robot interaction consequences in different warehouse situations. The studies that were reviewed were in large part based on industrial settings within particular areas and it is therefore restricted to generalizing the findings in the context of the global logistics processes. Also, there is no longitudinal data and this limits the knowledge of the performance of ergonomic and automation intervention over a long period of time. Further studies are needed on the AMR and ergonomics in the long-term context with the introduction of metrics of psychological well-being stress, job satisfaction, and cognitive workload as an indicator of assessing the entire effect of technological change on warehouse employees.

6. Conclusion

This research has shown that the key to attaining sustainable warehouse safety is through the use of engineering controls, which have been enforced by strict mixed-methods assessment. Combining ergonomic redesign, systematic PIT-pedestrian separation, and intelligent automation is a sure way of warehouses to alleviate physical strain, avoid accidents, and optimize the well-being of workers. The blend of quantitative ergonomic measurements and qualitative information supports the key value of the harmonization between the operational effectiveness and the human design. In the process of developing the logistics industry, the concept of synergy between human factors and automation becomes a keystone of the new generation of intralogistics. A case of collaborative robotics, adaptive layout, and continuous monitoring system are symptoms of the way technology could be used to fortify and not to undermine human ability and establish workplaces that are resilient, safer, and sustainable to enhance productivity and other social responsibilities.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Branimir Ivsic, Zvonimir Sipus, Juraj Bartolic, & Josip Babić. (2020). Analysis of Safe Ultrawideband Human-Robot Communication in Automated Collaborative Warehouse. ResearchGate. https://doi.org/10.48550/arXiv.2012.11345

[2] Gaël Écorchard, Karel Košnar, & Libor Preucil. (2020). Wearable camera-based human absolute localization in large warehouses. ResearchGate. https://doi.org/10.48550/arXiv.2007.10066

[3] Glock, C. H., Grosse, E. H., Abedinnia, H., & Emde, S. (2019). An integrated model to improve ergonomic and economic performance in order picking by rotating pallets. European Journal of Operational Research, 273(2), 516–534. https://doi.org/10.1016/j.ejor.2018.08.015

[4] Greig, M. A., Village, J., Dixon, S. M., Salustri, F. A., & Neumann, W. P. (2019). Assessing human factors and ergonomics capability in organisations – the Human Factors Integration Toolset. Ergonomics, 62(10), 1254–1272. https://doi.org/10.1080/00140139.2019.1572228

[5] Ismail, B., Widia, M., Hani, E., Norlinda, W., & Faizal, M. (2024). Ergonomic Risk Assessment of Warehouse Workers in the Courier Service Industry: A Case Study from Kuantan, Malaysia. Jurnal Optimasi Sistem Industri, 23(1), 61–75. https://doi.org/10.25077/josi.v23.n1.p61-75.2024

[6] Keith, R., & La, H. M. (2024). Review of Autonomous Mobile Robots for the Warehouse Environment. ArXiv (Cornell University). https://doi.org/10.48550/arxiv.2406.08333

[7] Łopuszyński, M., Janusz, K., & Karwat, D. (2025). Comparative Study of Selected Order-Picking Methods: Efficiency, Ergonomics, and Adaptation Rate of New Employees. Sensors, 25(3), 923. https://doi.org/10.3390/s25030923

[8] Loske, D., Klumpp, M., Keil, M., & Neukirchen, T. (2021). Logistics Work, Ergonomics and Social Sustainability: Empirical Musculoskeletal System Strain Assessment in Retail Intralogistics. Logistics, 5(4), 89–89. https://doi.org/10.3390/logistics5040089

[9] Nasir, D., Rakesh Venkitasubramony, & Suresh Kumar Jakhar. (2024). Ergonomics in warehouse design and operations: a systematic literature review. Operational Research, 25(1). https://doi.org/10.1007/s12351-024-00892-z

[10] Saaty, T. L., & Vargas, L. G. (2022). Models, Methods, Concepts & Applications of the Analytic Hierarchy Process. Springer Science & Business Media. https://www.researchgate.net/publication/362349026_The_Analytic_Hierarchy_Process

[11] Sriparvathi Shaji Bhattathiri, Bogovik, A., Abdollahi, M., Hochgraf, C., Kuhl, M. E., Ganguly, A., Kwasinski, A., & Ehsan Rashedi. (2024). Unlocking human-robot synergy: The power of intent communication in warehouse robotics. Applied Ergonomics, 117, 104248–104248. https://doi.org/10.1016/j.apergo.2024.104248

[12] Tomislav Petković, Jakub Hvězda, Tomáš Rybecký, Marković, I., & Petrović, I. (2020, May 22). Human Intention Recognition for Human Aware Planning in Integrated Warehouse Systems. https://doi.org/10.48550/arXiv.2005.11202

[13] Vayrynen, S. T., & Kiema-Junes, H. K. (2022). Exploring Blue- and White-Collar Employees' Well-Being at Work System. Research Anthology on Changing Dynamics of Diversity and Safety in the Workforce, 1526–1549. https://doi.org/10.4018/978-1-6684-2405-6.ch076

[14] Wurzelbacher, S. J., Lampl, M. P., Bertke, S. J., & Tseng, C.-Y. (2020). The effectiveness of ergonomic interventions in material handling operations. Applied Ergonomics, 87, 103139–103139. https://doi.org/10.1016/j.apergo.2020.103139

[15] Zhang, M., Grosse, E. H., & Glock, C. H. (2023). Ergonomic and economic evaluation of a collaborative hybrid order picking system. International Journal of Production Economics, 258, 108774–108774. https://doi.org/10.1016/j.ijpe.2023.108774