SYSTEM SAFETY: HUMAN - TECHNICAL FACILITY – ENVIRONMENT
6(1), 2024, pp. 371-383

VISUAL CONTROL SYSTEMS IN THE FOOD INDUSTRY: ENHANCING EFFICIENCY, QUALITY, AND SAFETY THROUGH TOYOTA PRODUCTION PRINCIPLES

DOI: 10.2478/czoto-2024-0039
Received: 19/11/2024
Accepted: 20/12/2024

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Abstract: Visual control systems are integral to enhancing efficiency, ensuring quality, and maintaining safety in the food industry. This study investigates the application of visual tools within a food production enterprise located in the Silesian province, aligning these practices with the principles of the Toyota Production System (TPS). Visual tools, such as monitoring systems and information boards, enable real-time decision-making, promote adherence to stringent quality standards like HACCP, IFS, and BRC, and support continuous improvement. The research, conducted using the BOST questionnaire, highlights key factors valued by production workers, such as cleanliness, flow, and monitoring. The results demonstrate the effectiveness of visual control in addressing the industry's unique challenges and underline its potential for broader implementation in small and medium-sized enterprises. This study aims to bridge theoretical principles with practical applications, providing insights into optimizing production processes through the Toyota management philosophy.
Keywords: Visual control systems, Toyota Production System (TPS), food industry, quality assurance, safety, BOST method.

1. INTRODUCTION

Visual control is a fundamental element of the Toyota Production System (TPS), designed to ensure that operational processes are transparent, standardized, and efficient. It involves the use of visual cues, tools, and displays to communicate critical information quickly and effectively to workers, supervisors, and management (Amasaka, 2012). These visual elements facilitate real-time decision-making, help identify abnormalities, and ensure that the work environment remains organized and safe. Visual control ensures that processes remain aligned with TPS principles, such as waste reduction, quality assurance, and continuous improvement (Kaizen). By making information accessible and actionable at a glance, it empowers employees to maintain efficiency, uphold standards, and contribute to the overall success of the production system. Visual control holds a special place at Toyota Motor Company, as it is a cornerstone of the TPS. This technique plays a critical role in supporting the company's continuous pursuit of operational

excellence and is directly integrated into processes designed to enhance added value (Liker, 2005).
A particularly important application of visual control is its integration into the TPS pillar known as Jidoka (autonomation), which focuses on building quality into processes and enabling machines or operators to detect and address abnormalities (Knop and Mielczarek, 2018). Within this framework, visual tools are used to signal issues, such as defects, delays, or equipment malfunctions, ensuring that problems are addressed promptly and efficiently. By embedding visual control into all aspects of production, Toyota ensures that operations remain transparent and that every team member can contribute to maintaining quality, efficiency, and safety (Gao and Low, 2015). This approach not only enhances the production process but also reinforces a culture of continuous improvement (Kaizen), empowering employees to proactively identify and address challenges.
Recent studies have highlighted the importance of visual control and related management practices in various industries, including food processing. For example, agile management practices, tailored to the specific needs of Polish organic food processing enterprises, have been shown to enhance operational efficiency and adaptability (Dziuba and Szczyrba, 2023). The implementation of Good Manufacturing Practices (GMP) further emphasizes quality and safety management in food production, ensuring compliance with stringent industry standards (Szczyrba and Dziuba, 2023). Additionally, the integration of Failure Mode and Effects Analysis (FMEA) with the Hazard Analysis and Critical Control Points (HACCP) system has been recognized as a valuable method for improving risk management and safety in the food industry (Szczyrba and Ingaldi, 2024). These methodologies underscore the evolving role of visual and systematic controls in enhancing production outcomes.
In the food industry, consumer preferences significantly influence packaging and product presentation. The use of the Kano model to decode these preferences has proven effective in aligning product attributes with customer expectations, demonstrating the intersection of quality management and consumer satisfaction (Szczyrba and Szataniak, 2023). Moreover, international perspectives on sustainable practices, such as those observed in Colombian coffee production, reveal critical innovation factors that could be adapted to other sectors, including food processing (Ramirez-Zuñiga et al., 2024). These insights contribute to a deeper understanding of how visual and systematic controls, combined with innovative practices, can drive improvements across diverse production environments.
The topic of visual control systems in the food industry is crucial because it directly impacts efficiency, quality, and safety, ensuring compliance with stringent regulations while meeting rising consumer expectations. These systems streamline operations, reduce waste, and enhance worker productivity, making them essential for competitive and sustainable food production. Moreover, they facilitate rapid problem-solving and consistent standards across global supply chains, ensuring reliability and consumer trust.
This article aims to analyze and emphasize the role of visual control in ensuring efficiency, quality, and safety within food industry enterprises. It highlights the significance of visual control tools in optimizing production processes and presents research findings conducted in a food industry enterprise to evaluate the effectiveness and impact of visual control systems.

2. RESEARCH METHODOLOGY

This article examines the responses provided to a specific question included in the BOST questionnaire (Borkowski, 2012). Understanding the perspectives of employees across various levels within the organization is crucial for forming a comprehensive opinion. Such insights enable a deeper appreciation of the enterprise from the viewpoint of its workforce, shedding light on operational strengths, weaknesses, and areas for improvement.

The BOST survey is designed with carefully tailored questions, making it a valuable tool for evaluating an organization's overall functioning and its intangible assets. By focusing on worker feedback, the questionnaire helps highlight key factors influencing efficiency, employee satisfaction, and alignment with the organization's strategic goals (Mielczarek, 2021).

Rooted in principles inspired by Taiichi Ohno's pioneering work on the Toyota Production System (2008), the BOST methodology emphasizes the importance of integrating employee insights into management practices. By doing so, it provides a framework for continuous improvement, fostering an organizational culture that values collaboration, innovation, and sustainable development. Through this analysis, the article aims to explore how the application of such tools can enhance understanding of enterprise operations and contribute to more effective decision-making processes (Borkowski et al., 2016).

The research was conducted in a food processing company. The study was carried out in 2022. The survey was conducted in the examined enterprise, covering 55% of production workers, i.e., more than half of the workforce. Such a large research group consisting of employees directly involved in production allows for a precise identification of factors in visual control. An important issue regarding the evaluation of visual control types appears in the E7 area of the BOST questionnaire (Borkowski et al. 2017). The content of the E7 area corresponds to the seventh principle of Toyota management. The question in the E7 area is as follows: "*What is the most important element in visual control?*" Respondents are asked to rank the factors by typing the numbers 1, 2, 3, 4, 5, and 6, with 6 representing the most important factor. This question aims to evaluate how well different aspects of visual control are prioritized and understood within the organization, providing valuable insights into the implementation and effectiveness of visual control mechanisms in line with Toyota's management philosophy (Borkowski, 2016).

CS		Cleanness/Order
EP		Flow
TI		Information board
UP		Participation in production places
ME		Monitoring
GW		Graphic presentation of results

These elements reflect various aspects of visual control and their contribution to efficient management practices. Each of these components aligns with the Toyota Production System's focus on improving productivity, reducing waste, and fostering continuous improvement. The primary criterion for selecting automotive companies for the research was the confirmed use (based on preliminary analyses) of a visual control system, which is a key component of the Toyota Production System. This system, known for its role in improving efficiency and quality, was a fundamental condition for including the companies in the study. Subsequently, a sample of production employees was surveyed using the

BOST questionnaire, which assesses various aspects of organizational management, including visual control systems. The sample was selected in a quasi-random manner, ensuring that the group represented a cross-section of employees across different roles and levels of experience. The key criterion for selecting production employees for the BOST survey was the proven interaction with the visual control system in their work areas, which was confirmed through preliminary analyses of their job functions. This ensured that all participants had relevant experience with visual management tools, allowing for accurate and meaningful feedback. A total of 36 employees were surveyed, and their opinions on the importance of various types of visual control—such as cleanliness, flow, and monitoring—were obtained. The feedback provided valuable insights into how employees perceive the effectiveness of visual control in improving their work environment and overall production efficiency.

3. RESPONDENTS' OPINIONS ON VISUAL INSPECTION

Visual inspection is one of the fundamental assessment tools in various fields such as industry, medicine, construction, and quality management. Visual inspection plays a crucial role in the food industry for several important reasons (Rosak-Szyrocka and Ulewicz, 2016). It helps ensure product safety by identifying contamination, physical defects, or irregularities in food products, which is vital for meeting safety standards and preventing potential hazards. Regular visual checks also help maintain hygiene standards by ensuring that equipment, workstations, and production areas comply with strict cleanliness requirements, which are critical in food processing. Respondents may have diverse opinions on this process, depending on their experiences, perspectives, and the area in which the inspection is applied.

Table 1
Assessment structure [%] of factor Importance in Area E7

Mark	Factor indicating					
	CS	EP	TI	UP	ME	GW
1	*0.0*	*0.0*	*26.5*	*11.8*	*41.2*	*20.6*
2	*0.0*	*8.8*	*38.2*	*23.5*	*5.9*	*23.5*
3	*5.9*	*17.6*	*20.6*	*17.6*	*29.4*	*8.8*
4	*8.8*	*50.0*	*8.8*	*14.7*	*8.8*	*8.8*
5	*41.2*	*11.8*	*5.9*	*8.8*	*5.9*	*26.5*
6	*44.1*	*11.8*	*0.0*	*23.5*	*8.8*	*11.8*

Source: own study.

From the preliminary analysis of the importance series for different types of visual inspection, it appears that the number and characteristics of visual inspection methods are unique and specific to the analyzed enterprise. This suggests that the choice and prioritization of inspection types are influenced by the enterprise's operational processes, industry standards, and individual requirements (Knop et al 2018). Additionally, the factors such as the complexity of the product, the skills of the personnel, and the available technology further shape the approach to visual inspection. Understanding these specifics is crucial for tailoring inspection procedures to ensure effectiveness and alignment with organizational goals. Moreover, it highlights the need for enterprises to regularly review and adapt their visual inspection strategies in response to evolving conditions and standards. Based on the data presented in the table, which were compiled from the responses of the surveyed crew, it can be observed that the most important factor, which was also rated the highest in the responses, is *Cleanness/Order* (CS), as well as *Flow* (EP). The distribution of the obtained results was illustrated to identify the most significant factor in visual inspection. Spatial histograms were used for this purpose, as shown in Figure 1.

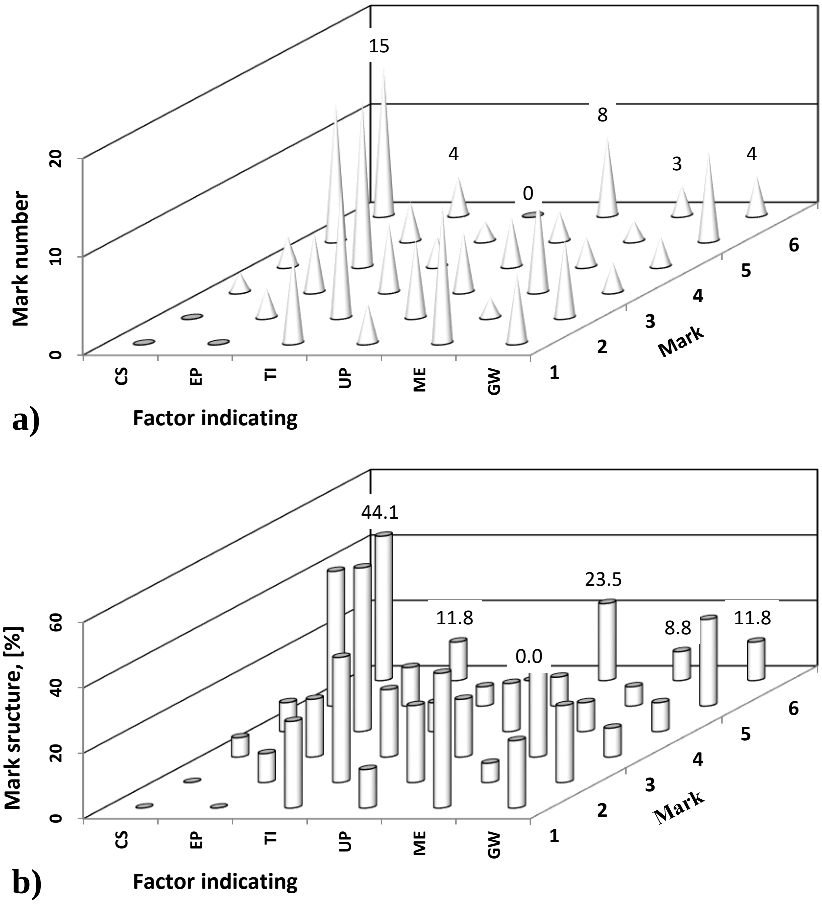

Fig. 1. Principle 7: Area E7. Spatial presentation of research results: a) number of evaluations, b) structure of evaluations

Analyzing the data presented in the chart, it can be concluded that for *Cleanness/Order* (CS) responses, the most frequently repeated rating was 6, with a result of 44.1%, followed by 5, which accounted for 41.2%. The third rating, in descending order, was 4, with a value of 8.8%, and 3, with 5.9%. None of the respondents rated this factor with a 1 or 2. For the next factor *Flow* (EP) the most common rating among the respondents was 4, which accounted for 50.0% of all responses. The second most common rating was 3, with a result of 17.6%. Both ratings 3 and 4 had the same result of 11.8%. The least selected rating was 2, with 8.8%, and there were no responses with a rating of 1. For the *Information board* (TI) factor, the most frequent rating was 2, with a 38.2% share. Close behind was rating 2, with a result of 26.5%. The next was 3, with a share of 20.6%. Ratings 4 and 5 followed in last positions with 8.8% and 5.9%, respectively. The *Participation in production places* (UP) factor was most commonly rated as 2 and 6, each with 23.5% of the votes. Rating 3 was selected by 17.6% of respondents. For *Monitoring* (ME) factor, it received the highest number of votes for rating 1, with 41.9%. Rating 3 was chosen by 29.4% of respondents. Finally, *Graphic presentation of results* (GW) factor was most commonly rated as 5, with 26.5% of responses. Rating 2 was not far behind, with 23.5%, while rating 1 accounted for 20.6%. Rating 6 was selected by 11.8%, and ratings 3 and 4 were chosen with equal percentages of 8.8%.

The results indicate varied opinions among respondents depending on the factors being evaluated. Factors such as (CS) and (GW) received predominantly high ratings, suggesting their high effectiveness and satisfaction. On the other hand, factors like (TI) and (ME) would require further analysis and potential improvements, as they received lower ratings, particularly for factor (ME), which was predominantly rated 1. These results provide insights for further actions aimed at improving the quality and effectiveness of processes related to these factors.

In Figure 2, the graphical results are presented using histograms, which visually display the distribution of ratings for each evaluated factor. The histograms allow for easy comparison of how respondents rated the various factors, highlighting the frequency of each score. The distribution patterns help identify the most commonly selected ratings, as well as the variation in responses across different factors. For instance, factors with a concentration of higher ratings, such as 5 and 6, are clearly visible, suggesting a positive perception. Conversely, factors with lower ratings, such as 1 and 2, can also be identified, indicating areas that may require attention or improvement. These histograms provide a clear and effective way to analyze the survey results and support decision-making.

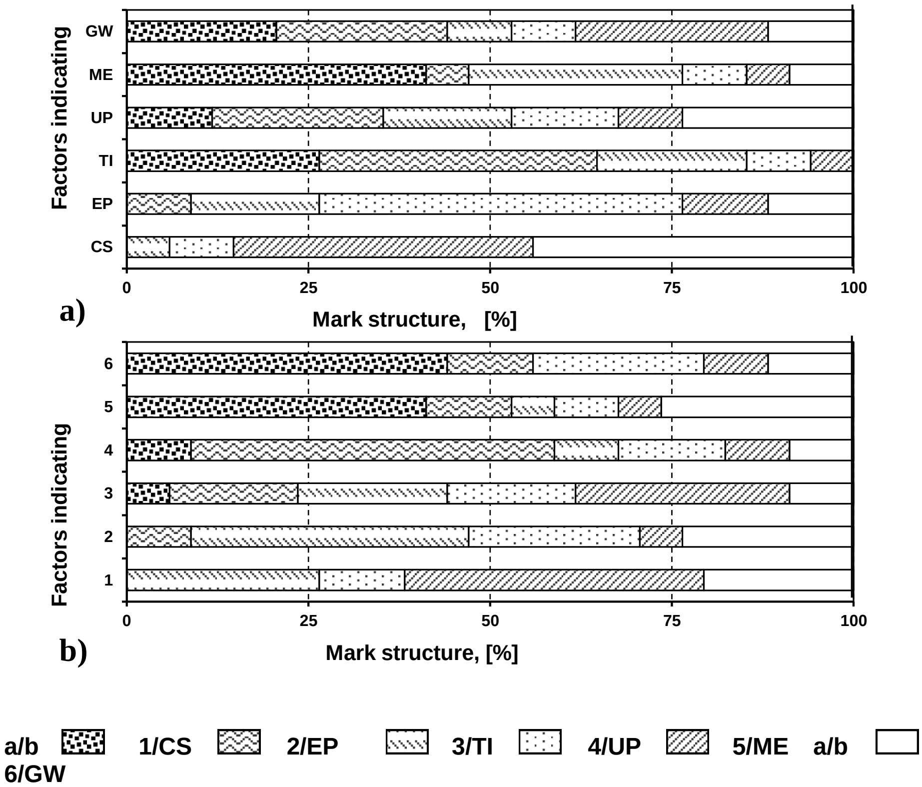

Fig. 2. Principle 7: Area E7. Principle 7: Summarizing histograms. comparison: a) structure of factor ratings, b) importance of factors in rating scales

Based on the presented data, it can be concluded that in the *Graphic presentation of results* (GW) area, the highest rating was 5, while the lowest were 3 and 4. For the

Monitoring (ME) factor, the most frequently selected value was 1, while 2 and 5 were the least marked — this area was rated the lowest of all. The remaining factors show noticeable divergence in the responses selected by the respondents. Analyzing Figure 2b, it can be observed that the highest-rated factor was the *Participation in production places* (UP) area. On the other hand, the *Monitoring* (ME) area received the lowest ratings across the board. This confirms that respondents had significant concerns about this factor, making it the lowest-rated aspect in the survey. Such a finding calls for a detailed investigation into what might be lacking or problematic in this area, and possible measures to improve it.

The examined numbers of the importance series were subjected to a detailed analysis due to their position within the individual series of visual inspection types. This analysis aimed to assess the significance of each visual control type based on its placement in the importance rankings, providing insights into which methods were prioritized and considered most essential for the evaluated processes. The summarized importance series of the visual control types for the enterprise is presented in the following model:

$$\mathbf{CS} \rightarrow \mathbf{EP} \rightarrow \mathbf{ME} \rightarrow \mathbf{UP} \rightarrow \mathbf{TI} \rightarrow \mathbf{GW} \qquad (1)$$

This model outlines the ranking of various visual control methods based on their importance within the enterprise. It provides an overview of how different inspection techniques are prioritized, offering insight into the factors considered most crucial for ensuring quality and efficiency in the production process. By analyzing these rankings, the enterprise can better understand which visual control types are most frequently applied and valued, aiding in the optimization of quality assurance practices and decision-making.

In Figure 3, the average importance ratings for the given factors are presented. This visualization provides a clear comparison of how each factor is valued across the evaluated areas. The chart helps to identify which factors are considered most critical and which may require further attention or improvement based on their average ratings.

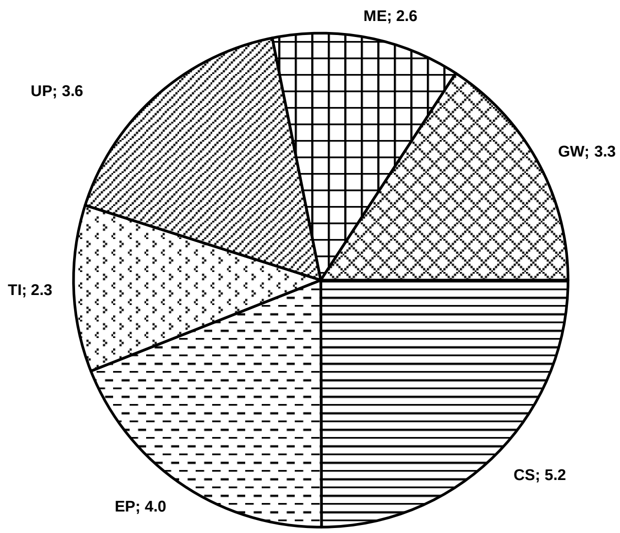

Fig. 3. Principle 7: Area E7. Principle 7.The average (%) importance ratings of the factors

As indicated by the data representation regarding the evaluation of factors, there is a noticeable dominance in the respondents' opinions that the most important factor is cleanliness and order. The second area mentioned in order of importance is flow. This suggests that respondents prioritize maintaining a clean and organized environment, viewing it as crucial for efficient operations. The emphasis on flow indicates that respondents also recognize the importance of smooth processes and efficient movement within the system to ensure overall effectiveness and productivity. In Figure 4, the correlation graphs for the factors of Principle 7 are presented, which are dependent on the characteristics of the respondents. These graphs illustrate the relationships between various factors, showing how they are influenced by specific respondent characteristics, such as experience, age or mobility. By analyzing these correlations, it is possible to gain deeper insights into how different variables interact with each other and how individual attributes of the respondents may affect their perceptions or evaluations of the visual control systems. This type of analysis helps identify patterns and trends in the responses, allowing for more targeted improvements in the visual control system based on the specific needs and characteristics of different groups within the enterprise. Additionally, it can highlight areas where further training or adjustments to the system might be necessary to ensure that all employees are effectively utilizing visual control tools to optimize production and maintain quality standards.

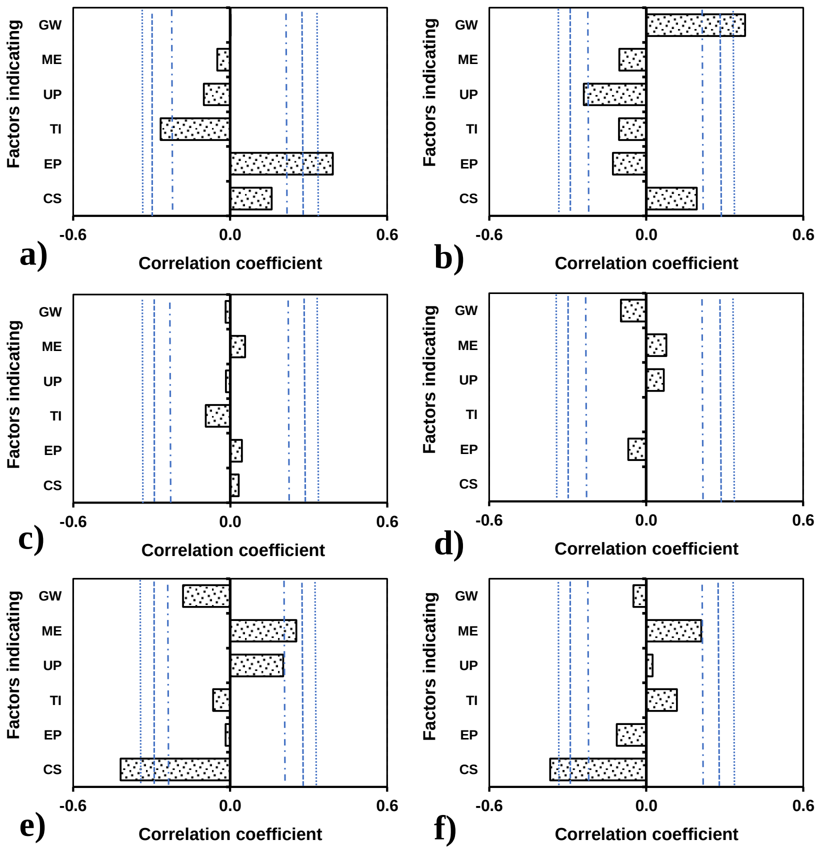

Fig. 4. Principle 7: Area E7. Principle 7. The correlation graphs of the factor ratings in the E7 area, depending on the respondents' characteristics: a) gender, b) education, c) age, d) work experience, e) mobility, f) employment type. α = 0.2 (inner lines), α = 0.1 (middle lines), α = 0.05 (outer lines).

According to the data presented in Figure 4, considering the relationship between the respondents' gender and their ratings, it can be observed that the *Information board* (TI) (TI) factor has a negative value, indicating that as the rating of this factor decreases, it results in a decrease in the rating of the second factor. This suggests that there is an inverse relationship between these two factors, where a lower evaluation of the *Information board* (TI) factor corresponds to a lower assessment of another related factor. On the other hand, the *Flow* (EP) factor shows a positive correlation, meaning that as the rating of the *Flow* (EP) factor increases, the associated factor also tends to be rated higher. This indicates that respondents who rate the *Flow* (EP) factor more highly also tend to rate the related factor more positively. Regarding the respondents' education levels, a positive correlation is evident between education and the rating of the *Graphic presentation of results* (GW) factor, which pertains to the graphic presentation of results. The analysis shows that individuals with higher education levels tend to rate the graphic presentations more favorably, suggesting that education may influence how respondents perceive and evaluate visual control tools. This could indicate that those with higher education might better understand the significance of such tools and thus assign higher ratings. When it comes to age, no clear correlation was found, indicating that the ratings of the visual control factors do not differ significantly across age groups. Similarly, no correlations were observed between work experience and the ratings of the factors, suggesting that years of experience in the industry did not appear to influence how the respondents evaluated the visual control tools. In terms of mobility, a negative correlation was observed for the *Cleanness/Order* (CS) factor, which indicates that higher mobility may lead to a decrease in the importance or evaluation of the *Cleanness/Order* (CS) factor. This suggests that employees with more frequent job changes or varied roles might value certain visual control aspects less, potentially due to their limited exposure or involvement with the tools in specific contexts. The same negative correlation was found when analyzing the type of employment, where employees' ratings of the *Cleanness/Order* (CS) factor decreased, possibly due to differences in job stability or job roles that affect their engagement with the visual control system.

4. CONCLUSION

How important are visual control tools in maintaining cleanliness and order in the company? The value of these tools is closely tied to 5S practices, which focus on organizing the workspace to improve efficiency and reduce waste. Visual control and 5S practices are not only interconnected but also work in tandem, creating a synergy that amplifies their individual effectiveness. The implementation of visual management systems stems from the need to enhance 5S practices in production processes, which are essential for improving both workplace organization and overall productivity. Keeping workstations and surrounding areas consistently clean and organized requires ongoing effort and dedication from all employees. Visual control tools, such as color-coded labels, signs, and markers, provide workers with clear and immediate instructions, making it easier to maintain cleanliness and organization. These tools also help standardize practices across the workplace, ensuring that cleanliness is maintained consistently, even as staff members change or rotate. Involving workers in maintaining cleanliness, while simultaneously utilizing visual control tools, enhances the significance of both 5S practices and the visual control system as a whole. This approach helps reinforce the principles of continuous improvement and fosters a culture of quality and order. Flow (EP) is a tool recognized as essential in the visual control system in the examined enterprise. To ensure the smooth, systematic, and continuous movement of products from one position to another, various visual tools were used in the enterprise, including kanban cards, colorful lines, Heijunka boards, and so-called one-piece flow cells, such as U-shaped lines in large-scale assembly operations. These tools are designed to create a seamless flow of materials and products, reducing delays and ensuring that each station in the production line operates efficiently. An important element of factory floor equipment was also the use of illuminated displays showing key process parameters, the size of the production plan, the current number of produced goods, and highlighting areas where problems occurred. These displays provide workers and supervisors with real-time data, allowing them to quickly identify bottlenecks, quality issues, or delays in the production process. By making this information readily accessible, the visual control system helps to maintain smooth operations and enables swift interventions to address issues as they arise. Additionally, these visual tools play a crucial role in maintaining consistent production levels, improving communication among teams, and ensuring that production targets are met. The use of such systems supports a culture of continuous improvement by providing clear, actionable data that drives decision-making and enhances overall productivity.

The graphic presentation of results (GW) is comparatively one of the least important types of visual control. According to the workers, its role in identifying problems on the shop floor was relatively smaller, as was its overall significance within the visual control system. While visual control methods such as kanban cards, color-coded lines, and illuminated displays directly address production flow and operational issues, the graphic presentation of results is more focused on presenting data rather than actively guiding immediate actions. Workers perceive this tool as less directly impactful because it does not provide real-time feedback or trigger immediate corrective actions in the same way other visual control tools do. For example, tools like kanban cards are designed to prevent disruptions in the flow of materials by visually signaling when to reorder, whereas the graphic presentation of results may primarily be used for post-process analysis or for tracking long-term trends, making it less urgent for daily operations. Moreover, the graphic presentation of results tends to be more useful for managers or supervisors who are looking for overarching trends and performance metrics, rather than for operators who need immediate visual cues to address problems in real time. As a result, while it has value for overall performance tracking and reporting, its contribution to the day-to-day management of the production process is more limited compared to other visual control methods that are directly involved in monitoring and maintaining smooth operations.

One of the main limitations of the study is the small number of respondents, primarily consisting of employees from the production department. The views of production workers may not fully represent the perspectives of other departments, such as management, quality control, or logistics. These departments might have different insights or experiences regarding the importance of various factors affecting food safety and quality, and their absence from the study could result in biased or incomplete conclusions. For instance, management might have a broader view of the strategic goals and challenges within the company, while quality control may focus more on the technical aspects of food safety that production staff may not be aware of. Another limitation is the reliance on self-reported data from the questionnaire. Respondents may have provided socially desirable answers or may not have been fully aware of all aspects of the visual control system. This could lead to discrepancies between their stated opinions and actual practices.

Furthermore, the study was conducted in a single company within the food industry, which may limit the generalizability of the findings. Results from this particular enterprise may not apply to other companies in the food sector, especially those operating under different conditions or in different regions. The company in question might have unique practices, challenges, or resources that do not represent the broader industry.

Future research directions may include expanding the sample to include employees from other departments such as management or quality control, comparing the application of visual control in different industries, analyzing the long-term effects of implementing visual control, studying the use of new technologies like AI or IoT, and examining the impact of organizational culture on the effectiveness of these systems. It is also worth investigating the specific challenges faced by small and medium-sized enterprises, the effectiveness of 5S methodology in conjunction with visual control, comparing different methods of assessing the effectiveness of these tools, and their impact on work organization and product quality. These studies could contribute to the development of better practices and tools for improving quality and efficiency in food industry production processes.

The contribution to science lies in demonstrating how the integration of visual control systems, rooted in Toyota Production Principles, can be adapted to the food industry's specific needs. This article bridges the gap between lean manufacturing methodologies and food production, offering a framework for improving operational efficiency, product quality, and safety while advancing knowledge on sustainable and standardized production practices in a heavily regulated sector.

REFERENCES

Borkowski, S., Ulewicz, R., 2009. *Instruments of Production Processes Improvement*, PTM, Warszawa.

Amasaka, K., 2012. *Science TQM, New Quality Management Principle, The Quality Management Strategy of Toyota Introduction,* Bentham Sc., U Arab Emirates.

Borkowski, S., 2012. *BOST Method as the Instrument of Assessment Process Functioning according to Toyota Principles,* University of Maribor, Maribor.

Borkowski, S., 2016. *Scientific Potential of Toyotarity and BOST Method*, Polish Quality Institute, Warsaw.

Borkowski, S., 2016. *Dokument zawierający opis skali rozstępu oceny preferencji przy różnej liczbie wyników badań i różnej skali ocen jako równoważnika skali porównawczej Thurstone'a. Potwierdzenie daty*. „AAK" KANCELARIA PATENTOWA s.c.. Częstochowa.

Borkowski, S., Rosak-Szyrocka, J., Klimecka-Tatar, D., Jagusiak-Kocik, M., Sygut, P., 2013. *Determination of the technology place in the metal company on the basis of the Toyota's management principles*, METAL 2013 - 22nd International Conference on Metallurgy and Materials, Conference Proceedings, 1691-1696.

Borkowski, S., Szota, M., Baryłka, A., Bajor T., Przybytnikowski, 2023. *The role of technology in industry according to the BOST method*. Journal of Achievements of Materials and Manufacturing Engineering, vol. 119, no. 2.

Dziuba, S., Szczyrba, A., 2023. *Agile management in Polish organic food processing enterprises*, Production Engineering Archives, 29(1), 101-107, DOI: 10.30657/pea.2023.29.12.

Gao, S., Low, S.P., 2015. *Toyota way style human resource management in large Chinese construction firms. A qualitative study,* International Journal of Construction Management, 15(1), 17-32.

Hamrin, P., Hoeft, B., 2012. *Quality Control throughout the Production Process of Infant Food*, Ann Nutr Metab 2012/60.

Klimecka-Tatar D., 2017. Value stream mapping as lean production tool to improve the production process organization – case study in packaging manufacturing. Production Engineering Archives, 17, 40–44, DOI: 10.30657/pea.2017.17.09

Knop, K., 2018. *Statistical Control of the Production Process of Rolled Products*, Production Engineering Archives, 20, 26-31, DOI: 10.30657/pea.2018.20.06

Knop, K., Borkowski, S., 2017. *Znaczenie kontroli wizualnej w przemysłach metalowym i motoryzacyjnym,* Przedsiębiorstwo Usługowo-Handlowo-Wydawnicze PUHW „AXON", Zawiercie.

Knop, K., Ingaldi, M., Smilek-Starczynowska M., 2018. *Reduction of Errors of the Conformity Assessment During the Visual Inspection of Electrical Devices,* Advances in Manufacturing (ed.) HAMROL Adam, CISZAK Olaf, LEGUTKO Stanisław, JURCZYK Mieczysław, Springer International Publishing, Cham

Knop, K., Mielczarek, K., 2018. *Assessment of Production Processes Functioning in the Case of Air Bag Production*, MATEC Web Conf., 183, 04009, DOI: 10.1051/matecconf/201818304009

Knop, K., 2020. Indicating and analysis the interrelation between terms – Visual: Management, control, inspection and testing, Production Engineering Archives 26(3), 110-120, DOI: 10.30657/pea.2020.26.22

Liker, J. K., Hoseus M., 2009. *Toyota Culture. The heart and soul of the Toyota philosophy,* Publisher MT Business, Warsaw.

Liker, J.K., Franz, J., 2011. *The Toyota Way to continuous improvement*, McGraw Hill.

Liker, J. K., 2005. *The Toyota Way. 14 principles of management of the world's leading manufacturing company,* Publisher MT Business, Warsaw.

Mielczarek, K., 2021. *Assessment of Production Processes Functioning in Enterprises from Metal Industry.* International Business Information Management Association (IBIMA) 37th International Business Information Management Association Conference.

Ohno, T. 2008. *System produkcyjny Toyoty. Więcej niż produkcja na dużą skalę.* Wrocław, ProdPress.com

Pułaska-Turyna, B., 2011. *Statystyka dla ekonomistów*, Difin, Warsaw.Salgar, J. B,. Bais, S. K., Pranali, S., 2023. *Sawant Review on Current Good Manufacturing Practice*, International Journal of Advanced Research in Science, Communication and Technology (IJARSCT), Vol. 3, Iss. 1.

Ramirez-Zuñiga, E.J., Castro-Silva, H.F., Velásquez-Pérez, T., Garcia-Cruz, E.K., 2024. *Unveiling Critical Innovation Factors in Sustainable Coffee Production: A Colombian Perspective.* Production Engineering Archives, 30(4), 431-441, DOI: 10.30657/pea.2024.30.4.

Rosak-Szyrocka, J., Ulewicz, R., 2016. *Workers' of Hospital Satisfaction Analysis in the Toyotarity Aspect*, Human Resources Management & Ergonomics, 10(1).

Sagan, A., 2012. *Value for the Customer in the Consumer Market. Methodological Aspects of Measurement and Analysis*, Publishing House of the University of Economics, Cracow.

Szczyrba, A., Dziuba S., 2023. *Good Manufacturing Practices for Quality and Safety Management in the Food Industry*, Materials Research Proceedings, 34, 288-297.

Szczyrba, A., Ingaldi, M. 2024*. Implementation of the FMEA Method as a Support for the HACCP System in the Polish Food Industry. Management Systems in Production Engineering,* 32(3), 357-371, DOI: 10.2478/mspe-2024-0034.

Szczyrba, A., Szataniak, M., 2023. *Decoding Consumer Preferences in Food Packaging with the Kano Model*. System Safety: Human - Technical Facility - Environment, 5(1), 83-92, DOI: 10.2478/czoto-2023-0010.

Selejdak, J., 2015. *Use of the Toyota Management Principles for Evaluation of the Company's Mission,* Production Engineering Archives, 1(1), 13-15, DOI: 10.30657/pea.2013.01.04

Silverman, D., 2012. *Conducting qualitative research*, Oxford University Press, Warsaw.

Siwiec, D., Pacana, A., 2021. *Method of improve the level of product quality*, Production Engineering Archives, 27(1).

Uçurum, M., Çolak, M., Çınar, M., Dışpınar, D., 2016. *Implementation of Statistical Process Control (SPC) Techniques as Quality Control in Cast Iron Part Production,* Journal of Engineering Precious Research and Application, 1(3), 14-24.

Zhuravskaya, M., Morozova, E., Anashkina, Ingaldi, M., 2016. *Toyota-Oriented Technologies as Ecological Management Tools for Transport Enterprises,* Polish Journal of Management Studies, 13(2).