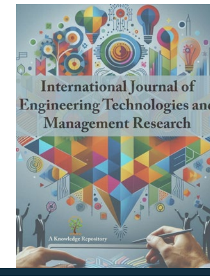
International Journal of Engineering Technologies and Management Research
April 2026 13(4)
www.ijetmr.com



Original Article

PREDETERMINED TIME SYSTEMS APPLIED IN SEWING PROCESSES: PROPOSAL FOR ADAPTING MOST SYSTEM TO AUTOMOTIVE SEWING

Genovevo Gonzalez De La Rosa [1*], Nidia Yasmina Rico Ramos [2], Gustavo Emilio Rojo Velazquez [3], Rosa Ma Amaya Toral [3], Juan Carlos Floriano Tiscareño [2]

[1] Technological Institute of Chihuahua II, National Technological Institute of Mexico, Mexico
[2] Division of Postgraduate Studies, Technological Institute of Chihuahua II, National Technological Institute of Mexico, Mexico
[3] Technological Institute of Piedras Negras, National Technological Institute of Mexico, Mexico

ABSTRACT

This article presents a literature review for determining standard times in automotive sewing operations by adapting the Maynard Operation Sequence Technique (MOST). The most commonly used methods in sewing processes are MTM and GSD, which are widely disseminated, but have limitations due to their complexity. The MOST system has been successfully applied to improve productivity in various processes, but rarely in sewing. Given this research need, it is proposed to develop a sequence of sub-operations that combines MOST's movement categories with technical sewing parameters (revolutions per minute, stitch length, stitches per inch). This approach represents methodological advancement that can be replicated in other industrial garment manufacturing processes and contributes to the development of hybrid work measurement models.

Keywords: Automotive Sewing, Industrial Productivity, MOST System, PMTS, Standard Time

INTRODUCTION

Predeterminated Motion Time Systems (PMTS) have proven to be essential tools in standardizing operations and improving productivity in various industries, such as automotive, metalworking, and garment manufacturing Mhatre and H (2019).

References have been found to the importance of predetermined time systems (PMTS) and their application in various industries, such as the study on work measurement techniques and their benefits Freire (2021), since it presents a historical overview and strategic advantages of PMTS in industrial productivity. In this work Freire (2021), he highlights the benefits of predetermined time systems in different industries and supports the idea that PMTS is a key tool for standardizing processes and improving productivity in textile manufacturing.

Studies have also been found comparing different standard time calculation techniques, such as the comparative article on time study techniques Rico (2005), which argues that PMTS surpasses traditional time studies and sampling. This work presents the historical evolution of work measurement, where PMTS represents a significant advancement.

*Corresponding Author:
Email address: Genovevo Gonzalez De La Rosa (D25550272@chihuahua2.tecnm.mx), Nidia Yasmina Rico Ramos (nidia.rr@chihuahua2.tecnm.mx), Gustavo Emilio Rojo Velazquez (grojov@gmail.com), Rosa Ma Amaya Toral (rosa.at@chihuahua2.tecnm.mx), Juan Carlos Floriano Tiscareño (juan.ft@chihuahua2.tecnm.mx)

Received: 28 February 2026; **Accepted:** 24 March 2026; **Published** 14 April 2026
DOI: 10.29121/ijetmr.v13.i4.2026.1749
Page Number: 42-46
Journal Title: International Journal of Engineering Technologies and Management Research
Journal Abbreviation: Int. J. Eng. Tech. Mgmt. Res.
Online ISSN: 2454-1907
Publisher: Granthaalayah Publications and Printers, India
Conflict of Interests: The authors declare that they have no competing interests.
Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.
Authors' Contributions: Each author made an equal contribution to the conception and design of the study. All authors have reviewed and approved the final version of the manuscript for publication.
Transparency: The authors affirm that this manuscript presents an honest, accurate, and transparent account of the study. All essential aspects have been included, and any deviations from the original study plan have been clearly explained. The writing process strictly adhered to established ethical standards.

Within the textile and apparel sector, the most widely used system is General Sewing Data (GSD), derived from Methods – Time Measurement (MTM) Dirgar and O (2024) Fuentes and V (2022). GSD has become the benchmark in sewing operations due to its ability to predict standard times and facilitate production line planning.

In the textile sector, the GSD system has been predominant as a technique for determining standard times, as Rivera Rodriguez explains in his industrial engineering thesis, where he describes the use of GSD as a standard tool for determining sewing times and its impact on efficiency Rodriguez (2009). Similarly, the article on sewing process databases Phan and P (2023) also mentions how GSD has been applied in actual garment making and its usefulness in standardizing processes. This allows us to justify why GSD has been the dominant method in garment manufacturing.

In parallel, other approaches have relied on technical variables such as stitch length, stitches per inch, and machine revolutions per minute Kirin and A (2024), Chowdhury and Moin (2013). These parameters allow for useful estimates, but they often lack a detailed analysis of the manual and auxiliary movements involved in the operations. Other studies that employ these methodologies where technical variables are used (seam length, stitches per inch, revolutions per minute), we have the standard time prediction article using SVM Shao and X (2022), which identifies precisely these variables as critical in time estimation.

On the other hand, the Maynard Operation Sequence Technique (MOST), an evolution of MTM systems, has gained relevance in assembly and discrete manufacturing industries by enabling the identification of unnecessary movements, standardization of methods, and improved productivity Mhatre and H (2019), Deshpande (2020), Rahman and K (2018). However, its application in sewing is still in its early stages, with few documented studies, which opens an area of opportunity for applied research in textile processes Monroy and G (2021).

MATERIALS AND METHODS

WORK MEASUREMENT AND PREDETERMINATE TIME SYSTEMS

Work measurement is an essential tool in industrial engineering, aimed at establishing standard times and designing methods that allow for maximum productive efficiency. Since the pioneering studies of Taylor and Gilberth, the discipline has evolved towards more scientific approaches, such as Predetermined Time Systems (PMTS), which assign standard times to elementary movements without the need for timekeeping Mahapatra and Aditya (2020). Work measurement has undergone a conceptual evolution and Lilyana Jaramillo Ramirez, in her thesis "Aggregate times, validation of a new work measurement technique. Case study in a company in the textile sector", presents an exhaustive analysis of work measurement techniques, including time studies, sampling and aggregated times, the latter being the most recent trend (hybrid systems).

Among the most widely used PMTS in industry are Methods – Time Measurement (MTM), General Sewing Data (GSD), the Modular Arrangement of Predetermined Time Standards (MODAPTS), and more recently, the Maynard Operation Sequence Technique (MOST). These systems have been applied in sectors such as automotive, textile, metalworking, and healthcare, with the purpose of standardizing processes, balancing lines, and improving productivity Dirgar and O (2024), Fuentes and V (2022), Mhatre and H (2019).

METHODS-TIME MEASUREMENT (MTM) AND GENERAL SEWING DATA (GSD)

MTM is based on breaking down work into basic movements such as reaching, moving, positioning, and releasing. These movements are quantified in Time Measurement Units (TMU), where 100,000 TMUs are equivalent to one hour of work. This allows for the identification of unnecessary movements, time reduction, and method improvement Dirgar and O (2024). Additionally, Kirin and A (2024), in his article, analyzes how MTM breaks down movements into basic elements and how standard times are calculated, providing technical support for the description of PMTS systems.

In the garment industry, GSD has become established as a system derivated from MTM, specifically adapted to sewing operations. Its application has allowed garment and automotive upholstery companies to systematically and internationally establish standard times Mahapatra and Aditya (2020). Recent studies highlight that GSD, along with MTM, are the most widely used systems in the textile sector and are essential references in sewing processes Fuentes and V (2022), Kirin and A (2024). In his thesis Rodriguez (2009) he explains the operation of the GSD system, its categories of movements, and standard time calculations, providing a detailed description of the theoretical foundation of GSD.

MAYNARD OPERATION SEQUENCE TECHNIQUE (MOST)

MOST, developed by H.B. Maynard in 1972, represents an evolution of PMTS by simplifying time measurement through motion sequences (general, controlled, and with tools). Unlike MTM, which analyzes movements in detail, MOST focuses on repetitive and semi-repetitive activities, achieving a balance between speed of application and accuracy in standardization Mhatre and H (2019).

There are three variants: MiniMOST (short cycles), BasicMOST (medium cycles), and MaxiMOST (long cycles). Their application in industries such as automotive, assembly, and discrete manufacturing has demonstrated productivity improvements exceeding 15%, as well as reductions in unproductive time and unnecessary movements Deshpande (2020).

PMTS APPLICATIONS IN THE TEXTILE INDUSTRY

In the textile industry, predetermined time systems have been widely documented using MTM and GSD, primarily for sewing, overcasting, buttonholes, and ironing operations Dirgar and O (2024), Fuentes and V (2022). For example, the implementation of time databases with MTM has allowed for the standardization of operations in companies like Azzorti in Colombia, directly impacting cost and productivity Fuentes and V (2022). However, the application of MOST in sewing is limited. In Mexico, Monroy, Alvarez, and Quiñonez Monroy and G (2021) applied MOST to a T-shirt production line, successfully balancing the workload and reducing the number of operators per line without impacting production. While promising, this study did not incorporate technical variables such as revolutions per minute or stitch length, thus limiting its methodological scope.

PRODUCTIVITY, EFFICIENCY AND LINE BALANCING

Productivity is defined as the relationship between inputs used and outputs generated, while efficiency reflects the degree to which actual output approximates expected output. In this sense, line balancing is critical, as it seeks the equitable allocation of workstations to minimize idle time and bottlenecks Mhatre and H (2019). Furthermore, Yepez and D (2024) in his case study, demonstrates how operations analysis positively impacts productive efficiency, reinforcing the application of these work study methodologies to improve productivity.

The use of MOST in line balancing has enabled the identification of non-value-added activities, the redesign of work methods, and increased production in sectors such as engine assembly, wiring, and automotive Mhatre and H (2019). In garment manufacturing, the integration of MOST could provide the same benefits by systematizing manual sewing movements and complementing the technical parameters of the machines.

CRITICAL VARIABLES IN CALCULATING SEWING TIME

The literature identifies the following variables as determinants of sewing time:

- **Stitch length:** proportional to operating time.
- **Stitches per inch (SPI):** related to stitch density and strength.
- **Sewing machine revolutions per minute (RPM):** a key productivity factor.
- **Auxiliary movements:** these include picking up, guiding, positioning, and cutting pieces, which are not always considered in current models Kirin and A (2024), Chowdhury and Moin (2013).

Shao and X (2022) also presents a predictive article that similarly identifies key variables in calculating sewing time based on length, SPI, and RPM, which reinforces the section on critical variables and their integration into the proposed methodology. Combining these factors with a predetermined motion system like MOST offers an opportunity to obtain more reliable standard times on automotive sewing lines.

RESULTS AND DISCUSSIONS

The MOST technique has proven effective in sectors such as automotive and assembly by reducing unproductive time and optimizing methods Mhatre and H (2019) Deshpande (2020). In garment manufacturing, the predominant methods continue to be MTM, GSD, and traditional time studies, widely used in time standardization studies Dirgar and O (2024), Fuentes and V (2022), Kirin and A (2024).

In Mexico, a study in Hermosillo applied MOST to t-shirt sewing, achieving line balancing and cost reduction through operator reassignment Monroy and G (2021). However, this application did not consider technical variables such as revolutions per minute or stitch length, a key aspect that this project addresses.

International research has developed standard time databases using MTM for sewing and finishing operations Mahapatra and Aditya (2020), Kirin and A (2024), as well as hybrid production system proposals that combine MTM with modular approaches Chowdhury and Moin (2013). This background confirms the relevance of studying the integration of a robust system like MOST in the automotive garment industry, where quality and productivity demands are critical.

Models have also been proposed to predict standard times in sewing processes with high accuracy, such as the one proposed by Shao and X (2022) where the relevance of technical variables (seam length, SPI, RPM) is shown, which our project seeks to integrate with MOST.

In his scientific article Phan and P (2023) he constructs a database of standard sewing operations and times using MTM and GSD, highlighting the differences with real-world data. Regarding our project, this allows us to argue that only GSD integrates technical and manual variables simultaneously.

In a case study Rahman and K (2018) he mentions how the implementation of MOST in an industrial environment achieves significant increases in productivity and reduction of times, which demonstrates the potential of MOST in manufacturing, although without adaptations to garment making.

A gap has been identified in the industrial sector regarding the adaptation of MOST to automotive sewing processes, making this project an innovative contribution in both the business and scientific fields. The following point highlight this research gap:

- According to Rahman and K (2018), the case study in the application of the MOST system showed improvements in productivity; however, its scope was limited to the analysis of movements, without considering technical variables specific to sewing, which highlights a gap in the application of MOST in garment processes with technical integration.
- For his part, Phan and P (2023) points out discrepancies between theoretical and actual times in sewing processes, which supports the argument that current methods do not achieve the required precision and confirms that the predominant approach continues to focus on systems such as MTM and GSD.
- Likewise, Shao and X (2022) incorporates key technical variables in the analysis of sewing processes; however, these are not linked to predetermined time systems (PMTS), reaffirming the non-existence of model that integrates predetermined movements with technical variables.
- According to Ramirez (2016), the analysis of hybrid techniques shows a current trend aimed at overcoming the limitations of traditional methods, identifying areas for improvement that strengthen the argument for the need to develop a more comprehensive method, such as the one proposed in this research.

CONCLUSIONS AND RECOMMENDATIONS

The literature review reveals the following:

- MTM and GSD systems are widely used in garment making, but they require expensive licenses and lengthy analysis times.
- MOST has proven effective in multiple industries, but its application in sewing remains limited and poorly documented Monroy and G (2021).
- No methodologies have been identified that integrate MOST with technical parameters specific to automotive sewing such as RPM and stitch length.

Thia gap supports the relevance of the present research, which seeks ti adapt MOST to automotive sewing operations, generating an innovative and replicable methodological proposal.

ACKNOWLEDGMENTS

I thank Dr. Alberto Camacho Rios, research professor at the National Technological Institute of Mexico, Chihuahua II Campus, for his guidance and advice in defining the thesis proposal that originated this documentary research.

REFERENCES

Mahapatra, P. J., and Aditya, A. (2020). Application of Pre-Determined Motion Time System to Develop Standard Data System for Measuring Work Content of Garments Finishing Operations. Journal of Textile and Apparel, Technology and Management, 1–30.

Chowdhury, J. M., and Moin, F. S. (2013). Investigation of a Hybrid Production System for Mass-Customization Apparel Manufacturing. Journal of Textile and Apparel, Technology and Management, 1–10.

Deshpande, S. R. (2020). An Overview on Lean Application Methods for Productivity Improvement. International Journal of Engineering Research and Technology, 225–233.

Monroy Melendez, D., and G. P. (2021). Estudio De Tiempos y Movimientos En Industria Textil En Hermosillo, Sonora. Universidad y Ciencia, 231–240.

Dirgar, E., and O. O. (2024). A Study on Defining Standard Movement Sets in Sewing Using the MTM Method. Tekstil: Journal for Textile and Clothing Technology, 160–167.

Fuentes Rojas, E. A., and V., G. (2022). Normalización De Tiempos De Confección En La Empresa Industrias INCA S.A.S. (AZZORTI), Por Medio De La Implementación De Bases De Datos Con Tiempos Analizados Por Medio De MTM. Ingeniería, Matemáticas y Ciencias De La Administración, 53–63. https://doi.org/10.21017/rimci.2022.v9.n18.a120

Freire, P. V. (2021). Análisis De Las Técnicas De Medición Del Trabajo Mediante La Revisión Sistemática De Artículos Científicos Para Determinar Los Beneficios Que Se Podrían Obtener Con Los Sistemas De Tiempos Predeterminados [Master's thesis, Universidad Técnica de Ambato].

Mhatre, H., and H. T. (2019). Work Content Reduction of Chassis Assembly Line Using MOST: A Case Study. Industrial Engineering Journal, 1–15. https://doi.org/10.26488/IEJ.12.8.1193

Rico, A. M. L. (2005). Técnicas Utilizadas Para el Estudio de Tiempos: Un Análisis Comparativo. CULCYT Cultura Científica y Tecnológica. Revista De Investigación En Ingeniería e Innovación Tecnológica, 9–18.

Rahman, M. S., and K., R. (2018). Implementation of Maynard Operation Sequence Technique (MOST) to Improve Productivity and Workflow: A Case Study. Journal of Emerging Technologies and Innovative Research, 270–278.

Phan, T. T., and P., D.-N. (2023). Improve Building Database on the Operation Process and Performance Time for Sewing Operations of Knitted Garments Products. Fibres and Textiles, 1–7. https://doi.org/10.15240/tul/008/2023-4-007

Ramirez, L. J. (2016). Tiempos Agregados, Validación de Una Técnica De Medición Del Trabajo: Estudio De un Caso en Una Empresa Del Sector Textil [Master's Thesis, Universidad Nacional de Colombia].

Rodriguez, C. J. (2009). Determinación de Tiempos Estándares Para la Industria de la Confección, a Través Del Sistema De Tiempos Predeterminados GSD (General Sewing Data) [Master's Thesis, Universidad de San Carlos de Guatemala].

Yepez, R. I., and D. I. (2024). Impacto Del Análisis De Operaciones En La Productividad De La Pequeña Empresa De Confección Textil de Imbabura, Ecuador. Revista Científica Profundidad Construyendo Futuro, 150–160. https://doi.org/10.22463/24221783.4487

Kirin, S., and A. H. (2024). Use of MTM, RAV and ZAK Methods in Determining Working Methods and Time Norms in Technological Operations of Sewing Clothes. Processes, 1–14. https://doi.org/10.3390/pr12040740

Shao, Y., and X. J. (2022). Prediction of Standard Time of the Sewing Process Using a Support Vector Machine with Particle Swarm Optimization. AUTEX Research Journal, 290–297. https://doi.org/10.2478/aut-2021-0037