



## Application of the SMED methodology through folding references for a bus manufacturing company

A. Juárez-Vite<sup>a,\*</sup>, J. R. Corona-Armenta<sup>a</sup>, H. Rivera-Gómez<sup>a</sup>, O. Montaño-Arango<sup>a</sup>, J. Medina-Marín<sup>a</sup>

<sup>a</sup> Área Académica de Ingeniería, Universidad Autónoma de Hidalgo, Carretera Pachuca-Tulancingo km. 4.5, Ciudad del conocimiento, Mineral de la Reforma, Hgo 42184, México

### References

- [1] J. P. Womack and D.T. Jones, *Lean Thinking*. New York, NY, USA: Free Press, 2003.
- [2] R. C. Cabrera, *Manual de Lean Manufacturing*: TPS Americanizado, 2014.
- [3] J. Lozano, "Methodology to Improve Production and Supply Chain on Food Industry Based on SMED", Ph.D. dissertation, University of La Rioja, La Rioja, Spain, 2019.
- [4] M. N. Bin Che Aini and M. S. S. Bin Shafei, "The Effectiveness of the Single Minute Exchange of Die (SMED) Technique for the Productivity Improvement," *Appl. Mech. Mater.*, vol. 465–466, pp. 1144–1148, 2014, doi: 10.4028/www.scientific.net/AMM.465-466.1144.
- [5] J. K. Liker, *The Toyota Way*, New York, NY, USA: McGraw Hill, 2006.
- [6] C. M. A. Pinto, J. Mendonça, L. Babo, F. J. G. Silva, and J. L. R. Fernandes, "Analyzing the Implementation of Lean Methodologies and Practices in the Portuguese Industry: A Survey," *Sustainability*, vol. 14, no. 3. 2022, doi: 10.3390/su14031929.
- [7] A. Cherrafi, J. A. Garza-Reyes, A. Belhadi, S. S. Kamble, and J. Elbaz, "A readiness self-assessment model for implementing green lean initiatives," *J. Clean. Prod.*, vol. 309, p. 127401, 2021, doi: <https://doi.org/10.1016/j.jclepro.2021.127401>.
- [8] R. Hardcopp, G. (Jason) Liu, and R. Shah, "Lean production and operational performance: The influence of organizational culture," *Int. J. Prod. Econ.*, vol. 235, p. 108060, 2021, doi: <https://doi.org/10.1016/j.ijpe.2021.108060>.
- [9] S. A. Villacís and P. S. Burneo, "UAVs' efficient assembly: Lean Manufacturing implementation in an UAVs' Assembly Company," *Int. J. Ind. Eng. Manag.*, vol. 11, no. 4, pp. 237–252, 2020, doi: 10.24867/IJIEM-2020-4-268.
- [10] C. J. Yuik and P. Puvanasvaran, "Development of Lean Manufacturing Implementation Framework in Machinery and Equipment SMEs," *Int. J. Ind. Eng. Manag.*, vol. 11, no. 3, pp. 157–169, 2020, doi: 10.24867/IJIEM-2020-3-261.
- [11] N. Vamsi Krishna Jasti and A. Sharma, "Lean manufacturing implementation using value stream mapping as a tool," *Int. J. Lean Six Sigma*, vol. 5, no. 1, pp. 89–116, Jan. 2014, doi: 10.1108/IJLSS-04-2012-0002.
- [12] M. Afonso, A. T. Gabriel, and R. Godina, "Proposal of an innovative ergonomic SMED model in an automotive steel springs industrial unit," *Adv. Ind. Manuf. Eng.*, vol. 4, 2022, doi: 10.1016/j.aime.2022.100075.
- [13] R. Şahin and A. Koloğlu, "A Case Study on Reducing Setup Time Using SMED on a Turning Line," *Gazi Univ. J. Sci.*, vol. 35, no. 1, pp. 60–71, 2022, doi: 10.35378/gujs.735969.
- [14] R. G. P. Junior, R. H. Inácio, I. B. da Silva, A. Hassui, and G. F. Barbosa, "A novel framework for single-minute exchange of die (SMED) assisted by lean tools," *Int. J. Adv. Manuf. Technol.*, vol. 119, no. 9, pp. 6469–6487, 2022, doi: 10.1007/s00170-021-08534-w.
- [15] M. A. Ribeiro, A. C. Santos, G. D. de Amorim, C. H. de Oliveira, R. A. da Silva Braga, and R. S. Netto, "Analysis of the Implementation of the Single Minute Exchange of Die Methodology in an Agroindustry through Action Research," *Machines*, vol. 10, no. 5. 2022, doi: 10.3390/machines10050287.
- [16] E. Fonda and A. Meneghetti, "The Human-Centric SMED," *Sustainability*, vol. 14, no. 1. 2022, doi: 10.3390/su14010514.
- [17] M. H. R. Utiyama, M. Godinho Filho, and P. C. Oprime, "An alternative for improving setup times and time between failures aiming at manufacturing lead time reduction," *Prod. Eng.*, vol. 15, no. 5, pp. 651–665, 2021, doi: 10.1007/s11740-021-01048-0.
- [18] A. Q. Basri, N. Mohamed, and Y. Yussof, "SMED Simulation in Optimising the Operating Output of Tandem Press Line in the Automotive Industry using WITNESS Software," *Int. J. Automot. Mech. Eng.*, vol. 18, no. 3, pp. 8895–8906, 2021, doi: 10.15282/ijame.18.3.2021.05.0682.
- [19] H. Herlambang, Z. F. Ikatrinasari, and K. Kosasih, "Single-digit time: Toward a quick change-over process with the SMED method using the vision system," *Oper. Res. Eng. Sci. Theory Appl.*, vol. 5, no. 1, pp. 56–68, 2022, doi: 10.31181/oresta190222076h.

- [20] K. Yazıcı, S. H. Gökler, and S. Boran, "An integrated SMED-fuzzy FMEA model for reducing setup time," *J. Intell. Manuf.*, vol. 32, no. 6, pp. 1547–1561, 2021, doi: 10.1007/s10845-020-01675-x.
- [21] H. Çelik, "A new approach to shorten changeover times: SMED Taguchi methodology," *Sak. Üniversitesi İşletme Enstitüsü Derg.*, vol. 2, no. 1, pp. 13–26, 2020.
- [22] J. Lozano, J. C. Saenz-Díez, E. Martínez, E. Jiménez, and J. Blanco, "Centerline-SMED integration for machine changeovers improvement in food industry," *Prod. Plan. Control*, vol. 30, no. 9, pp. 764–778, Jul. 2019, doi: 10.1080/09537287.2019.1582110.
- [23] İ. Z. Akyurt and E. Eren, "Application of SMED method to reduce the setup time," *Int. J. Econ. Soc. Res.*, vol. 15, no. 3, pp. 315–331, 2019.
- [24] T. Bidarra, R. Godina, J. C. O. Matias, and S. G. Azevedo, "SMED methodology implementation in an automotive industry using a case study method," *Int. J. Ind. Eng. Manag.*, vol. 9, no. 1, pp. 1–16, 2018, doi: 10.24867/IJIEM-2018-1-101.
- [25] M. K. Karasu and L. Salum, "FIS-SMED: a fuzzy inference system application for plastic injection mold changeover," *Int. J. Adv. Manuf. Technol.*, vol. 94, no. 1–4, pp. 545–559, 2018, doi: 10.1007/s00170-017-0799-7.
- [26] Z. P. Li, "Management decisions in multi-variety small-batch product manufacturing process," *Int. J. Simul. Model.*, vol. 21, no. 3, pp. 537–547, 2022, doi: 10.2507/IJSIMM21-3-CO15.
- [27] S. C. Trovinger and R. E. Bohn, "Setup time reduction for electronics assembly: Combining simple (SMED) and IT-based methods," *Prod. Oper. Manag.*, vol. 14, no. 2, pp. 205–217, 2005, doi: 10.1111/j.1987-5956.2005.tb00019.x.
- [28] Y. Dave and N. Sohani, "Single minute exchange of dies: Literature review," *Int. J. Lean Think.*, vol. 3, no. 2, pp. 27–37, 2012.
- [29] A. P. Dillon and S. Shingo, *A Revolution in Manufacturing: The SMED System*, Cambridge, MA, USA: Productivity Press, 1985.