Guest editorial: Lean Six Sigma developments in Türkiye

As a rapidly developing and growing economy over the past decades, Türkiye has emerged as one of the most potent regional economies at the point where Europe meets Asia, called Eurasia. Given the significant role of Türkiye in Eurasia, Türkiye has also been a role model for other developing countries and economies worldwide. Particularly, large-sized organizations in Türkiye have taken the lead role in bringing new management approaches and philosophies to the Turkish economy and medium- and small-sized organizations since the 1980s. LSS is listed as one of these management approaches and philosophies. These implementations have gained significant attention in various platforms and inspired a great variety of industries and organizations. These LSS implementations also achieved great success in numerous industries in Türkiye. Understanding LSS implementation in Türkiye may provide insightful knowledge for practitioners, researchers and academicians to understand the requirements of successful LSS practices. Although some Turkish companies have successfully implemented LSS and academicians have investigated LSS theoretically and practically over the past decades, the number of articles published in peer-reviewed scholarly journals is relatively limited. Therefore, this special issue provides academics, practitioners and researchers opportunities to publish their findings in the *IJLSS*.

The article "Reducing Turnaround Time in a Pathology Laboratory Using the Lean Methodology?" by Dr Akbulut *et al.* focused on determining the effects of lean methodology on the turnaround time in a pathology laboratory in a Joint Commission International–accredited university hospital in Ankara, Türkiye. The study consisted of three periods: the preintervention conditions, problem identification and root cause analysis and improvement opportunities. Using the lean tools helps identify and eliminate a great variety of wastes in this study. As a significant outcome, the turnaround time in the pathology laboratory was shortened, and the unnecessary steps were avoided with the changes made in the working methods and layout of the units in the laboratory. The results showed that applying lean techniques could reduce waste and increase participation in pathology laboratories. Considering the scarcity of lean practices in pathology laboratories, this study presents a compelling case study demonstrating how lean tools and techniques can be used in pathology laboratory settings.

The article "Application of Lean Six Sigma for yield improvement in the stainless steel industry: a recipe from Türkiye" by Dr Bilgin Turna is an excellent example of how LSS was implemented at a stainless steel manufacturer in Türkiye for yield improvement. The study was constructed upon the DMAIC process, along with a single descriptive case study. After identifying the downgraded rate in the manufacturing process, the study identified the root causes of the defectives and developed improvement alternatives. After completing the Six Sigma project, the rolled throughput yield increased to 99.05%, and the defect rate was reduced to 0.08%. The study reports that it is the first case study that examines the implementation of LSS to improve the yield of a medium-sized stainless steel company in Türkiye.

The article "Axiomatic design for lean autonomous maintenance system: An application from textile industry" by Dr Çevikcan *et al.* implements Autonomous Maintenance (AM) to monitor the manufacturing performance toward zero defects and zero breakdowns. The article emphasizes that AM systems implemented in a robust structure bring many

significant benefits, including high quality and short lead time. The study proposes a framework that contains a holistic AM design and detailed design of axiomatic design (AD) after presenting an extensive literature review of AM and AD. The implementation of the proposed framework is presented in a textile manufacturing system. The results show that the proposed framework improved average downtime by 43.9% and average elapsed time between two failures by 27.7% for all departments. It is the first study that combines AM and AD in a theoretical and practical way in the textile industry. The study is invaluable because it provides a comprehensive guideline to integrate the AM design into the lean concept to reduce non-value-added operations and actions in the textile industry.

The article "The academic pattern of Lean Six Sigma approach: Descriptive content analysis of project-based thesis within Turkey" by Dr Almaz and Dr Akar analyzes the academic pattern of the project-based graduate theses that focus on the LSS in Türkiye. The study analyzes 16 graduate theses registered in the National Thesis Center of the Turkish Council of Higher Education in Türkiye. The study implemented several data analysis methods, such as systematic analysis design and descriptive content analysis. It demonstrates that the number of graduate theses focusing on the LSS is relatively low and that various universities, institutes, disciplines and departments studied the subject. While most of the theses were written in Turkish, most advisors were in the rank of Assistant Professorship. The study also shows that the duration of the projects varies depending on the diversity of the features analyzed in the project.

The article "Implementing Lean Six Sigma methodology to reduce the logistics cost: a case study in Turkey" by Dr Şişman exemplifies how logistics costs can be reduced, and supply chain systems can be improved through an LSS framework proposed in a supply chain system in Türkiye. The study focuses on a case study that implements the DMAIC process. It reports that product quality and internal communication processes improved through DMAIC. The proposed framework reduced the percentage of customer orders transported by road from 13% to 5% and the percentage of the road transportation cost paid unnecessarily by the company decreased from 5% to 1%. The study demonstrates the practicality of the proposed framework in a case study performed in the plastics industry in Türkiye.

The article "Predictive Six Sigma for Turkish Manufacturers: Utilization of Machine Learning Tools in DMAIC" by Uluskan and Karşı focuses on implementing machine learning techniques in the DMAIC process. The study includes multiple linear regression, artificial neural network (ANN), random forests (RF), gradient boosting machines (GBM) and k-nearest neighbors in the Analyze and Improve phases of DMAIC. The ultimate goal of the DMAIC project analyzed in this case study was to reduce the number of fabric defects. The ML methods were used to identify the most important causes of defects identified on fabrics. The study also used parameter optimization to provide the minimum number of defects. The results demonstrated that ANN, GBM and RF were the best predictors and that machine speed and fabric width were the most important variables of fabric quality. Optimum values for the machine speed and fabric width were identified to minimize fabric defect using regression response optimizer and ANN surface optimization.

The article "A Novel Belief-Based QFD-AHP Model in Interval Type-2 Fuzzy Environment for Lean After-Sales Service in Automotive Industry" by Dr Başkır proposed a novel lean management model that includes belief space-evaluations, quality function deployment (QFD) and analytic hierarchy process (AHP) in an interval type-2 fuzzy (IT2F) environment. The model established in three phases was implemented in an automotive after-sales service organization in Türkiye and was compared to classical and type-1 fuzzy versions. The study reports that IT2F-environment provides a sensitive and flexible

evaluation of the model's linguistic scales. One of the practical aspects of the study is that it presents a dashboard developed in MS Excel to simplify the computational complexity of the model. From a decision-making standpoint, it also provides a Bayesian model combined with QFD–AHP approaches for decision-makers to integrate their perceptions and beliefs into decision-making processes and eliminate uncertainty and ambiguity in lean processes.

The article "Improvement for Surgical Mask Production: An Integration of Before-After Kaizen, 5S and Statistical Tools" by Dr Aktar Demirtaş *et al.* aimed to eliminate the causes of stoppages, increase the production volume and improve the efficiency of the workplace in a surgical mask production process. Considering that personal protective equipment, mainly surgical mask production, was a critical and challenging process when the COVID-19 pandemic hit the world, this study has been a good example to show how LSS can be used as a strategic approach to improve surgical mask manufacturing processes. This study is vital for LSS practitioners and academicians for several reasons. The study used essential statistical and lean tools in the surgical mask production process as the first case study published in the literature. It reported the findings using an integration of Before–After Kaizen approach. The study also reported a statistically significant decrease in the number of stoppages and increased production volume, as the main outcomes of the study.

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Fatma Pakdil
Department of Business Administration, Eastern Connecticut State University,
Willimantic, Connecticut, USA, and
Gülin Feryal Feryal Can and Pelin Toktaş
Department of Industrial Engineering, Baskent University, Ankara, Turkey