
Guest editorial: Operational research techniques and statistical learning for textile industry: look forward

1. Introduction

Operational research (OR) and statistical learning are critical to optimizing the decision-making process in the textile industry. Decision-making informed by data and insights drawn from well-formed OR models have changed the way of managing different stages of the traditional textile production process throughout the textile supply chain, from fiber production, fabric weaving and knitting units to garment manufacturing and retail sales (Ghasemy Yaghin, 2020; Darvishi *et al.*, 2020).

A variety of problems such as the lack of well-trained machine operators to find stable setting points of the weaving machines (Gloy *et al.*, 2015), assembly production imbalance (Chen *et al.*, 2012), incorrect cotton blending, infeasible production plan (Leung *et al.*, 2003), vulnerability in raw material procurement (Ghasemy Yaghin *et al.*, 2020; Karami *et al.*, 2021) or even technology-related issues can lead to production inefficiency. With the emergence of smart textile and the corresponding applications in the military, public safety, health care, space exploration, sports and consumer fitness domains, generous amounts of data are being generated on a rolling basis, and this deserves our attention for analysis. Even apparel fashion retailing has to adopt disruptive business solutions to address the traditional long lead-times and tap market trends for sustained competitive advantages (Hu and Yu, 2014). In attempting to address these problems, industry has resorted to trial-and-error strategies or *ad hoc* decisions. Unfortunately, these strategies and decisions, even if implemented properly, cannot always guarantee the optimal performance for textile manufacturers.

There is therefore a need and a role for disseminating and proposing suitable techniques to guide robust managerial decision-making. In this respect, OR- and statistical-based analytical models can supply valuable insights for the textile industry. Through this special issue, we seek to inform the textile managers in their journey to improving effectiveness and efficiency of the operations process.

2. Overview of special issue papers

This special issue calls for studies that bridge the nexus between *OR and statistical decision-making techniques* and *textile fashion management research*, while augmenting our understanding of textile productivity and competency. We were especially interested in those studies that apply analytical techniques to yield deep managerial insights for the textile industry. The research theme of the initial call is addressed by the papers in this special issue, albeit from different angles and foci.

The authors would like to express their deepest appreciation to all the reviewers who generously contributed their time and expertise to evaluate the papers for this special issue. The authors also thank the journal editor, Professor Gail Taylor, and the editorial staff for the generous support and guidance in hosting this special issue in their journal. Lastly, the authors are grateful to all the authors who submitted their work to the special issue for review.



The study by Imrith *et al.* makes use of statistical techniques to study engineered comfort textiles. They develop a model for ultraviolet protection factor (UPF), air permeability, water-vapor resistance, thermal resistance and thermal absorptivity of knitted fabrics using experimental data analysis. Imrith *et al.*'s other work focuses on engineering knits that will bestow the maximum UV protection while preserving thermo-physiological comfort through a linear optimization model. To maximize UPF, they insert thermo-physiological comfort and areal density constraints in their model. Das and Ghosh's work includes the multiclass classification of fabric defects using rough set theory. They extracted 12 decision rules for dealing with fabric defects based on data sets. The work of Sumo *et al.* calls on fuzzy analytical hierarchy process and data envelopment analysis to study fashion upcyclers. A fuzzy inference system is designed to assess the eligibility of the upcyclers. A modern production/operations problem in the fashion industry is considered by Perret. In that work, a line balancing-sequencing problem is formulated through a multiobjective optimization model, and genetic algorithm is used to find Pareto-optimal frontiers. Following this, Ramadan addresses the skew phoneme problem and finds a relationship between fabric skewness and twill angle based on a predictive analytics approach. Similarly, Leão *et al.* applied a stable matching process on a Brazilian textile cluster to determine the optimal supplier network structure through optimization and network analysis. The work of Dey *et al.* sheds light on the technical efficiency of the handloom industry in India. They apply data envelopment analysis and the bootstrap truncated regression approach to obtain the relative efficiency and determine the sources of inefficiency of microentrepreneurs in the Indian textile industry. Separately, Dey and Paul look at the determinants of profitability of the handloom enterprises in India. Table 1 provides a compendium of the nine papers listed in this special issue.

3. Discussion

These nine papers in our special issue make valuable contributions to the literature, notably on the implications of the new applications of OR and statistical methods for managing the textile and apparel industry. It is clear that these techniques contribute to textile manufacturing, and their potential impact on productivity should not be underplayed. Based on our observations together with the knowledge advanced by the contributing papers, we now present the new environment for the textile business.

Analytics has created much buzz and fanfare throughout the business world since the seminal piece on Competing on Analytics by Davenport *et al.* (2010). Indeed, analytics is weaponized in the hypercompetitive environment to realize smarter decision and better results through robustness. Analytics comprises the descriptive, diagnostic, predictive and prescriptive. By bringing together all of these parts in this special issue, we hope to inform firms on how to make robust informed decisions under volatile, uncertain, complex and ambiguous circumstances. In an interesting study, Ghahremani-Honarvar and Latif (2017) reviewed the papers in the area of wearable textiles by which huge amounts of health-care data are created through intelligent textiles and apparels. Through descriptive analytics, the textile industry could benefit from using innovative techniques on data to elicit interesting patterns and behavior. Doing so can address the what is happening now? and what exactly is the problem? Situations. To know what will likely occur in the future, the application of sophisticated statistical learning and analysis is a bonus. For instance, the drying period of wool yarn bobbins has been estimated by Akyol *et al.* (2014) using five machine learning regression models. In yet another interesting study, Agarwal *et al.* (2011) used decision trees to predict the effectiveness level of wash-ageing and fabric softener usage on the mechanical properties of knitted fabrics. In our special issue, Ramadan proposes the use of statistical

Title	Contributor(s)	Technique used	Focus of research
Engineering UPF and comfort parameters of knitted fabrics and validation using statistical techniques	M.K. Imrith, S. Rosunee, R. Unmar	Statistics, multiple linear regression	Air permeability, fabric comfort, thermal resistance
A rough set approach for classification of fabric defects	S. Das, A. Ghosh	Rough set theory, decision rules, classification	Fabric defects
Structural modelling of 100% cotton single jersey fabrics for optimum UV protection	M.K. Imrith, S. Rosunee, R. Unmar	Optimization	Knitted fabrics, UV protection
Efficiency evaluation and loan assessment of fashion upcyclers in Liberia using Fuzzy, DEA, and FIS models	P. D. Sumo, X. Ji, L. Cai	Fuzzy systems modeling, data envelopment analysis, optimization	Textile sustainability, recycling of textiles
A simultaneous balancing and sequencing algorithm to plan assembly lines in the fashion industry	J.K. Perret	Multiobjective optimization, genetic algorithm	Line balancing and textile operations planning, fashion industry
Statistical insights on the effect of twill angle on denim fabrics skewness	A. Ramadan	Statistical learning, data visualization	Fabric deformation, twill angle
Using an optimization model to support small sewing companies: A case study in a Brazilian textile cluster	J. Leão, L. de Sousa Pereira, M.L.X. Cavalcanti	Optimization, network model	Fashion industry, sewing operations, supply chain
Are handloom micro-enterprises in India efficient? Estimations based on DEA and bootstrap truncated regression approach	B.K. Dey, U.K. Paul, G. Das	Regression, bootstrap, data envelopment analysis	Handloom industry
What drives the profitability of Indian handloom enterprises? An insight based on the seemingly unrelated regression models	B.K. Dey, U.K. Paul	Regression, descriptive analytics	Handloom industry, profitability of textile industry

Table 1.
Papers in special
issue

studies to understand and predict the effect of twill angle on fabric skewness. Likewise, the combination of regression and data envelopment analysis is used in handloom industry by Dey *et al.*

Likewise, prescriptive analytics attempts to formulate a data-informed course of action using statistical learning tools and simulation. In short, prescriptive analytics involves a smart engagement with data to help industry prescribe what should be actioned for the future. In this regard, OR is a good fallback for the textile industry to use. For instance, Ghasemy Yaghin (2018, 2020) proposes a nonlinear optimization model to study the price setting and production plan of the textile supply chain. In this special issue, Perret uses optimization to formulate textile operations in a line balancing problem of the apparel industry.

Extracting past hidden trends and anomalies from data is useful to production and processing in the textile industry. For instance, [Yildirim et al. \(2017\)](#) studied a simple textile product (e.g. T-shirt) by which a huge amount of data is created and stored in data warehouses. In this respect, data mining techniques have been used in classical textile operations such as air permeability, sewing thread consumption, moisture and heat transfer rate in fabrics and automatic fabric detection. The textile industry should make use of analytics, OR and modeling to improve their suite of processes throughout the textile supply chain. Such mathematical and statistical-based techniques, enhanced with computer science, can significantly improve the performance of the industry. The interested reader may refer to [Gass \(2011\)](#) to better appreciate the follow-on savings of those organizations who have benefitted from OR and analytics.

4. Conclusion

We have presented the intent of this special issue in this editorial by carefully selecting nine papers. These papers provide valuable perspectives for both scholars and practitioners on the critical research agenda of analytics and optimization in the textile sector. These papers cover a wide range of important topics and perspectives, but unfortunately they do not capture the entire research scope intended for the special issue. We hope to encourage more interest from the OR and business analytics community to pursue relevant and meaningful research on analytics, statistical learning and optimization models for the textile industry.

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