Received: 11 October 2022 | Revised: 20 December 2023 | Accepted: 16 January 2024

DOI: 10.1002/qre.3490

REVIEW ARTICLE

WILEY

Optimization design of control charts: A systematic review

Salah Haridy[1,2] | **Ahmed Maged**[2,3] | **Nadin Alherimi**[1] | **Mohammad Shamsuzzaman**[1] | **Sondos Al-Ali**[1]

[1]Department of Industrial Engineering and Engineering Management, College of Engineering, University of Sharjah, Sharjah, United Arab Emirates

[2]Benha Faculty of Engineering, Benha University, Benha, Egypt

[3]Department of Mechanical Engineering, University of North Texas, Denton, Texas, United States

Correspondence
Salah Haridy, Department of Industrial Engineering and Engineering Management, College of Engineering, University of Sharjah, Sharjah, United Arab Emirates.
Email: sharidy@sharjah.ac.ae

Funding information
University of Sharjah, Grant/Award Number: 22020405194

Abstract

In today's competitive landscape, fulfilling customer expectations and achieving a competitive edge are crucial for business success. These objectives can be attained by effective monitoring in both manufacturing and service sectors to enhance quality, reduce variation, and augment productivity. The control chart, a widely used tool for this purpose, has attracted significant attention from researchers for its ability to detect anomalies and manage out-of-control situations. The optimization of control charts, a central focus of this review, not only enhances the detection effectiveness but also maintains the desired false alarm rate, thus ensuring efficient process control without additional cost, complexity, or operational challenges for shop floor personnel. The optimization process involves adjusting charting parameters like the sample size, sampling interval, and control limits within a hypothesis testing framework, thereby achieving optimal system performance. Numerous optimization models have been developed to enhance control chart performance. This paper introduces a classification scheme to analyze and categorize the existing research on control chart optimization. By conducting a thorough review of more than 240 articles, the study pinpoints research gaps and offers valuable insights, thereby advancing the future research in this domain.

KEYWORDS
control chart, optimization, quality control, statistical monitoring, statistical process control

1 | INTRODUCTION

Statistical process control (SPC) is a powerful method for problem-solving and process improvement.[1] Among its tools, the one most widely used in manufacturing organizations and service sectors is the control chart, initially proposed by Shewhart.[2] It is a simple real-time graphical tool used as feedback for stably monitoring and maintaining a process.[3,4] Furthermore, building up a control chart considers drawing samples from the process of interest obtained over various periods, then the monitoring statistic is calculated and plotted on the control chart. An SPC scheme is likely to produce an out-of-control signal in the presence of one or more assignable causes that may lead to a process shift.

Classical Shewhart charts have been commonly used for detecting large process shifts. However, practitioners have identified many drawbacks of the Shewhart-type schemes. For instance, they are not so efficient in detecting small changes in the process parameters. They suffer from rigidness and lack of memory (i.e., they conclude without considering the historical information of the process). Most importantly, they are not optimal; hence the best performance of the charts

