A Framework for Data-Driven Decision-Making for Cost Analysis of Implementing IoT in Warehouses

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Abstract

Managing warehouse operations poses a continuous challenge for companies due to associated costs and expenses. Inefficient utilization of warehouses leads to many undesired outcomes such as loss of manpower hours spent in storing or retrieving goods, degradation and obsoleteness of materials, etc. Therefore, optimizing the warehouse operations and improving its management will affect costs significantly. Nonetheless, it becomes necessary to first define the factors that affect the cost. This can be achieved by collecting related data, and then developing a sustainable and effective warehouse management system that can derive decisions accordingly. Furthermore, the nature of warehousing is becoming more dynamic such that the storing requirement is subjected to specific inputs and outputs related to, temperature, humidity, lightening, beside dedicated arrangements, etc. Thus, the ability to acquire a range of inputs, integrate and analyze them, is necessary to meet this objective.

IoT technology support is a key pillar of the data-gathering process that enables it to provide reliable data that can be utilized. Despite all the hype around IoT as a decision-support tool, improper implementation might lead to an ineffective system. Therefore, it is beneficial to evaluate the impact of adopting such technology. Hence, the objective of this project is to develop a framework for data-driven decision-making for cost analysis of implementing IoT in warehouses. To achieve this, a well-structured methodology is followed. The first phase of the methodology employed in this study included conducting an extensive literature review aimed at identifying cost-effective factors contributing to the implementation of IoT in warehouses. The literature review papers were found using specified key words such as IoT, warehouse, big data, cost-effective factors, and data-driven decision-making. Research papers related to the subject from trusted journals were chosen. In the second phase, the factors were gathered and classified based on specific criteria. Then, they were subjected to a filtering methodology. Here, the total number of factors that was collected in the literature review phase initially exceeded 290. Then, using the systematic approach to study and analyze the collected data lead to group the factors into 35 main factors and 71 subfactors.

In next phases of this project, those factors will be subjected to a common method bias test to ensure that the relationships between factors are not biased. This result will be statistically analyzed to rank them. This will be done

by distributing surveys and conducting statistical analysis on the obtained data to finally develop a comprehensive framework. Furthermore, the resulting framework will be validated using a suitable technique.

Keywords
Warehouse Management System, IoT, Framework, Data-driven decision-making and Cost-effective

Biographies
Razan Al Khambashi, Fatema Al Jadidi, Wasan Al Siyabi and Sharifa Al Riyami are undergraduate students at Sultan Qaboos university (SQU) in the Mechanical and Industrial Engineering department with a major in Industrial Engineering. They are expected to graduate by the end of May 2023.

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Niyazi Onur Bakır is an associate professor of Industrial Engineering at Sultan Qaboos University (SQU). His research interests include decision making under uncertainty, probabilistic modeling, homeland security, and economics of information. He received a Ph.D. degree in Industrial Engineering from Texas A&M University in 2004. He holds an M.S. degree in Economics from Texas A&M and a B.S. degree in Industrial Engineering from Bilkent as well. Prior to joining SQU, he served as faculty members at Altınbaş University, TOBB University of Economics and Technology and Bilkent University. He also worked as a postdoctoral research associate at the University of Southern California (USC) Center for Homeland Security. He serves regularly as a referee in operations research journals as well and is a member of INFORMS, Decision Analysis Society and Applied Probability Society.