Optimal Production-Inventory Control Policy for Manufacturing Systems Subject to Quality Deterioration

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Abstract

Production and inventory control decisions play a primordial role in manufacturing systems. However, most of the researches dealing with production-inventory control policies do not integrate explicitly the deterioration process due to product quality alteration. This paper studied manufacturing system optimal flow control composed of an imperfect process and a finished product inventory. After a random period operating in the 'in-control' state, the manufacturing system can switch to the 'out-of-control' state and starts producing non-conforming items. The manufacturing system 'in-control' horizons have a general deterioration distribution. Restoration actions with random durations are thus planned to restore the manufacturing system to the 'in-control' state after a specific logistic period to prepare required restoration resources. Restoration durations have a general distribution. In order to respond to demand and to hedge against shortages during restoration phase, a production-inventory control policy based on the hedging point policy is implemented. The control policy entails to build and to maintain a security stock of finished products during production phases. The problem is to control the manufacturing system production rate to minimize the policy overall cost including setup, restoration, inventory holding, shortage, and non-conforming items costs. An analytical model is proposed and the expression of the overall incurred cost is derived and used as a basis for optimal assessment of the production-inventory control policy. Numerical examples and sensitivity analysis are also carried out through a numerical simulation program in order to illustrate the effectiveness and the robustness of the proposed approach.

Keywords
Quality deterioration, Manufacturing systems, Optimal control, Hedging point policy, Numerical simulation.

Biography

Dhouib Karem received the B.S. degree in mechanical and manufacturing engineering from University of Québec, Québec, Canada, in 1988, the M.S. and Ph.D. degree in mechanical and manufacturing engineering from Laval University, Québec, Canada in 1990 and 1998. He also received the University Habilitation Degree (HDR) in Industrial Engineering from University of Tunis, Tunisia in 2010. From 1994 to 2014, he was a full time Professor with the Department of Mechanical Engineering and Productique, Tunis High National School of Engineers (ENSIT), Tunis, Tunisia. From August 2014, he became a full time Professor with the Department of Mechanical and Industrial Engineering, Faculty of Engineering, at Prince Sattam Bin Abdulaziz University in Kingdom of Saudi Arabia. He was with the Solids, Structure Mechanics and Technological Development Laboratory (LMSSDT) in Tunisia, and also a member of the Production System Design and Control Laboratory (C2SP) in Canada. Dr. Dhouib has published many scientific articles in well known journals such OMEGA the International Journal of Management Science, International Journal of Production Economics, International Journal of Simulation Modeling, International Journal of Production Research. His research interests are centred on modelling and analysis of manufacturing systems, system's reliability, maintenance optimisation, Production Control, Quality Integration, and simulation modelling. He is member of ATM, TSS, and IIE.