Proceedings of the International Conference on Industrial Engineering and Operations Management
Pilsen, Czech Republic, July 23-26, 2019

Solving the Dynamic Facility Layout Problem using Dynamic Programing

Saeideh Salimpour and Ahmed Azab
Production and Operations Management Research Lab
University of Windsor
401 Sunset Avenue, N9B 3P4, Windsor, ON, Canada
{salimpo, azab}@uwindsor.ca

Abstract

The Facility Layout Problem (FLP) is all about obtaining the optimal arrangement of machines or departments in a given area or plant. Most of the research in the area of the FLP assumes that the material flow between the departments is constant. However, in today's competitive and volatile manufacturing environments, this assumption does not usually hold. Layouts constantly need to be changed from one period to the other to adapt to the changes in the product mix and demand. The Dynamic Facility Layout Problem (DFLP) searches for a layout for each period of the planning horizon minimizing its respective total material handling costs, for all periods, as well as the total rearrangement costs between successive periods. Because of the prohibitive combinatorial nature of DFLP, absolute optimality is not usually sought and larger instances of the problem are solved using near-optimal algorithms. In this paper, Dynamic Programming (DP) is used to solve the DFLP problem. The layouts considered in each period forms the state space for DP; the problem is decomposed to stages— one for each DFLP period. This state space is arrived at using a hybridized heuristic approach that includes the use of a Simulated Annealing (SA) metaheuristic. Consistent with the rest of the literature, the proposed method is comprised of two phases; in the first phase, the set space to be considered and searched in each phase of DP are arrived at using SA and two different heuristic procedures. To obtain these layouts and for smaller manageable instances of the problem, exact optimum layout for each period is found by solving the QAP formulation of the static facility layout problem. As for larger instances and due to the inherent combinatorial nature of the problem, sub-optimum layouts for each period are arrived at using SA. Two other heuristics are utilized to complete the set space of layouts for each stage by applying different neighborhood functions to the previously obtained exact- and sub-optimum solutions. In the second phase, the DP recursive formulation is solved. Computational experience exhibits promise.

Keywords
Dynamic Facility Layout Problem, Dynamic Programing, Heuristics

Acknowledgments
The authors are thankful for the Natural Science and Research Council of Canada (NSERC). This research is funded by NSERC Discovery grant 811008.

Biographies

Saeideh Salimpour received her B.Sc. degree in Electrical Engineering from Azad University-Central Tehran Branch, Tehran, Iran, in 2011. She then completed an M.Sc. degree in Industrial Engineering from Iran University of Science and Technology, Tehran, Iran, in 2014. She is currently a Ph.D. candidate pursuing a doctorate in Industrial and Manufacturing Systems Engineering at the University of Windsor, Canada. She was one of two graduate students in Ontario who was awarded the 2017 Ontario Society of Professional Engineers scholarship. She was also one of three female international students in Ontario, one of seven all Canada wide, in 2018 to receive the Delta Kappa Gamma Society International World Fellowship. On top of that, she has also received the University of Windsor Alumni Association award for International Students, Graduate Student Society Scholarship, and the International Student Society Bursary award. Saeideh was the recipient of the best presentation award at 19th International Conference on Procurement, Logistics, and Supply Chain Management 2017 in Boston, USA. Her current research interests include Facility Layout Problem, Supply Chain Management, Production Planning and Scheduling, and Operations Research.

Ahmed Azab is the Director of the Production & Operations Management Research Lab. He has been a recipient and nominee for international and national research excellence awards. His research has been sponsored by National and Provincial granting agencies. He is one of three faculty members to receive a $1,000,000 CFI-LOF/MEDI-ORF grant supporting research infrastructure. For operating funds, he has earned to date about $500,000. Dr. Azab partners with national as well as international research collaborators from various research labs, and academic institutions in Europe, the Middle East, and USA.