An Optimization Framework for Dynamic Multi-Skill Workforce Scheduling and Routing Problem

Onur Demiray*[1], Eda Yucel†[2], Gultekin Kuyzu‡[2,3], and Mert Parçaoğlu§[2]

[1]Koç University – Rumelifeneri Yolu, 34450 Sarıyer-İstanbul, Turkey
[2]TOBB University of Economics and Technology [Ankara] – Turkey
[3]MIT-Zaragoza International Logistics Program, Zaragoza Logistics Center (ZLC) – Spain

Abstract

In workforce scheduling and routing problems (WSRPs), personnel having different skills are required to be assigned to set of geographically distributed tasks that arise at different time instants and have different priority levels and skill requirements. Due to dynamic nature of the problem, a significant portion of tasks is unknown at the beginning and new tasks show up dynamically as time passes. Since new tasks may be urgent, the personnel task plan (PTP) must be re-evaluated as more tasks become known, and may be re-optimized, if needed. In practice, when re-optimizing the PTP, a portion of it within a time interval called frozen period is kept unchanged. The tasks in the frozen period (i.e., frozen tasks), personnel-task skill consistency, and task priorities should be considered during re-optimization. To address the described dynamic multi-skill WSRP, we propose an optimization framework that is triggered whenever a predetermined number of new tasks arrive. The framework first identifies frozen tasks and determines the first available time and location of the personnel, and then re-optimizes the subsequent PTP with the objective of minimizing the total weighted completion time of all tasks. For the route redesign phase of the framework, we develop both a mathematical model and a heuristic algorithm. We test the performance of both approaches on realistic instances obtained from an energy distribution company that faces the problem on a daily basis. Through computational experiments, we analyze the effect of the redesign frequency and length of the frozen period on the solution quality.

Keywords: Dynamic Workforce Scheduling and Routing, Mixed Integer Programming, Heuristic Methods

*Speaker
†Corresponding author: edatyucel@gmail.com
‡Corresponding author: gkuyzu.etu@gmail.com
§Corresponding author: mertparcaoglu@gmail.com