FACULTEIT ECONOMIE EN BEDRIJFSKUNDE

UNIVERSITEIT GENT

Invitation

You are cordially invited to the public defense to obtain the academic degree of

DOCTOR OF BUSINESS ECONOMICS

by Forough Vaseghi

A new perspective on corrective action strategies for stochastic project control

Supervisor:
Prof. dr. Mario Vanhoucke

Monday, 16 September 2024 at 15h00
In the Faculty Board Room, Campus Tweekerken, Tweekerkenstraat 2, 9000 Ghent
Please confirm your attendance no later than 2 September by email to
forough.vaseghi@ugent.be

EXAMINATION BOARD

Prof. dr. Kris Boudt
Chair - Ghent University

Prof. dr. Mario Vanhoucke
Supervisor - Ghent University, Vlerick Business School, University College London

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dr. Annelies Martens
Vlaams Instituut voor Kwaliteit van Zorg

Abstract

Project management typically begins with negotiations between project owners and contractors to establish the project plan and target outcomes. Following these discussions, a contract is drafted to outline the responsibilities and expectations of both parties. Recognizing the uncertainties and variations inherent in *stochastic project environments*, which can lead to unforeseen deviations and disruptions, this thesis presents a series of research inquiries aimed at integrating *risk analysis*, *project control*, and *corrective action processes* within *stochastic project networks* and the framework of *data-driven project management*. These investigations combine various quantitative techniques from *decision science* and *data-driven project management*, including *risk analysis, cost-effectiveness analysis, cost-benefit analysis, statistical analysis,* and *probabilistic modeling*, to enhance the *corrective action decision-making process*. The primary goal is to highlight the importance of understanding and utilizing data to generate insights, thereby improving decision-making and providing project managers with actionable strategic guidance in dynamic and uncertain environments.

Study 1 incorporates risk analysis as a quantitative decision science technique into the project control and corrective action process. It introduces two types of analytical corrective actions aimed at reducing average activity durations and variability, as adjustments to the original activity duration distributions. An *analytical risk analysis* method is developed to quantify changes in the project's mean duration and variability, prioritizing activities based on their expected impact. This informs the creation of an *action set*, encompassing the most sensitive activities for potential corrective actions, aiming to reduce *control efforts* and minimize overreaction. **Study 2** compares two methodologies for ranking project activities to identify the most critical activities and control efficiency in *stochastic project networks*. It integrates *simulation-based sensitivity metrics* and *analytical ranking measures* into the corrective action processes, assessing their performance within an *activity-based bottom-up project control approach*. **Study 3** integrates a *probabilistic optimization model* tailored to the unpredictable nature of project networks. This model optimizes corrective actions by considering time, cost, and uncertainty, ensuring a specified percentile of the project duration distribution meets a deadline. The output is an *optimized action set*, enhancing project control in stochastic environments. Two project control strategies are presented: *preventive strategy*, conducting a one-time optimization before project initiation, and *protective strategy*, continuously re-optimizing during project execution to adjust the action set. The study assesses the impact of acquiring additional information during project execution on project duration distribution variability, referred to as the *value of information analysis*. **Study 4** expands beyond the traditional *contractor perspective* to include the *agency viewpoint* and *incentive contracting*, considering the interests of both parties involved. It integrates a novel *probabilistic optimization framework* into project control strategies, seeking to minimize the overall project cost for the owner while simultaneously maximizing the contractor's expected utility of profit. The goal is to minimize the misalignment, known as the *principal-agent problem*, highlighting the gap between the expectations of the principal and agent.

Curriculum vitae

Forough Vaseghi holds a Master of Science in Reservoir Engineering (2019) and a Bachelor of Science in Petroleum Engineering (2017), both from Amirkabir University of Technology. In October 2020, she joined the Operations Research and Scheduling Research Group at Ghent University, within the Faculty of Economics and Business Administration, Department of Business Informatics and Operations Management, as a PhD researcher.

Study 1 of her dissertation is published in the '*European Journal of Operational Research*' (EJOR, https://doi.org/10.1016/j.ejor.2024.02.040). Study 2 is published in '*Computers & Industrial Engineering*'(CIE, https://doi.org/10.1016/j.cie.2023.109505). Studies 3 and 4 are currently under review in peer-reviewed international journals. Forough has presented her research at several international conferences, including the 31st and 32nd European Conference on Operational Research (EURO: Athens 2021, virtual; Espoo 2022), the INFORMS Annual Meeting (California 2021, virtual), and the 18th and 19th International Workshop on Project Management and Scheduling (PMS: Ghent 2022, virtual; Bern 2024).