

**Models and Algorithms for Manpower Planning and Personnel Rostering:  
Towards An Integrated Approach**

**Komarudin**

**Promotor: Prof. dr. Marie-Anne Guerry**

**Public defense: March 26<sup>th</sup>, 2015**

**Thesis submitted in the fulfillment of the requirements for the degree of  
Doctor of Business Economics.**

**ABSTRACT**

Human resource management (HRM) becomes more and more important. It is estimated that in 2030, there will be a global workforce shortage. Moreover, personnel skill mis-match will be more severe. Due to the importance of HRM, our work is devoted to alleviate the current and future workforce challenges. In particular, it can be used to improve personnel planning activities in an organization/company.

We develop models and algorithms for two activities in HRM, i.e. manpower planning and personnel rostering. Manpower planning in an organization aims at meeting future human resource requirements. The personnel rostering problem is defined as the problem of assigning personnel to shifts, subject to legal and contractual constraints.

The main theme of the thesis is fulfilling the employer's and employees' aspirations, such as the long term organization's goal, the employees' career progression expectations and the rostering preferences. A solution must be a compromise of personnel rostering which tries to optimize short-term objectives and manpower planning which attempts to optimize long-term objectives. Therefore, the thesis concerns with integrating manpower planning and personnel rostering. The integrated model can be categorized as a stochastic black-box expensive optimization problem. Two optimization algorithms are proposed to solve the problem, i.e. response surface methodology (RSM) and simulated annealing (SA). Our work shows that the integrated model can provide recommendations for a manpower planning strategy that can lead to an improvement of the personnel roster quality.

Moreover, we tackle a manpower planning problem that can be modeled as a mixed integer non-linear program (MINLP). An approximation algorithm based on a piecewise linear formulation is introduced to solve the problem. We propose an iterative algorithm that can reduce the computational efforts. Furthermore, we study a stochastic optimization

problem to deal with the uncertainty of voluntary resignation from an organization. We present a complexity analysis of the stochastic optimization problem and show the problem to be NP-hard.

In addition, we deal with fairness in a personnel rostering problem. Fairness can be seen as the degree to which the work assignment and the personal preferences fulfillment are balanced over all employees. A new objective function is introduced in order to simultaneously maximize the personal preferences fulfillment and minimize their differences among employees. This approach can help an organization to improve employees' satisfaction.