An Inverse Optimization Model for Human Resource Allocation Problem Considering Competency Disadvantage Structure

ZHANG Lili* a, b, c

*School of Business, Dalian University of Technology, Panjin 124221, China

School of Systems Engineering, Dalian University of Technology, Dalian 116024, China

Dalian University of Technology-Beijing research institute, Beijing100000, China

Abstract

Most of serious and major accidents that happened during the production procedure of process industry are caused by improper equipment operations, which is further owing to inappropriate human resources allocation and ignorance of individual competencies differences. In order to take both of competency disadvantage and adjustment requirement into consideration, we use an inverse optimization method to solve a human resource allocation problem, and furthermore, adjust equipment operating parameters to make the per-defined settings optimized, such as the total number of jobs, security-related parameters and so on. In the solving process, firstly a standard competence hierarchy system is conducted; secondly we propose an assessment method according to disadvantage structure; thirdly we use inverse optimization method to solve the problem and optimize the predefined allocation plan. Lastly, we give an example to prove its feasibility and effectiveness. In this paper a novel formulation of human resource allocation problem is proposed, in which some of main individual characteristics are considered and described mathematically, including psychology, behaviour and characteristics diged from them such as weakness. The other contribution of this paper is using inverse optimization to adjust parameters based on the given ideal allocation plan. Both of these propositions have a positive significance on promoting development and security construction for process industries. This research incorporates the academic thinking of inverse optimization, it not only puts psychology and behavior into optimization model, but also data mines weakness characteristics under the psychology and behavior data, and find a new way to introducing the weakness characteristics into decision making model. It provides a new thought for the following decision making problem, that is the ideal decision plan is known, and optimization parameters are changeable. It promotes the combining of psychology, behavior and operations research, it is good for process industries to develop in a safety and efficiency way.

© 2017 The Authors. Published by Elsevier B.V.
Peer-review under responsibility of KES International

Keywords: inverse optimization; linear programming; human resource allocation; competency; evaluation according to disadvantage structure

* Corresponding author. E-mail address: lilizhang@dlut.edu.cn
1. Introduction

Process industry includes petrochemical industry, iron and steel industry, nuclear power industry and so on. All of these process industries are very important to the development and security of the country. Process industries partly deploy continuous production, the manufacturing process always goes with a series of physical changes and chemical reactions, which makes the whole production process very dangerous due to its inflammable and explosive properties. So security is the first concern for the whole equipment and human resources management in process industry. The production safety degree mainly relies on human resources competency with consideration of disadvantage, and most importantly, it depends on the allocation of human resources. The equipment operation competency always implies specific characteristics that differentiate competent operators from poor or normal ones. Competency management research of process industries still lag behind in the reality need. This issue is most noticeable at the human resources allocation and adjustment planning level. Human resources allocation of process equipment is inclined to use mathematical optimization methods, such as linear programming, nonlinear programming, multi-object programming, combinatorial optimization, integer programming, apply these models to achieve the best economy benefit under the constrains of workload needed with consideration of efficiency. Furthermore, most of the human resources optimization methods propose an optimization model under the condition of the known cost parameters, workload parameters, efficiency parameters, through some algorithm, to determine the value of decision variables (for example resources allocation plan), to achieve the goal of cost as small as possible or the profit as large as possible.

There are some particular characteristics of equipment operators, firstly, work efficiency depends on competency; secondly, equipment operation system security follow the "cask principle", an equipment operation system's safety depends on the weakest point which is worker's comprehensive evaluation of competency according to the disadvantage structure. In terms of extending cask principle, with consideration of equipment safety operation, we define work efficiency parameter in the optimization model as the average competency evaluation result according to disadvantage structure. Disadvantage structure is defined as the evaluation weight vector which can make the object achieve worst result. Also according to the characteristics of human resources, we integrate behavioral factors and psychological factors into optimization model.

However, in reality, sometimes the human resources allocation plan is determined, for example, the plan is an order from the top leader, under the pressure of human resources reform such as cutting down the number of person employed, so the resources allocation decision has to follow the order. Then this is a pre-set plan-driven human resources allocation problem, this problem has been on the rise in resources management practice. Also in the real world, human resources allocation problem always face the challenge on revealing unknown or implicit parameters in decision-making processes. But we can estimate parameters with experiences. In order to solve this kind of problem, the decision maker needs to change some of the model parameters to make the predefined resources plan the optimal solutions under the new parameters. This problem is through adjusting optimization model parameters to make the pre-set plan be the optimal solutions. All these problem features agree with the definition of inverse optimization. Inverse optimization consists of finding a minimal adjustment of the parameters such that a given set of feasible solutions become optimal. Especially, behavior and psychology features are very important to equipment operation safety, so in this work, an inverse optimization model is developed for allocating human resources to different jobs with consideration of psychology and behavior features. The adjusted parameters refers to the workload parameters. The cost parameters are determined according to average salaries, the efficiency parameters are determined by the comprehensive competency evaluation according to disadvantage structure. The decision variables express the number of personnel allocate to different job groups.
دریافت فوری
متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات