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An employee performance estimation model for the logistics industry

Yu-Jen Wu [1], Jiang-Liang Hou *

Department of Industrial Engineering and Engineering Management National Tsing Hua University Hsinchu (300), Taiwan

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ABSTRACT

In the last decade, the growing economy in Taiwan has brought about rapid growth in the logistics demands of enterprises. An important goal in the field of third party logistics (3PLs) is to improve the performance of logistics activities to enhance operation efficiency and enterprise competency. However, the employee performance must be determined in order to improve the activity performance of 3PLs. Thus, the aim of this research is to develop an employee performance estimation (EPE) model that includes three modules: direct performance determination (DPD), indirect performance determination (IPD), and performance score analysis (PSA). Moreover, a web-based logistics information management (LIM) platform was established via the EPE model in order to assist the managers in collecting and maintaining shop-floor operation data and to identify low-performance logistics tasks as well as inexperienced employees. In addition, a real-world case was used to demonstrate applicability of the proposed model and platform. As a whole, this paper presents an integrated model with the aims to more accurately calculate employee performance and significantly reduce the workload of 3PL decision makers.

1. Introduction

As the economy continues to grow in Taiwan, enterprises require more cooperation with professional logistics service providers in order to accomplish logistics activities since the complexity of logistics activities (e.g., distribution or warehousing) has gradually increased. This has resulted in a drastic increase in the number of third party logistics (3PLs) established for the purpose of fulfilling the logistics demands of enterprises. In order to enhance operation competency and efficiency, some 3PLs have utilized a variety of automated techniques and management strategies to improve the performance of logistical tasks.

Although conventional 3PLs invest a large amount of money and time in their logistic operations, operation competency and efficiency has not shown significant improvement because managers cannot systematically recognize either low-performance logistics tasks or inexperienced employees. Logistics managers do not take a systematic approach for determining the performance of operators. In addition, logistics-related data (e.g., operation time) from the shop floor cannot be accurately gathered and imported into a logistics database and thus, they cannot be employed for operator performance evaluation. Under such circumstances, 3PL managers have difficulties reusing and analyzing logistics-related data.

To overcome these problems, this research proposes a model aimed at determining the performance of different types of employees by utilizing the shop floor data of logistics activities. With regard to employee performance calculation, this research uses quantitative factors to estimate the operational performance of direct workers and indirect managers. Two performance reasoning modules are developed in this study:

- Direct Performance Determination: Used to determine the Real Performance (RP), Effective Performance (EP) and Derived Performance (DP) of direct workers.
- Indirect Performance Determination: Used to determine the Verification Performance (VP), Assessment Performance (AP) and Inference Performance (IP) of indirect managers.

The two modules can be combined to generate an integrated employee performance estimation model. In the proposed performance estimation model, the RP may first be calculated via the duration and quantitative outputs of logistical tasks. Subsequently, several quality indices (e.g., the operator trend index and operator idle index) can be formulated to determine the EP and DP. The team-level trend index, team-level quality index, schedule index and budget index can be formulated to estimate the VP, AP and IP. The operator and manager performance indices (i.e., RP, EP, DP, VP, AP and IP) can be given to logistics managers in order to identify both low-performance logistics tasks and inexperienced employees. In summary, the proposed performance estimation approach can be used in the logistics management systems of 3PLs to produce an automatic determination of employee performance in a logistics center.

* Corresponding author. Tel.: +886 3 5742658; fax: +886 3 5722685.
E-mail addresses: d947804@oz.nthu.edu.tw (Y.-J. Wu), adamhou@ie.nthu.edu.tw (J.-L. Hou).
[1] Tel.: +886 3 5715131x33981; fax: +886 3 5722685.

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By estimating the performances of all levels of employee, low-performance logistics tasks as well as inexperienced employees can be determined so that the demands of 3PLs for improvement in operational competency and efficiency can be fulfilled.

2. Literature review

In the field of employee performance evaluation research, related studies focus on evaluation schema construction and measurement item calculation. The previous groundwork is discussed below.

2.1. Evaluation schema construction

In a performance pyramid model [13], decision makers should determine performance evaluation factors based on organization levels. It is not only education levels and work experience that affect employee performance, but also job characteristics and workplace conditions [9]. In the past, many studies utilized literature reviews, expert interviews or questionnaire surveys to identify the appropriate performance evaluation factors of distinct industries. Sims et al. [15] employed interview and survey methodologies to determine how employees in the medical and manufacturing industries address task variety, task autonomy, task identity, information feedback, dealing with others, and friendship opportunity. In order to provide a comprehensive structure for performance evaluation, Coleman and Borman [4] first generated twenty-seven citizenship performance behaviors, based on previous research, and developed a performance evaluation structure composed of the interpersonal, organizational job/task dimensions via questionnaire. In addition, the TQM key components (e.g., problem-solving abilities of employees) were regarded as important factors for employee evaluation since enterprise managers could understand the performance of implementing TQM by evaluating employee performance via TQM factors [5].

For room attendants and reception clerks in the hotel industry [3,12], nurse anesthetists in the hospital industry [17], and technicians in the paper industry [18], expert interview methodology was used to generate factors for candidate evaluation. The importance of the candidate evaluation factors for managers is analyzed via questionnaire. Performance evaluation schemas (i.e., factors and their corresponding levels) and factor weights may be obtained by the analytic hierarchy process (AHP) method. In order to ensure the applicability of candidate performance evaluation factors, Chen [2] and Laio [11] used the Delphi and AHP methods to establish evaluation schemas for advertising executives in the newspaper industry and technicians in the free-air television industry. A fuzzy multiple criteria algorithm may also be used to analyze the consistency of performance evaluation factors. The MIJE (Metal Industry Job Evaluation) system applied to evaluate employee performance in the metal industry should improve its evaluation factor weights since the development of IT technologies and working conditions have caused managers in the metal industry to stress new factors. Hence, a revised MIJE system is proposed, using the expert interview as well as AHP approaches for an optimal evaluation schema in line with the characteristics of the metal industry [8].

2.2. Measurement item calculation

For the scoring of employees using evaluation factors, the PDA (Performance Distribution Assessment) model proposed by Kane and Kane [10] requests supervisors to first distribute a subjective score. The performance distributions for all employees can be established according to the frequencies occurring on different levels of the evaluation factors, while employee performance can be determined in terms of specific statistics (e.g., the median or mode). Although the work behavior of R&D engineers in the software industry cannot be easily measured, measurements of the key competencies for all R&D engineers could be acquired by their managers via Q&A. Using the differences in the measurements and the optimal values of key competencies, R&D engineers may be classified into several groups through the use of normal distribution. Furthermore, the performance of R&D engineers can be rated on a basis of group rank [14].

In order to solve the problem of evaluating employee characteristics, Ahn and Chang [1] regarded the know-how and the human capabilities of employees as product- and process-related tacit knowledge. In this study, tacit knowledge is transformed into organizational and financial performance by means of the DEA (data envelopment analysis) approach to investigate employee performance. It is not only regular work, but also job transfers and influence activities that affect employee performance. Eguchi [6] used the time series concept to estimate the financial profits that employees generate from regular work. He applied the opportunity cost concept to calculate the loss due to job transfers and influence activities. He then applied the averages of the fuzzy linguistic variables to estimate expected employee performance using the probabilistic/possibilistic approach. In order to provide lists to managers for the assignation of employees to jobs, employee performance must first be calculated according to the estimated results. In order to generate candidate employees, ranks of employees in distinct jobs may be determined on the basis of their job attributes and employee performance [16].

Regarding the benefits generated by employee cooperation on a job, employee combinations should be emphasized as employee performance is calculated for assigning employees to jobs [19]. First, the employee rank of distinct jobs can be determined using the standard fuzzy arithmetic and then feasible employee combinations can be generated via the triangular fuzzy number. The optimal employee assignment plan for designated jobs can be determined according to the job characteristics and may be provided to relevant supervisors for operational planning. The model proposed by Golec and Kahya [7] quantifies the performance evaluation factors using the heuristic method and calculates the scores of employees using the factors dictated by the fuzzy rules. The employee assignment program can be determined by ranking employee scores.

As shown in the above literature review, previous studies for evaluating direct employee performance stressed the analysis of the performance evaluation factors and calculations of the factor weights. However, it is critical to transform the measurement items of direct employees in the evaluation factors into direct employee performance. The derived performance can be used to measure the behavior of the direct employee and the employee assignment plan. Few studies have been dedicated to the evaluation factors and the factor weights for indirect employees (e.g., managers). In contrast to previous studies, this paper focuses on employee performance evaluation within the logistics industry. Performance evaluation factors were established according to the characteristics and organizational structure of a distribution center (DC). By utilizing the shop floor operation data, a systematic and quantitative algorithm was also developed to automatically calculate the performance of the direct workers and indirect managers of a logistics center.

3. Employee performance estimation model

In order to assist 3PL managers in estimating employee performance, this research develops an employee performance estimation (EPE) model to determine the performance of direct workers and indirect managers. To enable a determination of personal performance for each employee in a DC, staff levels and organization units must be defined to serve as input. After defining the DC organization, this study utilized the operation data of logistics activities, the records from exception reports, work schedules, and budget plans to derive the performance of each employee (including direct workers and indirect managers). The proposed EPE model can be categorized into three modules (Fig. 1).