A novel improving method of industrial performance based on human resources management

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Abstract: In this paper a decision-making tool for maintenance management process in a real-life case study is proposed, in order to improve maintenance performance. The proposed approach is based on an effective and optimal assignment process of human resources characterized by their competence and availability.

A discrete event simulation model based on Pareto multiobjectif optimization method is introduced. The proposed approach finds good solutions in a reasonable amount of time, and provides significant gains of maintenance performance extending up to 20%.

Keywords: Human resources assignment problem, Performance, Replacement, Hybrid method.

1. INTRODUCTION

Material resources used in the services and goods production and delivery constitute the main part of most companies' assets. For fear of the risk of deterioration with age and usage, it had become essential to maintain these resources and systems. Hence, a reliable management of maintenance service is highly important to ensure a good performance of the production plan. For that, according to (Parida & Chattopadhyay 2007), follow up the performance of maintenance process had become indispensable.

Several authors consider that maintenance plays the role of the major contributor to global performance and profitability of manufacturing systems (Al-Najjar & Alsyouf 2004; Parida & Kumar 2006; Kans & Ingwald 2008; Sari et al. 2015; Maletič et al. 2014). Thus, this function is identified in the literature as a significant component of companies' competitiveness (Maletič et al. 2014). Maintenance becomes then a vital function for the sustainable performance of a production plant.

On the other hand, human resources stand at the heart of all industrial activities in general and maintenance activities in particular. Human resources of maintenance are characterized by different competence (mechanic, electric, electronic, etc) and different level of qualification in each competence for each human resource (Lahiani, et al. 2014). This diversification of human resources is essential to maintain in operation condition the material resources. Maintenance performance depends then, in part, on a proportional basis management of maintenance human resources.

In literature (detailed in the next section), maintenance performance is often studied according to human resources competence. However, it is also important to integrate competences with field constraints as well as emergency of interventions. Within the framework of this paper, we intend to enrich this base by putting forward the impact of the human resources management and assignment on the performance of maintenance function and hence organization. Human resources competence and availability and the emergency of intervention are also considered.

The aim of this paper is to propose an original approach to improve maintenance performance based on an optimal assignment of human resources. For this purpose, an hybrid approach based on a combined discrete event simulation model and Pareto multi-objectif module is proposed. The proposed approach is tested on a real-life case study.

The remainder of this paper is organized as follows. In the next section, a literature review is presented focusing on the maintenance improving issues and the role of the human resource to improve it. The third section presents the problem description. In section four, the proposed approach is presented. In the fifth section, an example of solutions is presented. Lastly, section six concludes the paper with some suggestions for future works.

2. STATE OF THE ART

The literature is very rich with works dedicated to the different issues to improve maintenance performance. In previous works, maintenance performance improving issues are classified into four groups (Lahiani 2015). The first group

called "improving management function" contains the logistic activities (Chater et al. 2012), quality management (Maletič et al. 2014; Willmott 1994), spare part management (Alhouaij & Simeu-abazi 2008), production management (Muchiri et al. 2011) etc. The second group "human resources' operating systems" includes the choice of maintenance teams (Hedjazi & Zidani 2012). The third group named "human resources development" include the teamwork culture (Willmott 1994) and the motivation of maintenance staff. Finally, the forth group "strategy and development policies" concerns an appropriate maintenance strategy and policy (Chan & Prakash 2012), implementation

of technical tools like ERP (Kłos & Patalas-Maliszewska 2013), … etc.

In all these maintenance improving issues, human resources are constantly present. For this reason, this paper investigates the impact of the human resource assignment problems into maintenance performance.

The table 1 below presents a synthesis of literature review that considers the maintenance performance improvement based on an optimal assignment of human resources. Studies objects, modeling methods, considered constraints and solving methods are also presented.

Table 1. Assignment human resources impact in maintenance performance: State of the art.

Reference	Goal(s)	Modeling	Considered constraints	Resolution
(Ouardouz & Bernoussi 2014)	Maximize operational equipments Minimize cost Minimize energy Minimize displacements.	The techniques of cellular automata and Voronoi diagrams	Task duration, significant displacement time between the equipment and the site facilities, tasks' optimal scenarios, intervention, priority between tasks of the same entity, the necessary expertise for each task	No resolution
(Beliën et al. 2013)	Minimize labor costs which results from the forecast of the line maintenance program	Mixed Integer Linear Programming (MILP)	Human resources competence level, Predefined action ranges (depending on aircraft landing time), Imposed coverage constraints (not specified by time but by maintenance task), the number of persons working on a particular aircraft, Flexibility with respect to the maintenance exact timing	Enumerative bounding algorithm
(Kłos & Patalas-Maliszews ka 2013)	Maximize maintenance performance by implementation methodology of ERP systems	Simulation of human resources motivation by salary bonus.		
(Bennour et al. 2012)	Minimize the size of the teams occurring in the activities of given maintenance	Linear Programming	Competences detection and operators' control degree	Exact method under Matlab
(Dakkak et al. 2012)	Maximize service quality and preferences' integration	Mixed integer linear programming	Human resources' situation	Some resolutions' possibilities were mentioned without being developed
Hedjazi & Zidani (2012)	Minimize the weighted sum of the delays, Minimize the number of tasks delays.	Multi-objective linear programming	Human resources competences	Proposition of a static and dynamic resolution approach