

The impact of Fleet Maintenance Management
on project performance:
A case study in school bus transportation
in Madinah/Saudi Arabia

تأثير إدارة صيانة الأسطول على أداء المشروع:

دراسة حالة في النقل بالحافلات المدرسية

بالمدينة المنورة / السعودية

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Abstract

The paper refers to The importance of maintenance management to increase the vehicle fleet energy efficiency. The fleet maintenance management influences as the vehicle maintenance process itself as well as the primary transport process but also their environment. In order to increase fleet energy efficiency by means of a more efficient maintenance management, it is indispensable to observe maintenance process, transport process and the environment. Since different indicators can measure the implementation effects of such measures, this paper analyses the influence of indicators in all three mentioned areas on management decision-making. In this sense, appropriate indicators have been defined and subsequently used in fleet maintenance management.(Vujanović et.al., 2012).However, vehicle operation and maintenance processes differ from those related to industrial machines. The fact that vehicles are mobile assets, further affected by a large number of external environmental factors imposes the need for a different approach in their maintenance management, compared to other static machine. (Vujanović et.al., 2012).

INTRODUCTION

In this sense, for an efficient fleet maintenance management it is necessary to observe jointly: (1) the transport process as a primary (core) process that brings profit to the company; (2) the vehicle maintenance, as logistical support to the core transport process, which by means of maintenance interventions transforms vehicle condition from the state of “unready for operation” to the state “ready for operation”; (3) the environment, associated to safety and environmental protection from the maintenance impact, which is monitored via technical inspections. For an integrated approach to maintenance management an important concept is the “Process based maintenance” (Zhu, Gelders, & Pintelon, 2002) and (Zhu & Pintelon, 2001).

This concept, among other things, involves the definition of necessary indicators which allow measuring the implementation effects of specific measures during. (Vujanović et.al., 2012).maintenance management, monitoring the value of indicators in relation to the adopted thresholds and management decision making in the event of unauthorized indicator values deviation from threshold values.(Vujanović et.al., 2012). Therefore, the problem under consideration in this paper is to determine the level of interdependences of indicators and determine their significance and their relative weight in the maintenance management causing an increase in the fleet energy efficiency, provided that planned transport tasks are realized. As a solution, a model with ranked indicators upon their impact onto the fleet energy efficiency is obtained. The resulting model should point out to managers which indicators should be given more attention in measuring the implemented measures effects and in maintenance management decision-making. The proposed model can be used to evaluate the managers’ perception of the importance of maintenance management to increase the fleet energy efficiency. Also, managers can be evaluated by means of the

model upon their effectiveness and efficiency in the fleet maintenance management. .(Vujanović et.al., 2012)

A determining factor in efficient use of fleets of equipment is effective maintenance planning. Managing the maintenance of a fleet of equipment is a complex problem for a variety of reasons. In addition, the mathematical modeling domains required for developing such a strategy are defined. These domains include equipment-level maintenance scheduling, predictive maintenance, opportunistic maintenance policies, impacts of new technology, equipment retirement, and maintenance resource allocation. We explore these modeling domains as part of a collaborative research project.(Cassady, et.al..1998).

Performance measures should be linked to an organization's strategy in order to provide useful information for making effective decisions. The pitfalls relating to the indiscriminate use of common maintenance performance indicators are discussed in this paper. It also reviews four approaches to maintenance performance measures. The value-based performance measure evaluates the impact of maintenance activities on the future value of the organization.

Maintenance has a critical role in the transportation industry, as it is the guarantee for public transportation in providing continuous and safe services. The current study aims to explore the maintenance practices employed by public transport sector and investigate the environmental impact of the common maintenance practices. A comprehensive review of the state-of-the-art literature related to maintenance practices and environmental sustainability key performance indicators was conducted.(Alawaysheh et.al.,2020).

all companies have begun to focus on achieving higher performances, i.e. higher quality of their products/services, lower costs, sustainability control, etc. (Medina-Oliva et al. 2015). As a result, the importance of maintenance goals, objectives and requirements has increased due to their key role on improving e.g. system reliability, performance efficiency, and products/services quality (Babiarz 2015, Bajda et al. 2011, Kierzkowski et al. 2012, Restel 2014a, 2014b, Valis & Vintr 2006). In accordance to the rapid growth and evolution of maintenance as a technical and managerial process, the issues of management of inputs, outputs, and feedbacks of every maintenance aspects are probably as critical as the execution of maintenance itself (Cruz 2012, Kierzkowski & Kisiel 2014a, 2014b, Muchiri et al. 2011).

Process controlling

Processes oriented controlling can be described as a system for improving the management of business processes, with the support of the planning and control functions (Fink 2003). The main objective of controlling should be to increase the efficiency of the processes performed in a company, so that they are consistent with the adopted strategy, and thus also aimed at meeting the expectations of external and internal customers (Crochet 2013) (Fig. 1). It is also expected (Dłubak 2002): • reduction of processes performance time, • reduction of processes performance costs, • an increase in the quality of processes and financial products. (Tubis, & Werbińska-Wojciechowska.,2015).

The main information from maintenance management subsystem supply the planning subsystem (e.g. defined maintenance strategy/policy). The output data from maintenance work process are directed to control subsystem and are the basis for carrying out of performance analyses. The planning subsystem is also responsible for providing the standards for performed maintenance processes. The developed analyses are stored in information support subsystem, which is responsible for analysis if the level of performed maintenance processes indicates on the necessity of any changes in maintenance system or controlling system implementation. If there are necessary maintenance processes improvements, then information are sent to the maintenance management subsystems (e.g. recommendation for maintenance policy change). If the controlling system needs improvement, then necessary information is sent to planning subsystem. Moreover, the information support subsystem is responsible for providing information/reports for company's stakeholders. All the information flows between controlling subsystems are additionally coordinated. The coordination process is responsible for the correct execution of processes and information flows between the two systems in cooperation. (Tubis, & Werbińska-Wojciechowska.,2015).

Conclusions

The process of means of transport operation and maintenance is becoming a key competence in transport enterprises and is seen as an activity that adds value to the offered product. Means of transport's technical condition decides about travel comfort and quality of offered transportation service. At the same time, it can be visible that managers in Polish companies lack information support in decision-making processes performance. The high complexity and the large variety of operated and maintained means of transport make that maintenance managers do not have the ability to independently gather and analyse data necessary in the maintenance planning processes performance. Thus, there is a huge potential for the implementation of the concept of process controlling the area of maintenance management performance. Following this, authors in their future research work plan to focus on the developed model extension. The main areas of authors interest will be connected with investigation of the main (inter) dependencies which may occur between the modelled systems and development of maintenance decision support system which will be based on the continuous improvement of performed processes. The implementation of investigated solutions is planned to be performed in the road passenger transport companies, which operational and maintenance processes need taking into account various requirements (e.g. connected with different group of stakeholders' expectations). The presented article is the continuation of authors' research works presented e.g. in (Tubis 2015) where author focused on the issues connected with maintenance management processes performed in the chosen transportation company, and in work (Tubis & Werbińska-Wojciechowska in press), where authors provided the analysis of maintenance decision making process performance with taking into account necessary operational data availability

Methodology for integrated fleet MM

The methodology for integrated MM takes integrally and comprehensively into account the transport process, the vehicle maintenance process, as well as the environment. Transport process requirements are defined by the Operational Plan (OP), which according to [24] represents a collection of transport tasks that the fleet should accomplish in a given period.

Environment requirements represent the legislation for the safe road traffic, the environmental protection legislation, the warranty period conditions, the vehicle manufacturers' recommendations in terms of preventive maintenance, the vehicle service centers' locations and quality in the region, and many more. The vehicle maintenance process requirements are defined by maintenance workload to be realized in a given period, in accordance with OP and environment requirements. For the methodology, Process Based Maintenance (PBM) concept proposed by authors in paper [30] has an important role. The PBM concept requires defining appropriate indicators for measuring the effects of specific measures during the MM, monitoring indicators value in relation to the adopted thresholds, as well as making decisions in case of indicator values deviation from threshold values, among others.

model of controlling system for technical objects

maintenance processes performance In accordance to the definition given in the Section 2.3, first the maintenance management processes framework and decision-making process issues should be investigated. The state of maintenance business may be defined in terms of classical organizational levels (Fig. 2.). The proper definition of the main strategic, tactical and operational tasks gives the possibility to execute the maintenance. Thus, it gets a feedback to verify its strategic decisions that allow achieving maintenance objectives (Medina-Oliva et al. 2015). Taking one step further, the maintenance and operation decision-making process should be con-

case study—A passenger transportation company

The issues connected with controlling of maintenance processes performance are investigated in one of the common carrier that provides municipal transport services in one of the biggest city in Poland. The case company employs around 2000 workers in various positions from human resource, research department to transport and operation department. At present, the company transports about 200 million passengers per year with the use of more than 300 buses. In the analysed transport company performed maintenance operations are identified in the two main groups of tasks: • daily maintenance—activities performed daily by the driver to ensure technical readiness of the buses, • periodic maintenance—specific actions to take when a bus reaches defined time between maintenance action performance and activities performed before winter and summer times. During the daily service performance, the main driver tasks are connected with e.g. checking: the level of exploitation fluids (including fuel and engine oil levels), tire pressure and their condition, brakes condition, or vehicle and operationa

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