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POSSIBLE WAYS OF THE APPLICATION OF MODERN METHODS AND PROCEDURES IN THE MAINTENANCE OF THE VEHICLE TECHNICAL EQUIPMENT OF A LOGISTICS REGIMENT

Author's review and official evaluations of doctoral (PhD) dissertation

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1. OUTLINES OF THE SCIENTIFIC PROBLEM

In the past two decades there has been a tendency of the regular occurrence of new maintenance strategies and methods, following each other by not more than 4-5 years. The three main factors resulting in such a fast pace of development in civilian life are very clear. The first one is the general aim to optimise/minimise maintenance costs, while the other two are the efforts to increase the period of availability and the level of reliability, parallel with the attainment of the first objective. It is therefore reasonable to set and attain the above aims in respect of the maintenance of army technical equipment and systems as well, especially in view of the recent developments in military technology and the regular appearance of more and more modern devices, which are sometimes produced only in a limited number. It appears necessary to work out and introduce quasi-custom-made strategies in the field of the maintenance of equipment and systems of key importance by applying and combining the most suitable elements of the most recent maintenance methods.

In line with the above, the scientific problem serving as a basis for my research can be outlined as follows:

- Following the dissolution of the Warsaw Treaty and later Hungary's accession to NATO, the quantity and – along with the appearance of equipment meeting the requirements of today's level of technical development – the quality of the vehicle technical equipment fundamentally changed and it has been continuously developing since.
- In its present form, the six-level complex technical management system based on the principles of Scheduled Preventive Maintenance does not provide an optimal solution to the maintenance of vehicles produced with the use of state-of-the-art materials and technology.
- A considerable part of the maintenance of the majority of the assets handled in the system and procured within the framework of a vehicle acquisition programme are/can be performed exclusively by civilian companies, which poses a serious financial burden to the military organisation managing the assets.

2. RESEARCH OBJECTIVES

1. To examine the technical, infrastructural, economic and human resource components of the current maintenance activity of the Logistics Regiment,

2. To systematise and categorise the widely used current maintenance strategies according to their characteristics and their fields of possible application in order to assess their viability/feasibility in the field of military technology,
3. To determine the current and future maintenance requirements based on the data available and present them with the help of graphs and appropriately selected indices,
4. To make a proposition for the application of a "maintenance mix" that is capable of meeting the challenges to be faced in the field of maintenance.

3. RESEARCH METHODS

- I studied and processed the available Hungarian and international professional literature using secondary research methods. I systematised the information thus obtained and drew the appropriate conclusions.
- I applied mathematical statistical methods to evaluate the maintenance activity of the logistics regiment.
- I applied the historical research method on the one hand and comparative critical analysis on the other hand to examine the applicability of the various maintenance strategies for the attainment of the objectives I set.
- I used analysis strategies in the course of my research when examining the effects of the main pillars of different maintenance strategies on the maintenance activity as a whole, while I used the methods of synthesis when setting up the maintenance system valued as optimal in the earlier phase of my research.

4. A BRIEF DESCRIPTION OF THE RESEARCH CHAPTER BY CHAPTER

The first two chapters provide basic information in accordance with the formal and content requirements of a dissertation, as well as a key to the abbreviations often occurring in the body text.

CHAPTER 3:

I outlined the position and the role of the logistics regiment within the organisational structure of the Hungarian Army and gave a description of the major tasks of the regiment. I thoroughly examined the vehicle technical assets of the regiment. Table 1 shows the assets grouped according to types, Table 2 gives an account of their make and their year of procurement, while in Table 3 the assets are categorised according to their source of origin. To conclude this chapter, I collected the characteristics which have a determining influence on the effectiveness and the economy of the currently applied maintenance system.

CHAPTER 4:

I surveyed the regiment's infrastructural background, including the workshops, the tools and other equipment which is mostly inherited from the predecessor organisations and which the maintenance activity can rely on. In order to have a true picture of the current situation and to map possibilities and present ways of cooperation rendering work easier, I conducted interviews with the concerned commanders of the national support and the transportation battalions. As a result of the above, it can be claimed that it is the spare part supply, i.e. the regiment supply depot that proved to be the most neuralgic point of technical support. Due to the fact that the majority of the equipment, as well as their spare parts are no longer in production, it is extremely difficult to procure such items. Studying the stock inventory, it was discovered that the Army Unified Product Code is suitable for the identification of the spare parts only to a limited extent; large quantities of unmoved dead stock have been stored for years. I compared the actual number and composition of the staff of the special maintenance platoon with the figures indicated in the staff table and I examined the composition of the staff from the point of view of age, qualification and practical experience. I analysed the activity of the Development and Logistics Agency of the Ministry of Defence, which is one of the institutions taking part in the maintenance activity as partner organisations and that of the CURRUS company, which is a partner of special importance in the maintenance and refurbishment of army technical equipment.

CHAPTER 5

Applying the historical research method, I gathered the maintenance strategies that are currently widely used and that are suitable for use in the maintenance of military equipment as well, due to certain features of these methods. I therefore closely examined the Breakdown Maintenance (BM), the Scheduled Preventive Maintenance (SPM), the Condition-Based Maintenance (CBM), the Risk-Based Maintenance (RBM) and the Reliability-Centered Maintenance (RCM) strategies and I paid special attention to providing a detailed description of the concept of Total Productive Maintenance (TPM). When discussing the different strategies, I laid emphasis on the advantages of their application, as well as their potential disadvantages and their specific features relating them to certain specific fields. This chapter also provides a description of the widely known Computerised Maintenance Management System (CMMS), which is an indispensable basic element of any effective maintenance system, in spite of the fact that it is not a stand-alone maintenance strategy in itself.

CHAPTER 6

With the workshop diary and the repair orders serving as the basic documents of my examinations, I subjected the assets of the regiment to a multilevel filtering according to the working hours spent on their maintenance. Following a grouping of the equipment based on origin and type, I ranked the most frequent failure types according to their frequency of occurrence by applying the Pareto analysis in the case of two especially labour intensive types. To close the chapter, I used a pie chart to show in percentages the share of the strategies applied.

CHAPTER 7

Through practical examples, I justified the necessity of the application of the Overall Equipment Effectiveness (OEE) method and I determined and evaluated the values of a complex index system applied to the maintenance activity of the regiment. Following this, I gave a survey of the maintenance routines of the Rába–H series vehicles acquired by the regiment within the framework of the Vehicle Procurement Programme. I have found that external service providers are typically used for the task in question, while according to the findings of the Pareto analysis, the majority of the services ordered and performed do not require either specific equipment or specific knowledge. In light of this and of the information obtained about maintenance costs, I made a recommendation for the elaboration of a mix of the already known maintenance strategies by combining them in the appropriate ratio.

CHAPTER 8

Applying the indices used for the logistics regiment, I evaluated the maintenance activity and the maintenance unit costs per kilometres run in the case of the vehicles of a civilian enterprise possessing assets similar to those of the regiment. I have found that, primarily due to the maintenance system it applies, the civilian Neolit Ltd. is capable of achieving a higher availability index compared to that of the logistics regiment and at the same time it offers services profitable in the competitive sector as well.

5. SUMMARY OF CONCLUSIONS

In accordance with my objectives set up based on the scientific problems outlined, I drew up certain hypotheses. When proving my hypotheses, I drew conclusions summarised as follows:

In its present form, the six-level complex technical management system based on the principles of Scheduled Preventive Maintenance method does not provide an optimal solution to the maintenance of newly procured vehicles manufactured with the application of state-of-the-art materials and technology. A considerable part of the maintenance of the majority of the assets handled in the system and procured within the framework of a vehicle acquisition programme are/can be performed exclusively by civilian companies, which poses a serious financial burden to the military organisation managing the assets. It became clear in the course of the collection and analysis of data required for my dissertation that the maintenance staff spend a determining part of their working hours on the inevitable repair of rarely used 30-40-year-old vehicles, as well as on the performance of prescribed technical services. The simple technical construction of the above mentioned equipment and their annual running distance of not more than 5-800 kilometres render it possible for the drivers to perform most of the technical services themselves (after the appropriate courses and exams), thus removing some burden from the maintenance staff. If the maintenance staff apply a variant of the six-level complex maintenance system supplemented with RCM and TPM elements and based on diagnostics and if they obtain skills in the maintenance of state-of-the-art equipment, they shall be able to ensure operation security even in warfare or at missions abroad. A further advantage of the proposed modification is that, as a result of the decrease in the rate of external services used, expenses shall become lower. For this however, it is necessary that the current staff receive technical training from the producers of the equipment and that they have access to diagnostic equipment.

6. NEW SCIENTIFIC RESULTS

1. I have evaluated the maintenance activity of the logistics regiment by applying an index system expediently set up and I have concluded that in order to improve efficiency, it is necessary to increase the number of condition-based check-ups, as well as to significantly reduce the ratio of the services of external companies within the differentiated maintenance system.

2. I have developed a condition-based maintenance system model containing RCM and TPM elements, involving both drivers and service staff and based on regular trainings. Due to its self-regulatory mechanism, this autonomous maintenance system shall be capable of ensuring continuous availability for use in the time of peace, missions abroad or warfare.

3. Analysing the maintenance activity of a prospering civilian enterprise, I have identified the elements of the maintenance system which are of crucial importance in terms of efficient operation and which should be acquired and applied in the activity of the technical services of the logistics regiment in order to improve efficiency.

4. I have revealed that, if the maintenance system model I proposed is introduced, the maintenance expenses of the logistics regiment can be reduced by decreasing repair service fees paid to external service providers and by restraining the use of spare parts by the maintenance staff.

7. PRACTICAL APPLICABILITY OF THE RESEARCH FINDINGS, RECOMMENDATIONS

Findings of the dissertation can be used in the following fields:

1. In working out the development, procurement and maintenance concepts/strategies of the Hungarian Army in respect of vehicle technical equipments.

2. As an auxiliary material at the preparation of regulations, professional instructions and training materials.

3. New methods of analysis applied in the dissertation can be used for the overall scientific examination and the capacity analysis of other branches of the army as well.

4. At the improvement of educational materials for the subject of Military Technology.

8. LIST OF PUBLICATIONS RELATED TO THE SUBJECT OF PHD DISSERTATION

UNIVERSITY TEXTBOOK PUBLISHED IN HUNGARY:

1. László, Falmann – Géza, Cs.Nagy: Maintenance, ERFP-DD2002-HU-B-01-PROJECT 4, Pécs, 2004.
2. Géza, Cs. Nagy: Maintenance and Maintenance Management, ERFP-DD2002-HU-B-01-PROJECT 4, Pécs, 2004.

PUBLICATIONS VETTED AND PUBLISHED IN FOREIGN LANGUAGE IN FOREIGN JOURNALS:

3. Géza: Cs. Nagy Ważniejsze strategie konserwavji i remontów służących utrzymaniu sprawności urządzeń wojennych, Hadmérnök, 2009/2, pp. 259-268.

PUBLICATIONS VETTED AND PUBLISHED IN HUNGARIAN LANGUAGE IN HUNGARIAN JOURNALS:

4. Géza, Cs. Nagy: Cases of applicability of risk-based survey and maintenance strategies in the military and the civilian sector. *Kard és Toll*, 2006/II, pp.190-197.
5. Géza, Cs. Nagy: Modern maintenance systems. *Új Honvédségi szemle*, 2006/8, pp. 81-84.
6. Géza, Cs. Nagy: Possibilities and hindrances of the application of modern maintenance management systems. *Katonai Logisztika*, 2007/2, pp. 60-81.
7. Géza, Cs. Nagy: An analysis of technical, economic and staff components within the maintenance system of the vehicle technical equipment of a logistics regiment. *Hadmérnök*, 2008/4, pp. 53-64.
8. Géza, Cs. Nagy: Infrastructural and staff conditions in the maintenance of vehicle technical equipment in relation to the actual requirements of the transitional period. *Hadmérnök*, 2009/1, pp. 80-86.
9. Géza, Cs. Nagy: New challenges of the Hungarian Army in the maintenance of vehicle technical equipment. *GÉP*, 2009/4-5, pp. 57-60.
10. Géza, Cs. Nagy: A possible method to improve the cost-effectiveness of the maintenance of military vehicles. *Hadmérnök*, 2011/1, pp. 5-14.
11. Géza, Cs. Nagy: Key questions of the maintenance of military technical equipment in light of the military and civilian professional literature. *Hadmérnök*, 2011/1, pp. 15-21.

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12. Géza, Cs. Nagy: Principles of efficient maintenance, *Gyártás és Trend*, 2008/2. pp. 16-19.
13. Géza, Cs. Nagy: Maintenance, risks, reliability. *Gyártás és Trend*, 2009/3, pp. 16-18.

FOREIGN LANGUAGE PRESENTATION PUBLISHED IN THE PROCEEDINGS OF AN INTERNATIONAL CONFERENCE:

14. Géza, Cs. Nagy: A possible way to improve the maintenance activity in reference to military vehicles in the Hungarian Army, Fifth International PhD & DLA Symposium, Pécs, 19-20 October 2009, p. 50-51.
15. Géza, Cs. Nagy: How to evaluate the effectiveness of maintenance, and how to increase its flexibility, Sixth International PhD & DLA Symposium, Pécs, 25-26 October 2010, C p. 69 Rotari Press, Komló, 2010 ISBN 978-7298-40-0