

TELEMATIC SYSTEM FOR MONITORING THE OPERATION OF MACHINES AND VEHICLES IN A TRANSPORT-EQUIPMENT ENTERPRISE

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Summary

The performance and the effects of applying the telematic system to the building transport-equipment enterprise were analysed in that paper. The KOMTRAX system used for this purpose allows the operation of building machinery to be continually monitored. The system provides great advantages, including the prompt completion of work tasks (about 30-40%), the reduction of vehicle maintenance costs (about 20-30%), the decrease in unauthorised mileages (about 100%) and the reduction of fuel consumption (about 20%).

Keywords: technical diagnostics, telematics, GPS system.

TELEMATYCZNY SYSTEM MONITOROWANIA PRACY MASZYN I POJAZDÓW W PRZEDSIĘBIORSTWIE SPRZĘTOWO-TRANSPORTOWYM

Streszczenie

W artykule przeanalizowano funkcjonowanie i efekty zastosowania systemu telematycznego w przedsiębiorstwie transportowo-sprzętowym zaplecza budowlanego. Zastosowany tam system KOMTRAX pozwala na bieżące monitorowanie pracy maszyn budowlanych. System zapewnia duże korzyści m.in. zwiększenie terminowości wykonywania zadań (o około 30-40%), zmniejszenie kosztów utrzymania pojazdów (o około 20-30%), redukcję nieautoryzowanych przebiegów (o około 100%) oraz zmniejszenie zużycia paliwa (o około 20%).

Słowa kluczowe: diagnostyka techniczna, telematyka, system GPS.

1. INTRODUCTION

The service life of transport equipment in contemporary enterprises is mainly determined by the cost account and the moral wear. Respecting the fast progress in this field and easy access to new equipment, the idea of general overhauls prolonging its life has been abandoned. The elongation of the failure-free period of operation for this equipment could be also promoted by computer-aided modern troubleshooting systems. The technical diagnostics system for technological objects has been anticipated dichotomously as supported by models and as a symptom diagnosis [1]. Especially the last one in reference to vehicles has been done more and more often using the telematic systems [2]. Under the notion of telematics we understand solutions to telecommunication, information, computer science and automatic control adapted to requirements of serviced devices – following from their tasks, infrastructure, organisation, processes of maintenance and management – and integrated with these systems [3]. Nowadays, a great interest in these systems has been observed (e.g. in Poland in 2007 the sales volume of them increased by 400% versus 2006, source: TVP News of 22.03.2008).

Telematics in transportation makes it possible to influence the course of process mobility by increasing the transport capacity, improving the safety, reducing the negative effects on the environment and planning the transportation [4]. It results from long-term research carried out in the USA, Canada (and now also in Poland) that the application of telematic systems contributes the reduction of expenditures on the transport infrastructure even by 30–35% maintaining the same functionality of the system [5]. The essential element of such the system is measurement and automatic data acquisition with the use of sensors, detectors and other monitoring devices. They allow simultaneously the working processes of machines to be continuously monitored and thus immediately meet any abnormality in this scope. It brings the rational savings, rationalises the process of transportation, and facilitates operations carried out both by persons using the equipment furnished with telematic technique and also enterprises making use of this equipment [5]. The recognition of the practice in this scope with reference to machinery and other back-up facilities of a large enterprise implementing the building projects all over the state constitute the main research problem of the present paper.

2. DESCRIPTION OF A SYSTEM

The enterprise being tested applied the satellite system **Komtrax**, manufactured by Komatsu Poland Ltd. The Company Komatsu Ltd was established in Japan in 1921. Now it is a world-wide leader among producers of machinery for the building and the mining industry; it has their branches in many countries, including Poland. Komatsu is an owner of 44 factories all over the world, including 8 factories in Europe. Twenty of them produce engines, hydraulic systems, power transmission systems, whereas machines, mainly for the building industry are assembled in twenty four factories (some years ago Huta Stalowa Wola successfully manufactured bulldozers under Komatsu licence).

Komatsu Company is well-known for the implementation of state of the art technological innovations, including the satellite monitoring systems for machines such as Komtrax. According to Producer's data this system to its advanced design provides an exceptional solution on a world-wide scale. At present all over the world, there are operated 75 thousand machines equipped with a Komtrax system, and every month the next 2 thousand are introduced into operation [6]. This system is suitable mainly for machine of small or medium size and especially is useful if a machine is operated in outlying places and hard to reach for servicing.

Nowadays the wireless communication is omnipresent. Therefore, small wonder that it is present in building machinery where helps in monitoring the process parameters. Thanks to computers it is possible to trace all the data linked with the operation of machine systems not only by operators but also supervising personnel, mechanics and owners. The system collects important operational and system data. It also provides the communication with the global positioning system (GPS), which traces its position. By GPS it transmits all the data obtained to the database management centre. Data from this centre is transmitted by the Internet to the Komatsu's global server where is collected and analysed. Then data is sent to the local server of Komatsu distributor or "the local Internet system", where is processed according to User's requirements and formatted for displaying.

The Komtrax system due to the integrated GPS transmitter makes it possible to use a number of options, for instance determines the working areas for machines. In case of leaving this area, the Komtrax immediately initiates alarm, which is some kind of protection against theft or unauthorised use (for this reason it is possible to get some assurance discount for these machines). Since the dispatcher is able not only to cut off remotely the engine but also block its restarting. The route covered by the machine is displayed on a map or marked out with geographic coordinates (longitude and latitude). The location function makes it possible to optimise the fuel supply, planning for the maintenance service

and also taking the counteraction against theft or unauthorised use.

However, the designers of the Komtrax system are mainly motivated to reduce the costs of machine operations [7]. Thus, the machine equipped with the Komtrax system transmits relevant data to the Komatsu server at regular time intervals. It enables to create an accurate work protocol at a freely specified time interval. This peculiar "CV" makes it possible for the machine to determine the load it was subjected to and detect possible faults or else optimise the equipment capacity factor.

Komtrax allows the operation-hours counter to be daily read-off. Monthly reports for this parameter could be also presented in the form of a diagram. Komtrax makes the same information available that are displayed in machines on the computer screen (depending on qualifications of the machine operator). The transmission of information between machines and the system takes place in a continuous mode by Internet. The system could be also used by service workers for remote troubleshooting. A mechanic is also able by analysing the data recorded by the Komtrax system to foresee in advance the appearance of a fault and warn the user of it. It enables to reduce the losses suffered from shutdown of machines and increase the effectiveness of their use. So, owing to the Komtrax system it is possible to determine precisely the machine capacity factor on a given building site. In the end, it is possible for the equipment to be selected optimally for execution of a given task. It also prevents the machines from overloading which significantly reduces their wear. The operation sheet provides information on the way, the time and the effectiveness of machine operation, and also the operator's efficiency. This information is presented in the form of legible bar graphs illustrating: service time of an engine, worktime – operational activities of a machine and working accessories. Due to that it is easier to eliminate the cases of unauthorised use of machines. Komtrax allows the following process parameters to be obtained: fuel level and temperature of liquid coolant. The system transmits systematically warnings about all departures from the standard of machine operation, notifies properly in advance of the necessary routine maintenance.

Reports on the machine operation could be compiled in a daily, monthly and annular cycle. A daily report describes the location of a machine, its process parameters and the technical condition of the machine from the day preceding the read-out. A fuel level diagram shows the state of filling a tank at the end of the previous day. This diagram considerably facilitates planning the fuel supply for a building site.

The technical condition of machines, the information on the value of pressure in the hydraulic system and the loads they are subjected to are helpful for monitoring. This information performs the function of the warning signals with regard to the potential overloading or underloading the machine.

Due to this fact, one can easily check whether the machines are properly matched to the task being implemented. The monthly report in the graphic form presents the total worktime, the real time and the worktime during the idle running.

The possibility of undertaking the action aimed to limit the shutdown of machines, which is connected with excessive fuel consumption. Providing the continuous documentation of its technical condition and scrupulous keeping the dates of periodical surveys prevent from appearing the serious defects, causing losses following from shutdowns. It

contributes to increasing the useful life of machines and simultaneously reduces the costs connected with their routine maintenance. An undoubted advantage of this system is free of charge operation for the period of five years from the first activation [7].

3. SAMPLE SYSTEM CARDS

Examples of Komtrax system cards are illustrated in Figs. 1-6.



Fig. 1. Card „location of machine operation”



Fig. 2. Card „daily progress report”

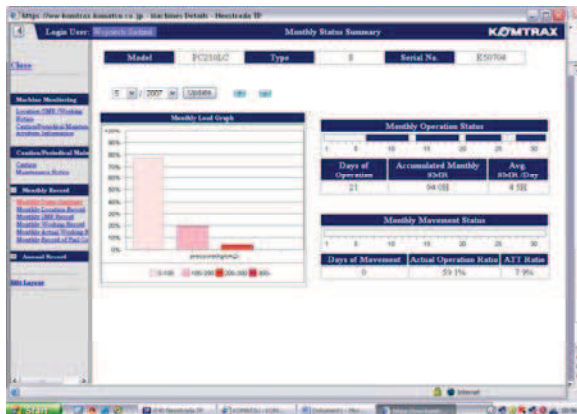


Fig. 3. Card „monthly progress report”

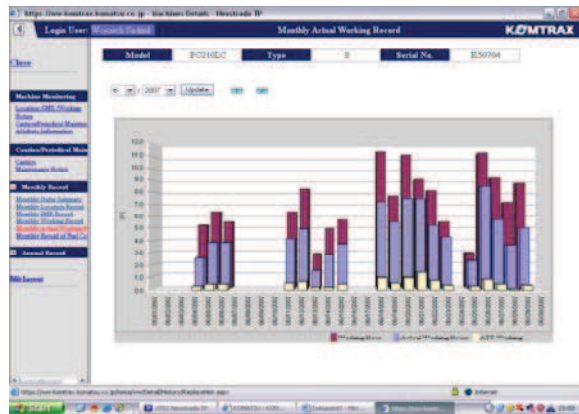


Fig. 4. Card „worktime of additional equipment”

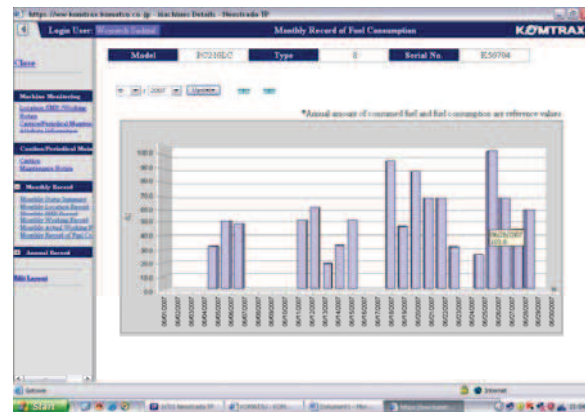


Fig. 5. Card „annual progress report”

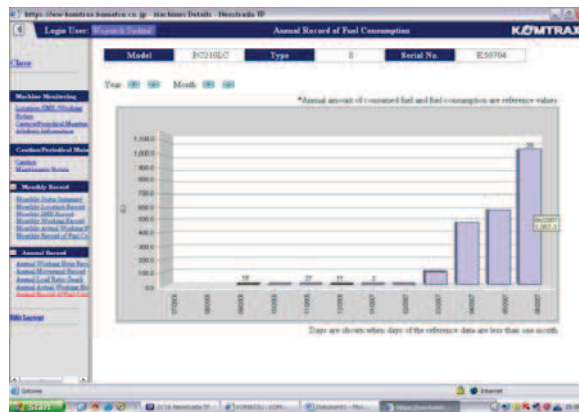


Fig. 6. Card „fuel consumption per month”

It results from analysis of applying the satellite Komtrax system to a given company, that these advantages could be divided into two groups: notable and immeasurable.

Notable advantages are more eloquent because they can be described with numbers. On the basis of own research and the experience of other users in the country it is possible to form an opinion that the system applied provides among others the prompt completion of work tasks (about 40-50%), the reduction of vehicle maintenance costs (about 20-30%), the decrease in unauthorised mileages (about 100%) and the reduction of fuel consumption (about 20%). Accurate percentage values are difficult to evaluate.

Immeasurable advantages result from the operational entirety of this system. Describing comprehensively the Komtrax system one can say that the Komtrax system provides an invaluable tool for managing and maintaining the traffic of building machines. The detailed recording of the machine route, speed, fuel level, operation of different auxiliary devices allows all the events connected with the operational use of this machine or a device to be precisely reproduced. It is a frequent problem of building enterprises that they have no control over operators, their style of work and conscientiousness. The system being offered shall put a stop to robbing the employer by dishonest operators (theft of fuel is limited). Exceptional accuracy of reports ensures the clear-cut settlement of contentious issues in this scope.

4. CONCLUSION

In Poland the telematic supervising of the building machines has not been sufficiently developed yet.

It is mostly affected by the following factors:

- obsolete stock of machines
- relatively high cost of devices,
- lack of experience in telematics,
- opportunism of managing personnel,
- high costs of mobile communications.

However, the situation starts to make a marked improvement due to undoubted advantages resulted from using this type of solution. If you want improve the output of machines, measure the punctuality and worktime you should use the satellite system. This would contribute to more efficient managing the work of operators which improve the output giving the savings in operation and cut down the "shady" routes. The system also ensures the interrupted contact of the dispatcher with operators in case of unexpected orders, failures or dispositions. More than anything else is to avoid shutdowns and guarantee the continuous contact with a customer, who wants to know at what stage is the implementation of his order.

Thus, the immeasurable advantages are equally important and maybe even more essential than calculated with a view of money.

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