

SMART MAINTENANCE SYSTEMS FOR AGRICULTURAL MACHINERY

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Abstract. The article deals with innovative telemetry and remote monitoring systems for agricultural machinery, which allow optimizing the process, making adjustments to the settings, planning maintenance, saving fuel, and increasing productivity.

Keywords: agricultural machinery, smart maintenance systems, remote system updates, telematics modules, data collectors.

The current level of agricultural production is determined by intelligent machine technologies and technical equipment of a new generation with modern information support and instrumentation. Highly efficient use of advanced high-performance machinery for designated purposes requires measures to keep it operational throughout the whole period of operation. The efficiency of technical services is determined by the technical condition and the quality of the machinery and equipment, their indicators of reliability and performance and the level of technical use.

Off-highway machines such as agricultural machines, excavators, soil compactors or wheel loaders are subject to high stress. While regular service intervals are part of the operators' routine, they do not offer any protection against unexpected failures. The costs of repairs are usually extensive, largely owing to the fact that the machines concerned are stationed in remote locations. In many cases, further breakdown costs are also incurred, e.g. for transport vehicles. To ensure high availability, it is necessary to detect looming failures early on.

In the future, it will become increasingly vital to know where the mobile working machine is currently located, how much diesel it is consuming and when the next service is due. The focus of digitalisation strategies for the off-highway markets is increasingly shifting towards remote diagnosis – and thus the registration, evaluation and analysis of operating data which enable conclusions regarding performance and cost effectiveness to be drawn.

Thanks to their intelligent analysis tools, the machines draw attention to malfunctions in good time before they result in high costs. At the same time, the service

lives of engines and hydraulic pumps are extended thanks to operation at their respectively ideal operating point, while energy consumption is also reduced.

Besides the usual parameters such as temperatures or current flows, fault detection by means of vibration measurement is crucial. Rotating machine parts, in particular, cause specific vibration patterns in the event of looming failures. By means of frequency analysis, these vibrations can be used to determine the wear status of hydraulic units, engines and gearboxes. As soon as the cause of the fault code or the alarm has been identified, the problem can be rectified as quickly as possible.

Apps support mobile diagnosis using a smartphone or tablet. All relevant engine data and the fault memory can be read out via a Bluetooth connection and sent to the local service partner – online and in real time. On this basis, the service partner decides whether remote service can be used to restore the operability of individual vehicle components online without the necessity of working on site. If a repair is unavoidable, the responsible technician immediately arrives with the required replacement parts and tools. Fleet operators can use the apps to comfortably manage their engines and to determine maintenance windows. All-inclusive packages for machine diagnosis go one step further and additionally include optimisation of the mobile working machines based on the determined data as well as training options for employees.

In addition to service-relevant data, information concerning the state of the machine, which was previously only ascertainable in the workshop, is also increasingly being transferred in the agricultural sector. In this process, remote flash reprogramming comfortably ensures that agricultural machinery and implements are always operated with the latest software. As soon as the farmer receives the push message for new firmware on his smartphone, he confirms that the machine or the engine is ready for the flash reprogramming process and starts the update directly.

Remote monitoring and remote diagnosis alone do not ensure more efficient operation. What is important is the idle time in relation to a machine's activity. Registering the times during which machines are not running at full capacity or could be used elsewhere is important. IT-supported fleet and order management has long since become an established part of the daily routine of farmers and contractors who cultivate their land with multiple machines and in various locations. A clearly arranged map provides them with an overview of their fields at all times, allows them to display the current position of each machine and enables them to monitor work progress.

High-performance telematics modules combine satellite navigation with mobile communications. Further wireless interfaces such as Wi-Fi or Bluetooth are optionally available. These modules undertake all of the functions required for the real-time-acquisition, evaluation and transfer of the specific machine data. They operate autonomously and are able to cooperate with various control

units. Regardless of whether a combine harvester, a forage harvester or a silage trailer is involved – older harvesting machines can also be connected to the fleet management system using flexibly configurable telematics modules.

1. Global trends in the development of monitoring systems for mobile agricultural equipment. [Electronic resource]: – Mode of access: <https://doi.org/10.1051/e3sconf/202015701013> – Date of access: 11.02.2022.

2. From remote maintenance to telematics. [Electronic resource]: – Mode of access: <https://www.agritechnica.com/en/systems-components/assisted-farming-engineering-agriculture-through-smart-solutions/from-remote-maintenance-to-telematics>. – Date of access: 11.02.2022.

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THE ROLE OF MAINTENANCE IN IMPROVING PRODUCTIVITY AND SERVICE LIFE OF AGRICULTURAL MACHINERY

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Abstract. The article deals with agricultural machinery maintenance and its role in agricultural production. Technical and economic factors determining the possibility of repair as well as basic types of repairs are described.

Keywords: agricultural machinery maintenance, repair, machines, service life.

Introduction

Agricultural machinery maintenance plays a decisive role for successful agricultural production as it guarantees the safety of operations and availability of machines and related equipment for different farming operations. Moreover, it is one major cost for agriculture operations. The timing of tillage, cultivation, fertilizing, harvesting and planting of crops depends on qualitative agricultural machinery maintenance, which affects the yield and its quality. Machines used in agricultural processes must be ready for operation on time – otherwise, there could be significant losses to the farm as a whole. In addition, facilities meant to process and store foodstuffs must be kept safe, clean, and structurally sound in order to guarantee that the farm's product is safe for consumption.

Main part

Agricultural maintenance is the main link in the overall system of measures aimed at maintaining machines in working condition. It includes a set of opera-