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Remote service with agricultural machinery

Technical and logistic problem areas

The trend in agricultural engineering for powerful and large-capacity machinery continues unabated. Alongside the classical operational areas for complex, self-propelled machinery, these type of models are also becoming important in other fields. The wish for maximum availability and minimum downtime for such implements, especially during seasonal peak times, opens the door to thoughts on remote servicing.
On this subject the Institute for Agricultural Machinery and Fluid Technology of the TU Brunswick has investigated some of the logistic-economical questions.

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Keywords

Remote service, remote diagnosis, remote data transmission

The application potential for remote service systems has already been described in detail in other places [1]. The system is thus only reiterated here in collated form. Remote service uses modern information and communication technology for:
- remote maintenance and diagnosis
- remote operation and manipulation
- process and machinery modelling
- customer orienting regarding services and recycling systems

Requirements and limits

Remote service is of great interest especially for machinery where downtime is exceptionally expensive. This situation can be caused by strictly limited seasonal operational periods, high capital costs and possibly threatening financial penalties (fixed date costs or the costs of missed times in further processing operations). With complex self-propelled vehicles such as potato or beet harvesters, but also with cleaner-loaders and combines, such conditions appear together with exacerbating interaction. This has already led to the designing of such machines so that all the important machinery and processing parameters are relatively easy to access for diagnostic work. As a rule, bus data systems such as CAN are used for this. CAN bus systems with remote diagnosis options are applied in tractors too [2]. *Figure 1* shows schematically how this bus data system with its monitoring and control functions and the linked machine components works directly with the environment as well as indirectly over the parts of the machinery that are not connected to the bus system. Thus, not directly-measurable phenomena with regard to the machinery, as well as external influences, are able to be recorded, in so far as the processes of the machinery are well enough known.

Data transmission

For the moment, the transmission of data can only be practicably achieved through use of the existing GSM mobile radio network. A comprehensive offer featuring the new UMTS technology cannot be expected in the medium term. GPRS represents a possible extending of the system which would realise many times the current possible data rate. But it is still open as to when this technology will be applicable in low-population areas. Presently, the transmittable data rate is thus limited to around 56 Kbytes/min which makes sending data in compressed form practical. Alternatively, there exists the option of sending ASCII data as SMS which offers the advantage of dependable transmission even where the network connection is very weak.

Data management/evaluation

Collected data can be stored either for a defined or undefined period or only stored when desired values are under or over a threshold level (triggered storage). Moreover, there exists the possibility of determining index values from the measurement values and measurement value combinations via empirically-calculated algorithms. For this, data types have to be defined and the index construction must be carried out according to logical rules and algorithms from the data types. Earlier investigations [3, 4] have shown that breakdown behaviour often can be described through a Weibull distribution.

A still-to-solved problem for consideration is the legal question of data protection with regard to collection and storage of machinery data and personal information.

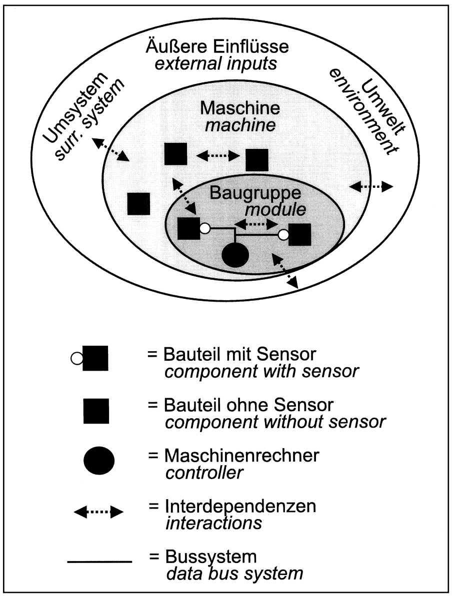

Fig. 1: Interaction between environment, machine and control system

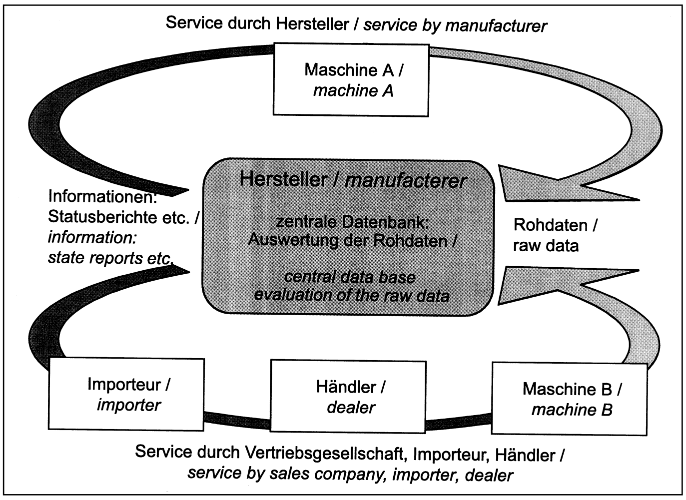

Fig. 2: Flow of data and information in a central data base according to [6]

Changes in service

Alongside the technical modifications to the machine and the establishment of machinery and process models, the implementing of a remote service system requires the restructuring of after-sales facilities.

Central to this is the further development of service strategy from a breakdown or preventative concept to a monitoring and diagnosis concept. A major problem of the breakdown concept, which is the one most commonly-met in practice, is the inability to determine the availability of the machine and the associated downtime costs which, especially with complex machines, can mean several hundred DM per hour. While downtime caused by a fault could be reduced by a preventative concept, this would mean, however, the potential of the individual modules not being fully exploited, and sudden changes of individual condition parameters not being recognised [5].

Serious changes are required – especially on the part of the manufacturer and servicing organisation. A focal point is the creation of a communications centre where collected data can be processed and where there is sufficient expert knowledge available for remote diagnosis. The establishment of such a centre, and its introduction into the construction and running organisations of the manufacturer, might well mean great effort. But there's an even greater potential for cost savings. Personnel and travel costs, especially, may be substantially reduced. A look at other branches shows that reductions of up to 25% are completely realistic.

At the same time, the data and information flow can be designed according to the different types of service required. *Figure 2* shows a possible structure for the information flow, whereby the central data bank should always be implemented by the manufacturer in order to keep the know-how inhouse.

Advantages for the farmer

The customer's extra costs for a remote service function would represent less than 1% added to the normal large-scale machinery hourly rates [6]. In return breakdowns can be avoided more often or there's a substantial reduction in downtime before a breakdown is repaired. The investment in the system can repay itself through downtime being reduced by just a few hours per year [6].

Additionally, the system can allow the manufacturer to give a mobility guarantee which protects the operator from especially expensive long-term downtime.

Further cost reductions are available through optimum exploitation of the modules and a condition-dependant servicing carried out when it best suits the operator's requirements. *Figure 3* demonstrates how the condition reports of individual machinery components can generate warning and the stopping of the machine. On this basis and with suitable experience a module-specific remaining-lifetime prognosis is possible.

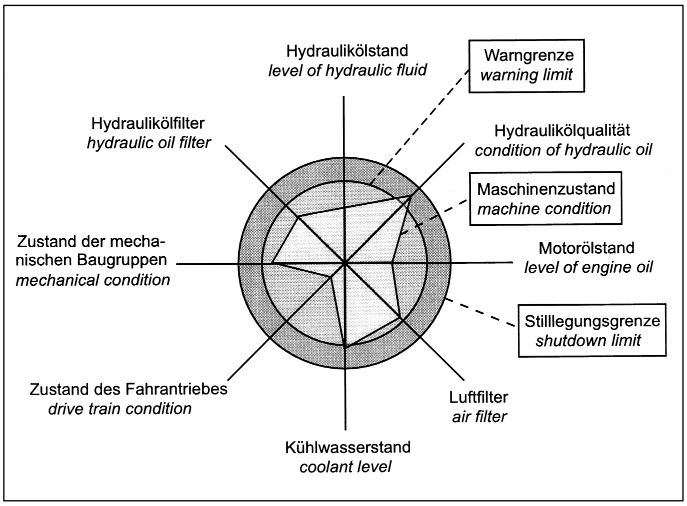

Fig. 3: Spider diagram to qualify the machine condition

Outlook

Despite data protection legal problems which still remain to be clarified, remote service is a very promising medium for increasing the working time capacity of machinery which then means more statistically-based data for product development towards increased quality.

Literature

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