Information and process control on the farm

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The increasing specialisation and expansion of farms by leasing of land imposes ever greater mental stress on the farm manager. At the same time his relationship to the farm is intensified, so that it becomes increasingly difficult to take time off for leisure or in the event of illnes. Hence greater efforts must be made towards automatic information processing and to control production by self-contained control mechanisms on the farm.

New information technologies for the farm

The advance of electronic data processing by miniaturisation with a simultaneous increase in capacity and additional cost reduction have given information processing a new dimension. Traditional methods of communicating information are thus being questioned to an increasing extent and replaced by new forms. These relationships are shown in Fig. 1 for the agricultural sector.

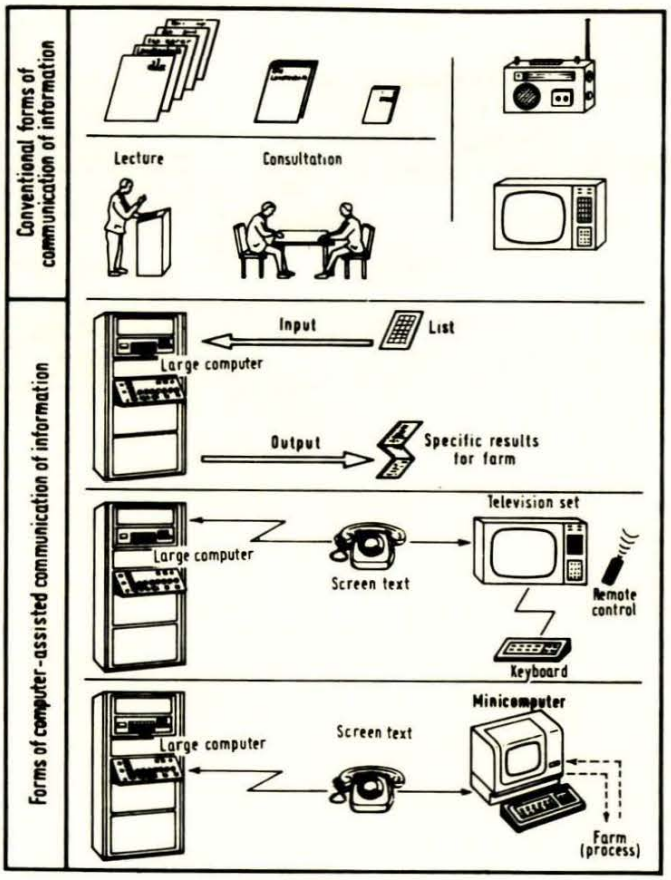

Fig. 1: Forms of communication of information (schematic)

At the top of the diagram the conventional methods of communicating information are represented by newspapers, books and reference works and also lectures and consultations. These contrast with the computer-assisted methods, which were initially pure calculation aids and were used in a complicated and tedious manner in batch operation. However, more recent work involving the screen text system will in future permit a real dialogue via the television set or a farm minicomputer. The computer will thus become a supplier of all conceivable information when used exclusively as a computer.

Information on the farm

Information is an indispensable aid for production or an integral part of the latter. In theory it is used by man to produce the optimum output from a defined input. Information is on the one hand a process condition indicator and on the other an aid to process control in the form of "know how". Consequently the greater the intensification of the process and the higher the required efficiency, the better, i.e. the more accurate, must be the information. This applies both to the information on the process and to that for process control.

Taking dairy farming as an example, these considerations lead to the relationships shown in Fig. 2 according to which man (the farm manager) takes action and is superior to production. He receives information from analysis of the input for the dairy cow in the form of available feeds, available feed quality, production period of the animal, its well-being and the environment. In the absence of the necessary sensors for direct detection of the condition man uses suitable aids such as scales, thermometers or feed analyses. In connection with the required animal yield the farm manager now carries out the corresponding metering of production requisites, whereby he must be familiar with the information on conversion rates etc. Finally the production can be controlled on the basis of the output achieved in the form of yield and health, but also with the aid of the waste products, so that the required output can now be achieved more easily by direct intervention.

According to the output 3 areas of information requirement are thus recognisable:

Information on animal yield is subject to the heaviest economic pressure. It can be obtained relatively easily and quickly in the form of milk yield and permits early intervention in the input.

Information on animal health requires very high expenditure on recording and a substantially wider variety of aids to supplement the existing human sensors, particularly with an increasing herd size.
Information on the waste products usually receives insufficient attention. In addition, it is particularly difficult to obtain, e.g. gas content of the housing air or the quantities of faeces and urine specific to the animal.

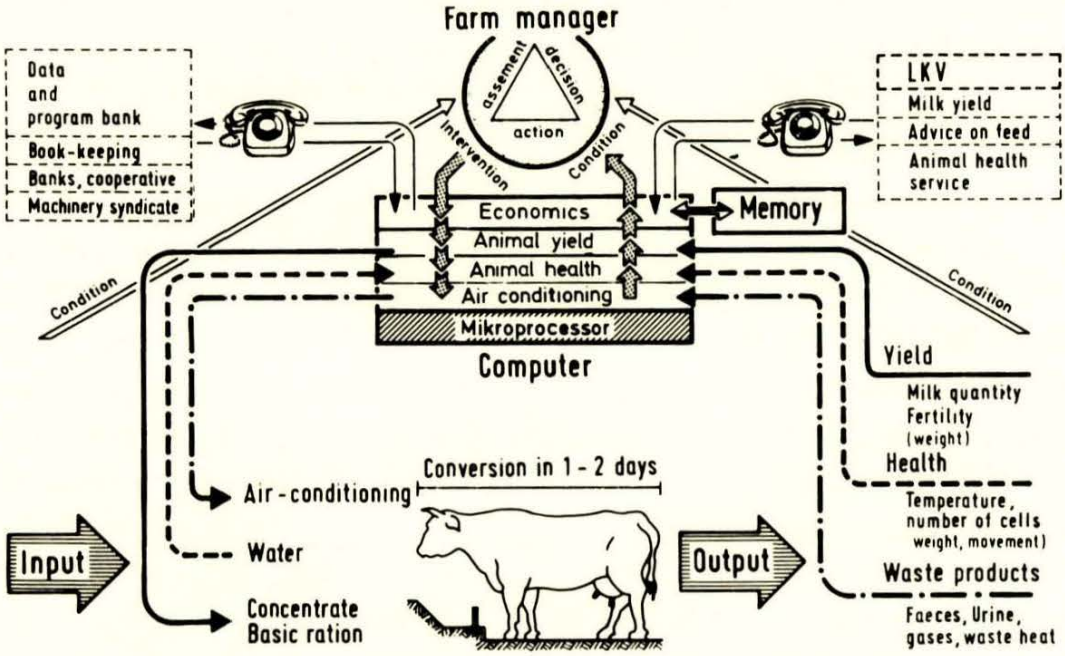

Fig. 2: Process control and integrated data processing in dairy cattle management

However, these three areas of information requirement also lead to different forms of information processing. For example, the air conditioning as a function of the waste products and waste heat will be the easiest to control. In addition, this control circuit is suitable for complete automation, because the output can be used as direct control elements for control or because input and output are in a constant ratio to each other.

This relationship is substantially less stable between the output health and the required input in the form of preventive measures and therapeutic intervention. In this case direct control reactions can no longer be derived, so that the information processing possibility has to perform a monitoring function with a warning when a threshold value is exceeded.

By contrast real control is possible with the milk yield, if the corresponding

feed constituents are known and the biological conversion can be checked.

In accordance with these relationships many partial solutions exist today, the solutions to problems having logically begun with simple interactions. Control of forced ventilation, for example, is now just as much recognised practice as feed metering via automatic "on demand" feeding systems. Similar examples can also be cited from pig and poultry keeping. By contrast all the more complex solutions are still in their early stages and it is feared that either

the sophisticated partial solutions will greatly delay a complete solution or possible complete solutions will make all previous partial solutions worthless.

Interconnected information supply

Genuine relief for the farmer having to cope with increasing supervision of events on the fram can in future be achieved only if control and monitoring of the various processes, planning with the required data and methods and finally the economical evaluation from the data processing point of view are undertaken through a largely independent computer centre (Fig. 3).

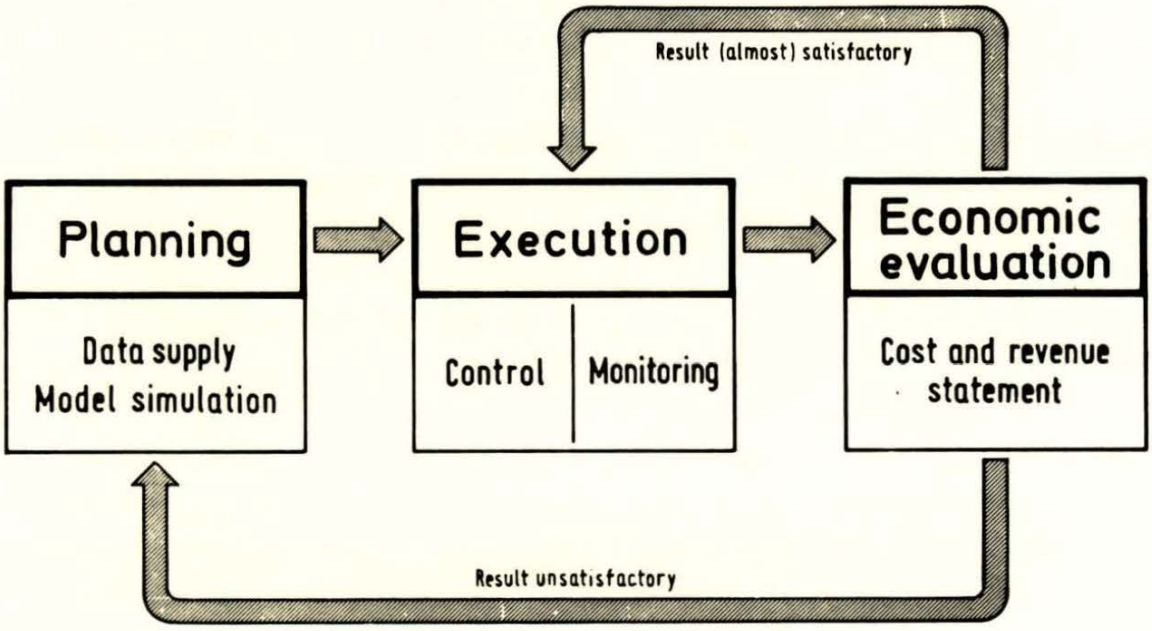

Fig. 3: Areas of the production process (schematic)

Two alternatives are possible:

A common facility is suitable for smaller farms. This form is already being used in the central accounts departments, for example, although the solution is again only a partial one. If a comprehensive solution is to be provided for these farms, the following technical aids would be required on the farm:

- screen text connection to the large computer
- lists of machines and equipment in the large computer as a basis for planning calculations and economic transactions
- automatic recorders for product quantities on the farm, e.g. the daily milk yields of the cows etc.
- machine-readable herd calendar for input of the dates such as oestrus, serving fertility checks etc.
- machine-readable weighing lists for pig fattening farms etc.

Despite these prerequisites the actual process monitoring and in particular the process control would, however, remain more of a long-term solution and thus unsatisfactory with regard to the above mentioned situation in agriculture.

A central data processing unit in the form of a minicomputer

This form is the complex solution of process control and monitoring and also serves as a basis for production planning and economic production evaluation. Two stages permit a type of internal introduction and internal extension.

Extension stage 1: The minicomputer takes over control of the main process on the farm, e.g. dairy cattle management. All data accumulated from this process are stored. Partial process control can be effected via own microprocessors, if data transfer to the minicomputer is ensured. In addition the rest of the data specific to the farm is collected and recorded because the computer capacity is not fully utilized.

The minicomputer also serves as a screen text terminal. When performing this function it can undertake all the data processing required for optional decision-making programs in large computers (e.g. fertiliser estimate, monthly milk record etc.). After evaluation in the large computer the minicomputer takes over the results obtained.

Extension stage 2: The large central computer becomes the program bank, from which the farm minicomputer selects the program required specifically for

this computer and specifically for this farm. The management costs are thus presumably reduced to a minimum and at the same time the highest form of data protection is probably achieved.

Outstanding questions concerning use of a minicomputer on the farm

As previous efforts at process control on the farm have been devoted almost exclusively to monitoring*) and to a small extent to yield-related feed distribution**), it is planned to investigate the data path between the farm minicomputer and a large computer via the screen text system in our own research project.

In this pig fattening project feed mixing and distribution is envisaged as process control on the farm, whereby an attempt is to be made to optimise the feed constituents in both computers. The main aspects of the investigation will be as follows:

- required hardware configuration
- prerequisites for screen text utilization
- compilation of a farm data matrix
- activation of process control
- automatic logging of decission-making data on the farm
- program utilization in the large computer
- program transfer to the minicomputer
- working time spent on system construction
- working time spent on system utilization
- cost analyses.

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*) Burema, H.J. and J.A. Kerkhof: A Dairy Management and Health Control System. Paper from the Institute of Agricultural Engineering. Wageningen (Netherlands) 1979.

**) Artmann, R.; Schlünsen, D. und H. Schön: Process control in agriculture - described with dairy cattle management as an example. Landtechnik 36 (1981), No. 4, pp. 207-210