# Modern Identification Techniques, and Their Importance in Following Livestock Production and Products From Conception to Consumption"

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**Summary**

To an increasing degree the reliable, unambiguous identification of the individual animal in the herd has become a statutory demand. In addition, consumers rightly expect that the food producers (farmers and the food industry) are in a position to document that the food they sell is healthy, free of residues and produced under ethically acceptable conditions.

In order to be wholly able to live up to this demand, it will be of essential importance to have a database which is maintained and accessible by all links in the food production chain (from conception to consumption). Without unambiguous identification such a database will not work. Electronic identification in combination with visual ID increases reliability and the application possibilities.

**Keywords:** Identification, electronic identification, R.F.I.D., P.M.R., cattle database.

**Modern cattle farming presupposes identification**

During the last few years, the unambiguous identification of livestock, especially of large animals such cattle, has been brought more and more into focus all over the world. There are several reasons for this, but the ones listed below are among the most important (not in order of priority).

- Herd size is on the increase everywhere. This reduces the farmers' possibilities for identifying the individual animal purely by sight, leading to increased daily problems.
- Increasing herd sizes also mean that the value of the herds is rising. This fact leads to increased demands on the documentation of the in/outflows of animals.
- Electronic data processing of herd and yield data requires unambiguous identification.
- On the part of the farmers there is a general wish that a particular set of data should only have to be reported **once**, and subsequently the data thus reported should be directly available for use in all the programs of the database.
- The consumers' increased demands on the producers to document the health of the animals that form the basis of food production, also necessitate an unambiguous identification of the

individual animal. The process of following each individual animal from "conception to consumption" is thus made reliable and unbureaucratic.

- Modern breeding objectives imply both a very stringent selection of the sires/dams of future breeding animals and consequently a very heavy demand for the few selected specimens - this applies especially to male animals. The preservation and further development of the genetic base presupposes reliable identification techniques, both in respect of production characteristics and the endeavors to prevent the spread of hereditary defects, etc. This may also apply to the preservation of genetic reserves in the shape of endangered species and breeds.
- In the course of time the facts mentioned above have among other things given rise to legislative changes in many countries, and demands are specified in relation to reliability and the techniques applied for livestock identification.

**Identification systems are developed at a rapid pace**

Over the last few decades, most countries have adopted general identification systems that are based on eartags. Initially, metal eartags were used, but presently there is a clear trend towards the application of plastic eartags. The reason being that as they are carriers of unambiguous identification systems, they are able to fulfil the demand for reliability, and at the same time they also fulfil the legitimate demand of the individual farmer to be able to read the number of each animal at a reasonable distance. The farmer needs to be able to read the identification data both from a position in front of and behind the animal. For instance as in a tie-up cowshed or in a milking pit. It is therefore necessary that the plastic eartag consists of two halves, no matter whether it is combined with electronic identification or not. In addition, plastic eartags are more appropriate when considered in the animal welfare perspective.

Simultaneously, a considerable technological development has taken place implying that the introduction of electronic identification (E.I.D.) is now imminent. This in turn implies revolutionary advantages to all parties involved. A clear indication that there is a market for this system can be found in the interest shown both by the agricultural organizations, by the agroindustrial community and by industry as a whole.

E.I.D. must be welcomed for these particular reasons:

- Increased reliability of identification in situations where animals are traded, pass national boarders, undergo disease control, etc.
- Increased reliability of identification in situations where the identity of an animal was previously manually recorded, e.g. milk recording, AI and veterinary services, etc.
- The possibilities of automatic registration in milking parlors, at concentrate dispensers, when passing gates, etc. are improved and simplified.
- Increased reliability of slaughterhouse identification of animals which are registered and received for slaughter, if E.I.D. is used consistently and if on reception at the slaughterhouse a connection is created to the internal slaughterhouse identification of the individual carcass.

- It is worth stressing that E.I.D. does not in itself solve any tasks, which **cannot** also be solved manually by way of taking data down in registration forms, etc. But reliability is dramatically improved, because manual registration of multi-digit numbers invariably takes a long time and will lead to more errors being made. In other words, one can cut down on bureaucratic registration procedures - all this naturally on condition that reliable electronic systems with a high degree of functional reliability and a long life are applied.

**The demands made on E.I.D. are not of a purely technical nature**

The successful implementation of E.I.D. must therefore be considered a realistic possibility, provided that some vital preconditions are fulfilled. One of these are that the decision-making bodies, which will prepare the introduction of the system, must be made very aware that E.I.D. should not only fulfil the overall statutory demands applying to livestock identification, although they must of course be carefully complied with. E.I.D. should also be allowed to operate as a simplifying and reliability improving factor in the management of each single farming enterprise. At the same time E.I.D. should be organized in such a way that integration with the service organizations of the farmers is made possible, via.such organizations as the milk recording societies, the AI societies, the herdbook-keeping associations, the veterinary services and their databases. The ideal way to structure the requisite database would naturally be to merge into one the databases of all the individual organizations. This will hardly be feasible everywhere, but Danish experience shows that an agreed policy for communication between the various databases will do a lot to achieve a fully satisfactory and functional system. To which extent such an integration is possible or should be carried, must of course be decided by the decision-making bodies of each individual country, but the fact that E.I.D. techniques are chosen and the costs of the systems chosen should not prevent a widespread application of E.I.D., i.e. if the decision to introduce E.I.D. is to become a success in relation to all parties involved.

Below the possibilities and advantages of E.I.D. are described and analyzed in relation to application within cattle farming. The main emphasis will be on the logistics of placing orders, of delivery, of application by the cattle farmer and subsequently at the slaughterhouses. The description will consider the dataflow in great detail. The very important fields of logistics and dataflow do not seem to have been described in their entirety before. So far the overall majority of activities within this field have been concentrated on the technical aspects. The value of these activities should not be disparaged, but the delivery of a given number of identification units to a customer does not mean that E.I.D. has been introduced - on the contrary one could almost say! If the logistics and the dataflow have not been carefully worked out and prepared, the desired advantages will not be achieved - neither for the individual farmer nor for his business partners.

In conclusion the suitability of various E.I.D. systems will be evaluated in relation to the logistics and the dataflow - as described above.

At the moment there seems to be two different technical options. One is based on radio- frequency technology (R.F.I.D.), and within this area developments were originally directed towards implantation systems. Many experiments show that slaughterhouses are having difficulties in finding the devices again, and this must be considered an indispensable requirement - at least in regard to animals that form part of the human food chain. Another version of the R.F.I.D. system thus is to build the unit into a button, which then constitutes one half of a plastic eartag. The option is, however, not ideal as it makes visual reading both from in front and from behind impossible.

The second option is based on Programmable Magnetic Resonance technology (P.M.R.). This type of identification system (MAGTAG) is based on a very well-known technology, which is used for safety tagging in numerous department stores. What is new is that this technology has been further developed and now has 64 bits as prescribed by the ISO standard no. 11.784.

**Statutory demands on identification and databases**

As an example of a statutory demand, Council Directive 92/102/EU has been chosen. This directive lays down the demands on cattle identification applying within the EU, where the total cattle population amounts to approximately 83 million heads of cattle, out of which 22 million are dairy cows and 9.5 million are beef cows.

**The main demands are:**

- Within 30 days after being born (however, always before a change of owner if this takes place sooner) all calves must have been eartagged with an approved tag.
- The identification number must facilitate the unambiguous identification of both the individual animal and the herd where it was born.
- Each individual farmer must keep a record of all the animals in his herd and of all inflows and outflows of animals. Participation in a milk recording scheme or in a beef cattle registration scheme satisfies this demand.
- A competent authority must supply the herd with the eartags, i.e. a governmental body or an organization/company which has been authorized by the government. Falsification of the eartag must not be possible, it must be legible for the entire life of the animal, and it must not give rise to any problems with animal welfare.

The above main demands represent a short description of the demands that have been fixed by law and which apply to the identification system itself and to the application thereof.

The overall objective of making demands on the identification systems is to ensure that each animal that is covered by the resulting regulations, can be followed from the time it is born to when it is slaughtered or dies. In this way one can make sure that veterinary standards are upheld and improved, and at the

same time this also ensures that documentation is available to certify the health of the animals and products to the consumers.

Irrespective of the fact that no rules have as yet been laid down for E.I.D., it is considered a matter of course that E.I.D. systems - as far as application and design goes - must comply with the same demands in order to be legally approvable.

Another important precondition of what is described below is that E.I.D. can be incorporated into the plastic eartag that bears the visual number. The reason why this must be so is that the application of implantation systems must be considered unrealistic, primarily because there is no guarantee that the devices can be relocated (the product liability of slaughterhouses!).

In consideration of the fact that the farmer must be able to make **daily** use of the visual eartag, it is important that it has as few digits as at all possible, e.g. a combination of a herd number and a serial number. In the daily management of his farm the farmer then only needs to concentrate on the serial number. In their endeavors to keep the identification system simple, the competent authorities should also be very aware of the daily needs of the farmer, otherwise, there is a risk that he will insert a "user number," and thus the connection to the database will be impeded.

**Some crucial questions in connection with the introduction of E.I.D.**

Prior to the introduction of E.I.D. into a country or a region a number of practical questions will need to be solved. It would be beyond the scope of this paper to try and describe these questions and to indicate possible solutions, because no two countries/regions would be the same.

There are, however, some essential questions that need answering prior to the introduction of E.I.D., and it must be strongly recommended that all the parties involved contribute their share. Among these questions are:

- Is the introduction of E.I.D. a general demand, or should it be left to the individual farmer to decide whether he wants to make use of the technique?
- On incorporation of the E.I.D. unit into the eartag it must be decided whether one should be able to read the visual number both from in front and from behind. In most cases, the individual cattle farmers would - for practical reasons - probably want both. This would require that both halves of the eartag should be large enough to allow a visual number to be printed on them.
- It must be legally clarified which number is to be considered valid in cases where the visual number and the E.I.D. number are not identical.

In regard to, for instance, MAGTAG, this will represent no problem as the two numbers are **always** identical.

- It must be legally clarified which measures should be taken, if an E.I.D. replacement tag does not have the same number as the tag that was lost. In situations like this, a demand that the

identification number of an animal should not ever be changed would not be feasible, and administrative procedures must exist that ensure that this does not prevent permanent identification.

In regard to, for instance, MAGTAG, this will represent no problem as the two numbers are **always** identical.

- It must be administratively clarified how the database connection between the R.F.I.D. (radio-frequency technology) supplier and the eartag supplier can be established and ensured.

In regard to ,for instance, MAGTAG, this will represent no problem as the two processes of encoding the MAGTAG unit and laser-engraving the actual eartag form part of the same sequence of operations.

The real problem is not whether there are one or two databases, but the administrative problems involved in always having to keep two databases up-to-date would have to be solved.

**Logistics and dataflow when ordering and delivering the identification carrier (E.I.D. eartag)**

The following is a short description of the typical course of events from when an order is placed and until the ordered number of MAGTAG E.I.D. eartags are dispatched.

- A written order for the required number of eartags is placed with the nearest service office (or, if possible, directly with the central database via VOICE response).
- At the central database, the data already registered under the farmer's herd number are updated with the date of the order and the number of eartags ordered; the numerical sequence used in connection with the herd number in question is updated and continued with the number following immediately upon the last number of the previous delivery. On account of the safety procedure no number can be supplied twice, except with replacement tags which are marked separately.

After the database has been updated, the order is sent on-line (in some cases via diskette) directly to the eartag engraving station. Data files have been attached to the actual order, containing forwarding address, etc.

- The eartags and the E.I.D. (MAGTAG) are encoded in the following order:
    1. The ordered animal number is encoded into the MAGTAG unit according to the information received from the central database.
    2. Reading check
    3. The MAGTAG unit is sealed within the eartag
    4. The MAGTAG unit initiates the laser-engraving process used for printing the visual number onto the eartag. This number is completely identical to the number encoded into the MAGTAG unit.
    5. Quality control and dispatch.

E.I.D. applied in conjunction with programmable electromagnetic resonance technology (P.M.R. - e.g. MAGTAG) will - as described above - result in the visual number and the E.I.D. number always being identical, in contrast to the situation that would result if E.I.D. and radio-frequency technology (R.F.I.D.) were combined. In that case, the two numbers would typically differ from each other, as the visual number would refer to a particular herd whereas for technical and financial reason the E.I.D. number would be a serial number without any direct reference to the herd in question.

In principle the logistics involved in the procedures applied for encoding MAGTAG/E.I.D. eartags do not differ from the logistics involved in producing an ordinary eartag without E.I.D. The only difference being that here the data from the central database are encoded directly into the numbering station. The central role played by the database is described in annex 1, and the most important dataflows are outlined in annex 2.

**Creating the E.I.D. number belonging to a particular animal**

Each farming enterprise should always have a small store of E.I.D. eartags so that all newborn calves can at once be tagged with an identification number. The safety routines of a modern database should be made up in such a way that only numbers that are comprised by an ordered or produced numerical sequence can be applied. The next step in the procedure is then that the farmer or the person who is responsible for the identification of newborn calves, after having attached the eartag, causes the database to be updated by submitting in writing (or via VOICE response) the data (date of birth, sex, dam, sire) appertaining to the animal that has been eartagged. For safety reasons, the period of time allowed for causing this update to be made must be as short as possible. Within the EU the maximum period allowed is 30 days (however, always before a change of owner as mentioned above). From this time on, the animal can be unambiguously identified and with a modern database as the focal point it is now possible to follow the animal and its performance all the way to the time when the animal is slaughtered or dies - no matter whether a change of owner or other changes should take place.

**Milk recording and registration**

The proportion of a cow population which is affiliated to a milk recording society is rising in most countries. This means that in relation to the cattle database, the milk recording schemes constitute an important element, because a very considerable share of the information contained in the database is "born" under the auspices of the milk recording societies: data such as the birth dates of the calves, all data on yield and inflows and outflows of animals.

In many countries such concepts as registered herds versus commercial herds are applied - while in other countries registrations are based on the data made available by the milk recording societies. In both cases the focal point is unambiguous identification. Using unambiguous identification, e.g. MAGTAG, as a key both the registration (reporting of relevant data on all newborn calves) and the milk recording dataflows to the database can take place in a very simple way.

As for the milk recording schemes there is another important flow of data consisting of the identification of the milk samples, which are sent to laboratories to be tested for fat and protein content an to have

somatic cell counts performed. And of course the process must be reliable all the way from the farmer over the laboratory and to the database, where the necessary calculations are made. The automatic reading of the identification number of each individual cow, e.g. with a hand-held reader in combination with an encoder, maximizes reliability.

**Management/Service**

The results from the periodic milk recording tests may be accompanied by update feeding plans - possibly in the shape of a diskette or via modem that can be used for updating concentrate dispensers, which are controlled by the E.I.D. of the individual animal. Again completely reliable dataflows controlled by unambiguous identification must be presupposed, so that the updated feeding plans can take into account such things as yield changes, calvings, changes in pregnancy status, etc.

**Calculation of breeding values/breeding plans**

In modern cattle farming, the calculation of breeding values takes place via the application of advanced statistical methods which include data on the performance of previous generations. It is thus a basic fact that a reliable identification system for controlling the dataflow is of fundamental importance.Reliability is increased with an increased number of observations. It is therefore of great importance that the data from the breeding value calculations and the milk recording tests are correlated, when and if the data on the descent and performance of the individual animal are reliably controlled by way of unambiguous identification. Breeding value calculations as they were in former times, when they were based on agreements with a number of herds or on stationary performance testings of progeny groups, are thus no longer necessary, and the whole of a cattle population can now be included in an active pool of breeding material, as long as it is also included in a milk recording scheme.

So far when animals have changed owners, an immense amount of data on the descent and the performance of the animals has been "lost" - simply because of the nonexistence of unambiguous identification systems. Or because the databases have been organized in such a way that all data had to be resubmitted after a change of owner. Unambiguous identification entails that all data follow the individual animal! Due to the unambiguous identification system both the agricultural sector and society as such will receive quicker, more reliable and cheaper breeding results. Even greater achievements can be obtained in the shape of improved E.I.D. reliability.

**The slaughterhouse**

Finally, all healthy animals should be included in the human food chain. The consumers can very legitimately demand that they must be able to buy food that originates from healthy animals - and the producer, the food industry and the retail trade must be able to document that this is

so, and the demands made on documentation will become still more stringent that the diseases/treatments to which an animal has been subjected are registered. This will only be possible with an unambiguous identification system and a database.

A consistent, qualitative and quantitative registration of animal by-products (blood, hides, organs, glands, etc.) with reference to the unambiguous identification of the animal will facilitate financial optimization both with the primary producers and in the food industry.

It is therefore important that the slaugtherhouses are also connected to the database, which can then be updated with slaughter data, including quality evaluations of animal by-products (e.g. hides and glands).

**The suitability of various technological systems**

Based on a general overall evaluation it may be concluded that any technological concept is suitable, provided it complies with the ISO (International Standard Organization) standard on coding structures (ISO standard no. 11.784). The subsequent standard on the technical properties of R.F.I.D. technology (ISO no. 11.785) naturally only applies to this type of technology and should not act as a limiting factor on technological developments, including the introduction of an E.I.D. system based on a different technology (e.g. P.M.R.), provided that the standard applying to coding structures is complied with.

**View: The Unique Identification - a key to a new world**

In a number of areas there are, however, decisive differences between the two technological options, especially if seen in relation to their possible applications in modern cattle farming and taking into account the desire for optimum and unbureaucratic utilization. The below table illustrates some of the important differences, which should not be disregarded.

| | P.M.R. | R.F.I.D. |
|---|---|---|
| Database requirements | 1 | 2 |
| Encoding of ID | Decentralized | Centralized |
| Compliance with ISO 11.784 | OK | OK |
| Visual no. identical with E.I.D. no. | Yes | No |
| Replac. E.I.D. no. ident. w. 1st E.I.D. no. | Yes | No |

**References**

International Standard Organization (ISO), standard numbers 11.784 and 11.785.

Electronic Identification guidelines for transponder ... and attachments. ICAR - working group on Animal Identification, December 7, 1993.

**Annex 2. Examples of an ideal dataflow from and to various program operators in a central cattle database**

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**Annex 3. MAGTAG I/S**

MAGTAG I/S is an undertaking established by the three firms or institutions described below with the purpose of developing and marketing an electronic livestock identification system based on P.M.R. technology (P.M.R. **P**rogrammable **M**agnetic **R**esonance).

MAGTAG I/S has acquired the development rights to the patented identification system based on the P.M.R. technology, which was developed by the Scientific Generics Limited, Cambridge, Great Britain.

The three firms or institutions that have established MAGTAG I/S:

**The Danish Agricultural Advisory Centre, Udkaersvej 15, DK-8200 Aarhus N**

The Danish Agricultural Advisory Centre, which was established by the Danish Farmers' Unions and the Danish Family Farmers' Association in 1971, offers advisory and counselling services to all branches of Danish agriculture. The Centre employs a little over 300 people, the majority of which hold a university degree.

**THE DANISH LIVESTOCK AND MEAT BOARD, Vesterbrogade 6D, DK-1620 Copenhagen**

The Danish Livestock and Meat Board/D.L.M.B. is the trade organization of the Danish beef and veal sector. The board is located in Copenhagen. The members of the board represent organizations, associations, firms and private enterprises engaged in producing and selling slaughter cattle as well as beef, veal and other beef products. The D.L.M.B. was established in 1972. The D.L.M.B. was established because the agricultural sector and the beef sector needed a central/independent body within the sector. Another reason for establishing the D.L.M.B. was Denmark's membership of the EU.

**S.F.K. a.m.b.a., Avedøreholmen 96-98, DK-2650 Hvidovre**

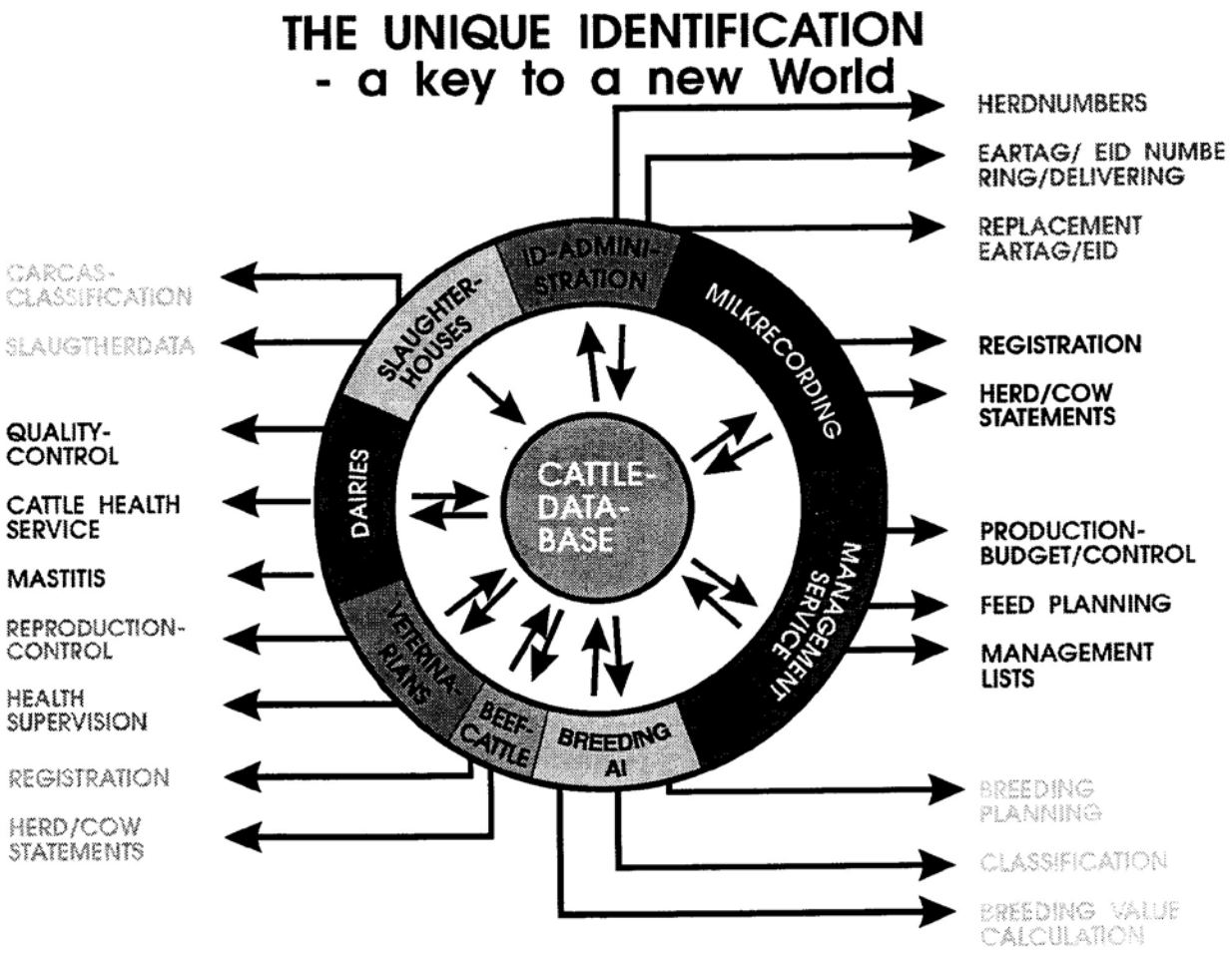
S.F.K. a.m.b.a. was founded in 1931 by a group of Danish slaughterhouses in Copenhagen. The objective was to establish a cooperative purchasing organization that could satisfy all the needs of the slaughterhouses, such as hand tools, equipment, clothing, machinery, spices, ingredients, packaging, cleaning and sanitary agents, etc. Today, S.F.K. is a modern, dynamic company employing approximately 450 people and with a product program totalling about 15,000 stock items. S.F.K. is not only the major supplier to the slaughterhouses. We also supply the entire Danish food industry: Poultry, fish, confectionery, canned food, snacks, bakeries, nurseries, etc. as well as the pharmaceutical industry.

In addition, we export our products to a large number of countries through our sales offices and agents.

*S.K.F. comprises four divisions:* Food, Non-Food, Packaging, By-Products and Veterinary Products. In all four divisions our qualified staff will give customers the best possible advice and service, internally as well as externally.

*S.K.F. has three subsidiaries:* The S.K.F. Meat Systems a.m.b.a., which markets systems and equipment for pig, cattle and sheep abattoirs as well as equipment for cutting, boning and industrial packaging. The

S.K.F. Technology A/S, which specializes in equipment for measuring and quality control in the meat industry and animal husbandry. The LASK ApS., which deals in consumer goods and business products for administrative tasks in agriculturally owned companies.



# Examples of an ideal dataflow from and to various program operators in a central cattle database

ANNEX 2

| | | FROM THE DATABASE | TO THE DATABASE | |
|---|---|---|---|---|
| | ID Administration | * Numerical sequences supplied | Numerical sequences ordered | |
| | | * Replacement tags supplied | Replacement tags ordered | |
| | Milk Recording | * Herd file (accumulated yield)<br>* Individual animal file (accumulated yield, calvings, descent) | Inflows and outflows of animals (registration) Updates with calculated production results | |
| | Management/Production Budget/Control | * Production level/cow<br>* Pregnancy status/cow | * Planned culling | |
| | | | | |
| | Breeding (Dairy Cows) | * Breeding values, yield<br>* Classification<br>* Bulls used for previous inseminations | * Updated breeding values, yields<br>* New classifications<br>* Bull applied for most recent insemination | |
| | Beef Cattle Breeding and Production) | * Herd file<br>* Individual animal file (calvings, descent, etc.)<br>* Updated breeding values for daily gain, conformation | * Inflows and outflows of animals (registration)<br>* Weight data<br>* Conformation data | |
| | Veterinary Services | * Insemination data<br>* Previous diagnosis | * Reproduction diagnoses<br>* Diagnosis | |
| | Dairies | | * Result of health control via milk samples<br>* Somatic cell counts performed on tank milk samples | |

| | | | | |
|---|---|---|---|---|
| | Slaughterhouses | | * Slaughter data (date, weight)<br>* Carcass classification<br>* Animal by-products | |