

APPLICATION OF DATANETWORKS AND DATABASES TO THE SLAUGHTERLINE

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Since the middle of 1990 DMRI has worked on development and installation of a new concept for data collection and sorting of carcasses on the slaughterline and in the chilling room. The resulting systems are up till now (spring 1992) installed in 10 danish production environments. By the end of 1992 the systems will be installed in all danish abattoirs.

The system specification and development is prepared in accordance with a superior plan for implementation of Computer Integrated Manufacturing (CIM) in the danish abattoirs. The CIM-analysis was carried out by DMRI in the period 1988-1990 and these new data systems for the slaughterline are the first practical implementation of this long term planning for implementation of integrated information systems in the danish companies.

The new data systems fulfil the following main objectives:

- Automatic sorting of carcasses in the chilling room based on data collected on the slaughter line.
- Flexible storing of production results (e.g. carcass data) which allows future applications and reporting especially with focus on production planning.
- An "open" data system which allows future integration of new equipment without changes in the existing systems.

The technology used to achieve these goals are mainly:

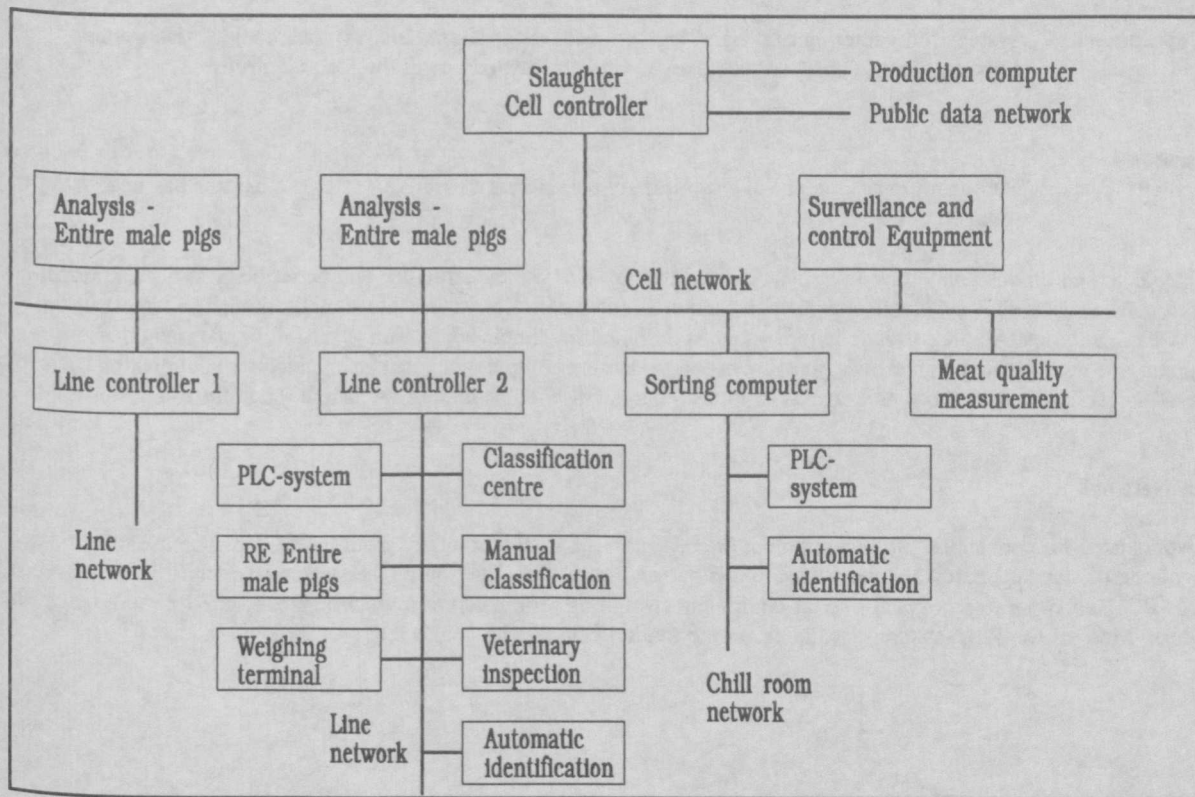
- Application of data networks installed along the individual slaughterlines.
- Application of modern database techniques and graphical user interfaces.
- Widespread use of existing standards and standard components e.g. application of Personal Computers (PC's).

The experience with the systems up till now has been very positive and the systems have been adopted easily by the companies due to a parallel educational programme. The flexibility of the systems has been proved lately by the integration of a new system for automatic data collection of remarks from the meat inspection on the control platforms.

The paper describes the new concept for data integration on the slaughterline, especially with focus on technology. Furthermore the experience from the danish installations will be discussed.

1. Main Architecture

The main architecture of the new data systems that are being installed at Danish pig slaughterhouses is illustrated below.



Data network on the slaughterline

The individual sub-systems have the following meaning:

Line network, Cell network, Chill room network	Data networks which are used for communication between systems on the slaughterline or in the total slaughter area.
Automatic ID	The identity of each individual carcass is read automatically by means of barcodes, vision technique or radio tags.
Veterinary inspection	Data terminal for keying in disease codes from the meat inspection.
Weighing terminal	Automatic weighing and manual keying in of supplier identification etc.
Sampling Entire male pigs	Receiving Equipment for sampling of entire male pig carcasses. At this station a sample of backfat is taken from each male pig. The sample is automatically placed in a beaker with a barcode and is sent for analysis in the laboratory (PTE). The data of the sample is stored in the Cell Controller.
Classification Centre, Manual classification.	Automatic and manual carcass classification.
PLC-system	PLC system controlling the conveyor. The system controls movement and shifting on the conveyor systems on the slaughterline or in the chilling room.
Line Controller	Computer which controls the data capture on the individual slaughterline.
Cell Controller	Computer which controls the data capture in the total slaughter area.
Analysis - Entire male pigs	Pre Treatment Equipment (PTE) Automatic analysis of samples taken at the slaughterline. The analysis results are stored in the Cell Controller and can thus be used for sorting and reporting.
Sorting computer	Sorting computer for automatic sorting of carcasses to overhead rails in the chill room.
Surveillance and control equipment	System for gathering and handling technical data, alarms etc. At the moment this system is not installed, but gathering and logging of technical alarms are carried out in the Cell Controller.
Meat quality measurement	Data from measurement of meat quality parameters carried out after the carcass has been transferred to the chill rooms.

An individual slaughterhouse may have several slaughterlines. In this case the structure will be replicated with additional Line Controllers, networks etc. The figure shows a single slaughterline and one Line Controller for another slaughterline. The largest installation in Denmark contains 4 slaughterlines. All the software in the system is designed for simple adaptation to the individual slaughterhouse. The volume/type of equipment, the number of slaughterlines, installation of production computer etc. can be changed without making corrections in the basic software. This facility makes it possible to install future equipment without having to change the software.

2. Data Network

The networks used for connection of the equipment are based on the BitBus standard from Intel Corp. The use of this standard means that a large volume of standard hardware and software can be used in the construction of the system. It is thus possible to buy standard products for PCs and connector boxes for serial equipment (weighing terminals etc.) which makes it possible to connect the equipment to the network. Most of the PLC-systems available on the market can also be connected.

The data network is especially suited for installation in an industrial environment. The transmission speed used is 62.5 kbit/sec, but can be increased up to 1 M bit/sec. The cable is a shielded twisted pair which is laid out along the overhead conveyor system of the slaughterline.

In relation to the BitBus-standard from Intel Corp. the DMRI has developed a number of superstructures and auxiliary tools that are integral parts of the network. These facilities include:

- Standardization of data telegrams and addresses
- Surveillance of the transmission and alarm in case of transmission error
- Statistical functions for fault-finding and operational statistics

Standards have also been made for communication protocols and integration with the various operating systems (DOS, OS/2 etc.) so that connection of new data systems can be carried out in a simple manner.

3. Line Controller and Data Capture on the Slaughterline

The data capture on the slaughterline is related to the ID-number of each individual carcass. The carcass number is recorded at each measuring station and the data are transferred to the Line Controller where they are entered into a data base.

The data base in the Line Controller contains all the information recorded for each individual carcass as long as the carcass is still on the slaughterline. The main structure of the captured data looks like this:

ID-number
Supplier no.
Weighing data
Classification data
Veterinary remarks

The data base in the Line Controller contains standards for how to read and write data. By using these standards the individual data systems on the slaughterline are able to freely reading and writing data in the data base. It is also simple to add further information to the data base. This construction makes it possible to change one data system on the slaughterline without necessarily changing the other systems, and the system is flexible for implementation of new equipment on the slaughterline.

The data systems on the slaughterline are able to request data in the data base using the ID-number as entry key. The Classification Centre uses data from e.g. the weighing terminal for calculation of meat content. When a carcass arrives at the Classification Centre the ID-number will be read and the data system will read the required data in the data base. When the classification results are available they will be entered into the data base.

When the carcass leaves the slaughterline, data for the carcass will be transferred from the Line Controller to the Cell Controller.

4. Cell Controller

The Cell Controller is a computer that collects data from all slaughterlines and stores data in a data base. In addition to carcass data, data from the backfat samples for boar taint analysis are also stored in the Cell Controller.

The equipment for boar taint analysis can read and write data in the data base of the Cell Controller. When a sample is entered into the analysis equipment the corresponding data are read from the data base, and when the analysis result is available it is added as an extra measuring result for the respective carcass.

In this way the data base in the Cell Controller will contain all data about the production of the day. The data base is built up using standard tools and reports, and screen displays makes it possible to request information about the production of the day. This information may contain:

- Totals for the production results of the day
- List of entire male pig samples that have not yet been analysed in the laboratory
- List of entire male pig carcasses for resampling

Tools for report generation can also be used and specific reports can be defined this way.

The Cell Controller can be connected to a production computer. Data from the slaughterline can thus currently be transferred for production planning or accounting.

The system has a possibility for analysing backfat samples from another slaughterhouse. Sample data and analysis results can be exchanged via modem.

In addition to slaughter data and analysis data the Cell Controller can store and display all alarms in the slaughter area. This alarm log can be used by the technical staff in connection with fault-finding or maintenance. An alternative to this alarm log would be to attach a specific system for operational surveillance. There are a large number of standard products on the market for this purpose and most of them are based on PC-technology and can be connected directly to the data network.

All data gathered in the Cell Controller can be made available for an automatic sorting of carcasses in the chill rooms. The sorting is carried out by a Sorting computer.

5. Sorting Computer

The Sorting computer is a computer which together with a PLC-system and equipment for automatic identification is able to sort carcasses to specific overhead rails in a chill room. The sorting is carried out as follows:

When the carcass arrives at the chill room the ID-number is read automatically. The number is sent to the Sorting computer which decides in which **sorting group** the carcass shall be placed. The sorting group is transmitted to the PLC-system which controls that the carcass is placed on a rail belonging to the relevant sorting group.

For this sorting process the Sorting computer uses a pre-entered definition of **sorting groups** and a **disposal plan**.

The sorting group definition specifies the sorting groups and how each individual group is defined. A sorting group can be defined freely on the basis of all the data captured on the slaughterline. A group definition could look like this:

Group 1 = (55 < Weight < 60) and (Lean meat > 57)

All other data captured on the slaughterline can similarly be part of the definition and in this way a number of special groups can be defined. Sorting on the basis of the analysis result from the entire male pig carcass analysis equipment is an example of how carcasses with an unacceptable level of boar taint may be handled. Individual groups can have priority in relation to each other and a group can have a stop criterium so that the group will be closed when the desired number of carcasses has been reached. The formation of sorting groups is typically made by the production planning department on the basis of the known sales requirements.

The disposal plan defines the physical use of rails in the chill room i.e. a specification of which rails shall be used for a given sorting group. This plan can be revised as required when the chill rooms are being filled.

The Sorting computer also has facility for a number of summary displays and reports which makes it possible for the personnel in the chill room to follow the day's production results continuously.

6. Conclusion

The installation of new data systems at Danish slaughterhouses is part of a long term creation of integrated information systems. The first systems are installed at the slaughterline, but the same concept is expected to be used in other departments in the meat industry.

So far the results have been good. The introduction of slaughtering of uncastrated male pigs creates quite new requirements for identification, registration and sorting. The systems have contributed efficiently to achieving the aims. The systems have also contributed to an improved summary of the daily production and of the operation of the technical equipment. The improved data registration and reporting also form part of a long term quality assurance strategy.