Strategic Variables, Processes and Technologies in the Meat Production System - Current Trends and Research Requirements

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I. Introduction

The intention of this paper is to outline a general framework for CIM (Computer Integrated Manufacturing) concepts (4,22) tailored to the specific needs of the slaughter industry. The framework will be discussed from the perspective of a system analysist. As a first step in his early analysis he would try 'to understand the situation', i.e. try to identify strategic business variables, processes and technologies. On his search we will accompany the analysist by seeking answers to five major questions:

1. What is the basic business process?
2. What data is currently used in the process?
3. What are the limits of the actual organisation and information system?
4. What performance controls are used?
5. What would an 'ideal system' with 'perfect technology' look like?

Trying to find answers to these questions, hopefully, will result in a clearer picture/understanding of how future CIM systems for the slaughter industry should work (requirement specification). This knowledge, then, may represent a sound platform to enter a further discussion about the usefulness and feasibility of specific technologies. In this paper the requirement specification (14) for decisive strategic business processes, namely, the classification process and the pay-out price evaluation/cheque writing routine will mainly be dealt with, so that the most important variables, in my opinion, will serve as an example.

II. Basic Analysis

The first question to be answered in an early analysis (24) will always be:

1. What is the basic business process?
Comparable to all other industries (fig. 1), the process of managing a slaughterhouse can be described as organisation of the basic input-transformation-output process. A management simultaneously looks at the product market (needs) and its prices as well as on the supplies and prices of the raw material market and - based on this information - tries to organise the transformation process in a way that secures the longterm survival and growth of the firm. While this is common to all industries, the slaughter industry has to deal with 3 decisive peculiarities:

There are no well-defined standards for the raw material, nor for the final products, as there are for e.g. for screws in the machine manufacturing industries (DIN-, ISO-rules). Since managerial accounting/planning systems (1, 11, 13, 19) must be based on well-defined calculation objects, the ability to classify or describe animals and final products - in a way that best supports the information requirements of the slaughter (as well as the animal production and meat processing) management information systems - is a major success factor. A second peculiarity of the slaughter process is, that the value added in the process (≈ 9 %) is very small as compared to other industries (≈ 40 %). A breakdown of the average sales dollar in a pig slaughterhouse (fig. 2) shows that the raw material cost accounts for about 90 %, the wages and salaries for 3 %, inspection, depreciation and energy for about 6 % of the sales dollar.
The profit is only about 1 % on an average basis.

Since depreciation and inspection cost cannot be influenced at all, and energy and water costs only to a limited extent, the classification and the subsequent value assessment for animals with specific traits remains consequently - besides labour performance and cost control - as a strategic area over which management should have as much (insight and) control as possible. Perhaps if the process of determining the raw material pay-out-price is misleading on an average basis by only 1.11 percent, this would already take the total profit away and may eventually lead to bankruptcy. Due to the dominance of raw material cost, the process of pay-out price evaluation (2, 12, 18) should be a major concern of a slaughterhouse's top management.

The third peculiarity of the slaughter business is that the manufacturing process is a dissassembly process with single animals as raw material and a variety of so-called 'joint products' resulting from the production process (fig. 3). Most of all other industries have an assembly type production.

Since all managerial accounting/planning systems are based on two balances:

a. the material balance,
b. the value balance,

the structure of the input-output process predetermines, to a large extent, the possible and meaningful accounting routines to be applied in an industry. While in the machine manufacturing industries (assembly type production), the main calculation object is always the final product, the raw material (= animal) is the logic correspondent independant variable or calculation object in dissassembly type productions (slaughterhouses). A mathmatical proof for this is given in Müller-Merbach (15).

The reason is that in case of a dissassembly production process the material balance as well as the value balance can

(GRADED) ANIMAL

ECONOMIC STRUCTURE:

TECHNICAL STRUCTURE: SIMPLE JOINT PRODUCT PRODUCTION

RETURNS, COSTS AS WELL AS THE VALUE OF BY-PRODUCTS ARE NOT CALCULATED FOR IN THIS SYSTEM

FIG. 1:

THE BASIC BUSINESS PROCESS IN THE (SLAUGHTER) INDUSTRY AND THE ROLE OF MANAGEMENT

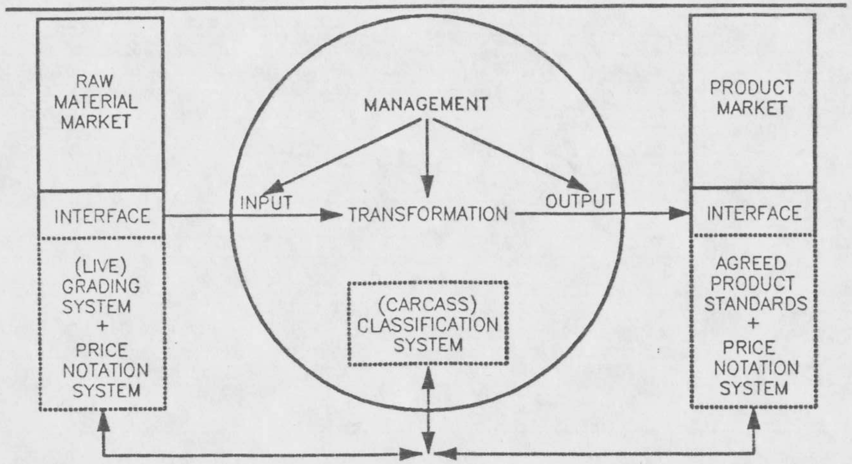


FIG. 2:

COMPOSITION OF THE SALES DOLLAR IN A (HOG) SLAUGHTERHOUSE

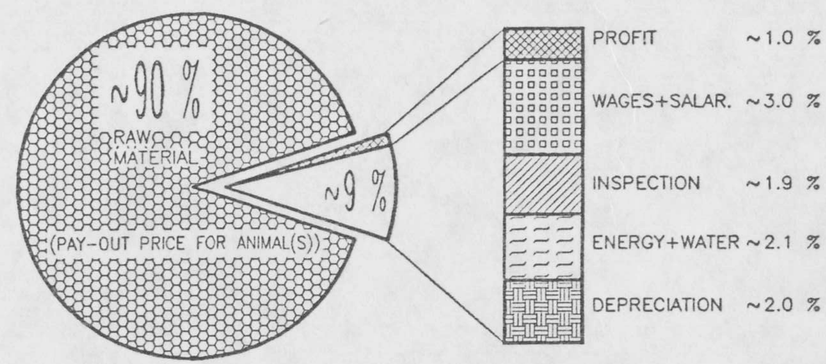


FIG. 3:

TECHNO-ECONOMIC STRUCTURE OF THE SLAUGHTER PROCESS

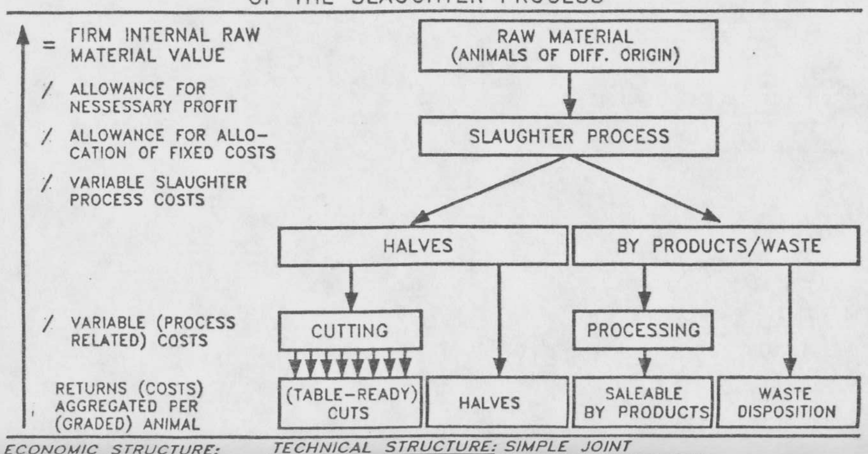
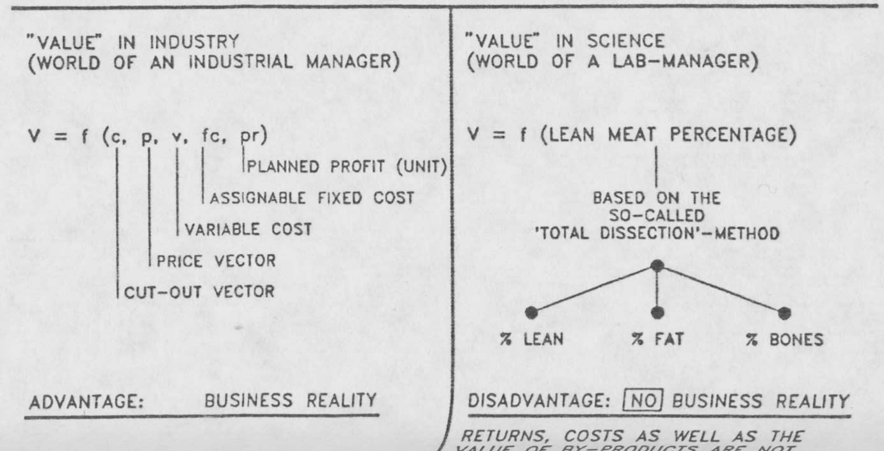


FIG. 4:

ANIMAL/CARCASS "VALUE" DETERMINATION IN INDUSTRY AND IN SCIENCE



only be solved for the raw material and not for the final products (see fig.3).

Thus, a slaughterhouse manager aggregates the returns of an animal (cut-out vector x price vector), subtracts the variable process related costs, allocates a so-called planned fixed cost rate and a planned per unit profit and ends up in a 'firm internal value' of the respective animal/carcass in a backward calculation. This calculation routine is described in Greer (8), O'Bryant (18), Riebel (20), Lorenz (13). So far we have outlined the basic slaughterhouse business process as far as the value balance and the material balance is concerned.

Now let us find an answer to the next question:

2. What data is currently being used in the process?

As stated beforehand, in the 'world of an industrial manager' the value of an animal/carcass (fig. 4) is a function

$V = f\ (c, p, v, fc, pr)$,

where c is cut-out-vector, p is price vector, v is variable process cost, fc is assignable fixed cost and pr is (necessary) per unit profit.

In sharp contrast to this managerial logic, most scientists use a completely different definition of animal/carcass value:

Def.: V = f (total lean meat percentage),

a definition, in which the lean meat percentage is based on a fictive so-called 'total dissection method'. The obvious disadvantage of this method is that the 'total dissection method' used in laboratories by-passes business reality; (but slaughterhouse managers have to deal exclusively with reality).

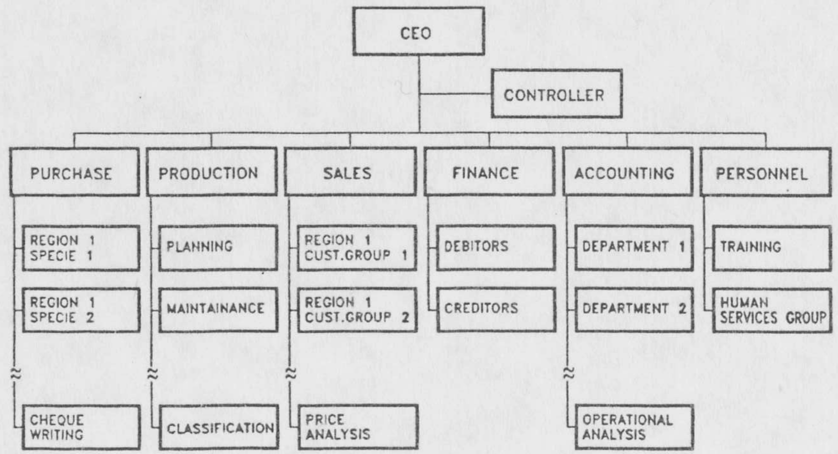
The returns and costs that can be assigned to an animal are not accounted for in this definition so that a manager does not know how he can take responsibility for the slaughterhouse profit when he has to use a classification and subsequent pay-out/cheque writing procedure which is based on assumptions and not on 'hard' facts. Unfortuneately EEC slaughterhouse managers had to accept a pig grading system (forced by legislation) based on this false assumption so that they now face serious difficulties in setting up meanigful accounting systems.

The next question to be analysed is:

3. What are the limits of the actual organisation and actual information system?

The typical slaughterhouse organisation (fig. 5) is based on the basic functions that have to be provided by management so we normally find a purchase, production, sales, finance,

FIG. 5: TYPICAL SLAUGHTERHOUSE ORGANISATION CHART



UNANSWERED QUESTIONS LEFT BY THE ORGANISATION CHART:
I WHY AND HOW DO PEOPLE INTERACT WITH EACH OTHER?
II HOW DOES INFORMATION PASS BACK AND FORTH?

FIG. 6: THE CHALLENGE OF MODERN MANAGERS: INTEGRATION OF ALL DEPARTMENTAL INFORMATION PROCESSES

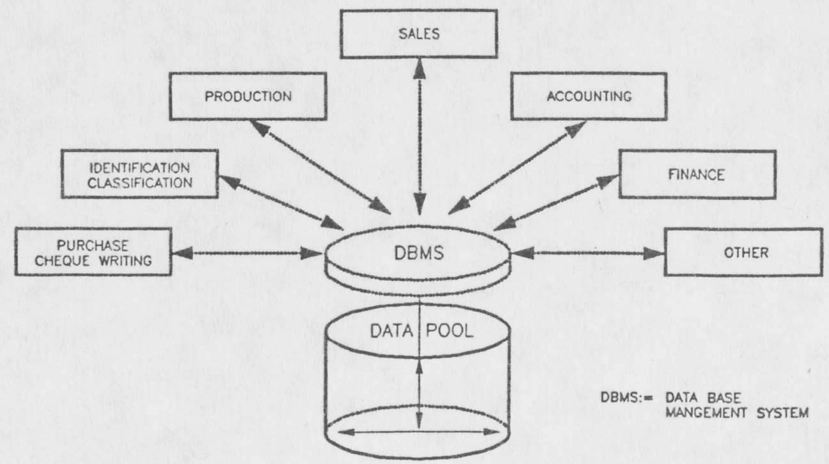


FIG. 7:
PAY-OUT PRICE DETERMINATION – FUTURE INTEGRATION NEEDS

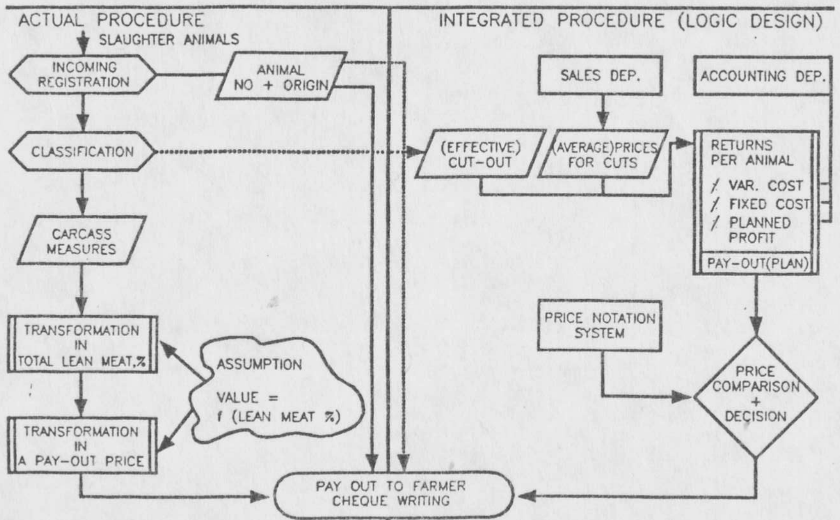
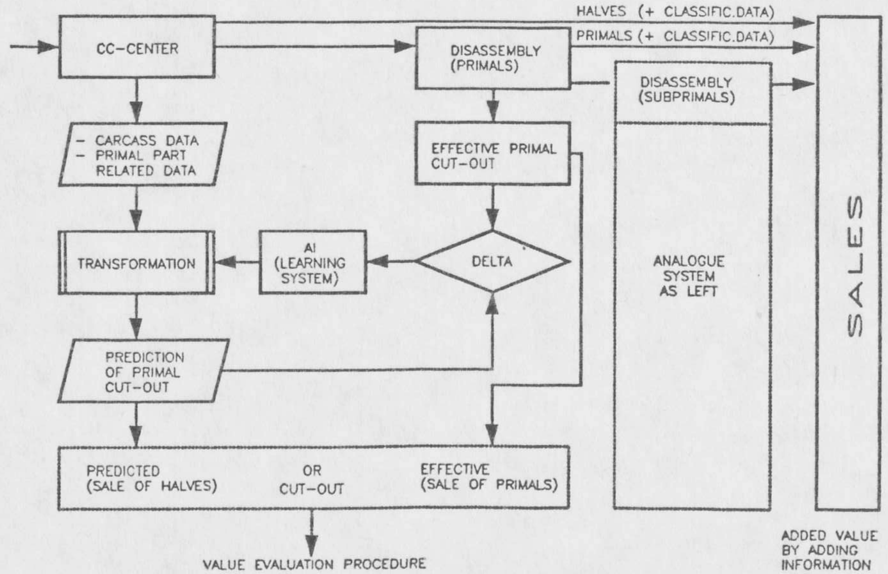


FIG. 8: CUT-OUT EVALUATION (PREDICTION) IN FUTURE CLASSIFICATION CENTERS



accounting and personnel department on the respective organisation chart. The unanswered questions left by such an organisation chart are:

a) Why and how do people interact with each other?
b) How does information pass back and forth?

Due to the departmental organisation business routines have developped mostly within the departments without being interrelated to the routines of other departments and without a total integration concept for information from the side of the slaughterhouse management. There is very little doubt that this lack of integration is a major factor for the failure of some slaughterhouse enterprises.

Not only in the slaughter business but in all businesses the actual challenge of managers, therefore, is to accomplish an integration of all departmental information processes (fig. 6). Ideally, all information users should have access to a data pool - organised by a data base management system - in order to be supplied with accurate, up-to-date information for their business routines/decisions which may result from many sources. One basic precondition for an optimal interdepartmental interaction is that the logic of the planned total information system (9) is clearly outlined (in entity - relationship models with a common data dictionary) so that there is no misunderstanding in what data has to be furnished by a single department or technology and above all, why.

4. What performance controls are used?

For example, the cheque writing routine for slaughter animals accomplished by the purchase or production department should be based on information resulting from the classification (centre), the price analysis team of the sales department as well as on actual cost information furnished by the accounting department. The corresponding logic design of such an integrated cheque writing routine is given on the right-hand side of fig. 7.

Since the pay-out-price for a specific animal (carcass) should be less or, at maximum, equal the returns provided by this animal minus the cost resulting from it's processing, the pay-out-price evaluation must be based on this information. As far as the returns are concerned, these can only be calculated or forcasted, if the industrial cut-out that will result from the animal is being provided by a suitable classification (centre).

In the EC - due to EC legislation - we mostly find classification systems that only serve one purpose and that is, to predict the total lean meat percentage; hence the existing cheque writing routines start with this data.

The obvious disadvantage of this procedure is that there is no logical link to the returns and costs created by the respective animal/carcass.

Therefore, we do not normally find any cut-out-control system in slaughterhouses that compares predicted cut-out to actual cut-out. Nor do we find subsequent controls as far as returns and the pay-out-prices are concerned. This implies that slaughterhouse managers today have almost no economic control over the process which they are responsible for.

Now I'd like to turn to the fifth and last question:

5. What would an 'ideal system' with 'perfect technology' look like?

If we intend to implement pay-out-systems that take the returns (and costs) into consideration, we, above all, have to determine the industrial cut-out (7) resulting from an animal.

Thus, we have to develop classification centres (fig. 8) that take those carcass (animal) data that can be easily transformed into predictable primal cut-out. If a carcass is not sold as such and is transferred to a subsequent primal dissassembly, we can obtain the weight of the primals online. A comparison of actual weight data with the predicted weight data will then tell something about the accurateness of the transformation equations used in the primal weight prediction module. Additionally, we can think of a learning system to adapt these transformation equations when found necessary. AI (Artificial Intelligence) - methods should be considered for this task. The effective (in case that primals are produced) or the predicted (in case that the carcass is sold) cut-out then should be transferred to a data pool to be ready for use in further routines such as the possible pay-out-price determination routine. Above all, future (III. generation) classification centers (fig. 9) should predict/determine the primal cut-out as well as the resulting 'quality' of halves/primals instead of just giving a 'total lean meat percentage' which managers don't know how to use.

In addition to this basic data an ideal classification system should be able to create additional data which is of value for business relations. So if customers want to know the exact lean to fat ratio, the 'ideal' classification centre should be able to create these data too. Thus, classification techniques must be based on a modular concept (Clausen (6), Nielsen and Verwohlt (17)) which can be adapted for future external (customer) or firm internal needs.

The data created by classification centres too should be designed for and ready for use at the animal production/slaughterhouse as well as slaughterhouse/customer market interface (fig. 10).

If we intend to create additional value at these interfaces (21) to intice our customers, we should perhaps ask what information would be helpful for optimally doing business in customer areas (23).

FIG. 9:

ANTICIPATED DEVELOPMENT STAGES OF CARCASS CLASSIFICATION SYSTEMS

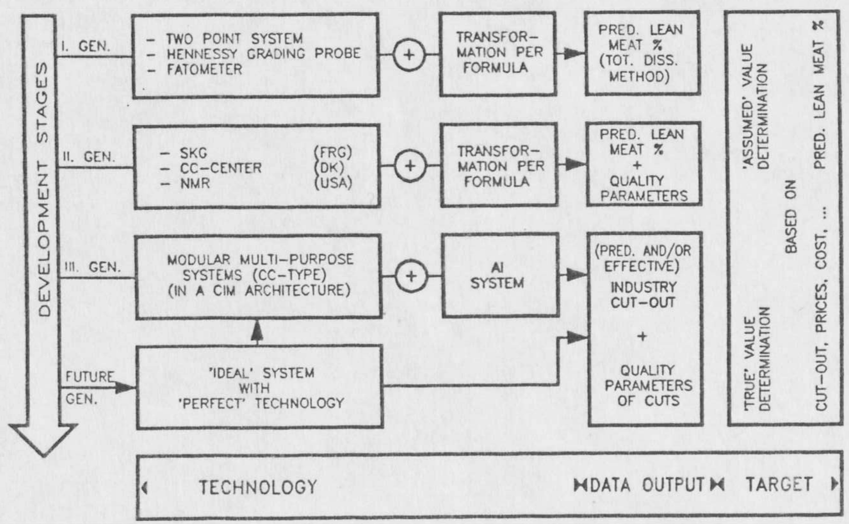


FIG. 10:

INTERFACE-MANAGEMENT AS A PRECONDITION FOR THE DECISION MAKING SUPPORT IN THE MEAT PRODUCTION CHAIN

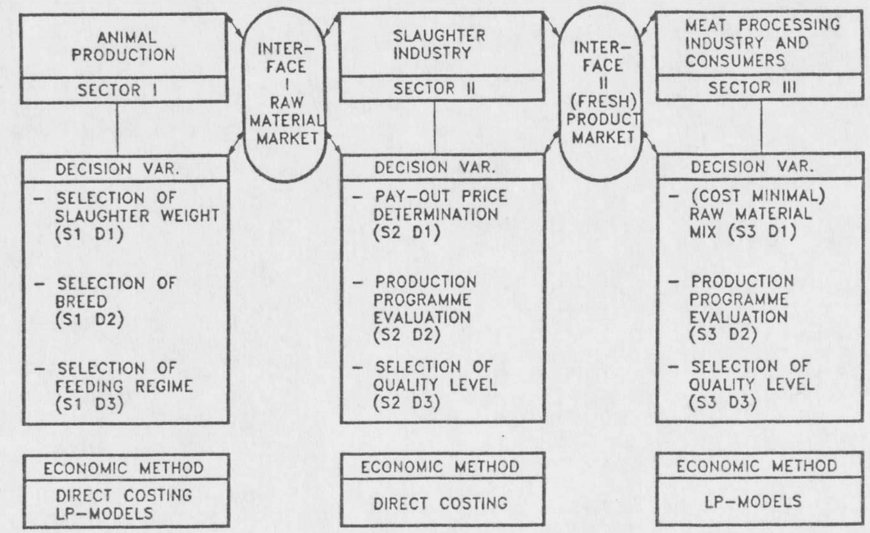


FIG. 11: FUNCTIONALITY OF AN 'IDEAL' ANIMAL MARKET INTERFACE

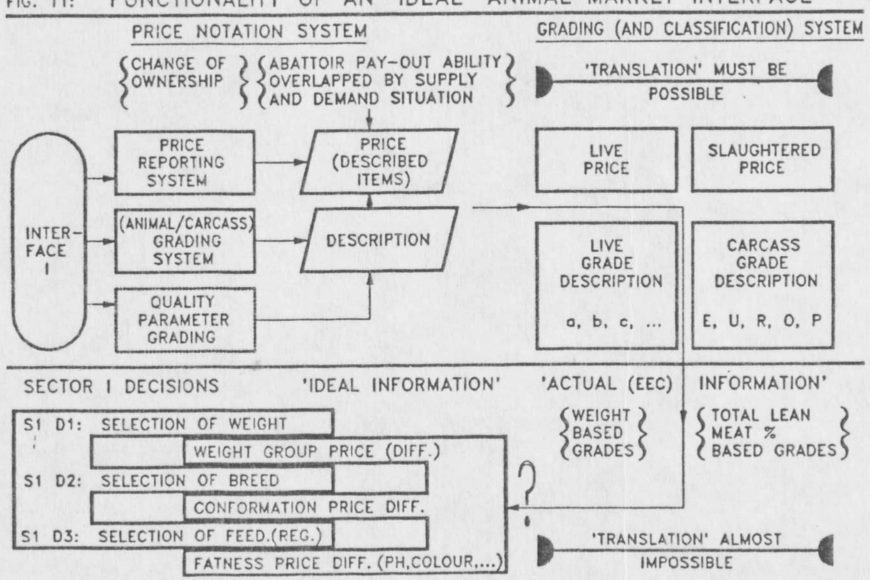
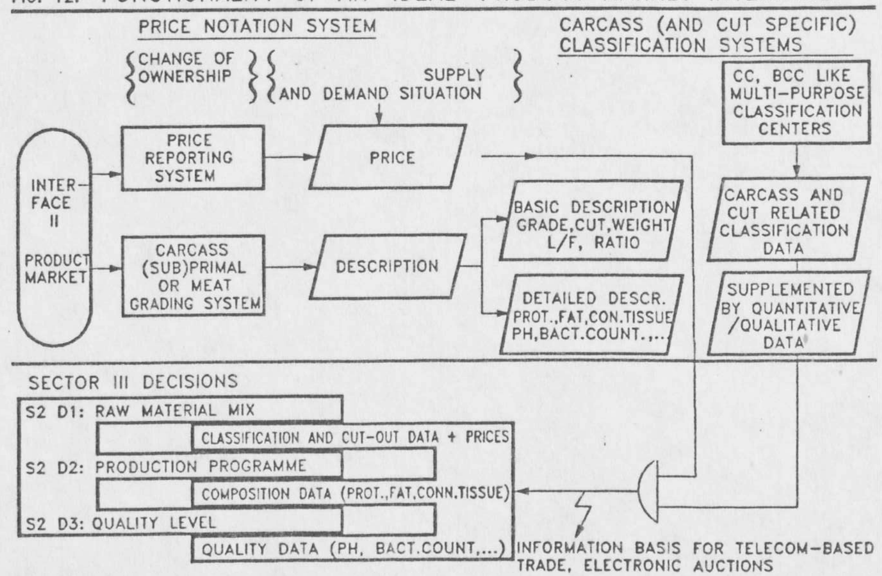


FIG. 12: FUNCTIONALITY OF AN 'IDEAL' PRODUCT MARKET INTERFACE



In the animal production sector, for example, the main decision varibles are the selection of the slaughter weight as well as the initial choice of the breed (12). Thus, an ideal raw material market interface should be designed to answer these questions ((3), (5)) or at least to support these key decisions.

Comparable considerations can be applied to the slaughterhouse/meat customer interface, which too should be designed in a way that it supports decision making in the meat processing industries in an optimal way. For determination of the cost minimal raw material mix, a meat processing firm needs, above all, a clear description of the available raw material as far as (predicted) cut-out and the chemical analysis are concerned.

Additionally, quality parameters such as pH and bacterial count are highly appreciated for the judgement whether the material fits into the firm's production plan or not.

These market interfaces (fig. 11 and 12) which basically serve the purpose 'change of ownership' normally consist of a price as well as a descriptive component; the latter being the result of the classification process. In an 'ideal' system it should be easy to 'translate' a live grade description into a carcass description, as well as to 'translate' the live price into a 'slaughtered' price and vice versa.

As far as the current EEC regulations for pigs are concerned, it is (almost) impossible to translate weight based live grades into reliable total lean meat % based carcass grades and vice versa.

Additionally, the pricing system should tell something about desired animal/carcass traits or their defects (3), which implies that the price/value for an animal should be broken down - by means of regression methods (fig. 13) - into components that tell something about the value of specific animal traits (10). A stepwise regression as provided by many statistical programme packages (e.g. SPSS (16)) can be very helpful in identifying the most important traits. Such a value assignment to animal traits from the side of the slaughterhouses would help farmers to identify the optimal breed, the optimal weight and would additionally clarify the buying competitiveness of slaughterhouses.

The use of electronic marketing/auction systems, too, will depend heavily on the ability to describe animals as well as to determine animal value by assigning value to its traits.

III. Closing Remarks

Future modular-multipurpose classification systems should be able to serve these different internal and external purposes. A precondition for the development and implementation of suited technologies is a clear-cut outline of their intended functionality (logic design). Instead of starting a direct

ATION OF BEST ESTIMATES FOR ANIMAL/CARCASS VALUE

ANIMAL NO. / S FICATION DATA	1	2	3	...	n
VE WEIGHT [kg] [xxx.xx] RCASS WEIGHT [kg] [xxx.xx] NGTH [mm] [xxx.xx] T DEPTH [mm] [xx.xx] EAT DEPTH [mm] [xx.xx] US ADDITIONAL IMAL/CARCASS DATA EATED BY CLASS. CENTER					
LCULATED LEAN MEAT % FECTIVE LEAN MEAT %					
UT-OUT DATA AM [KG] [GRADE] [PRICE] HOULDER LLY UTLET					
TURN PER CARCASS (ANIMAL) RIABLE COST					
EATED VALUE BY SLAUGHTERING	xxxx.xx	xxxx.xx	...	...	...

SSION	1 V = f (% LEAN)	$R^2=$
	2 V = f(WEIGHT,FD,MD,∢)	$R^2=$
	3	$R^2=$
	4	$R^2=$

discussion about different techniques, the intention of this paper was to give, first of all, an outline of how we think an 'ideal system' with 'perfect technology' should work.

Once the logical design of a strategic technology - such as the classification centre - is well defined, the contruction and implementation is but a clear engineering task, a very demanding, but mostly feasible one.

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