TOWARDS A DATA BASE FOR A SLAUGHTERHOUSE MANAGEMENT INFORMATION SYSTEM

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I. Introduction

This paper outlines a general framework for a Slaughterhouse Management Information System (SMIS). Special emphasis is given to the problems connected with the necessary data design and generation in order to be able to run such a system.

At first a "top down design" of the total system proposed is presented. It starts with the primary management goals, is followed by the tools which are indispensable for an informed management and which themselves have to be provided by suited management tools (such as EDP, Data Base Systems, Electronic Grading Devices) and ends with the outline of the due data design and generation of all the involved (slaughterhouse and animal related) areas. In this context, in a second step a conception is being presented that enables management to implement the necessary integration of direct costing data, (carcass) classification data and a subsequent determination of possible pay-out prices. This integration is the "essence" of a Slaughterhouse Management Information System due to the axiom that no management can pay out more for an animal/carcass (in the long run) than it gets for it on the market minus the costs involved in converting the animal to salable products (10, 11, 15, 16). Based on these key elements, examples for the management tools pay-out price evaluation and evaluation of production program are given. These (and other) tools enable management to take better decisions, thus significantly improving economic results.

An additional effect is a distorsion free transfer of final product market signals back to farmers/breeders, which too leads to better decisions/results in this area. Finally, the proposed Management System can easily be expanded to analyse the income contribution of different customers and sales outlets.

II. The Slaughterhouse Management Information System and its Data Base

Top Down Design of the System

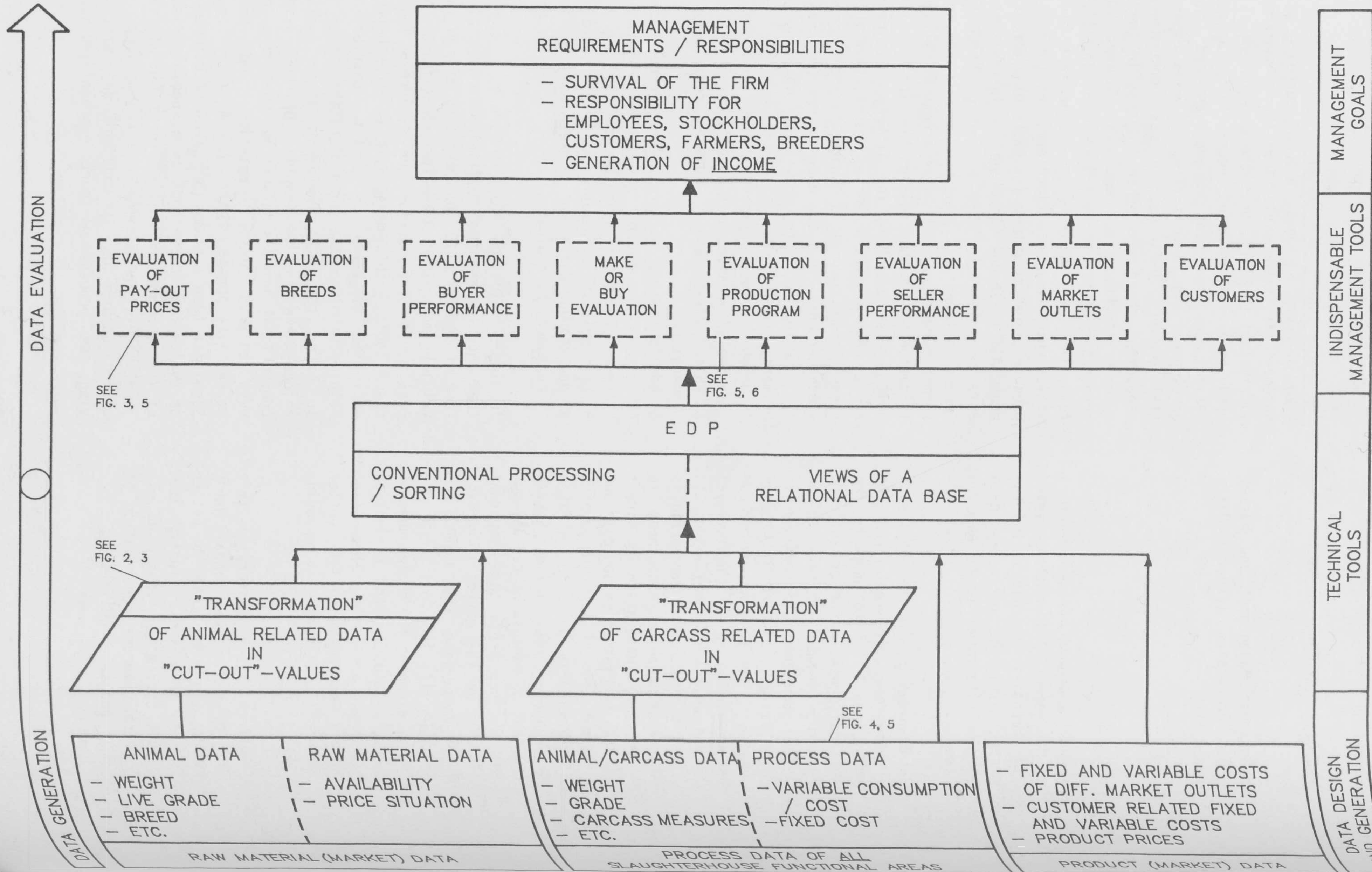
Like in every business, a slaughterhouse management is responsible for the (longterm) survival of the firm. Only the wise use of all production factors can secure this target. Besides the management of employees and (the development of) their skills, which is essential to every business, for a slaughterhouse management there are other business partners such as stockholders, customers, farmers and breeders who have to be solicitated. In addition, the total facility has to be kept in a status which ensures a (longterm) "readiness to produce", just to name a few tasks of a management. All these and additional obligations can only be fulfilled, when a certain level of income is (constantly) generated. Thus, an informed management must have access to an Information System that relates the firm's profit and loss statement to the different business areas where profits or losses result. When this breakdown of sources of income is made for a slaughterhouse in a top down design (see FIG. 1), the following decision areas have to be primarily considered:

1. Which pay-out prices should apply for animals/carcasses with specific traits?
2. Which breed would enhance contribution margins?
3. How could buyer performance be evaluated?
4. What is the optimal production program in terms of a contribution margin?
5. How could seller performance be evaluated?
6. How could different market outlets and customers be evaluated?

If these evaluations (32) are done in a way that they represent a realistic economic picture of the firm (19, p. 29), they are an invaluable management tool for identifying the real causes for success (or failure). Thus, these tools enable management to make better decisions in terms of profit contribution helping to ensure the survival of the firm.

In todays business environment these evaluations have to be provided by EDP using conventional processing/sorting algorithms or even better by using a relational data base system like ADABAS, DBASE or similar systems. Such data base systems (34) allow a print-out of evaluations to be made as a special "view" of the firm data which is stored (in minimal form) within the system. Since no business can afford "garbage in - garbage out" data processing, the process of purpose-orientated data

CONSTITUENT ELEMENTS OF A SLAUGHTERHOUSE MANAGEMENT INFORMATION SYSTEM (SMIS)



generation and evaluation deserves the unqualified backing of management.
Within the proposed slaughterhouse management information system these data needs concern the raw material (market) area, the slaughterhouse process areas, as well as the (product) market area. A critical point within this top down concept is the transformation of animal/carcass classification data into cut-out data, the latter only being able to serve a useful purpose within an information (accounting) system. This aspect will now be discussed further.

Conception to integrate animal-/carcass classification data with direct costing and pay-out price evaluation

In FIG. 2 the basic structure of such a conception is drafted, starting with the (main) functional areas - these are transportation, slaughter, disassembly and distribution - and their economic equivalent which is variable (volume dependent) and fixed costs and in the case of the sales and distribution department in addition returns. Based on this economic data in a backward orientated calculation (10, 16, 26, 31) margins per animal/carcass can be evaluated and a "planned" pay-out price can be derived. This is only possible if information about cut-out values that will result from the disassembly process (and for which later on returns are obtained by the sales department) is forcasted precisely by the classification system (and a subsequent data transformation system) at an earlier stage of the process. Additionally, these possible pay-out prices have to be related to the traits of the respective animals that were used as process input. This combination of direct costing data and classification data secures the bottom line of the slaughter business - that the pay-out price for a specific animal must always be less than (at max. can be equal to) the respective returns minus the variable costs of processing it. Additionally, there should be something left to cover a certain part of the fixed cost block as well as to generate a (planned) per unit profit.
Thus an informed management must always have up-to-date evaluations at hand which show that this basic relationship between returns, costs and pay-out prices is always maintained (Greer, (11)).
FIG. 3 gives more details of the proposed integrated system of cost accounting, classification and pay-out price evaluation. It presents a visualisation of (basic) direct costing principles as related to the slaughterhouse process.

At first, animal related returns are calculated as product of the effective cut-out vector multiplied by the respective price vector (cost vector in the case of waste, condemned), then the (animal related) variable costs of all involved functional areas are deducted, the result forming a so-called margin I (over variable costs) of the animal/carcass.

Then in a second step, a planned rate for covering fixed costs is deducted, the remainder forming a margin II (over fixed costs) of the animal. Out of this margin II (short term: margin I) the pay-out price for the animal has to be paid as well as a positive remainder - called profit - should result.
If this relationship is maintained for each and every animal, it is of course too maintained for the production in total, leading to a total plant profit - which can be considered as the "quality label" of good slaughterhouse management.

A problem incorporated in the slaughterhouse management information and control system is, that normally the (possible) pay-out price for animals has to be evaluated and paid out before actual performance in terms of cut-out vector (and price vector) is obtained. Thus, a management has to use "planned" or "estimated" values in much of its accounting procedures (see middle right part of FIG. 2 + 3).

An "ideal" classification system in this context - from a management point of view - is a system that produces minimal variances between forcasted and effective (live weight based) cut-out values. A step forward towards this goal would be to think of the classification process as a cycle to be regulated. If intolerable cut-out variances occur, an "ideal" system should have room to adapt either the parameters taken while classification and/or the transformation function (animal/carcass data → cut-out data) in order to fulfill its basic management task:
the most precise possible prediction of effective cut-out values.
(A much similar view of an "ideal" classification system is given by Luby, P. (17) and Schön, L. (35).)
Thus factors, that have to be paid much more attention within classification systems (4, p. 14) are:

1. What parameters should be taken during classification and why?
2. How can these parameters be best transformed into cut-out values?

FIG. 2

BASIC STRUCTURE OF THE CONCEPTION TO INTEGRATE ANIMAL–/CARCASS–CLASSIFICATION WITH DIRECT COSTING AND PAY–OUT–PRICE EVALUATION

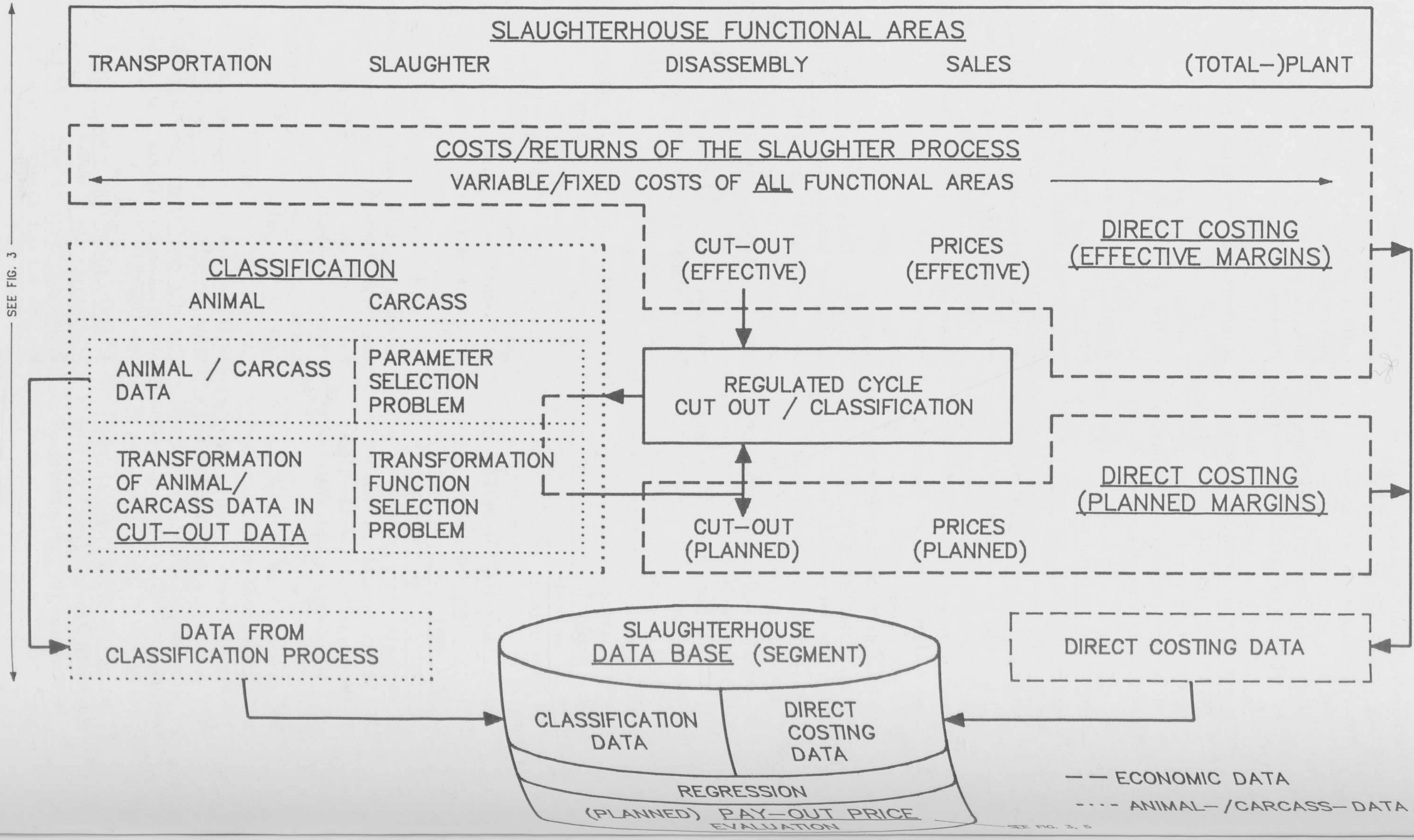
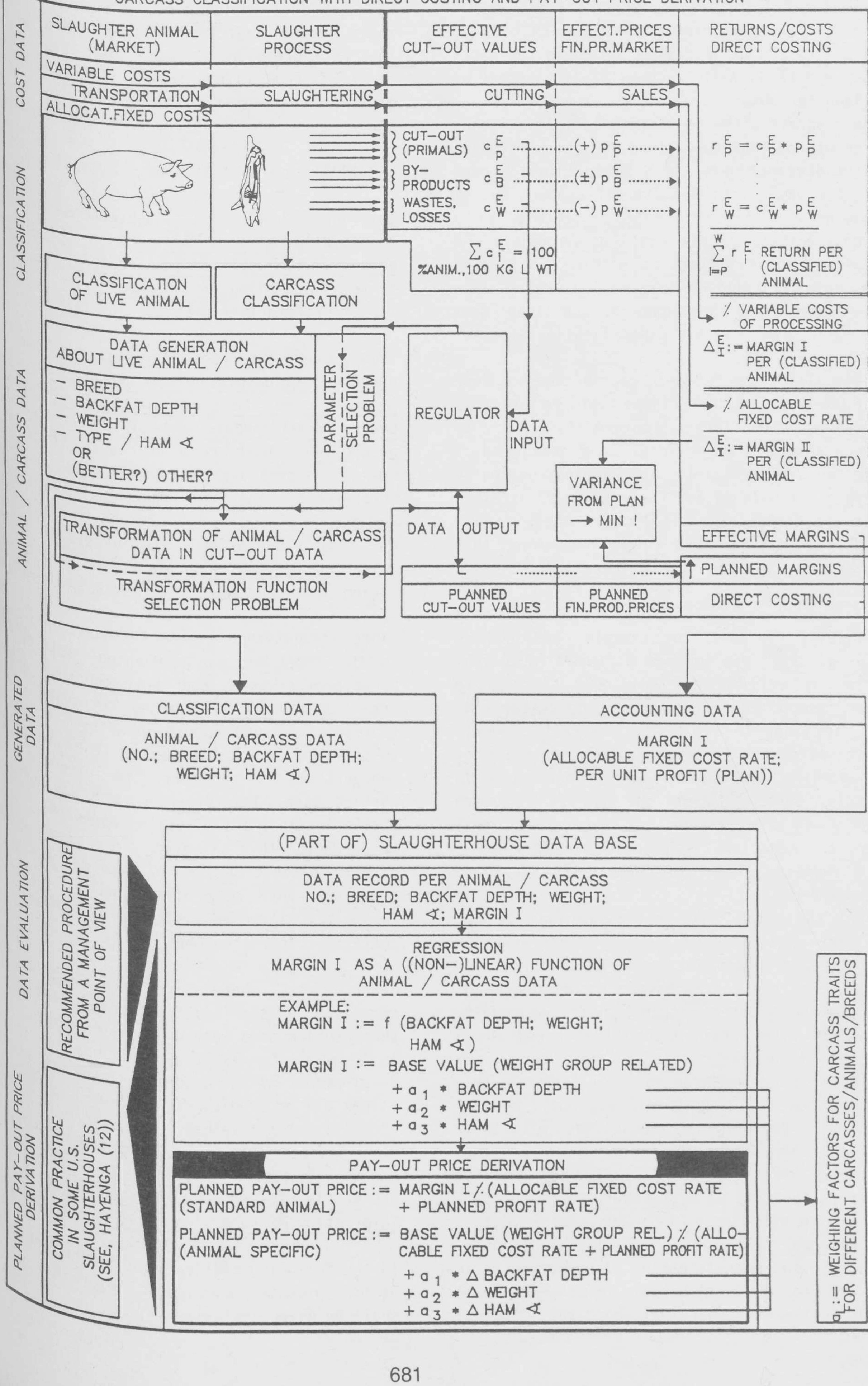


FIG. 3

FRAMEWORK FOR THE DATA GENERATION IN A SLAUGHTERHOUSE INTEGRATING CARCASS CLASSIFICATION WITH DIRECT COSTING AND PAY-OUT PRICE DERIVATION



Only with correct cut-out forcasts generated by a suited classification/grading system, a correct backward orientated evaluation of pay-out prices can be installed, which is the backbone of a financially responsible management of a slaughterhouse.
If one agrees with the above principles, it has to be stated that the actual EEC (pork) grading system does not serve this purpose in the best possible way (5, 6, 8). The EEC grading system produces a "total lean meat percentage" of a carcass/animal, a data that has obviously no clear-cut logical function within the drafted managerial acccounting/information system. (For a more detailed critique of the lean meat percent approach within classification systems, see Lorenz (16)).
Additionally, the EEC lean meat percentage concept does not differentiate between animals/carcasses of different conformation which by chance show a similar total lean meat percentage. When additionally, the same pay-out price is then established for these animals/carcasses that are definitely different in their (sub-) primal cut-out and thus in their returns, this represents a fundamental vulneration of basic accounting needs.
Some countries have (partly) recognized this difficulty, so that for example, the Netherlands quickly supplemented a "type" (muscling) factor as well as an additional class S to their form of the EEC pork grading system (24, 27), in order to avoid the severest economic fractions of the system; a similar adaption of the grading system has been implemented in Bavaria, Germany, where the SKG II is often used which also takes the "type" (muscling) into consideration by measuring the ham angle of a carcass. In Belgium this system has been recommended, too (7).
Since the total lean meat percentage in the EEC pork grading system is the result of apparatus-specific formulae using original carcass parameters, the latter have a higher degree of information content than their aggregate. Therefore, the question should be asked why a derived value like total lean meat percentage is being used in grading (and unfortunately very often in subsequent pay-out) systems instead of the original carcass data with their higher information content.
To solve this problem (20, 22, 23), in the lower part of FIG. 3 a procedure has been drafted, which has already been outlined in detail by Hayenga (12) and which is used advantageously in several leading slaughterhouses in the US. For each slaughter animal the basic data (estimated) margin I and the original (carcass) parameters carcass weight (CWEIGHT) back fat (BF) depth, and a muscling score (MS) index (or ham angle) are stored in a data file. Then a regression is made that explains the margin I as a (linear) function of these original carcass/animal data (lower part of FIG. 3). This is done for every weight group. RESULT:

$$MARGIN\ I = a + a_1 * BF + a_2 * CWEIGHT + a_3 * MS$$

This approach allows a slaughterhouse management to develop a premium/discount schedule with economically justified incremental price adjustments for animals/carcasses with different traits. For further details, see (12).

This procedure helps management to maintain the proper relationship between returns, costs and pay-out prices in an optimal way for each and every animal/carcass and thus for the total production, which is a necessity if it is to operate responsibly (and profitably).
Furthermore, the feeders/breeders obtain clearer economic signals concerning the "true value" of animals/carcasses with different traits, which too leads to a more sophishicated decision making in this area (also compare Bichard, M. (3)).
Since slaughterhouse managers are normally not in the forefront of developing sophisticated management systems, the above mentioned problem area has not yet been fully recognised by the (european) slaughterhouse industry. This is due to the fact that the majority of slaughterhouse managers was not yet forced to integrate direct costing with classification and pay-out price derivation in a total systems approach.
In Germany, this situation is changing because of the dramatic decline of profits in the last two years that very often changed into (big) losses (2, 21) in many slaughter plants. In this context, compare too Gans, K. (9, p. 213+ 214).

Newertheless, there have been some European firms that already felt that better solutions in this problem area were urgently needed.
In Denmark, for example, this has lead to the development of a grading system (25), that allows for a prediction of (sub-) primal part specific cut-out values. Such systems are easier to integrate into the logic of the proposed management system (FIG. 3), than the existing EEC grading system with the economically "dummy" information of total lean meat percentage.

In the following section more details (of parts) of the proposed management information system shall be given.

How to generate the necessary (process related) accounting data

FIG. 4 represents an example mass-flow-graph of the basic slaughterhouse operations. The mass-flow starts with the transportation of the raw material, is then reflecting clerical treatment by the live animal buying and trade department, then the raw material is send to the slaughter area, where in joint product production the halves and by-products result. Halves are sent to a cooler or processed further to (sub-) primals in the respective areas, which additionally, may process halves or primals/cuts that have been purchased by meat buyers if this procedure seems to be profitable. Similar basic production patterns are developed for all other slaughterhouse functional areas. Based on this picture of real operations, the necessary cost centers of an appropriate accounting system can be identified and departmental cost sheets (with a suited definition of their cost units) can be developed. (In a slaughterhouse, these units are mostly no. of animals, 100 %/kg live weight, 100 %/kg dead weight, but other units to which costs can be clearly related to, can be additionally introduced, if appropriate.)

Additionally, some of a management's decision areas become obvious, for example:

1. What prices to pay out free ramp / free farm gate?
2. Should transportation be made by a self-owned truck-fleet or by a third party?
3. Is (additional) purchase of (certain) meat items profitable?
4. How far to process the raw material (carcass, primals, subprimals ...)?

to mention only a few of the most common decisions. In order to reach the best possible decisions/results, management must always have a clear-cut evaluation with the relevant accounting data at hand. The basis for these evaluations (also compare FIG. 1) can be furnished by a tailormade direct costing system. Its principle is, that for every cost center a breakdown of direct and indirect assignable costs is being made, differentiating between fixed (calculation period related) and variable (departmental volume related) costs. When this is accomplished, a management can simulate the (total) cost/revenue effect of different production volumes which is indispensable for any comparison of business alternatives (departmental production volume alternatives). In anglo-saxon countries, this breakdown of costs is usually made by defining cost elements as being variable or fixed already within the financial bookkeeping system.

The German system of Grenzplankosten- und Dekkungsbeitragsrechnung (Kilger (13, 14), Riebel (28), Scheer (33)) presents a more precise approach. This system is additionally based on technology related consumption standards as well as a standard price system.

Thus, variances between actual and standard consumptions (costs) of production factors (energy, labor etc.) can be better analysed and the responsibility thereof can be clearly assigned to department managers (control function of an accounting system). The output of the departmental cost sheets, which is mainly variable and fixed costs of the respective operation has then to be used intelligently in setting up the indispensable management evaluations/tools (FIG. 1).

As an example for such evaluations, the evaluation of margins of different production alternatives for grade (E, ...) hogs is given in FIG. 5. As a side effect, the possible pay-out price(s) can be determined simultaneously.

In this figure all cut-out data - that has to be furnished by an adequate classification system - are listed in a way that they represent 100 %/kg liveweight or in a logic sence the "recombined" animal (26, 31). Returns obtained and the variable costs involved in applying different production alternatives are then additionally transferred from the direct costing (revenue) system. This leads to a margin I for the production alternatives of grade E hogs. Then a (planned) fixed cost rate and a per unit profit is deducted, resulting in a <u>planned pay-out price</u>.

Since the raw material market does not always exactly reflect the thus obtained firm internal raw material price pattern, management should try to take advantage of this effect by considering the actual market price and evaluating - especially the <u>positive</u> - deviations from plan. Thus, profitable weight groups, grades, breeds etc. can be scanned with only minor modifications of this basic backward orientated calculation procedure.

Additionally, in an integrated breeder-feeder-packer system, better recommendations concerning the <u>"true" value of breeds</u>, <u>carcass traits</u>, <u>weight groups</u> etc. can be made if adequate information is generated and evaluated as drafted in FIG. 3 and FIG. 5.

Finally, in FIG. 6 a summation of all grade related evaluations (according to the procedure outlined in FIG. 5) for a specific weight group is created which serves as a report for top management.

FIG. 4

FUNCTIONAL AREA AND COST CENTER ORIENTATED MASS-FLOW-GRAPH FOR A HOG SLAUGHTER PLANT (PART A)

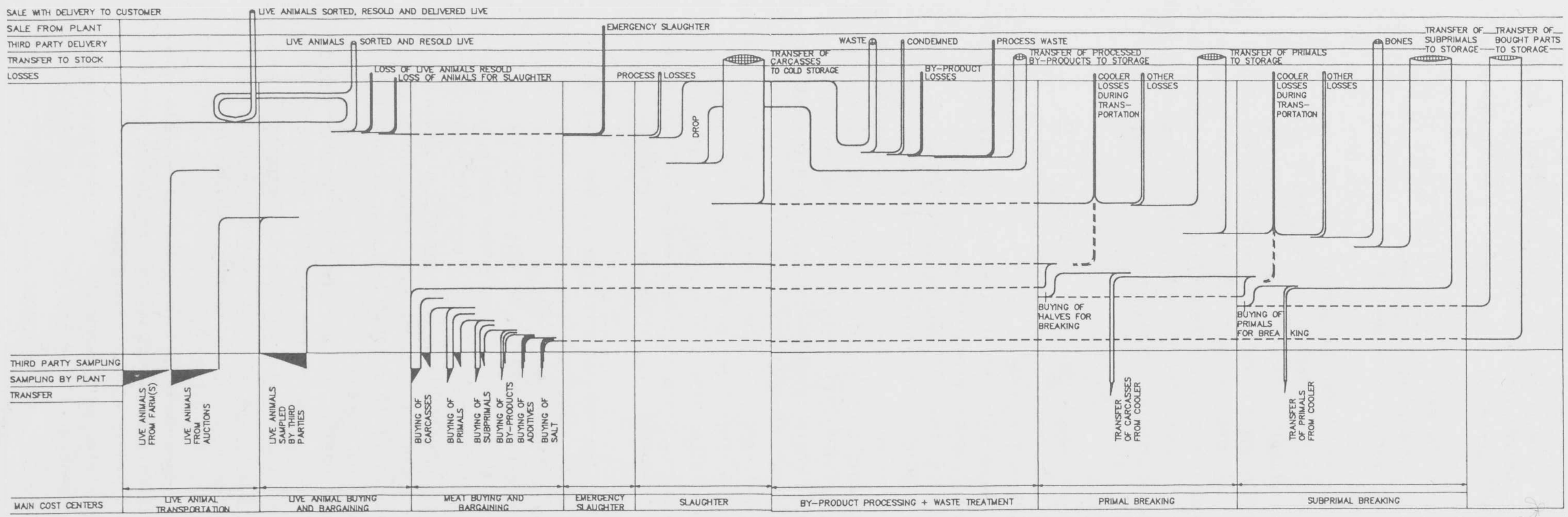
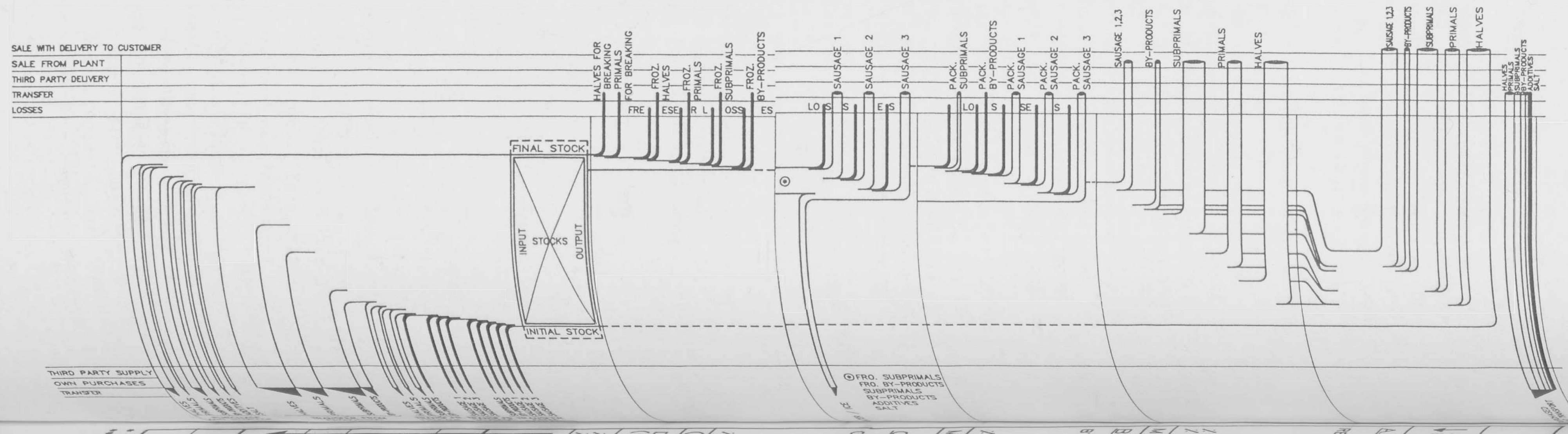


FIG. 4

FUNCTIONAL AREA AND COST CENTER ORIENTATED MASS-FLOW-GRAPH FOR A HOG SLAUGHTER PLANT (PART B)



EVALUATION OF MARGINS* OF PRODUCTION ALTERNATIVES FOR GRADE (E, ...) HOGS INCL. DERIVATION OF PLANNED PAY-OUT PRICES

PRODUCTION ALTERNATIVES → / ↓ ACCOUNTING DATA / ↓ CUT-OUT DATA	CUT-OUT OF THE ALTERNATIVE: 100 % OR KG LWT [DWT]	PRICES OF THE ALTERNATIVE: PRICE [PER KG]	SUBPRIMALS: VALUE PER 100 % LWT [DWT]	PRIMALS: VALUE PER 100 % LWT [DWT]	HALVES: VALUE PER 100 % LWT [DWT]
A. CARCASS RELATED DATA					
RETURNS		$\times \vec{p} =$	RETURNS FROM SALE OF SUBPRIMALS	RETURNS FROM SALE OF PRIMALS	RETURNS FROM SALE OF HALVES
CARCASS WT (COLD)	78,39				
COOLER SHRINK	0,50				
CARCASS WT (WARM)	(78,89)				
./. VARIABLE COST OF SUBPRIMAL PRODUCTION					
./. VARIABLE COST OF PRIMAL PRODUCTION					
MARGIN OF CARCASS			272,80	302,48	275,58
B. BY-PRODUCT RELATED DATA					
BY-PRODUCT RETURNS		$\times \vec{p} =$	RETURNS FROM SALE OF BY-PRODUCTS		
BY-PRODUCT WT (SALE)	10,06				
BY-PRODUCT LOSSES	3,00				
BY-PRODUCT WT (WARM)	(13,06)				
./. VARIABLE COST OF BY-PRODUCT PROCESSING					
MARGIN OF BY-PRODUCTS			8,45	8,45	8,45
C. WASTE RELATED DATA					
COST OF WASTE DISPOSAL		$\times \vec{p} =$	COST OF WASTE DISPOSAL		
WASTE WT (PAYED)	7,55				
WASTE SHRINK	0,50				
WASTE WT (WARM)	(8,05)				
./. VARIABLE COST OF WASTE TREATMENT					
(NEGATIVE) MARGIN OF WASTE DISPOSAL			./. 0,60	./. 0,60	./. 0,60
D. SUM A + B + C (:= LIVE WT)	100,00		280,65	310,33	283,43
./. VARIABLE COST OF SLAUGHTER ./. VARIABLE COST OF OTHER COST CENTERS			./.11,11	./.11,11	./.11,11
Δ_I MARGIN I (ANIMAL RELATED PER 100 % OR KG LWT [DWT]) (SHORT TERM MAX. PAY-OUT PRICE)			269,54	299,22	272,32
./. ALLOCABLE FIXED COST RATE			./.20,00	./.20,00	./.20,00
Δ_{II} MARGIN II (ANIMAL RELATED) (AFTER FIXED COSTS)			249,54	279,22	252,32
./. PLANNED PER UNIT PROFIT			./. 2,50	./. 2,50	./. 2,50
FIRM INTERNAL RAW MATERIAL VALUE ** (PLANNED PAY-OUT PRICE)			247,04	276,72	249,82
./. EFFECTIVE PAY-OUT PRICE			./.249,12	./.249,12	./.249,12
VARIANCE FROM PLAN			./. 2,08	27,60	0,70

* all data is to be interpretated as "model data"
** transformation in values related to 100 kg deadweight or per head possible, but here omitted due to reasons of space

This report outlines clearly the economic consequences of different production alternatives for the different grades, so that management can choose the most profitable way of operation. The information of which grade and/or weight group is being used advantageously in the different production channels then forms an invaluable tool for profitably balancing the slaughterhouse's total product demand with the raw material input and production capacities.

The majority of the necessary evaluations to which a slaughterhouse management should have access to can be developed on the basis of the calculation methods outlined in FIG. 3 and FIG. 5; for example, an evaluation of buyer performance can be made by simply comparing the actual pay-out prices of a buyer with the planned pay-out prices and aggregating the variances. For a more detailed outline of this procedure taking the skill of a buyer to grade (live) animals additionally into account, compare AMI (1).

When these fundamental (raw material input and production related) evaluations have been implemented by a slaughterhouse management, a similar analysis of the sales area of the business should be done (30). Evaluations to be created in this area concern the relative profitability of different customers and market outlets, respectively. The due data basis for these evaluations can be furnished by applying the same data design and generation principles (technological process breakdown, direct costing) as this has been drafted in this paper for the production sector.

Up to this point, accounting aspects have mainly been dealt with, so that the question may arise how quality aspects should be dealt with in the proposed system.

<u>How to integrate quality aspects in a slaughterhouse management accounting system</u>

In this context the first statement is, that in <u>no</u> business an accounting system is set up to secure quality (see too (18, 29)). The second statement is that the outlined <u>basic logic</u> of slaughterhouse management <u>does not change in any way when management is dedicated to "quality meat" production</u>.

Thus, the very simple solution for integrating quality aspects in the proposed system is to label products of higher quality (which show no PSE-character) accordingly and to differenciate sharply their returns, costs and pay-out prices from products of normal (minor) quality.

Then the key question whether the production of high quality products pays out or not will be, whether the consumer is willing to pay an adequate price for these products. An answer to this question can easily be generated by the proposed management information system, if all the outlined accounting procedures are done in parallel for high and normal (minor) quality products/raw materials.

<u>III. Closing remarks</u>

The proposed management information system will serve as a useful decision-making aid for slaughterhouse managers. It clearly outlines the most profitable course of action to be taken by revealing the real sources of income and is additionally a useful instrument in controlling departmental and total plant costs. Thus, it represents a invaluable management tool in preventing financial losses or vice versa in applying sound business policies leading to success.

The major obstacle in implementing the proposed slaughterhouse management information system presumably consists of the problem of setting up adequate classification (and (sub-) primal specific cut-out prediction) systems that take the basic accounting principles/needs of the slaughterhouse business into consideration. These needs especially concern the very precise prediction of (animal related) cut-out values by classification systems as well as the evaluation of economically justified pay-out prices for animals with specific traits.

Now, that this problem area has been focused on precisely, it should be possible to implement more sophisticated solutions by interdisciplinary efforts.

*) I owe a special word of thanks to

Hargens, R.: for programming (much of) the system on an MS-DOS computer as well as contributing a lot of practical ideas,

Krell, E.: for assistance in constructing details of the direct costing system,

Rehmer, Elsa: for her full engagement in elaborating all figures with an AutoCAD system.

<u>IV. References</u>

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FIG. 6

MANAGEMENT REPORT (AN ILLUSTRATION)

GRADE RELATED MARGINS PER WEIGHT GROUP DUE TO PRODUCTION / SALES ALTERNATIVES
(RAW MATERIAL WEIGHT GROUP: 90 KG LWT; CALCULATION BASIS: 100 % OR KG DWT)

GRADE	PRODUCTION ALTERNATIVES	MARGIN I	ALLOCABLE FIXED COST RATE	MARGIN II	PLANNED PER UNIT PROFIT	FIRM INTERNAL RAW MATERIAL VALUE	EFFECTIVE PAY-OUT PRICE	OVER / UNDER PLAN	GRAPHIC (positive values: +) (negativ. values: −)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				(3 = 1 − 2)		(5 = 3 − 4)		(7 = 5 − 6)	
E	HALVES	340,92	25,03	315,89	2,00	313,89	313,00	0,89	
	PRIMALS	374,60	25,03	349,57	2,00	347,57	313,00	34,57	++++++
	SUBPRIMALS	337,44	25,03	312,41	2,00	310,41	313,00	− 2,59	
	COMBINATION	383,04	25,03	358,01	2,00	356,01	313,00	43,01	+++++++
U	HALVES	308,58	25,16	283,42	2,01	281,41	289,99	− 8,58	−
	PRIMALS	258,59	25,16	233,43	2,01	231,42	289,99	−58,56	−−−−−−−−−−
	SUBPRIMALS	308,05	25,16	282,89	2,01	280,88	289,99	− 9,11	−−
	COMBINATION	320,05	25,16	294,89	2,01	292,88	289,99	2,89	
R	HALVES	284,32	25,70	258,62	2,05	256,57	263,95	− 6,37	−
	PRIMALS	262,21	25,70	236,51	2,05	234,46	263,95	−28,49	−−−−−
	SUBPRIMALS	283,12	25,70	257,42	2,05	255,37	263,95	− 7,58	−
	COMBINATION	295,12	25,70	269,42	2,05	267,37	263,95	4,42	+
O	HALVES	267,92	26,07	241,85	2,08	239,77	233,92	5,85	+
	PRIMALS	310,52	26,07	284,45	2,08	282,37	233,92	48,46	++++++++
	SUBPRIMALS	311,52	26,07	265,45	2,08	263,37	233,92	49,45	++++++++
	COMBINATION	322,66	26,07	296,59	2,08	294,51	233,92	60,59	++++++++++
P	HALVES	250,91	27,69	223,22	2,21	221,01	220,79	0,21	
	PRIMALS	283,03	27,69	255,34	2,21	253,13	220,79	32,33	+++++
	SUBPRIMALS	284,84	27,69	257,15	2,21	254,94	220,79	34,15	++++++
	COMBINATION	303,24	27,69	275,55	2,21	273,34	220,79	52,55	+++++++++

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