1977

Representative Iowa swine production systems: budgeting analysis with computerized modelling procedures

Terry Jon Wood
Iowa State University

Representative Iowa swine production systems: Budgeting analysis with computerized modelling procedures

by

Terry Jon Wood

A Thesis Submitted to the

Graduate Faculty in Partial Fulfillment of

The Requirements for the Degree of

MASTER OF SCIENCE

Department: Economics
Major: Agricultural Economics

Signatures have been redacted for privacy

Iowa State University
Ames, Iowa

1977

TABLE OF CONTENTS

CHAPTER I. INTRODUCTION

Swine production, as measured by the number of hogs marketed per year, has traditionally been a major agricultural industry in Iowa. According to national statistics, Iowa ranks first in the United States in pork production, and annually produces almost 25 percent of all hogs marketed.[1] Thus Iowa swine producers are constantly seeking improved methods of producing hogs.

Swine production takes place in a variety of systems ranging from relatively primitive open-pasture farrowing to the more recent appearances of modern total confinement birth-to-market "pig factories." A farm firm that wishes to produce hogs has a large variety of systems to choose from. The existing physical resources, capital availability, labor supply, and personal choice all help dictate which system to choose. Not only are single farm operators involved, but increasingly, so are corporations, partnerships and cooperatives. Many of these multiownership organizations are composed of individuals with major nonfarm interests.

Several factors contribute to this growing interest in different swine production facilities. Initially, though hog prices have fluctuated in recent years, swine production has remained a relatively profitable farming enterprise. This profitable situation, in addition to the need for lower labor requirements, has led to an increased awareness by producers of the different hog production systems available.

[1]Dr. L. L. Christian, lecture notes, Animal Science 425, Iowa State University.

Secondly, the premium values placed on productive Iowa farmland by profitable crops have caused farmers to seek swine production systems which require little land. Also, higher priced land makes purchasing land difficult for swine production.

This second reason should be expanded to better understand the sequence of events that have brought the swine industry in Iowa to its present state of production diversity. Beginning perhaps twenty years ago farm size, measured in acreage, began a rapid increase. Two major factors which contributed to this increase were labor availability and increased prices. Labor contributed to these two factors in the form of an exodus from agriculture. Alternative labor opportunities off the farm caused an outmigration leaving fewer farm workers. In addition, improved farm technology increased the productive value of the existing farm labor, requiring still fewer farm workers.

The other major factor, prices, are a direct result of inflationary farm values. Adaptation of new, improved farming technology both increased the farmer's business investment and his farming efficiency. The farmers who failed to adopt these newer technological advances, became relatively less efficient and many were forced out of farming. This new technology was adopted by farmers through either the expansion of farm acreage or the increased volume of livestock production or both. Nonetheless, the effect remained the same--farms increased in size, both in dollar investment and/or acres while the number of practicing farm operators declined.

With a decreasing amount of available farm labor, the remaining farm enterprises must shift from a labor-intensive agriculture to a capital-intensive agriculture which reduces the labor requirement per unit of actual production. Parallel to this capital-for-labor shift comes the advancement in the development and adoption of a capital-requiring technology. In an essay on farm-firm growth, Kay states that with the expansion of row crop acreage, the initial technological advances assume the forms of large scale machinery--combines, tractors and tillage equipment--which have high fixed costs in comparison to their relatively low variable costs [21, p. 2]. Meanwhile, the farmer who expands his output by more intensive livestock enterprises realizes these higher fixed costs in the form of feed-grain storage and handling systems, enclosed confinement structures, and elaborate automated waste disposal construction. Whether the farm expansion is through cash-grain or livestock operations, the farm manager realizes that the cost advantages of the new technology can only be gained by spreading these larger fixed costs over more units of production.

These changes in livestock production can be focused to subjectively present three different methods of hog production. In no way do these three systems represent the entire Iowa swine industry. Rather, they are merely illustrative of the wide variety of present pork production methods in use.

One method of hog production would picture the individual producer operating on a modest scale with no major financial commitments to farmland purchases or elaborate facility investments. One prototype would be a small farrow-to-finish operation in which the facilities are minimal but adequate with low overhead costs. The feed grains could be almost entirely homegrown and the operator furnishes most, if not all, of the labor.

Secondly are the hog producers who have consistently expanded their swine programs along with increasing their acreage. His animal numbers have steadily increased in conjunction with an increased availability of feed grains. This operator has taken full advantage of the new technologies of capital-intensive swine production facilities. These labor-saving devices may be environmentally-controlled farrowing, nursing and/or finishing units, with the attendant automated feeding, cleaning and waste disposal systems, all of which require a minimal need for seasonal outside labor.

Third are the automated, capital-intensive swine operations situated on a relatively small tract of land (10-40 acres) and operated by a salaried manager. This swine system maintains its outside capital reserves and operating funds from both farm <u>and</u> nonfarm investment sources.

This "investment group" can be best described as a hog production cooperative. Initially, some hog production cooperatives consisted of farmers banding together and producing a specific type of market animal. A common example of this cooperative venture has been with farmers in a local area building a central farrowing structure, hiring an outside manager, and then purchasing part or all of the feeder pigs for finishing on their respective farms. An older farmer may use this "feeder pig cooperative" because of the labor savings, while a younger producer may participate in this enterprise because of the cost-benefits gained by the larger farrowing unit. Whatever the personal reasons, a cooperative production unit can offer to its investors construction cost savings, economies of scale in operating costs, and a more reliable supply of healthy market or feeder stock.

Though practicing farm operators are the cooperators in an above production venture, some recent trends suggest that nonfarm investors are increasingly contributing capital start-up funds. The objectives of these nonfarm investors may not only be a reliable product from the cooperative, but also the overall return on investment. This return may be a direct dividend per dollar invested, or indirectly, in the form of tax advantages through write-offs, investment credits, or real estate trusts. From an agricultural standpoint, the initial composition of this production unit depends not only on the make-up of the farming individuals in the group, but also the desires of the nonfarm investors and the overall return on everyone's investment capital.

Whatever the composition of this enterprise, the investment nature of a cooperative project places four constraints on that system:

1. a small acreage land base because of the total-confinement nature of the swine enterprise;
2. the required purchase of all feed grains, in addition to all other feed and nonfeed inputs;
3. automated confinement systems for all phases of the operation--farrowing, nursery, finishing--and, feeding and waste disposal construction;
4. the availability of qualified and experienced management.

Although the fourth constraint is necessary for profitable operations of any size swine system, it is most important with an investor-owned, highly capitalized and high volume swine confinement program. Without skilled management, the problems of farrowing schedules, least-cost ration formulations, marketing/price analysis and disease control become insurmountable.

These three basic swine production adaptations have been specifically developed to form a broad base from which to establish, categorize, and manipulate a limited number of representative Iowa swine production systems. However, these broad representations carry within their descriptions some small variation which forms literally hundreds of different swine production systems. Some immediate variations may consider the dissimilarity of building structures as related to the total number of hogs marketed, and also the limits to growth among similar production systems. Another variation may consider the ages of different farm operators in their desire to expand hog production. Would one type of individual expand his operation because of a known future source of reliable labor (i.e. college sons returning to the family farm)? Has the farmer in the second group been expanding his swine enterprise to absorb his increasing feed grain output from additional row crop acres, or vice-versa; does he add more acreage to fuel his expectations and building plans for a more profitable expansion within his hog operation?

The composition of investor group III raises interesting and provocative questions. For instance, was this sudden, outside interest in swine production attracted solely by the profitability in hogs? What will be the future basis for this interest when traditionally cyclical hog prices decline--will production continue because of tax write-off implications or will it be abandoned? Have these nonfarm investors been close enough observers of agricultural fluctuations in the past to rely on the judgments of the farm managers hired by them?

Indirectly and within this study, a suitable answer to some of these questions may be found. The purpose of this paper is to present basic descriptions and budgeting representations of Iowa swine production systems. The budgeting technique itself may indicate the circumstances that make one swine system more desirable to a particular individual or investor group. However, the ultimate purpose of this study will be to establish, through input data estimation and computerized budgeting techniques, some guidelines by which new investment within an existing swine enterprise may be profitably undertaken.

CHAPTER II. REVIEW OF LITERATURE

Many swine production systems have been developed by various agencies for their own particular use. The approaches have been as varied as the final objectives sought by the researchers themselves. As a result, there has been disagreement in the definition of what is a "basic, representative" swine production system. One field of interest, composed of farm operators and extension personnel, agree that a basic swine system should reflect conditions faced by the practicing hog producer. University researchers and statisticians, on the other hand, define representative operations within the computerized methods of secondary material estimation and statistical extrapolation.

To better understand this latter group, a brief reference to a recent study is presented. Finley, Devisch, and Retzlaff [12] estimated different hog production units using data from university research, farm business records, and housing facility contractors to develop a series of standards on which representative swine budgets were constructed. Six basic swine capacity levels were constructed to estimate some economies of scale in swine production. The answers they sought were obtained by altering the type of system, using different types of farrowing structures and intensities, or by changing the physical production capacities of given swine operation. Through each modification they asked if the benefits derived justified the additional costs, either in construction expenditures or in additional management skills. The fundamental problem with this secondary data approach is whether the information or parameters accurately measure the specific swine production model.

Previous work by Crall [11] attempted to quantify and validate the estimated data into swine modelling systems before he computed the economies of scale between different hog production schemes. Crall's procedure was to classify swine management systems on the basis of existing survey and budgeting data. His modelling classified three management systems into ten levels of production ranging from 25 sows to 1000 sows. Each production level was then divided into four phases (gestation, farrowing, growing, and finishing) with each phase containing fourteen different items of production--buildings, equipment, number of sows and boars, feed supplies, etc. With careful budgeting, a series of short-run cost curves were developed for each system.

The budgeting systems, as defined, are useful when considered within the framework of unlimited management and resource capabilities. Neither of these assumptions specifically pertains to any arbitrary justification for a basic, representative swine system. Both Crall's study and the previous work represent empirical estimations of swine systems that have unlimited horizons for increasing hog production. Both studies optimize production at different levels, and also offer some definition of what a basic swine system constitutes. However, the organization of a representative swine program should include direct data from practicing producers that operate viable hog production enterprises.

Galm [13] gathered statistical information from 489 Iowa swine producers. Within a rigid outline, these randomly-drawn producers were divided into six size categories ranging from less than 100 hogs produced to those farmers marketing 1000 or more hogs annually. Within these size categories he fitted information about the physical facilities and input mix each farmer employed to produce a given number of hogs. As an end result, different types of production systems were identified within each size production group. Galm did not attempt to optimize any existing hog operation, but instead described the various combinations of swine production employed by hog producers. The descriptive nature of Galm's production systems is illustrated by the guidelines he set forth:

> (Because of this study)[1] . . . farmers should benefit directly by the knowledge of production practices and trends common to different size categories of producers. It is not apparent that any particular production system is best for all producers. However, an inventory of current production practices will provide information needed by producers in their decision-making activities. An inventory of the current production practices will also provide an indication of producer response to changing economic conditions [13, p. 3].

To specifically describe a basic and representative Iowa hog operation, one paper has dealt exclusively with a detailed description of the physical requirements, prices, costs and given parameters of active Iowa swine production systems. Trede [32] organized thirty-six farmer participants within a fourteen county area of central Iowa who had maintained a rigid recordkeeping program of one year's duration. The farm records required by the participants included complete inventories and financial records of all farm business transactions. These records were also gathered as they related to the swine production system on each farm [32, p. 12]. Each participant was asked to define, in precise terms, the nature of his hog operation and, particularly, the information relating to the fixed capital investment in swine buildings and equipment. Trede realized the statistical limitations of using a small number of producers

---

[1]Parentheses added for clarification only.

from which to infer major conclusions in his study. But barring this example limitation, he justifiably argues the validity of his essay:

> However, by using a selected sample of willing cooperators with recordkeeping experience, the data collected will be more reliable and accurate. This study did not have as its purpose to (objectively) determine the popularity of a system, but rather to measure the requirements and benefits for producing swine under different production systems [32, p. 18].

Underlying these previous studies is a basic concern that most swine producers maintain their own sense of what is a representative hog operation. To visualize the average costs, prices, and profits of an efficient system, the producer must choose from a vast range of separate facility items needed for the construction or remodeling of his present operation. These physical requirements and prices can be estimated from secondary materials gathered from distinct and separate farm studies which, given the descriptions of actual working hog farms, can serve as a reliable base for future estimations. Within this present study, an attempt is made to estimate, categorize, and budget representative swine systems. By this method of data presentation, a farmer can best establish what <u>he</u> feels is a basic and efficient production unit applicable to his farming operation. In turn, an extension individual can also make useful representations of "typical" swine operations through this system of budgeting data.

CHAPTER III. OBJECTIVES AND PROCEDURES

As discussed in the introduction, swine production systems have become more capital-intensive, more specialized with respect to the specific phases of the swine life cycle and more restrictive as to capital management and planning. The actual number of swine producers within Iowa has been declining with the number of hogs produced per individual increasing in volume. Subsequently, the primary areas of emphasis will be in the issues of swine production specialization and its attendant costs, budgeting procedures, and recommendations for modifying or expanding an existing swine production enterprise.

This study will attempt to seek some answers to the problems faced by a progressive swine producer, an individual who is committed financially and historically, or with personal preferences, to the continued production of hogs. Though recognizing the difficult start-up problems involved, the study will not consider the problems of getting established in swine production, but will assume that this initial hurdle has been overcome. The budgeting models to be built will focus on the established swine producer who wishes to modify his existing system. Some reasons for this modification may be to increase his personal income/consumption to reach a more efficient level of operation gained by economies of scale or to enlarge his system to better utilize his existing managerial potential.

Specifically, this study will:

1. Identify characteristic "representative" swine production systems within the Iowa swine industry, which will be

analyzed for each size group.

2. Determine the physical requirements for each system selected.
3. Obtain investment data corresponding to the actual physical requirements of the selected production systems.
4. Budget costs, both fixed and variable, and the calculated returns with reference to:
    a) land
    b) labor
    c) capital
    d) overhead
    e) risk, and
    f) management.
5. Develop recommendations, suggestions, and guidelines for producers who wish to modify their swine operations.
6. Identify alternative planning procedures which appear to be promising to future management uses by Iowa swine producers.

Procedures

The actual procedures used will depend upon two basic criteria. First, will the procedure be compatible with present information retrieval services, and with the knowledge of available computerized budgeting methods? Second, will the procedure adequately incorporate the relevant data from previous studies on swine production?

To adequately identify a limited number of "representative" swine production systems, previous swine studies will be reviewed to establish the basis for developing input data for common Iowa operations. With further exploration of this data, the specific systems are established with respect to four categories:

1. size (total hogs marketed per year)
2. farrowing intensities (the number of farrowing per sow per year)
3. degree of confinement (included in this category is also the alternate methods of waste management)
4. the physical restraints present for all systems (land, the availability of feed grains, labor, capital restrictions, level of management ability, etc.).

Physical facility requirements for the different systems can be estimated with secondary data sources from state agricultural experiment stations, previous swine production research data, and private industry sources, gathered from both practicing hog producers and commercial building contractors.

Cost estimations of the above physical requirements are established with similar secondary source material, but using current prices to validate this "bench-mark" data. With the present retrieval of information from state extension field staff and the current market information, these costs can be accurately established by using a best available estimate. The purpose of this concept is not to maintain a rigid and static set of production coefficients, but rather to allow future budgeting procedures to easily incorporate subsequent changes in input-output data.

Costs, once obtained and categorized, are further developed with the computerized assistance of the Oklahoma State Budget Generator. This computerized budgeting output is established for each of the respective production systems. The computer develops models simulating swine production of different production levels, farrowing intensities and parameter restrictions. The models, though designed for cost-return optimization, will lend themselves to testing various outcomes over a wide range of production and price coefficients. From these simulation production systems, a producer can align himself with the computerized budgeting model which best fits his actual program. By the comparison of actual management with a model illustrating the best available estimate of his operation, the possibility of major discrepancies within the data estimation can be held to narrowly defined dimensions.

With the development of production estimates using the computerized budgeting procedures, suggestions and recommendations can be forwarded to cooperating swine producers. Implementation of these production guidelines could be made directly through extension personnel and the state field staff. Farm publications, building suggestions to commercial swine systems contractors, or local lending institutions could serve as indirect channels to dispense this production information.

In conjunction with this dispersion of budgeting recommendations, the study may also suggest alternative and equally useful procedures whereby swine producers may receive data feedback for their operations. One possible suggestion may call for the necessary cooperation between farmers, lenders, extension personnel, and the extension field staff to reformulate and "de-bug" any existing computerized budgeting program not currently enjoying a high degree of participation by swine producers. With an existing program, a system could be devised which enables farmers to participate in a program's creation, to adequately understand the skeletal form of a computerized planning/budgeting model, and to manipulate his own swine program data without the constant intervention by outside state personnel. With these suggestions, several existing programming methods which approach the "ideal" criteria mentioned above could be analyzed and adapted to extension programs between producers and researchers.

In summary, it is the objective of this study to identify existing swine production systems and fit them into a workable extension system model - a model which would capitalize on the existing swine production data and programming procedures now available. This information would then be manipulated to be readily adaptable to the characteristic swine programs now in existence among Iowa swine producers.

CHAPTER IV. MODELS DEVELOPED FOR FARM BUDGETING

Conventional research procedures have been established which have developed two alternative methods of the budgeting concept. The first involves a "representative" approach developed from a normative or analytical model, a representation which is then used to examine the effects of different management decisions or the addition and subtraction of specific exogenous variables [14]. Normally, but not always, this type of model is largely confined to studying the major effects of management changes, be they large private firms or government program decisions [8]. A general farm model similar to the above description would probably be potentially capable of reproducing many specific farm optimizations, of differing size and organization. Blackie and Dent [8] have suggested that the potential range of production alternatives (even within a given geographical area) is often too large and diverse, and that any individual farm would only contain a subset of this range of alternatives. This type of model suffers from two important disadvantages. Initially, adjusting the general model to a specific farm will render large segments of the program redundant. Secondly, the business detail provided by a general model of acceptable size and cost of operation may not be sufficient for planning purposes. In most instances what finally occurs in the construction of a specific, purpose-built model for an individual farm is that the model correctly indicates a static optimal solution, but fails to fully integrate the aspect of farm budgeting as an integral component.

The second type of computer simulation is known as a "skeleton" model [7, 8]. This alternative relates to the construction of a budgeting model representing a logical computer-structured program and includes only the basic exogenous parameters of the real farm systems to be considered. This model becomes fully functional only when "coupled" with specific data from the individual farm and, in its "coupled" state remains unique to that farm. The farmer and researcher, together, compile this data which "fleshes" out the particular skeleton. Because the model must be capable of reflecting both the sequence and timing of feasible farming decisions which accurately convey the individual management policies, the program must have the capability to distinguish between different systems [8, p. 166].

Once the original skeleton model is developed and tested, a manager (the actual beneficiary of the model) can use the program on his own enterprise at a reasonable cost, and independently of the research consultant who had initially assisted in the original data manipulations. The farmer, having complete access to his private computer file, can easily make amendments if he decides to change his management strategies, or if additional data has been discovered, to substantially change his production guidelines. The computer makes the budgeting decisions based on selected and current farm inputs. These decisions represent the constant readjustment of a feasible management strategy from the present farm organization to one new and current which fully incorporates these new budget input decisions.

The Oklahoma State University
Enterprise Budget Generator

In terms of a local[1] "costs and returns" budgeting model which would be developed by state extension personnel, three basic components must be considered:

1. The budgeting procedure must reflect a degree of cooperation between the research staff and the field personnel who are ultimately responsible to the users for its interpretation.
2. The model must adequately reflect representative input data through some previous research, with updated monitoring by the research staff.
3. Budget projections must be reasonable approximations of what is occurring among practicing users--that is, the budget must be credible to the producers.

The Oklahoma State University Budget Generator [22] has met these criteria and among all possible budgeting models now used in costs and returns analysis, it shows the most promise for applications within the swine industry. The advantages of its input forms, its clarity of calculations, and its easily interpreted output will become apparent with further use. Before the model can be actually described, some background information for the budget generator is needed.

---

[1]The term "local" defines not a geographical area, but rather a livestock enterprise common to a particular region; in this instance, swine production in Iowa.

Buel Lanpher [23], of the USDA, mentions that costs and returns budget building has experienced a resurgence of popularity among both farmers and extension personnel in recent years:

> In (extension)[2] farm management particularly, budgets have been the backbone of the work with individual farmers, designed to assist them in making decisions, and as an aid in teaching basic economic principles. This has been true in a similar fashion for (nonfarm business) marketing programs where "feasibility analysis" has been the term used for cost and return budgets in providing assistance to marketing firms. (With these marketing strategies in mind) . . . extension has recently increased their emphasis on encouraging producers to carefully consider their production costs in the process of deciding whether to hedge or to use forward contracts [23, p. 27].

In addition to developing commodity marketing strategies, volatile farm prices and high production costs have led producers and extension staff to conclude that these highly variable input costs will mean greater importance for budgeting.

Besides the producer's desire to allocate scarce resources to his operation through budgeting, there are two additional factors that are making farm businesses more conscious of costs when making production decisions--inflation and uncertainty. Hinton [15] sees the constant pressure of inflation pushing future prices upward and the variability of year-to-year prices and production yields are producing wide swings in net profits. Because of this inflation uncertainty, he states that farmers need to do a better job of pricing and to understand the valuing of their assets. In addition, Hinton states that there is the need to help farmers understand the concept of costs that are being proposed as a basis for (government) income payments to agriculture. (That is,

---

[2] Parentheses added for clarification only.

"target prices" have conceptually replaced "parity prices" in the formula for income support payments to agriculture.)

The reasons, therefore, are well-established for the development of an adequate costs and returns budgeting procedure that will incorporate most of the production problems facing the farm producer.

A description of what model is sufficient to handle these above problems gives credence to the usage of the Oklahoma Budget-Generator. Lanpher [23, p. 29-30] specifically refers to the standardization of the Oklahoma model as a practical criterion for its use among extension personnel. He cites that because of this budget-format standardization, the ease of communication between researchers and users, and among professional colleagues would be increased. The format standardization reduces the difference between coefficients and input data. Lanpher states that normally more effort is expended sorting out the different assumptions of different conflicting budgeting models instead of actually examining the results of each model. The Oklahoma model reduces these differences, smoothing the way for the real analysis of the output data.

To best summarize this flexibility, Lanpher lists the traditional information problem areas in this output analysis. He projects better communications between:

1. state, regional and federal agricultural research workers,
2. different agriculturally related business organizations (e.g. the budgeting results desired by seed companies versus the output sought by country grain elevators),
3. Individual sub-farm enterprises (i.e., the same budgeting format can be applicable to hogs as well as cattle

feeding, plus all the row crop operations on an Iowa farm).

In addition, this flexibility is evident when a researcher, for whatever reason, wishes to side-step the standardized budget format, but can still achieve much of the budget's advantages by using the input forms and coefficient definitions.[3]

Finally, the model exhibits ease by which individual sub-farm enterprise budgets can be adapted to and integrated within the whole-farm aggregated production unit. Lanpher suggests two approaches to this aggregation:

1. The computerized budget-generator can be used in a supportive role for developing a linear programming sequence for the whole-farm enterprise.
2. The given analysis of a whole-farm enterprise may be disaggregated into its sub-farm components with the budget-generator. In this "reverse aggregation" the sum of the parts, reconstructed, will equal the existing total farm production.

The reasons for using the budget-generator as this study's "cost of production" model have been presented. However, the advantages and disadvantages of the Oklahoma model will become apparent within the actual workings of the budgeting process itself. These limitations will be explored in the remaining chapters, in addition to gathering and budgeting of Iowa Swine production data. These data will be measured and

[3]The swine productions to be later budgeted will illustrate this flexibility.

validated to determine its "fit" to the Oklahoma generator technique. The physical structure of the input form and the reinterpretation of the raw data into computerized language will further illustrate the model's capabilities.

CHAPTER V. BUDGETING AND DATA PRESENTATION

Specific Iowa swine production systems have been classified with respect to size, farrowing intensity, degree of confinement and the physical restraints or parameters common to all swine systems. This categorization, as previously defined in the procedures section, lends itself to two immediate advantages. For one, this classification of data is easily computed by the Oklahoma Budget Generator. Secondly, "whole systems" can be constructed, as in a farrow-to-finish operation, and then, in turn, be disaggregated into specific swine subsystems (i.e. farrow-to-feeder pig sales or finishing purchased feeder pigs).[1]

One method of representing a basic series of whole systems is to concentrate on three of the above categorizations and then to vary the fourth. For instance, a budgeting procedure could hold constant one system size, one degree of farrowing intensity, and also assume that the given parameters[2] are roughly equal across swine systems. The single variation is the degree of confinement. In this case the degree of confinement is varied by changing the physical structure of one or more housing units within the life cycle of a market hog.

---

[1]To best define the capabilities of the Budget Generator, only one basic farrow-to-finish system will be presented in this section. Expanded variations and subsystems are illustrated both in the following sections.

[2]The parameters or restraints include the following assumptions:

1) Above average management.
2) Equal restrictions as to capital borrowings.
3) Equal availability of labor, farm acreage and feed grains.

A basic production unit may serve to illustrate this point. Suppose two systems are essentially equal--that is each operation is farrowing twenty sows per year, both systems are finishing market hogs in open-front finishing lots, both are maintaining similar feed efficiencies, mortality rates, litter numbers, and market weights. The single difference is the degree of confinement to be used in the central farrowing house. Three different farrowing structures could be chosen for the two systems in comparison:

1. Remodeled older central farrowing house with a solid concrete floor. The cost of this structure is relatively low; most older farmsteads have an existing building of this description.
2. Reproduced solid or slotted floor farrowing house adapted to provide such amenities as farrowing crates, space heaters, self-feeders, insulation, ventilation system--in short, a moderately-priced modern central farrowing structure.
3. An environmentally-controlled central farrowing house complete with slotted floors, under-the-floor manure holding pits, self-feeders and waterers in crates, and heating-air conditioning systems (totally automated).

Because of these farrowing house variations, three separate but distinct systems can be constructed. Initially, all of these variations seem minor, and perhaps of limited use for budgeting and planning purposes. However, these changes replicate the manner in which actual swine producers modify or expand their own hog enterprises. Within a building-block fashion, an individual producer observes what is the weakest link within his operation; he asks what is the physical unit that can be remodeled or replaced which would return the greatest dollar efficiency per dollar invested. Once the producer has established this "weak link" (which could be the farrowing, growing or finishing phase), he then allocates the necessary resources with which to modify the program.

A more important aspect of this modification may be the opportunity for growth within a specific production enterprise. The three previously described farrowing house modifications present an opportunity to study the growth implications of each variation on a basic farrow-to-finish system. Each separate modification indirectly dictates the subsequent future modifications to that basic swine system.

The enterprise variation with a newly-constructed and environmentally-controlled farrowing structure (#3) illustrates this growth potential. This farrowing structure, with its large outlay of fixed capital, assumes that swine production has been and will continue to be a major operation within this farm's productive future. The choice of this farrowing modification reflects the presence (or the need) for highly competent professional hog management which can achieve the production potential of this system. The growth implications of this farrowing improvement will be immediately obvious to an astute farm manager. If, for example, this individual decides to increase the farrowing intensity from four to six farrowing per year, he will directly gain a building cost advantage within the pig turnover numbers. With the capacity increased to six farrowings per year, he will decrease the "pay-back" period[3] on the

[3]"Pay-back" represents the amount of time that the initial fixed capital outlay will be repaid to the owner; this return is dependent on the projected production from the initial investment.

farrowing structure. But by increasing farrowing frequencies, he places another strain on his existing farrow-to-finish system. Whereas with four farrowings per year, he could adequately use the farrowing house as a pig nursery, six farrowing periods introduces a "squeeze" situation. Where does he now place the older litters to make floor space for the first litters of the following farrowing? Either additional floor space should be constructed or the older litters should be sold. Assuming this is a farrow-to-finish system, a pig nursery needs to be constructed or a building modified to handle this small-pig overflow. If and when this nursery facility is constructed, it will then correct the increased farrowing problems. The nursery has solved the immediate expansion problem, and simultaneously expanded the limits to growth within the swine enterprise.

The personal objectives of an individual farmer greatly influence the decision to modify or expand an existing hog program. The age of a producer, for example, may have a significant influence on his desire for future growth. The decision, as in the above example, to construct a modern totally confined farrowing structure, indicates a relatively young producer, or at least, a producer who anticipates continuing production of hogs for many years to come. A young producer may rely on his own management ability to operate an expanding and complex swine system, while an older individual may anticipate potential labor/ management abilities in his children. In either case, the management requirement is anticipated over a relatively long production period.

The expansion problems and complexities of various productive systems can be manipulated according to the input data provided by the producer. His present system, based on his production data, is optimized according to that data. The production output, inputs, and parameters are budgeted in addition to the producer's assumptions on mortality rates, feed efficiency, number of pigs weaned per litter, etc. Common assumptions as to depreciation schedules on machinery and buildings, usage proportions on swine equipment, labor and tax rates, and useful life expectations on the breeding herd are handled by one of two methods. The producer can accept the pre-established assumptions of the research budgeting model, or, can modify these assumptions to best fit his production scheme.

The most expeditious method of presenting this modeling procedure is to refer to a basic swine system that has been reconstructed from second dary hog data and is capable of extensive modifications. Arbitrarily chosen, the system to be budgeted is a low-investment central farrowing house with an open-front finishing system that markets about 600 slaughter hogs annually. The farrowing structure consists of a moderate-cost, solid floor building that has been remodeled to the extent of adding supplemental heat and insulation. The 20-crate farrowing unit, with natural ventilation and hand manure removal, is capable of farrowing 80 litters per year (two groups of 20 sows, each group farrowing twice annually). A farrowing house with this description is easily designed and constructed with minimal outside professional labor by using construction literature produced by agricultural engineers at state universities [1, 2, 3, 4, 19, 25, 26, 27]. Twenty-crate farrowing structures have been mentioned in previous literature [25, 30] and lend themselves readily to the typical management of Iowa swine producers. Though four farrowings per year are easily managed within this system, an occasional pasture or additional seasonal farrowing can be "squeezed in" without seriously affecting the system's litter capacity or a structure's pay-back capital. The adaptability of this size farrowing facility is further enhanced when the farrowings are completed, the pigs weaned, and the building then doubles as a weanling (growing) facility. The central farrowing house can also serve gestating females, both sows and gilts or may be left idle between farrowing periods to reduce disease. Also, if farrowings are scheduled less than four times annually, the market hogs can be housed in this same farrowing structure for part of their growth.

One reason for this size farrowing facility rests with the assumption that a high proportion of present Iowa swine producers farrow in some type of central confinement structure [13, p. 33a]. With a facility in existence, the possibilities for the expansion of production become feasible. First, a modern nursery facility may be constructed to co-exist with increased frequencies of farrowing periods. Second, a growing-finishing facility can be built to east the potential increase in production numbers. Because of the existence of a moderate-cost farrowing house, the construction flexibility of higher cost pig structures can be more easily justified.

The open-front growing-finishing facilities, described by this system, are also considered "typical" among Iowa swine producers. Examples of finishing variations might be where the finishing hogs run behind cattle or the hogs are finished out on what was formerly a cattle feedlot area. The shelter in this instance may be only a three-sided lean-to construction or an attached shed to an existing barn, an old barn itself, or portable pasture shelters pulled together into a dry lot. Other variations represent a moderate-to-high cost new building with open front construction and sloping solid concrete feeding areas. Manure disposal in the more primitive finishing lots is by tractor scrape and hand scoop. However, with a constructed sloping floor lot, gravity and lagoons or pits can handle the bulk of the manure problem.

To summarize this wide range of finishing possibilities would be to assume that this finishing unit is not totally enclosed or environmentally controlled. The construction costs of most open-front finishing units are largely dependent on the cost of concrete, the costs of additional feeders and waterers, and the amount of bedding needed per system. The construction materials are simple and straightforward (rough lumber, metal roof sheeting, wire fence panels, posts, etc.) and most, if not all, of the labor can be farm supplied. Only if the farmer opted for a prefabricated finishing system would the construction costs form a substantial capital outlay.

Gestation facilities for boars, sows, and gilts would be conventional and quite primitive. Existing alternatives could be found in pull-together pasture structures, abandoned chicken buildings, or an unused corner of an old barn. The boars would be housed in similar facilities and have breeding access on dirt floor areas. The only major consideration in gestation and boar facilities is that the structures be relatively draft-free and that the animals have access to outdoor exercise areas.

Tables 1a and 1b reproduce the completed budget generator input forms required to collect the data for this basic system of 600 hogs. The input data are classified into three areas--production (output), operating inputs and equipment requirements. The machinery required for the livestock operations is minimal (e.g. tractor, pick-up, grinder-mixer) and is therefore described within the equipment requirements.

Lines 1 through 10 comprise the production output broken down into the actual number of market hogs sold (560), the number of cull sows and nonbreeders sold after each farrowing, and the number of open gilts taken to market. The different and staggered selling periods illustrate the approximate market dates that coincide with seasonal farrowings. For whole systems, this period analysis is more flexible than this example--what's necessary is the total production numbers and the description of the specific animals sold.

The operating inputs represent both out-of-pocket variable costs and farm supplied inputs priced at the current market price.[1] Corn, for example, normally is farm supplied, but still maintains an opportunity cost if sold rather than fed through the hog system. Supplement feed costs can be partially offset by legumes, soybeans or other farm supplied sources, but the price reflects the recommended protein requirement to produce a 220-lb. hog from breeding to market [29]. Veterinary care and medicine, trucking, power and miscellaneous costs have been estimated by previous swine studies, information from extension data files, and verified with personal interviews with swine producers.

[1]These variable costs actually reflect price estimates as of June 15, 1976, the date the budgets were first generated.

Table 1a. Production and operating inputs[a]

	COL 1	COL 2	COL 3	COL 4	COL 5	COL 6	COL 7
PRODUCTION	JAN	FEB	MAR	APR	MAY	JUN	JUL
1. Market hogs			140.			140.	
2. Cull sows	3.	2.		3.	2.		3.
3. Open gilts		2.			2.		
4.							
5.							
6.							
7.							
8.							
10.							

OPERATING INPUTS					(rate per head)		
11. Corn						6.65	
12. Supplement						78.5	
13. Vet-Med			.25			.25	
14. Trucking, marketing			.25			.25	
15. Power, fuel			.25			.25	
16. Miscellaneous expense			.25			.25	
17.							
18.							
19.							
20.							
21.							
22.							
23.							
24.							
25.							

[a]Kletke (22, pp. 79-80).

COL 8	COL 9	COL 10	COL 11	COL 12	COL 13	COL 14	COL 15	COL 16	COL 17	COL 18
AUG	SEP	OCT	NOV	DEC	PRICE	CWT	UNITS CODE	ITEM CODE	TYPE CODE	YEAR CODE
	140.			140.	48.	2.2	16.	48.	2.	x
2.		3.	2.		40.	4.25	16.	46.	2.	x
2.			2.		42.	3.00	16.	42.	2.	x

					PRICE	# OF HEAD	UNITS CODE	ITEM CODE	TYPE CODE	YEAR CODE
				6.65	2.37	600.	2.	72.	3.	x
				78.5	.081	600.	12.	141.	3.	x
	.25			.25	2.70	600.	15.	416.	3.	x
	.25			.25	.22	600.	15.	481.	3.	x
	.25			.25	.80	600.	15.	420.	3.	x
	.25			.25	.90	600.	15.	400.	3.	x

Table 1b. Equipment requirements[a]

	COL 1	COL 2	COL 3	COL 4	COL 5	COL 6
	JAN	FEB	MAR	APR	MAY	JUN
26. Farrowing house						
27. Open front finishing house						
28. Gest house-sows						
29. Gest house-gilts						
30. Boar housing						
31. Grain Bin						
32. Supplement Storage						
33. Utility Tractor						
34. Grinder-Mixer						
35.						
36.						
37.						
38. Manure loader						
39. Manure spreader						
40. Pick-up						
41.						
42.						
43.						
44.						
45.						
46. Young female						
47. Mature female						
48. Mature male						
49. Livestock labor-year 1	130.	130.	130.	130.	130.	130.
50. Livestock labor-year 2						

[a]Kletke (22, pp. 79-80).

COL 7	COL 8	COL 9	COL 10	COL 11	COL 12	COL 13	COL 14	COL 15	COL 16	COL 17	COL 18
JUL	AUG	SEP	OCT	NOV	DEC	# OF UNITS	PROP OF COST	POWER UNIT	ITEM CODE	TYPE CODE	YEAR CODE
						1.	1.	x	5.	5.	x
						1.	1.	x	13.	5.	x
						1.	1.	x	36.	5.	x
						1.	1.	x	38.	5.	x
						1.	1.	x	40.	5.	x
						1.	1.	x	56.	5.	x
						1.	1.	x	58.	5.	x
						1.	.75	x	62.	5.	x
						1.	.75	x	63.	5.	x

						# OF UNITS	PROP OF COST	POWER UNIT	ITEM CODE	TYPE CODE	YEAR CODE
						1.	.5	x	68.	5.	x
						1.	.5	x	69.	5.	x
						1.	.2	x	95.	5.	x
						40.	1.	x	97.	5.	x
						60.	1.	x	98.	5.	x
						2.	1.	x	99.	5.	x
130.	130.	130.	130.	130.	130.	x	x	x	x	x	x

Total operating inputs (1.0 represents 100% of the total cost) are broken down into the monthly period that would correspond to its payment by the farm operator. In the case of feed inputs, the budget assumes that twice per year, the producer will inventory his supply of feed grains and supplements--once in late fall after harvest, and once in early summer. The early summer estimate reveals whether an existing supply will carry the swine system until harvest or whether feedstuffs will need to be purchased. The remainder of the operating inputs will normally be paid after each group of hogs are marketed. which would be approximately four times annually.

Six hundred is the number of market hogs over which the operating inputs are to be allocated. Assuming normal pig mortality rates, eighty live litters should produce 600 head of market hogs. In practice, the total number of farrowings may exceed 80 litters. In order to achieve these required 80 farrowings, forty replacement gilts are retained. However, more mature sows can also be retained within each farrowing period to compensate for poor conception rates and mothering abilities in the replacement gilts. Only when the system is assured of eighty litters can the undesirable females be culled from the breeding herd. The penalties for excess litters per quarterly farrowing are small compared to the problem of not having adequate females to fill the system's farrowing capacity. The number of adequate females for breeding requires 40 gilts to be retained; because of this retention, only 560 actual market hogs are sold. Since all of the system's data inputs are charged to market weight hogs (600 reaching 220 lbs.), the actual numbers reaching this weight have to be included whether sold or retained as gilts.

The units code column 15, Figure 1a, designates to the computer the physical description names for the production numbers and operating inputs. The number "16" relates to the unit "head" whereas "12" designates "pounds (lbs.)." Table 2 illustrates all the possible label designations for all output and input data.

The item code column 16 describes to the computer the specific name for each line input. Code number "416" refers to the "Vet-Med" abbreviation, while "46" translates to "Cull Sows." A master computer file lists 400 names of all possible farm labels, which includes production output, operating inputs, machinery, livestock, grains, and equipment and miscellaneous designations.

Table 2. Possible label designations for all output and input data[a]

1.	Hd.	(Head)
2.	Bu.	(Bushels)
3.	Tons	
4.	Dz.	(Dozens)
5.	Gal.	(Gallons)
6.	Bl.	
7.	Acre	
8.	Hr.	(Hours)
9.	Days	
10.	Lbs.	(Pounds)
11.	Pt.	(Pints)
12.	Qt.	(Quarts)
13.	Dol.	(Dollars)
14.	Cwt.	(Hundredweight)
15.	Oz.	(Ounces)
16.	Mile	
17.	Feet	
18.	(To be designated by the user)	
19.	Sqft.	(Square feet)

[a]Source: [19, p. 110].

The type code in column 17 normally indicates the type of budgeting this section of data represents. Four numbers "tell" the computer at which intervals to separate the input data in distinct categories for budgeting. The numbers are as follows:

2.0 Production item

3.0 Operating input

4.0 Machinery usage line (this number will be unused for livestock)

5.0 Equipment or capital livestock line.

All nonlivestock fixed capital items are listed as equipment requirements (lines 26-45). These requirements indicate the bulk of the equipment needs necessary to operate this basic swine system. The housing requirements, for example, attempt to replicate an existing hog operation, and with the costs of housing units predetermined within the cost data files of the computer, give an estimate of the start-up needs of a particular system. Because of computer space and time limitations, there is obviously a great deal of aggregation among the different equipment requirements. The final estimate of the user-determined price for the farrowing house will include the individual items of heat, insulation, the building shell requirements, farrowing crates, grading the site, electricity and plumbing work and the inside finishing work.

Following this list of probable equipment requirements comes the problems of assigning the proportion of this equipment item that is to be charged solely to the swine enterprise. Some items such as a manure loader may only be needed 50 percent of its farm life for the hog operation, with the balance of its use charged to the other farm activities.

This proportion of use (and cost) is a very "rough" estimate and may prove difficult to estimate by the farm operator. One simplification is already present if hogs are the only livestock enterprise on the farm--in this case all actual livestock equipment requirements are charged to the hogs. The small utility tractor is assumed to be used almost exclusively for the hog herd, with only 25 percent of its total cost charged to other nonswine activities. Opposite of this may be a pick-up truck which is in very little actual use for hogs; therefore 20 percent is allocated to the herd. The item code numbers for the equipment requirements are labeled according to a separate computer file, distinct from the master file of 400 names as used by production and operating inputs.

Lines 46-48 are normally reserved within the computer budgeting files for livestock input requirements. Animal numbers for this specific swine system were established with reference to different gestation and breeding successes for gilts versus sows. The following calculation traces the numbers of females needed to acquire 20 live litters throughout a "typical" farrowing frequency period:

1. Sows needed: 20 females (carried over from a previous farrowing-age - 2-4 litters)
   - 3 females (less sows culled for poor mothering ability, milk production, age, etc.)

   17 mature females ready to breed

   x .9 (90% conception rate for mature sows)

   leaves 15 mature sows bred (2 open cull sows marketed).

2. Gilts needed: 10 replacement gilts from farm herd

x .8 (80% conception rate for untried gilts)

leaves 8 bred gilts (2 open gilts marketed)

3. Number of total females (sows + gilts) entering the farrowing period:

15 mature females bred

+ 8 young gilts bred

23 total females

\- 3 (less 11% of females lost before, during, and after farrowing)

gilt gestation and farrowing death loss = 3%

females inability to farrow live litters plus abortion during gestation = 8%

results: 20 actual live litters farrowing each frequency period.

The actual numbers of females required when listing the livestock equipment requirements appears, at first glance, to be an unusually high number of females with which to begin the production year. In reality, these numbers represent the actual number of sow and gilt "equivalents" that are to be housed, bred, fed and managed. This concept of management equivalents is better understood if it is realized that the year-end farrowing results have consisted of two groups of 20 sows each, with each group farrowing twice. With this perspective there is obvious double-counting initially of actual numbers. However, what the budgeting procedure computes is the needed livestock input to result in 80 live farrowing litters per year. One sow, though one actual animal unit, is computed as two (2) sow equivalents, with one equivalent for each time she farrows during the production year. Her feed, housing, and management requirements begin anew with each successive farrowing frequency period. As with nonlivestock equipment items, these livestock requirements are disaggregated according to costs of depreciation, years of useful life, labor requirements, etc. The breakdown of capital outlays for livestock is strictly followed to determine the most efficient use of the breeding herd.

Boars, in this computation procedure, are treated differently than the females. In line 48, the number two (2) represents the actual physical number of boars present throughout the production year. A single boar may become incapacitated during the breeding year, and a replacement animal quickly found, but the number of boars-on-farm remains at the same level. For most producers, two boar-equivalents are more than adequate to service the total number of breeding females--27--for each mating period. An older boar is normally retained for the mature females, while a new, younger male services the 10 replacement gilts. As a final note, it is obvious that 100% of all the livestock inputs are required by the swine operation--hence, the proportion of cost (use) column is 1.0 for all animal requirements.

Livestock labor is calculated for year 1, which is compatible with the assumed one-year production swine operation. If a cash-flow scheme was devised for a two-year enterprise, both labor requirement line 49 and 50 (Table 1b) would be completed. The monthly labor requirement simply illustrates an "average" livestock labor need for this 80-litter system. With four farrowing frequencies, there will be variable periods of high and low labor requirements. The annual labor requirement (130 hours/ month x 12 months = 1560 hours) has been created by the synthesis of secondary production data [20, 28, 31] and with producer-survey averages [13]. With the assumption that this labor figure represents purely livestock handling labor (boar selection, farrowing aid, baby pig handling, sorting, hand feeding and watering), the following calculations are considered representative:

1560 hours divided by 600 market weight hogs produced annually = 2.6 hours/market hog (all breeding herd labor, etc. is charged to the market weight hog produced).

With this study, variations on swine labor requirements, according to the different systems described, will be presented. Two assumptions must be considered in the estimation of all labor requirements:

1. The livestock labor estimate does not reflect the labor required to maintain and repair equipment items. For example, normal repairs to hog feeders are considered within the data file pertaining to that particular item's cost proportions. If included again within actual hand livestock labor, this would constitute double-counting. Previous studies have normally not made this labor differentiation.
2. There will, of course, be some livestock savings gained among the varying degrees of confinement facilities. An observable difference is between a pasture-farrowing increases rapidly due to hand watering and feeding to the pasture area, fence construction and maintenance, and increased vigilance of the swine herd in this open area. Another example of increasingly

confined facilities is that labor for manure disposal drops rapidly and feed preparation becomes more automated.

These reasons represent partially the argument for different labor requirements among swine systems. They are by no means conclusive. As in the second example above, tighter confinement may gain labor advantages in manure disposal, but the tighter areas may bring increased disease problems and more management time spent with the growing animal herd. With all the labor controversy aside, this "best estimate" is just that--an estimate. A producer, if so inclined, may painstakingly calculate his labor requirements and still neglect to include some management time for his swine system. From the basis of previous swine studies, surveys, and producer conversations, this labor estimate is adequate for the computer's budgeting purposes.

Before the actual computation of this input data is undertaken, a statement concerning the other model assumptions should be made. Parameters for any given livestock system have been previously "built-into" the system. Such parameters as the price of gasoline or diesel fuel and the price per kilowatt of electricity represent an assumption of the power requirement cost of a typical farm. Interest rates, insurance rates, and tax rates are the capital restraints which outline the annual costs for specific equipment inputs. Livestock labor parameters are listed as equipment labor per hour (repairs and maintenance) and hand livestock labor per hour. If an adjustment in this parameter cost is needed to update realistic labor wages, the researcher simply inserts the proper wage reflecting modern farm labor prices.

The final assumptions of this, or any, swine budgeting system is that the farm operator has sufficient and available quantities of feed grains, capital, labor, and management skills. The sole limitation on the specific system budgeted is voluntary. The size of swine herd desired (in the sample budget--600 head marketed) or restricted is the limitation. For this system, once chosen, the operating, equipment, and livestock inputs are assumed available, either farm-produced or through an individual's borrowing ability. The actual procedure for the budget generator is to first assume or to acquire the needed resources, estimate the present or projected size of the hog operation to be budgeted, and then compare the model's established parameters and restraints with the realistic data of the producer. With this data sequence entered into the budget generator, the output can then be computed according to the characteristics of this basic swine system representation.

CHAPTER VI. RESULTS AND ANALYSIS

The budgeting output represents costs and returns for "whole farm" analysis; this analysis is for an entire farrow-to-finish swine production system. The various forms of computer output presented reflect the returns to the entire enterprise rather than calculating the return per litter or the return per market hog sold.

One reader observation should be considered: The profit or calculations for this particular basic swine operation may not be compatible with actual production expectations for an existing 600-head hog operation.[1] From the computerized budget's perspective, explicit costs and data inputs were computed from "ground level zero."[2] In contrast to this, the practicing hog producer has the advantage in that his existing swine system is an enterprise that is economically compatible to the entire farm's operation. Within this established farm organization, there is already an existing "support system" (machinery, equipment, and buildings) that can be used by the swine operation with very little modification. Most swine producers possess a utility tractor, pick-up truck, and other machinery already in use on the farm. The existence of this support system partially offsets certain fixed costs of ownership (e.g. depreciation, interest, insurance, and taxes). The budget generator makes

---

[1]The reader should be reminded that this budgeting procedure is only an illustrative representation of estimated input data, and that no attempt is made to exactly replicate an actual existing swine operation.

[2]"Ground level zero" means a complete reproduction of a comparable swine system using only bare farmland and sufficient capital for start-up investment costs.

realistic allowances for these fixed items, but in no way can it estimate the worth of this existing support system as calculated by each producer in the field. In other words, an existing farm operation can absorb these expensive start-up requirements whereas the budget has to assume its system literally starts from "scratch."

The same reasoning can be applied to replacement animals for use in the breeding herd. Given certain replacement policies, a practicing hog producer can retain new breeding stock from his existing swine herd at less expense than the assumed replacement costs used by the budget generator. Some discrepancies may arise in this animal replacement cost comparison if a hog producer places a lower production cost on his retained breeding stock. Within the budget figures, the assumption is made that the replacement animals represent their opportunity cost to the producer given their fair market value.

The Output of the Budget Generator

Initially, some very general observations can be made concerning Output 1 and 2: (following pages)

1. Output 2 shows the livestock investment whereas Output 1 does not.
2. Gross receipts shows per animal values in Output 2 but not in Output 1.
3. Variable costs in Output 1 includes labor and interest on operating capital whereas in Output 2 these two items are excluded as the variable cost. This exclusion is made so

	Item	Weight each	Unit	Price or cost/ unit	Quantity	Value or Cost
1.	Gross receipts					
	Market hogs	2.20	Cwt.	48.00	560.00	59135.98
	Cull sows	4.25	Cwt.	40.00	20.00	3400.00
	Open Gilts	3.00	Cwt.	42.00	8.00	1008.00
	Total					63543.98
2.	Variable costs					
	Corn		bu.	2.37	13.30	18912.59
	Supplement 14-18%		lbs.	.08	157.00	7630.20
	Vet & Med		dol.	2.70	1.00	1620.00
	Trucking, marketing		dol.	.22	1.00	132.00
	Power, fuel, etc.		dol.	.80	1.00	480.00
	Miscellaneous expense		dol.	.90	1.00	540.00
	Equipment (fuel, lube, rep.)		dol.			1993.95
	Labor, equipment		hrs.	3.50	50.75	177.62
	Labor, livestock		hrs.	3.50	1560.00	5460.00
	Interest on operator capital		dol.	.90	8589.07	773.02
	Total variable costs					37719.36
3.	Income above variable costs					25824.63
4.	Fixed costs					
	Interest on livestock capital		dol.	.09	21449.99	1930.50
	Interest on other equipment		dol.	.09	28308.09	2547.73
	Depreciation on mature male		dol.			300.00
	Depreciation on other equipment		dol.			4012.34
	Other FC, machinery & equipment		dol.			727.51
	Total fixed costs					9518.06
5.	Total costs					47237.41
6.	Net returns					16306.57

Output 1. Low investment--central house farrowing system open front growing-finishing facilities, 80 litters farrowed yearly (2 groups of 20 sows, each group farrowing twice)

Livestock Investment	Units	Size	Number	Value/Unit	Value
Young Female	Head	1.00	40.00	150.00	6000.00
Mature Female	Head	1.00	60.00	250.00	14999.99
Mature Male	Head	1.00	2.00	225.00	450.00
Total Livestock Investment					21449.98

Production	Units	Quantity	Weight	Price	Value/Unit	Value
Market Hogs	Cwt.	560.00	2.20	48	105.60	59135.98
Cull Sows	Cwt.	20.00	4.25	40	170.00	3400.00
Open Gilts	Cwt.	8.00	3.00	42	126.00	1008.00
Total Receipts						63543.98

Operating Inputs	Units	Rate/Unit	# of Units	Total Units	Price	Value
Corn	Bu.	13.30	600	7979.996	2.37	18912.59
Supplement 14-18%	Lbs.	157.00	600	94200.000	0.08	7630.20
Vet. and Medicine	Dol.	1.00	600	600.000	2.70	1620.00
Trucking, Marketing	Dol.	1.00	600	600.000	0.22	132.00
Power, Fuel, Etc.	Dol.	1.00	600	600.000	0.80	480.00
Miscellaneous Expense	Dol.	1.00	600	600.000	0.90	540.00
Equipment Fuel and Lube						488.62
Equipment Repair						1505.32
Total Operating Cost						31308.71

Returns to Land, Labor, Capital, Machinery, Overhead, Risk, and Management	32235.27

Output 2. Low investment--central house farrowing system open front growing-finishing facilities, 80 litters farrowed yearly (2 groups of 20 sows, each group farrowing twice)

Capital Cost		Price	Amount	Value
Annual Operating Capital		0.09	8589.074	773.02
Equipment Investment		0.09	28308.090	2547.73
Livestock Investment		0.09	21449.988	1930.50
Total Interest Charge				5251.24
Returns to Land, Labor, Machinery, Overhead, Risk and Management				26984.03
Ownership Cost: (Depreciation, Taxes, Insurance)				
Equipment	Dol.			4739.84
Livestock	Dol.			300.00
Total Ownership Cost				5039.84
Returns to Land, Labor, Overhead, Risk and Management				21944.18
Labor Costs		Price	Hours	
Equipment Labor		3.5	50.75	177.62
Livestock Labor		3.5	1560.00	5460.00
Total Labor Cost				5637.62
Returns to Land, Overhead Risk and Management				16306.56

Output 2. (continued)

that an allocation to capital and labor could be made in a later analysis.

4. Fixed costs in Output 2 are subtracted from the returns above operating input costs incrementally so that returns to the several fixed factors could be tabulated. This is part of the analysis procedure to subtract a market return (cost) for the use of some factors while allocating the residual to the remaining "unpaid" resources (capital, management, labor).

In specific comparisons of Outputs 1 and 2, the results can be similar. In the following passages, both Outputs 1 and 2 will be separately presented, and then the two will be compared for their respective advantages.

Output 1 presents:

1.	Gross receipts (all animals marketed)	$63,543.98
2.	Variable costs of production (these figures have been budgeted using the input amounts found in the previous data presentation)	$37,719.36
3.	Income above variable costs (gross receipts minus variable costs)	$25,824.63
4.	Fixed costs (calculated through the equipment complements and operating parameters for each item as stored in the budget generator)	$ 9,518.06
5.	Total costs	$47,237.41
6.	Net returns to this particular annual system	$16,306.57

Output 2 presents:

1. The total livestock dollar investment $21,449.98

2. The total gross receipts of all animals marketed $63,543.98

3. Total operating cost (variable costs of production $31,308.71

4. The returns to land, labor, capital, machinery, overhead, risk, and management (gross receipts minus operating costs) $32,235.27

5. Capital cost (using an interest rate of 9%) Total interest charge on capital $ 5,251.24

6. The returns to land, labor, machinery, overhead, risk, and management ($32,235.27 minus capital charge, $5,251.24) equals $26,984.03

7. Ownership cost--depreciation, taxes, insurance These amounts are pre-determined by the parameters given to the budget generator $ 5,039.84

   (depreciation rate)[3] x (purchase price of equipment items)

   \+ (tax rate) x (purchase price of equipment items)

   \+ (insurance rate) x (purchase price of equipment items)

   ---

   total $4,739.84

   \+ 300.00 (depreciation rate) x (purchase price of livestock items)

   ---

   total $5,039.84 ownership cost.

---

[3]These rates will be fully explained later in the chapter.

8. Returns to land, labor, overhead, risk and management ($26,984.03 minus ownership cost, $5,039.84) equals $21,944.81

9. Labor costs: livestock labor plus equipment labor equals $ 5,637.62

10. Returns to land, overhead, risk, and management ($21,944.18 minus labor costs, $5,637.62) equals $16,306.56

Output 1 and Output 2 are very similar in many respects. Output 1 is organized after a typical income statement whereas Output 2 is more detailed and analytical. Of particular interest is the allocation of income to the various resources or costs of production:

Output 1 (variable costs)	Output 2 (variable costs)
1. 'Corn' through miscl. expense	1. Corn through miscl. expense
	2. Equipment (fuel and lube only)
2. Equipment (fuel, lube, and repair)	2a. Equipment repair
3. Labor, equipment	These items (3, 4, 5) are considered in Output 2 as distinct and separate 'returns' categories
4. Labor, livestock	
5. Interest on operating capital	

Fixed costs between the two outputs is distinguished by the grouping of different items:

Output 1 (fixed costs)	Output 2 (fixed costs)
1. Interest on livestock capital--fixed cost	1. Interest on livestock capital--capital cost

2. Interest on other equipment--fixed cost
3. Depreciation on mature male--fixed cost
4. Depreciation on other equipment--fixed cost

Other fixed costs (FC), machinery and equipment.

2. Interest on equipment investment--capital cost
3. Livestock--ownership cost (depreciation)
4. Equipment--ownership cost (depreciation, taxes and insurance).

The costs presented in Output 1 are more inclusive, simplified, and will be the output form that will be referred to in the following discussions. The term "net returns" in Output 1 is synonymous with the designation in Output 2 of "returns to land, overhead, risk, and management." Both labels indicate the return generated above costs for this specific hog production system. Output 1, given its more direct categories of variable and fixed costs, and net returns, will be referred to in the next section when the individual output items are expanded in greater detail.

The first item to be be computed is the interest on operating capital, $773.02, and more specifically, how the operating capital for this particular swine budget is determined. All annual operating capital costs are determined by the number of months during the calendar year that an actual capital expenditure is utilized.

An example of the above statement is to suppose that $100 of capital was needed to maintain operating expenses each month of a typical operating calendar production year (January through December). If all of these monthly capital needs carried an interest price tag of 9%, this would designate the cost of using (or borrowing) a capital amount of \$1200 for that calendar production year. But in simple interest terms, not all of that \$1200 is subject to a full 9% interest for twelve calendar months. One hundred dollars (\$100) of capital is expended in each month and the total cost of each monthly capital outlay is determined at the end of the year. (This particular loan is repaid at twelve months, but the same example could be made for 3 or 6 month operating loans.) Obviously, the interest cost of borrowing \$100 in January until its repayment in December (using this initial \$100 for 12 months) will be considerably more than the borrowing of \$100 in November of that same year. The months of the calendar year for which each \$100 is carried determines the total annual capital cost for that monthly expenditure. December, in this specific example, is the month when all capital costs are recovered, or debts repaid. (In reality, borrowings and repayments take place simultaneously. In this example and the budget's example, the generator must fix an annual capital cost to this continuous interchange of operating funds.)

In this specific swine system, June is the capital recovery month. This month is established by default and may not necessarily coincide with actual farrowing and/or marketing periods experienced by practicing swine producers. This month of June is established as the capital recovery month for clarity and accounting simplicity.[4] Hogs, in this

---

[4]This accounting month can be any calendar month of production. If the researcher or user makes no deliberate change in the budget, June becomes the capital accounting month by default.

particular budget, are marketed four times yearly, expenses are paid quarterly, but the accounting procedure assumes that all capital transferrals are recorded within the month of June.

To restate in other terms, capital may be utilized or borrowed for only part of the year or approximately for 1-11 months, depending on the calendar month of borrowing. In our budget, if an expense was entered in July, 1975, the annual capital interest charge would be carried eleven months (June, 1976 being the capital recovery month). If the expense was entered in January, 1976, the annual capital charge would be only for five months (January, February, March, April, and May - June is excluded as it is the recovery month) [22, p. 27]. An example of a specific capital cost in this swine system will better illustrate these calculations.

In Output 2, both equipment fuel and lube and equipment repair are handled as operating inputs. Assuming these equipment costs are spread evenly across all twelve months of production, the variable equipment costs per month would be \$40.72 (fuel and lube) and \$125.44 (repair). During the month of July, these above expenses are the only out-of-pocket costs incurred in the hog operation. This total annual operating cost for \$166.16 (\$125.44 + \$40.72) is to be carried for eleven months until this capital expense can be recovered in the following month of June. The equation which determines the amount of annual capital for this July expenditure is:

(the total capital used in July) x (the number of months until the following June)

-- all divided by 12 (months)

or, in this specific example of the July expenditure:

$$\frac{\$166.16 \times 11}{12} = \$152.31.$$

Repeating the above formula for each capital expenditure within the hog operation up to, but not including, the recovery month of June gives the total annual operating capital for the system of $8,589.07. From this total amount an interest rate of 9% gives the capital cost of $773.02. This final figure reflects the cost of maintaining the variable expenses of the basic swine system over the calendar production year.

Specific formulas are also used to compute the other cost categories of the system. In Output 2, the capital cost of equipment and livestock investment has been calculated using the cost of the equipment/livestock item, the established interest rate parameter, and the number of units of a particular item used in the actual swine enterprise. As an example of the equipment investment, the following formula (22) is used for the farrowing house of this example 600-hog system:

Equipment investment of the system's farrowing house =

$$\frac{\text{Purchase price + salvage value}}{2} \times \text{(Interest rate)} \times$$

(the proportion of cost of the farrowing house to be charged to the hog operation - i.e., the percentage of use given the entire farm's activities) x

(the number of units of farrowing houses)

Substituting the real numbers into the above equation:

$$\frac{(\$14,000 + \$1,400)}{2} \times .09 \times 1.0 \times 1.0 \text{ units} = \$693.00.$$

The equipment capital investment for the farrowing house equals $7,700 - That is, $\frac{(\$14,000 + \$1,400)}{2}$. The ownership cost of maintaining this farrowing house within the system, on an annual basis, is $693, the interest rate paid on the investment capital.

The coefficients used in the above formula were taken from Table 3. This table constitutes a "master file" listing all possible swine equipment items required in the production of hogs.[5] Within the farrowing house example, the size (capacity) is 20 sows, consisting of one unit (i.e. one farrowing house), with the number "2" designating this equipment requirement as a nonlivestock input. The list price and purchase are identical.[6] For this particular farrowing house, the code line number is "5", the structure costs $14,000 to construct, and its expected years of life are fifteen. Columns 8, 9 and 10 represent the proportions of the purchase price that are to be charged for salvage value, repair of the structure (annually), and the fuel and lubrication costs needed for the building's maintenance. The farrowing house has a salvage value after 10 years of $1,400 (10% of the original cost). The repair costs to this structure will amount to $4,200 per year ($14,000 x .3). No fuel and lubrication costs are allocated to this structural piece of equipment--normally this cost is computed only for machinery-type items, e.g. utility tractors, grinder-mixers, and pick-up trucks. Ten annual hours of equipment labor are used to maintain or repair this farrowing house.

---

[5]All possible swine equipment items simply means the major requirements for organizing a hog production system.

[6]Although list and purchase prices are identical in this master list, there may be occasions in actual practice where pre-payments or bulk purchases may have a price effect. These are not assumed in these prices.

Table 3. Master equipment complement for Iowa swine systems

Item name	Code	Size	Unit	Type
Water System	1.	500.00	1.	2.00
Water System	2.	1000.00	1.	2.00
Farrowing House	3.	20.00	1.	2.00
Farrowing House	4.	20.00	1.	2.00
Farrowing House	5.	20.00	1.	2.00
Farrowing House	6.	40.00	1.	2.00
Nursery Modern	7.	300.00	1.	2.00
Nursery Remodel	8.	600.00	1.	2.00
Open Front Grow House	9.	150.00	1.	2.00
Open Front Grow House	10.	150.00	1.	2.00
Open Front Grow House	11.	300.00	1.	2.00
Open Front Finishing House	12.	150.00	1.	2.00
Open Front Finishing House	13.	300.00	1.	2.00
Open Front Finishing House	14.	600.00	1.	2.00
Modern Open Front Grow House	15.	150.00	1.	2.00
Modern Open Front Grow House	16.	300.00	1.	2.00
Modern Open Front Grow House	17.	600.00	1.	2.00
Modern Open Front Fin. House	18.	150.00	1.	2.00
Modern Open Front Fin. House	19.	300.00	1.	2.00
Modern Open Front Fin. House	20.	600.00	1.	2.00
Enclosed Grow House	21.	150.00	1.	2.00
Enclosed Grow House	22.	300.00	1.	2.00
Enclosed Grow House	23.	600.00	1.	2.00
Enclosed Finishing House	24.	150.00	1.	2.00
Enclosed Finishing House	25.	300.00	1.	2.00
Enclosed Finishing House	26.	600.00	1.	2.00
Pasture Farrowing Shelter	27.	20.00	1.	2.00
Pasture Farrowing Shelter	28.	10.00	1.	2.00
Pasture Farrowing Shelter	29.	20.00	1.	2.00
Pasture G & F Shelter	30.	150.00	1.	2.00
Pasture G & F Shelter	31.	300.00	1.	2.00
Pasture G & F Shelter	32.	600.00	1.	2.00
Pasture Shade Shelter	33.	150.00	1.	2.00
Pasture Shade Shelter	34.	300.00	1.	2.00
Gestation House - Sows	35.	60.00	1.	2.00
Gestation House - Sows	36.	60.00	1.	2.00
Gestation House - Gilts	37.	40.00	1.	2.00
Gestation House - Gilts	38.	40.00	1.	2.00
Boar Housing	39.	2.00	1.	2.00
Boar Housing	40.	2.00	1.	2.00
	41.	0.0	0.	0.0
Water Fountain	42.	80.00	5.	2.00
Water Fountain	43.	1.00	20.	2.00
Water Tank Wagon	44.	500.00	5.	2.00
Feeder	45.	60.00	2.	2.00

List price	Purchase price	Years life	Salvage prop of list	Repair prop of list	Fuel & lub as prop	Annual hours labor
1600.00	1600.00	15.00	0.0	.300	.0	0.
3000.00	3000.00	15.00	0.0	.300	.0	0.
18000.00	18000.00	15.00	0.10	.300	.0	0.
23000.00	23000.00	15.00	0.10	.300	.0	10.
14000.00	14000.00	10.00	0.10	.400	.0	10.
42000.00	42000.00	15.00	0.10	.300	.0	10.
11000.00	11000.00	15.00	0.10	.300	.0	10.
13880.00	13880.00	15.00	0.10	.300	.0	10.
8100.00	8100.00	15.00	0.10	.200	.0	10.
4050.00	4050.00	15.00	0.10	.200	.0	10.
13800.00	13800.00	15.00	0.10	.200	.0	10.
7500.00	7500.00	15.00	0.10	.300	.0	10.
13500.00	13500.00	15.00	0.10	.300	.0	10.
21000.00	21000.00	15.00	0.10	.300	.0	10.
11250.00	11250.00	15.00	0.10	.200	.0	5.
22500.00	22500.00	15.00	0.10	.200	.0	5.
39000.00	39000.00	15.00	0.10	.200	.0	5.
10800.00	10800.00	15.00	0.10	.200	.0	5.
25500.00	25500.00	15.00	0.10	.200	.0	5.
48000.00	48000.00	15.00	0.10	.200	.0	5.
13500.00	13500.00	15.00	0.10	.200	.0	5.
27000.00	27000.00	15.00	0.10	.200	.0	5.
51600.00	51600.00	15.00	0.10	.200	.0	5.
14250.00	14250.00	15.00	0.10	.300	.0	5.
27000.00	27000.00	15.00	0.10	.300	.0	5.
51000.00	51000.00	15.00	0.10	.300	.0	5.
2900.00	2900.00	8.00	0.0	.200	.0	0.
1500.00	1500.00	8.00	0.0	.200	.0	0.
1700.00	1700.00	8.00	0.0	.200	.0	0.
5138.00	5138.00	10.00	0.10	.200	.0	0.
7500.00	7500.00	10.00	0.10	.200	.0	0.
12000.00	12000.00	10.00	0.10	.200	.0	0.
756.00	756.00	5.00	0.0	.200	.0	0.
1500.00	1500.00	5.00	0.0	.200	.0	0.
8100.00	8100.00	15.00	0.10	.300	.0	5.
4500.00	4500.00	15.00	0.10	.300	.0	5.
5600.00	5600.00	15.00	0.10	.300	.0	5.
3200.00	3200.00	15.00	0.10	.300	.0	5.
690.00	690.00	15.00	0.10	.300	.0	5.
250.00	250.00	15.00	0.10	.300	.0	5.
0.0	0.0	0.0	0.0	.0	.0	0.
85.00	85.00	8.00	0.0	.100	.0	0.
75.00	75.00	8.00	0.0	.050	.0	0.
1200.00	1200.00	8.00	0.10	.400	.0	2.
300.00	300.00	8.00	0.0	.100	.0	0.

Table 3. (continued)

Item name	Code	Size	Unit	Type
Feeder	46.	80.00	2.	2.00
Feeder	47.	100.00	2.	2.00
Creep Feeder	48.	5.00	2.	2.00
Creep Feeder	49.	10.00	2.	2.00
Feed Pan	50.	1.00	20.	2.00
	51.	0.0	0.	0.0
Portable Wire Fence	52.	10.00	19.	2.00
Portable Wood Fence	53.	10.00	19.	2.00
	54.	0.0	0.	0.0
Grain Bin	55.	2000.00	2.	2.00
Grain Bin	56.	3000.00	2.	2.00
Grain Bin	57.	6000.00	2.	2.00
Supplement Storage	58.	6.00	3.	2.00
Supplement Storage	59.	12.00	3.	2.00
	60.	0.0	0.	0.0
Utility Tractor	61.	55.00	24.	2.00
Utility Tractor	62.	70.00	24.	2.00
Grinder Mixer	63.	3.00	3.	2.00
Feed Wagon	64.	3.00	3.	2.00
Finish Feed Storage	65.	3.00	3.	2.00
Miscellaneous Feed Equipment	66.	1.00	20.	2.00
	67.	0.0	0.	0.0
Manure Loader	68.	5.00	19.	2.00
Dry Manure Spreader	69.	140.00	2.	2.00
Dry Manure Spreader	70.	350.00	2.	2.00
Liquid Manure Spreader	71.	1500.00	5.	2.00
Liquid Manure Spreader	72.	2250.00	5.	2.00
Manure Pit Pump	73.	300.00	2.	2.00
Manure Pit Pump	74.	600.00	2.	2.00
	75.	0.0	0.	0.0
Pressure Washer	76.	0.50	24.	2.00
Holding Crate	77.	1.00	20.	2.00
Portable Scales	78.	500.00	12.	2.00
Stand-by Generator	79.	1.00	20.	2.00
Power Failure Alarm	80.	1.00	20.	2.00
	81.	0.0	0.	0.0
	82.	0.0	0.	0.0
Farrowing Crate	83.	1.00	1.	2.00
Inside Feeder Cart	84.	1.00	20.	2.00
	85.	0.0	0.	0.0
Pregnancy Detector	86.	1.00	20.	2.00
Miscellaneous Health Aid	87.	1.00	20.	2.00
	88.	0.0	0.	0.0
Portable Load Chute	89.	1.00	20.	2.00
Sorting Panels	90.	1.00	20.	2.00

List price	Purchase price	Years life	Salvage prop of list	Repair prop of list	Fuel & lub as prop	Annual hours labor
400.00	400.00	8.00	0.0	.100	.0	0.
490.00	490.00	8.00	0.0	.100	.0	0.
75.00	75.00	8.00	0.0	.100	.0	0.
140.00	140.00	8.00	0.0	.100	.0	0.
4.00	4.00	5.00	0.0	.0	.0	0.
0.0	0.0	0.0	0.0	.0	.0	0.
16.00	16.00	12.00	0.0	.0	.0	0.
12.00	12.00	10.00	0.0	.100	.0	0.
0.0	0.0	0.0	0.0	.0	.0	0.
2100.00	2100.00	20.00	0.0	.100	.0	0.
2400.00	2400.00	20.00	0.0	.100	.0	0.
2880.00	2880.00	20.00	0.0	.100	.0	0.
330.00	330.00	15.00	0.0	.100	.0	1.
560.00	560.00	15.00	0.0	.100	.0	1.
0.0	0.0	0.0	0.0	.0	.0	0.
9570.00	9570.00	10.00	0.10	.250	.05	10.
11830.00	11830.00	10.00	0.10	.250	.05	10.
3220.00	3220.00	8.00	0.10	.500	.0	5.
1700.00	1700.00	8.00	0.10	.500	.0	2.
400.00	400.00	15.00	0.0	.100	.0	0.
300.00	300.00	10.00	0.0	.100	.0	0.
0.0	0.0	0.0	0.0	.0	.0	0.
1200.00	1200.00	8.00	0.10	.600	.0	1.
1500.00	1500.00	8.00	0.10	.600	.0	2.
3600.00	3600.00	8.00	0.10	.600	.0	2.
4000.00	4000.00	8.00	0.10	.600	.01	2.
5000.00	5000.00	8.00	0.10	.600	.01	2.
2500.00	2500.00	8.00	0.10	.600	.01	1.
3500.00	3500.00	8.00	0.10	.600	.01	1.
0.0	0.0	0.0	0.0	.0	.0	0.
600.00	600.00	7.00	0.0	.100	.0	0.
330.00	330.00	8.00	0.0	.100	.0	0.
320.00	320.00	10.00	0.0	.100	.0	2.
2000.00	2000.00	15.00	0.10	.200	.02	2.
80.00	80.00	15.00	0.10	.200	.0	2.
0.0	0.0	0.0	0.0	.0	.0	0.
0.0	0.0	0.0	0.0	.0	.0	0.
110.00	110.00	8.00	0.0	.200	.0	0.
55.00	55.00	10.00	0.10	.0	.0	0.
0.0	0.0	0.0	0.0	.0	.0	0.
900.00	900.00	10.00	0.10	.200	.0	0.
100.00	100.00	5.00	0.0	.0	.0	0.
0.0	0.0	0.0	0.0	.0	.0	0.
450.00	450.00	7.00	0.10	.100	.0	0.
42.00	42.00	7.00	0.0	.100	.0	0.

Table 3. (continued)

Item name	Code	Size	Unit	Type
Miscellaneous Load Aids	91.	1.00	20.	2.00
	92.	0.0	0.	0.0
Heat Lamps	93.	1.00	20.	2.00
Portable Heat	94.	1.00	20.	2.00
Pickup	95.	0.75	3.	2.00
Pig on Feed 40L	96.	40.00	12.	1.00
Young Female	97.	1.00	1.	1.00
Mature Female	98.	1.00	1.	1.00
Mature Male	99.	1.00	1.	1.00

List price	Purchase price	Years life	Salvage prop of list	Repair prop of list	Fuel & lub as prop	Annual hours labor
60.00	60.00	7.00	0.0	.100	.0	0.
0.0	0.0	0.0	0.0	.0	.0	0.
11.50	11.50	5.00	0.0	.300	.0	0.
285.00	285.00	8.00	0.10	.200	.02	0.
4500.00	4500.00	8.00	0.10	.250	.05	10.
40.00	40.00	.33	1.00	.0	.0	0.
150.00	150.00	.25	1.00	.0	.0	0.
250.00	250.00	1.00	1.00	.0	.0	0.
300.00	300.00	1.00	0.50	.0	.0	0.

For each equipment item, the above formula is used and the equipment investment cost is computed. The only note of importance is that the nonlivestock and livestock equipment items are totalled separately. Under the section of Output 2 entitled "capital cost," the total annual equipment investment cost is $2,547.73, and the total annual livestock investment cost is $1,930.50.

The ownership costs for the system are shown in Output 2 as depreciation, taxes, and insurance. The same figures are stated in Output 1 as fixed costs and are broken down into "depreciation on equipment" and "other fixed costs."

A formula can be stated for the depreciation costs:

$$\frac{\text{(Purchase price - salvage value)}}{\text{The number of years of life}} \times$$

(The number of units of this equipment item) x

(The proportion of cost of this item which is to be charged to the swine enterprise)

Substituting real numbers from Table 3 for the farrowing house example gives:

$$\frac{(\$14{,}000 - \$1{,}400)}{10 \text{ years}} \times (1 \text{ unit}) \times 1 = \$1{,}260.$$

In these calculations, it is again important to note the proportion of a specific cost which is to be charged to the swine operation. Table 4 recreates the input forms which, among other information, presents the proportions of each equipment item that is charged to the hogs. The proportion of cost for each of the first seven equipment items equal one (1.0). However, the remainder of the items, "utility tractor" through "pick-up," the proportion of cost allocated to the swine operation is less

Table 4. Low investment--central house farrowing system, open front growing-finishing facilities, 80 litters farrowed yearly, (2 groups of 20 sows, each group farrowing twice)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Production					No. of units				
Market Hogs	0.0	0.0	140.00	0.0	0.0	140.00	0.0	0.0	140.00
Cull Sows	3.0	2.0	0.0	3.0	2.0	0.0	3.0	2.0	0.0
Open Gilts	0.0	2.0	0.0	0.0	2.0	0.0	0.0	2.0	0.0
Operating Inputs					Rate/unit				
Corn	0.0	0.0	0.0	0.0	0.0	6.65	0.0	0.0	0.0
Supplement 14-18%	0.0	0.0	0.0	0.0	0.0	78.50	0.0	0.0	0.0
Vet. and Medicine	0.0	0.0	0.25	0.0	0.0	0.25	0.0	0.0	0.25
Trucking, Marketing	0.0	0.0	0.25	0.0	0.0	0.25	0.0	0.0	0.25
Power, Fuel, etc.	0.0	0.0	0.25	0.0	0.0	0.25	0.0	0.0	0.25
Miscellaneous Expense	0.0	0.0	0.25	0.0	0.0	0.25	0.0	0.0	0.25
Machinery Requirements						Hours			
Equipment Requirements									
Farrowing House									
Open Front Finishing House									
Gestation House-Sows									
Gestation House-Gilts									
Boar Housing									
Grain Bin									
Supplement Storage									
Utility Tractor									
Grinder Mixer									
Manure Loader									
Dry Man Spreader									
Pickup									
Livestock Investment									
Young Female									
Mature Female									
Mature Male									
Livestock Labor	130	130	130	130	130	130	130	130	130

Oct	Nov	Dec	Price	Weight	Unit code	Item code	Type	Cont
0.0	0.0	140.00	48.000	2.20	16.	48.	2.	0.
3.0	2.0	0.0	40.000	4.25	16.	46.	2.	0.
0.0	2.0	0.0	42.000	3.00	16.	42.	2.	0.
			Price	Number units	Unit code	Item code	Type	Cont
0.0	0.0	6.65	2.370	600.00	2.	72.	3.	0.
0.0	0.0	78.50	0.081	600.00	12.	141.	3.	0.
0.0	0.0	0.25	2.700	600.00	15.	416.	3.	0.
0.0	0.0	0.25	0.220	600.00	15.	481.	3.	0.
0.0	0.0	0.25	0.800	600.00	15.	420.	3.	0.
0.0	0.0	0.25	0.900	600.00	15.	400.	3.	0.
					Power unit	Mach code	Type	Cont
			Number units	Proport of cost		Equip code	Type	
			1.	1.000		5.	5.	0.
			1.	1.000		13.	5.	0.
			1.	1.000		36.	5.	0.
			1.	1.000		38.	5.	0.
			1.	1.000		40.	5.	0.
			1.	1.000		56.	5.	0.
			1.	1.000		58.	5.	0.
			1.	0.750		62.	5.	0.
			1.	0.750		63.	5.	0.
			1.	0.500		68.	5.	0.
			1.	0.500		69.	5.	0.
			1.	0.200		95.	5.	0.
			40.	1.000		97.	5.	0.
			60.	1.000		98.	5.	0.
			2.	1.000		99.	5.	0.
130	130	130						

than 1.0. To calculate the actual depreciation cost, for instance, for each of these items, the individual equipment depreciation amount must be multiplied by its respective proportion of use. In the case of the utility tractor, only 75% of its depreciation cost is allocated to the hog operation. Actual depreciation charged to the system is $798.53 ($1,064 x .75). When this multiplication is completed for each item, the individual costs are then totalled and entered into Output 1 as "depreciation on other equipment."

The final costs budgeted to this system are the fixed costs of taxes and insurance. The percentages to be used in calculating the tax rate has been entered into the program with the parameters on the input forms (Table 5). The parameter values in this listing have been established to represent the "best estimate" of a percentage that would correspond to the actual ownership costs paid out in taxes and insurance annually on a typical hog operation. In this estimation, a "rough" idea is presented to parallel some existing expenses that practicing swine producers have to meet given the variability of local tax and insurance rates, the age differences of physical structures, the type of physical production system used by each producer, and the extent of insurance coverage by different operators. From these criteria alone, the range and variability of these estimates are as wide as the personal preferences among hog producers.

In calculating equipment insurance costs, the rate is .6% (.006). This percentage represents the insurance payment per average dollar of equipment investment. Using again the budget's farrowing house as an example, the following calculation is presented:

$$\text{Insurance cost per year} = \frac{(\text{Purchase price} + \text{salvage value})}{2}$$

x (the insurance rate).

Table 5. The parameter values used by this basic 600-head production system

1.	The interest rate on borrowed capital	.09	(9%)
2.	The equipment insurance rate (price per dollar of average investment insured)	.005	(.5%)
3.	The equipment tax rate (price per dollar of average investment)	.01	(1%)
4.	The price of livestock per hour	$3.50	

In real numbers, this equals:

$$\frac{(\$14,000 + \$1,400)}{2} \times (.005) = \$38.50$$

The proportion of each item's insurance cost is multiplied by the percentage used in the swine enterprise:

(The insurance cost per year) x (The number of units) x

(The proportion of cost)

Using the example of the utility tractor gives:

$$\text{Insurance cost per year} = \frac{(\$11,830 + \$1,183)}{2}$$

x (.005) = $32.53

($32.53) x (1 unit) x (.75) = $24.40

This final amount is the actual insurance cost of the utility tractor to the hog operation.

The other fixed ownership cost computed is the taxes paid on each swine equipment piece. The tax calculation for the farrowing house example follows this equation:

(Purchase price) x (Tax rate) x (The number of units) x

(The proportion of tax cost to be charged to the swine enterprise)

The tax cost for the utility tractor is computed using real numbers:

($11,830) x (.011385 -- the tax rate[7]) x (1.0)

x (.75) = $101.02.

For output clarity, tax and insurance costs have been combined and presented in Output 1 as "other FC (fixed costs), machinery and equipment." Within this total of $727.51, the correctly proportioned equipment costs have been computed and totalled.

A final statement should be noted concerning the different output formats and the intermediate output shown in this section of results and analysis. Outputs 1 and 2 essentially present the same computational results for this basic 600-hog production system. Output 1 is more condensed and readable whereas Output 2 more explicitly breaks down the returns on the investment in a step-by-step fashion. The advantage of Output 2 is that a producer can readjust the value of his own management labor - either as his own salary or as payment to outside labor - and by doing so can change the returns on his investment capital. In this basic swine system, labor costs have been accounted as if that management labor was paid a real wage. In this output, the labor cost was deliberately

---

[7]Table 5 simplifies the annual equipment tax proportion to .01 for clarity; the computer uses .011385 for accuracy.

subtracted before the final return on the capital investment has been computed.

Output 1, in a more condensed form, computes the gross receipts, the variable costs, the fixed costs, the total costs, and finally, the net returns. Initially, this output is easier to read and is more readily understood. This form of output will become useful when this basic 600-head production system is expanded and modified by changing the degree of confinement structures in the next section. With these modifications, the differences between fixed costs among similar size systems will become apparent, with less drastic changes in the comparisons of variable costs. Output 1 best suits the purpose of comparison study between similar swine production systems.

Table 3 presents a master list of swine production equipment items. From this list the necessary physical requirements have been drawn, both for cataloging purposes, and for further computational procedures. From the columns 6 through 10, both variable and fixed costs can be calculated using this system's input data and the parameters of Table 5. These parameters have also been stored within the computer memory files, and, unless changed by the budget operator, will automatically be used by the computational procedures. (If unchanged, the parameter values stored are used by default.)

Another intermediate output is shown by Table 4. In this printout the swine budget input information has been reprinted for reference when reading Outputs 1 and 2. This "referral" printout clearly reorganizes the input data and, in calculation of equipment costs, supplies the number of units and the proportion of costs for each item. As a reference this intermediate output enables the reader or user to double-check the computer's mathematical procedures and the computational methods that create the final budgeting printouts. A number of other intermediate printouts can be used to further clarify a particular system's budgeting output, but these would only be needed if a specific computational question arose.

The ultimate purpose of this printout description is to illustrate the ease and accuracy with which swine costs and returns can be budgeted. The formulas used and the mathematical steps conducted can all be performed with a desk calculator or by tedious long-hand computations. The speed and accuracy with which these calculations for many swine systems can be manipulated is the advantage of the budget generator. The authors of the Oklahoma State University Budget General Manual [22] describe the budgeting procedure as consisting of one main program which, in turn, calls a great number of subroutines [22, p. 1]. These subroutines or mathematical procedures organize the data into standardized printout format. Although each swine system may be unique in size, composition, and its physical restraints, the organizing methods of the computer's subroutines, through the use of command cards, can manipulate raw data into readable output.

This present section has shown the budget generator's abilities to compute and organize a basic swine system. Once this basic representative enterprise has been disaggregated and understood, other parallel hog operations can be introduced and compared. In the following section typical Iowa swine systems will be hypothesized for illustrative purposes.

CHAPTER VII. COMPARATIVE SWINE PRODUCTION SYSTEMS

The basic swine system as illustrated by the budget generator can easily be expanded to include other representative hog operations. Twelve possible production systems were budgeted to provide a broad representation of the swine industry in Iowa. These systems include:

System 1 - Low-investment 600-hog farrow-to-finish operation (as illustrated in the past two chapters).

System 2 - Moderate-cost, partial confinement farrow-to-finish operation (600-hog capacity).

System 3 - High-cost, total confinement farrow-to-finish operation (600-hog capacity).

System 4 - System 1, with the addition of a modern pig nursery. This nursery expands the system's capacity to 120 litters produced per year, or 900 market hogs in this farrow-to-finish enterprise.

System 5 - System 2, with the addition of a nursery also. Capacity: 900 market hogs in a farrow-to-finish system.

System 6 - System 3, with the addition of a nursery. Capacity: 900 market hogs in a farrow-to-finish system.

System 7 - A very low investment, winter/summer farrow-to-finish operation. Forty (40) litters farrowed yearly -- 29 litters farrowing in a central house in winter, 20 litters farrowing on summer pasture. Capacity: 300 market hogs.

System 8 - A low-investment system (similar to System 1). Capacity: 600 head, but selling 40 lb. immature feeder pigs.

System 9 - Moderate-cost system (similar to System 2). Capacity: 600 head, but selling 40 lb. feeder pigs.

System 10 - High-cost system (similar to System 3). Capacity: 600 head, but selling 40 lb. feeder pigs.

System 11 - Finishing out 780 purchased feeder pigs using open front finishing facilities. Buying feeders at 40 lb., selling at 220 lb.

System 12 - Finishing out 780 purchased feeder pigs using total confinement finishing facilities. Buying feeders at 40 lbs., selling at 220 lb.

These twelve are not inclusive of all Iowa swine production systems. They are merely representative of common categories in which diverse production practices may be grouped or classified. The systems are illustrative hog budgets that indicate slight structural alterations among hog systems of similar size, production capacity and/or farrowing intensities.

As stated earlier in this paper, certain parameters are common to all twelve representative budgets. For example, within the farrow-to-finish (Systems 1-10), the average number of pigs produced per litter is assumed to be constant - 7.5 pigs/litter. Also, in feed conversion, the twelve systems assume equal amounts of feed to reach certain market weights. In real practice, this may not always be true; i.e., hogs finished in total confinement may experience an average daily gain higher than those animals finished in open front facilities. The results of such gain studies among different facilities are not yet conclusive. It is not the scope of this paper to compare gains between alternate swine production facilities. The following comparisons between hog operations point out the differences occurring when either a segment of the facility requirement is altered or, the farrowing intensity of a particular system is increased.

The following passages will group the twelve systems according to their productive capabilities (i.e., farrow-to-finish operations vs. farrow-to-feeder pig vs. feeder-to-finished market hog). The output shown for each system will resemble the same format as Output 1 in the previous section. With these outputs presented, comparisons will be made of production systems within each group. Resource requirements, facility structure, and the profitability between single group systems will be briefly mentioned. These descriptions and comparisons will differentiate between hog enterprises of similar basic production capabilities.

Systems 1, 2, and 3 are reproduced on the following pages. All three are similar in production capacity, but they all differ slightly in farrowing, growing, and finishing structures. Systems 1 and 2 have identical open-front growing and finishing facilities. However, System 2 has a modern, slotted-floor central farrowing house. The farrowing house in System 1 consists of a remodeled, solid-floor central farrowing house that had previously existed on the farmstead. System 3 represents total-confinement, high-cost construction for both the farrowing and the

ITEM	WEIGHT EACH	UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OR COST
1. GROSS RECEIPTS					
MARKET HOGS	2.20	CWT.	48.00	560.00	59135.98
CULL SOWS	4.25	CWT.	40.00	20.00	3400.00
OPEN GILTS	3.00	CWT.	42.00	8.00	1008.00
TOTAL					63543.98
2. VARIABLE COSTS					
CORN		BU.	2.37	13.30	18912.59
SUPPLMT 14-18%		LBS.	0.08	157.00	7630.20
VET & MED.		DOL.	2.70	1.00	1620.00
TRUCKING, MKTG.		DOL.	0.22	1.00	132.00
POWER, FUEL, ETC		DOL.	0.80	1.00	480.00
MISCL EXPENSE		DOL.	0.90	1.00	540.00
EQUIPMENT(FUEL,LUBE,REP)		DOL.			1993.95
LABOR, EQUIPMENT		HRS.	3.50	50.75	177.62
LABOR, LIVESTOCK		HRS.	3.50	1560.00	5460.00
INTEREST ON OPER.CAP.,		DOL.	0.09	8589.07	773.02
TOTAL VARIABLE COSTS					37719.36
3. INCOME ABOVE VARIABLE COSTS					25824.63
4. FIXED COSTS					
INT. ON LIVESTOCK CAPITAL		DOL.	0.09	21449.99	1930.50
INT. ON OTHER EQUIPMENT		DOL.	0.09	28308.09	2547.73
DEPR. ON MATURE MALE		DOL.			300.00
DEPR. ON OTHER EQUIP.		DOL.			4012.34
OTHER FC, MACH & EQUIP.		DOL.			727.51
TOTAL FIXED COSTS					9518.06
5. TOTAL COSTS					47237.41
6. NET RETURNS					16306.57

System 1. Low investment--central house farrowing system, open front growing-finishing facilities, 80 litters farrowed yearly, (2 groups of 20 sows, each group farrowing twice)

	ITEM	WEIGHT EACH	UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OR COST
1.	GROSS RECEIPTS					
	MARKET HOGS	2.20	CWT.	48.00	560.00	59135.98
	CULL SOWS	4.25	CWT.	40.00	20.00	3400.00
	OPEN GILTS	3.00	CWT.	42.00	8.00	1008.00
	TOTAL					63543.98
2.	VARIABLE COSTS					
	CORN		BU.	2.37	13.30	18912.59
	SUPPLMT 14-18%)		LBS.	0.08	157.00	7630.20
	VET & MED.		DOL.	2.70	1.00	1620.00
	TRUCKING, MKTG.		DOL.	0.22	1.00	132.00
	POWER, FUEL, ETC		DOL.	0.80	1.00	480.00
	MISCL EXPENSE		DOL.	0.90	1.00	540.00
	EQUIPMENT(FUEL,LUBE,REP)		DOL.			1893.95
	LABOR, EQUIPMENT		HRS.	3.50	50.75	177.62
	LABOR, LIVESTOCK		HRS.	3.50	1428.00	4998.00
	INTEREST ON OPER.CAP.,		DOL.	0.09	8543.24	768.89
	TOTAL VARIABLE COSTS					37153.23
3.	INCOME ABOVE VARIABLE COSTS					26390.75
4.	FIXED COSTS					
	INT. ON LIVESTOCK CAPITAL		DOL.	0.09	21449.99	1930.50
	INT. ON OTHER EQUIPMENT		DOL.	0.09	33258.09	2993.23
	DEPR. ON MATURE MALE		DOL.			300.00
	DEPR. ON OTHER EQUIP.		DOL.			4132.34
	OTHER FC, MACH & EQUIP.		DOL.			854.72
	TOTAL FIXED COSTS					10210.78
5.	TOTAL COSTS					47364.01
6.	NET RETURNS					16179.98

System 2. Partial confinement system--total confinement central farrowing house, open front growing-finishing facilities, 80 litters farrowed yearly (2 groups of 20 sows, each group farrowing twice)

ITEM	WEIGHT EACH	UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OF COST
1. GROSS RECEIPTS					
MARKET HOGS	2.20	CWT.	48.00	560.00	59135.98
CULL SOWS	4.25	CWT.	40.00	20.00	3400.00
OPEN GILTS	3.00	CWT.	42.00	8.00	1008.00
TOTAL					63543.98
2. VARIABLE COSTS					
CORN		BU.	2.37	13.30	18912.59
SUPPLMT 14-18%		LBS.	0.08	157.00	7530.20
VET & MED.		DOL.	2.70	1.00	1620.00
TRUCKING, MKTG.		DOL.	0.22	1.00	132.00
POWER, FUEL, ETC		DOL.	0.80	1.00	480.00
MISCL EXPENSE		DOL.	0.90	1.00	540.00
EQUIPMENT(FUEL,LUBE,REP)		DOL.			2163.95
LABOR, EQUIPMENT		HRS.	3.50	45.75	160.12
LABOR, LIVESTOCK		HRS.	3.50	984.00	3444.00
INTEREST ON OPER.CAP.,		DOL.	0.09	8666.99	780.03
TOTAL VARIABLE COSTS					35862.87
3. INCOME ABOVE VARIABLE COSTS					27681.12
4. FIXED COSTS					
INT. ON LIVESTOCK CAPITAL		DOL.	0.09	21449.99	1930.50
INT. ON OTHER EQUIPMENT		DOL.	0.09	40683.09	3661.48
DEPR. ON MATURE MALE		DOL.			300.00
DEPR. ON OTHER EQUIP.		DOL.			4942.33
OTHER FC, MACH & EQUIP.		DOL.			1045.54
TOTAL FIXED COSTS					11879.85
5. TOTAL COSTS					47742.71
6. NET RETURNS					15801.27

System 3. Total confinement farrow-finish system, 80 litters farrowed yearly (2 groups of 20 sows, each group farrowing twice)

growing-finishing facilities. The difference between facility requirements shows itself most readily in the form of equipment labor. The labor per litter in System 3 equals 45.75 hours whereas the labor per litter in Systems 1 and 2 reaches an amount of 50.75 hours. The actual net returns per system are lower as the degree of confinement increase. This factor is due primarily to the greater degree and cost of initial overhead in the total confinement facilities.[1]

Systems 4, 5 and 6 (following pages) illustrate the expansion of the three initial systems into a 6-litter/year farrowing intensity. An intensity such as this dictates a high degree of breeding scheduling, with the additional strain placed on existing production facilities. To alleviate the overflow of small pigs from the extra two farrowings, a modern total-confinement nursery is added to each of the three initial hog operations, giving us Systems 4, 5 and 6. One particular note of interest with these increased yearly farrowings is the overall profitability of each expanded system. With 120 litters farrowed per year, the least totally-confined production system is most profitable. The second best for profitability goes to the total-confinement System #6. System 5 has not made the increased transition as profitably as the other two systems.

System 7 deals with a very low investment production system that enables a young producer to enter the hog business with minimum cost. Very little remodeling work has been done to this farrowing house for winter farrowings, (page 83), and very little effort is expended on

[1]Prices for both gross market receipts and input costs expressed in current market prices as of June 15, 1976.

ITEM	WEIGHT EACH	UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OR COST
1. GROSS RECEIPTS					
MARKET HOGS	2.20	CWT.	48.00	810.00	85535.88
CULL SOWS	4.25	CWT.	40.00	36.00	6120.00
OPEN GILTS	3.00	CWT.	42.00	12.00	1512.00
TOTAL					93167.88
2. VARIABLE COSTS					
CORN		BU.	2.37	13.30	28368.89
SUPPLMT 14-18%		LBS.	0.08	157.00	11445.29
VET & MED.		DOL.	2.70	1.00	2430.00
TRUCKING, MKTG.		DOL.	0.22	1.00	198.00
POWER, FUEL, ETC		DOL.	0.80	1.00	720.00
MISCL EXPENSE		DOL.	0.66	1.00	594.00
EQUIPMENT(FUEL,LUBE,REP)		DOL.			2315.15
LABOR, EQUIPMENT		HRS.	3.50	60.75	212.62
LABOR, LIVESTOCK		HRS.	3.50	2160.00	7560.00
INTEREST ON OPER.CAP.,		DOL.	0.09	12657.14	1139.14
TOTAL VARIABLE COSTS					54983.07
3. INCOME ABOVE VARIABLE COSTS					38184.80
4. FIXED COSTS					
INT. ON LIVESTOCK CAPITAL		DOL.	0.09	32399.98	2916.00
INT. ON OTHER EQUIPMENT		DOL.	0.09	37069.08	3336.22
DEPR. ON MATURE MALE		DOL.			600.00
DEPR. ON OTHER EQUIP.		DOL.			4985.53
OTHER FC, MACH & EQUIP.		DOL.			952.67
TOTAL FIXED COSTS					12790.41
5. TOTAL COSTS					67773.44
6. NET RETURNS					25394.44

System 4. Low investment--central house farrowing system, open front growing-finishing facilities nursery added, 120 litters farrowed (3 groups of 20 sows, each group farrowing twice)

ITEM	WEIGHT EACH	UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OR COST
1. GROSS RECEIPTS					
MARKET HOGS	2.20	CWT.	48.00	810.00	85535.88
CULL SOWS	4.25	CWT.	40.00	36.00	6120.00
OPEN GILTS	3.00	CWT.	42.00	12.00	1512.00
TOTAL					93167.88
2. VARIABLE COSTS					
CORN		BU.	2.37	13.30	28368.89
SUPPLMT 14-18%		LBS.	0.08	157.00	11445.29
VET & MED.		DOL.	2.70	1.00	2430.00
TRUCKING, MKTG.		DOL.	0.22	1.00	198.00
POWER, FUEL, ETC		DOL.	0.80	1.00	720.00
MISCL EXPENSE		DOL.	0.66	1.00	594.00
EQUIPMENT(FUEL,LUBE,REP)		DOL.			2215.15
LABOR, EQUIPMENT		HRS.	3.50	60.75	212.62
LABOR, LIVESTOCK		HRS.	3.50	1620.00	5670.00
INTEREST ON OPER.CAP..		DOL.	0.09	12611.30	1135.02
TOTAL VARIABLE COSTS					52988.95
3. INCOME ABOVE VARIABLE COSTS					40178.93
4. FIXED COSTS					
INT. ON LIVESTOCK CAPITAL		DOL.	0.09	32399.99	2916.00
INT. ON OTHER EQUIPMENT		DOL.	0.09	42019.08	3781.72
DEPR. ON MATURE MALE		DOL.			600.00
DEPR. ON OTHER EQUIP.		DOL.			5105.53
OTHER FC, MACH & EQUIP.		DOL.			1079.89
TOTAL FIXED COSTS					13483.13
5. TOTAL COSTS					66472.06
6. NET RETURNS					26695.81

System 5. Partial confinement system--central house farrowing, open front growing-finishing facilities nursery added, 120 litters farrowed (3 groups of 20 sows, each group farrowing twice)

ITEM	WEIGHT EACH	UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OR COST
1. GROSS RECEIPTS					
MARKET HOGS	2.20	CWT.	48.00	810.00	85535.88
CULL SOWS	4.25	CWT.	40.00	36.00	6120.00
OPEN GILTS	3.00	CWT.	42.00	12.00	1512.00
TOTAL					93167.88
2. VARIABLE COSTS					
CORN		BU.	2.37	13.30	28368.89
SUPPLMT 14-18%		LBS.	0.08	157.00	11445.29
VET & MED.		DOL.	2.70	1.00	2430.00
TRUCKING, MKTG.		DOL.	0.22	1.00	198.00
POWER, FUEL, ETC		DOL.	0.80	1.00	720.00
MISCL EXPENSE		DOL.	0.66	1.00	594.00
EQUIPMENT(FUEL,LUBE,REP)		DOL.			2485.15
LABOR, EQUIPMENT		HRS.	3.50	55.75	195.12
LABOR, LIVESTOCK		HRS.	3.50	1368.00	4788.00
INTEREST ON OPER.CAP.,		DOL.	0.09	12735.05	1146.15
TOTAL VARIABLE COSTS					52370.58
3. INCOME ABOVE VARIABLE COSTS					40797.29
4. FIXED COSTS					
INT. ON LIVESTOCK CAPITAL		DOL.	0.09	32399.98	2916.00
INT. ON OTHER EQUIPMENT		DOL.	0.09	49444.07	4449.96
DEPR. ON MATURE MALE		DOL.			600.00
DEPR. ON OTHER EQUIP.		DOL.			5915.53
OTHER FC, MACH & EQUIP.		DOL.			1270.70
TOTAL FIXED COSTS					15152.19
5. TOTAL COSTS					67522.75
6. NET RETURNS					25645.13

System 6. Total confinement farrow-finish system, nursery added, 120 litters farrowed (3 groups of 20 sows, each group farrowing twice)

ITEM	WEIGHT EACH	UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OF COST
1. GROSS RECEIPTS					
MARKET HOGS	2.20	CWT.	46.00	280.00	29567.99
CULL SOWS	4.25	CWT.	40.00	10.00	1700.00
OPEN GILTS	3.00	CWT.	42.00	4.00	504.00
TOTAL					31771.99
2. VARIABLE COSTS					
CORN		BU.	2.37	12.82	9115.02
SUPPLMT 14-18%		LBS.	0.03	156.00	3790.80
VET & MED.		DOL.	2.70	1.00	810.00
TRUCKING, MKTG.		DOL.	0.22	1.00	66.00
POWER, FUEL, ETC		DOL.	0.80	1.00	240.00
MISCL EXPENSE		DOL.	0.90	1.00	270.00
LEGUME PASTURE		ACRE	35.00	0.02	176.50
EQUIPMENT(FUEL,LUBE,REP)		DOL.			1912.45
LABOR, EQUIPMENT		HRS.	3.50	40.75	142.62
LABOR, LIVESTOCK		HRS.	3.50	984.00	3444.00
INTEREST ON OPER.CAP.,		DOL.	0.09	4682.23	421.40
TOTAL VARIABLE COSTS					20390.76
3. INCOME ABOVE VARIABLE COSTS					11381.23
4. FIXED COSTS					
INT. ON LIVESTOCK CAPITAL		DOL.	0.09	10949.99	985.50
INT. ON OTHER EQUIPMENT		DOL.	0.09	25523.09	2297.08
DEPR. ON MATURE MALE		DOL.			300.00
DEPR. ON OTHER EQUIP.		DOL.			3912.84
OTHER FC, MACH & EQUIP.		DOL.			655.94
TOTAL FIXED COSTS					8151.34
5. TOTAL COSTS					28542.10
6. NET RETURNS					3229.89

System 7. Pasture-low investment central house farrowing system, one farrowing on summer pasture--the other in the central farrowing house, 40 litters farrowed yearly (one group of sows farrowing twice)

summer farrowing facilities. The advantage to this representative system is the flexibility with which a producer may enter or leave the hog industry. Some disadvantages to this 2-litter system may, potentially, be a higher-pig mortality rate per litter (due to summer farrowings), or the inability to expand rapidly in hog production given an upturn in hog prices. The 2-litter system is representative of both small and very large Iowa hog producers, with some immediate disadvantages present with the higher number of productive acres tied up in the summer-farrow period.

Systems 8, 9 and 10 (pages 85, 86, and 87) have again reconstructed the first three systems discussed, but have omitted the finishing phase of the production operation. The noticeable difference in these three operations is the much smaller feed requirement per litter. (The bulk of the feed requirement in a hog's life cycle is from 40-220 lb.) In order of profitability per system, the most confined system is the most profitable (System 10), with System 8 being the next most profitable.

Systems 11 and 12 eliminate all farrowing and only represent the finishing phase of hog production (following pages). The feed and labor requirements charged per market hog are less than in a farrow-to-finish operation. However, the investment capital required to purchase 40 lb. feeder pigs is greater than the capital needed in a hog operation that farrows its own replacement feeder stock. These two systems primarily represent the producer who has neither the desire nor the labor to continue to farrow pigs. On the other hand, this producer may still wish to remain in the hog business, but only to finish out purchased feeder pigs. The facilities needed can be less elaborate than what is needed to

ITEM	WEIGHT EACH	UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OR COST
1. GROSS RECEIPTS					
FEEDER PIGS	0.40	CWT.	100.00	560.00	22399.98
CULL SOWS	4.25	CWT.	40.00	20.00	3400.00
OPEN GILTS	3.00	CWT.	42.00	8.00	1008.00
TOTAL					26807.98
2. VARIABLE COSTS					
CORN		BU.	2.37	3.32	4721.04
SUPPLMT 14-18%		LBS.	0.08	42.00	2041.20
VET & MED.		DOL.	2.29	1.00	1374.00
TRUCKING, MKTG.		DOL.	0.13	1.00	78.00
POWER, FUEL, ETC		DOL.	0.56	1.00	336.00
MISCL EXPENSE		DOL.	0.50	1.00	300.00
EQUIPMENT(FUEL,LUBE,REP)		DOL.			1831.95
LABOR, EQUIPMENT		HRS.	3.50	50.75	177.62
LABOR, LIVESTOCK		HRS.	3.50	996.00	3486.00
INTEREST ON OPER.CAP.,		DOL.	0.09	3313.20	298.19
TOTAL VARIABLE COSTS					14643.98
3. INCOME ABOVE VARIABLE COSTS					12164.01
4. FIXED COSTS					
INT. ON LIVESTOCK CAPITAL		DOL.	0.09	21449.99	1930.50
INT. ON OTHER EQUIPMENT		DOL.	0.09	25338.09	2280.43
DEPR. ON MATURE MALE		DOL.			300.00
DEPR. ON OTHER EQUIP.		DOL.			3688.34
OTHER FC, MACH & EQUIP.		DOL.			651.18
TOTAL FIXED COSTS					8850.43
5. TOTAL COSTS					23494.41
6. NET RETURNS					3313.57

System 8. Low investment--central house farrowing system, open front growing facilities selling 40 lb. feeder pigs, 80 litters farrowed yearly, (2 groups of 20 sows, each group farrowing twice)

ITEM	WEIGHT EACH	UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OR COST
1. GROSS RECEIPTS					
FEEDER PIGS	0.40	CWT.	100.00	560.00	22399.98
CULL SOWS	4.25	CWT.	40.00	20.00	3400.00
OPEN GILTS	3.00	CWT.	42.00	8.00	1008.00
TOTAL					26807.98
2. VARIABLE COSTS					
CORN		BU.	2.37	3.32	4721.04
SUPPLMT 14-18%		LBS.	0.08	42.00	2041.20
VET & MED.		DOL.	2.29	1.00	1374.00
TRUCKING, MKTG.		DOL.	0.13	1.00	78.00
POWER, FUEL, ETC		DOL.	0.56	1.00	336.00
MISCL EXPENSE		DOL.	0.50	1.00	300.00
EQUIPMENT(FUEL,LUBE,REP)		DOL.			1731.95
LABOR, EQUIPMENT		HRS.	3.50	50.75	177.62
LABOR, LIVESTOCK		HRS.	3.50	744.00	2604.00
INTEREST ON OPER.CAP.,		DOL.	0.09	3267.37	294.06
TOTAL VARIABLE COSTS					13657.85
3. INCOME ABOVE VARIABLE COSTS					13150.13
4. FIXED COSTS					
INT. ON LIVESTOCK CAPITAL		DOL.	0.09	21449.99	1930.50
INT. ON OTHER EQUIPMENT		DOL.	0.09	30288.09	2725.93
DEPR. ON MATURE MALE		DOL.			300.00
DEPR. ON OTHER EQUIP.		DOL.			3808.34
OTHER FC, MACH & EQUIP.		DOL.			778.39
TOTAL FIXED COSTS					9543.15
5. TOTAL COSTS					23201.00
6. NET RETURNS					3606.98

System 9. Partial confinement system--total confinement central farrowing house, open front growing facilities, selling 40 lb. feeder pigs, 80 litters farrowed yearly, (2 groups of 20 sows, each group farrowing twice)

ITEM	WEIGHT EACH	UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OR COST
1. GROSS RECEIPTS					
FEEDER PIGS	0.40	CWT.	100.00	560.00	22399.98
CULL SOWS	4.25	CWT.	40.00	20.00	3400.00
OPEN GILTS	3.00	CWT.	42.00	8.00	1008.00
TOTAL					26807.98
2. VARIABLE COSTS					
CORN		BU.	2.37	3.32	4721.04
SUPPLMT 14-18%		LBS.	0.08	42.00	2041.20
VET & MED.		DOL.	2.29	1.00	1374.00
TRUCKING, MKTG.		DOL.	0.13	1.00	78.00
POWER, FUEL, ETC		DOL.	0.56	1.00	336.00
MISCL EXPENSE		DOL.	0.50	1.00	300.00
EQUIPMENT(FUEL,LUBE,REP)		DOL.			1803.95
LABOR, EQUIPMENT		HRS.	3.50	45.75	160.12
LABOR, LIVESTOCK		HRS.	3.50	636.00	2226.00
INTEREST ON OPER.CAP.,		DOL.	0.09	3300.37	297.03
TOTAL VARIABLE COSTS					13337.32
3. INCOME ABOVE VARIABLE COSTS					13470.66
4. FIXED COSTS					
INT. ON LIVESTOCK CAPITAL		DOL.	0.09	21449.99	1930.50
INT. ON OTHER EQUIPMENT		DOL.	0.09	33258.09	2993.23
DEPR. ON MATURE MALE		DOL.			300.00
DEPR. ON OTHER EQUIP.		DOL.			4132.34
OTHER FC, MACH & EQUIP.		DOL.			854.72
TOTAL FIXED COSTS					10210.78
5. TOTAL COSTS					23548.10
6. NET RETURNS					3259.89

System 10. Total confinement system, selling feeder pigs at 40 lbs., 80 litters farrowed yearly, (2 groups of 20 sows, each group farrowing twice)

ITEM	WEIGHT EACH	UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OF COST
1. GROSS RECEIPTS					
MARKET HOGS	2.20	CWT.	48.00	780.00	82367.94
TOTAL					82367.94
2. VARIABLE COSTS					
CORN		BU.	2.37	9.98	18449.02
SUPPLMT 14-18%		LBS.	0.08	99.00	6254.52
VET & MED.		DOL.	1.87	1.00	1458.60
TRUCKING, MKTG.		DOL.	0.22	1.00	171.60
POWER, FUEL, ETC		DOL.	0.56	1.00	436.80
MISCL EXPENSE		DOL.	0.20	1.00	156.00
EQUIPMENT(FUEL,LUBE,REP)		DOL.			1274.95
LABOR, EQUIPMENT		HRS.	3.50	25.75	90.12
LABOR, LIVESTOCK		HRS.	3.50	756.00	2646.00
INTEREST ON OPER.CAP.,		DOL.	0.09	1417.97	127.62
TOTAL VARIABLE COSTS					31065.50
3. INCOME ABOVE VARIABLE COSTS					51302.43
4. FIXED COSTS					
INT. ON LIVESTOCK CAPITAL		DOL.	0.09	31199.99	2808.00
INT. ON OTHER EQUIPMENT		DOL.	0.09	16235.60	1461.20
DEPR. ON OTHER EQUIP.		DOL.			2275.34
OTHER FC, MACH & EQUIP.		DOL.			417.25
TOTAL FIXED COSTS					6961.79
5. TOTAL COSTS					38027.29
6. NET RETURNS					44340.65

System 11. Finishing out 780 purchased feeder pigs using open front growing-finishing facilities, buying at 40 lbs., selling at 220 lbs.

ITEM	WEIGHT EACH	UNIT	PRICE OF COST/UNIT	QUANTITY	VALUE OF COST
1. GROSS RECEIPTS					
MARKET HOGS	2.20	CWT.	48.00	780.00	82367.94
TOTAL					82367.94
2. VARIABLE COSTS					
CORN		BU.	2.37	9.98	18449.02
SUPPLMT 14-18%		LBS.	0.08	99.00	6254.82
VET & MED.		DOL.	1.87	1.00	1458.60
TRUCKING, MKTG.		DOL.	0.22	1.00	171.60
POWER, FUEL, ETC		DOL.	0.56	1.00	436.80
MISCL EXPENSE		DOL.	0.20	1.00	156.00
EQUIPMENT(FUEL,LUBE,REP)		DOL.			1544.95
LABOR, EQUIPMENT		HRS.	3.50	20.75	72.62
LABOR, LIVESTOCK		HRS.	3.50	636.00	2226.00
INTEREST ON OPER.CAP.,		DOL.	0.09	1541.72	138.76
TOTAL VARIABLE COSTS					30909.14
3. INCOME ABOVE VARIABLE COSTS					51458.80
4. FIXED COSTS					
INT. ON LIVESTOCK CAPITAL		DOL.	0.09	31199.99	2808.00
INT. ON OTHER EQUIPMENT		DOL.	0.09	23660.60	2129.45
DEPR. ON OTHER EQUIP.		DOL.			3085.34
OTHER FC, MACH & EQUIP.		DOL.			608.08
TOTAL FIXED COSTS					8630.86
5. TOTAL COSTS					39540.00
6. NET RETURNS					42827.94

System 12. Finishing out 780 purchased feeder pigs using total confinement growing-finishing facilities, buying at 40 lbs., selling at 220 lbs.

produce small pigs, and the high overhead costs of maintaining a breeding herd can be eliminated.

As the descriptions of the previous systems suggest, no attempt is made to favor one system over another. Rather, an attempt is made to illustrate representative categories of swine production systems. A producer, in viewing such generated budgets, may decide to align one of these enterprises to his own operation. Also, he may ask how does one particular system relate to the total farm operation, and, if so, is this relationship complementary to a profitable farming business. It is to these last questions that the next chapter answers.

CHAPTER VIII. THE ADAPTATION OF A SWINE SYSTEM TO WHOLE-FARM ANALYSIS

An attempt is made, in this chapter, to show how the basic 600-hog system (referred to as System 2 in the previous chapter) could fit within the confines of an Iowa grain and livestock farm. This "typical" Iowa farm consists of:

265 acres - Nicollet/Webster soil type
40 acres - Clarion soil type
5 acres - pasture (no soil type designation)

310 acres total available to the farm without additional land rental

Labor, in addition to land, is restrained by the number of owner/operator hours available to the operation:

Month	Maximum operator hours available
December-February	735
March	245
April	245
May	245
June	245
July	245
August	245
September	245
October	245
November	245

Labor, as in the budget generator, is assumed to be worth $3.50/hour.

This figure could either represent the opportunity cost to the manager/ owner for his own labor, or could be considered as the cost of additional, outside hired labor.

Also, as in the budget generator, each litter of pigs farrowed represents an additional 75 pigs to be transferred to the farming operation.

Borrowing of capital for operating expenses is not considered as a restraint and is left unlimited in this farm's operation.

Some of the operations (or columns) within the linear programming matrix represent the possible tillage and harvesting operations, in addition to the other livestock activities that may compete for the available labor and capital with the basic hog enterprise.

Five distinct crop rotations are available to the farm's planning structure:

Continuous corn	CCC (the matrix designation)
2 years corn, 1 year soybeans	CCS
1 year corn, 1 year soybeans	CS
Corn, oats, 2 years meadow (legumes)	COMM
2 years corn, oats, 1 year meadow	CCOM

These above rotations can be interfaced with the two soil types, Nicollet/Webster and Clarion, the dominant soil types of Central Iowa farmland.

Five harvest options are available to the planning matrix:

1. Corn harvested as grain,
2. Corn harvested as silage,

3. Soybean grain harvest,
4. Oats harvest,
5. Alfalfa harvested as a forage material.

The crop selling and storage activities include:

1. Corn silage storage,
2. Corn grain selling - fall,
3. Corn grain selling - spring,
4. Corn grain buying - spring,
5. Corn grain storage,
6. Soybeans selling - fall,
7. Soybeans selling - spring,
8. Soybeans storage,
9. Oats selling - fall,
10. Oats buying - spring,
11. Oats storage,
12. Alfalfa selling,
13. Alfalfa buying,
14. Converting hay to pasture grazing rather than legume harvesting,
15. Pasture improvement operations,
16. Unimproved pasture maintenance,
17. Supplement of pasture grazing with hay feeding,
18. Purchasing oat straw,
19. Selling oat straw.

The swine activities coincide with the farrowing and selling structures found within the budget generator:

1. Farrowing - March,
2. Farrowing - June,
3. Farrowing - September,
4. Farrowing - December.

Feeder pigs, if sold or purchased, coincide with the same months in which farrowing take place.

Within this whole-farm analysis (or matrix), alternative cattle operations compete with the swine enterprise:

1. Steer calf purchase (@ 450 lb. each),
2. Cow/calf operation (April/October),
3. Cow/calf operation (November/March),
4. Raising heifers for replacement within the cow herd,
5. Selling cull cows,
6. Selling calves - heifers,
7. Selling calves - steers,
8. Raising farm-produced calves - steers,
9. Raising farm-produced calves - heifers,
10. Feeding purchased steer calves to market weight (1150 lb.)
11. Feeding purchased steer calves from March-September,
12. Feeding purchased steer calves from October-February.

Labor, in addition to operator-furnished labor, can be hired throughout the year; i.e., hired labor is not considered a restraint to the whole-farm operation.

The basic 600-hog system consists of a total-confinement farrowing house with open front growing and finishing facilities (System #2). Within the context of a whole-farm matrix, the cost per litter that this

80-litter system requires is approximately $100. The calculations for this figure were computed using the budget output from System 2 (reprinted on following page):

Total variable costs	$37,153.23
<u>less</u> total corn costs (corn costs are included in the matrix)	18,912.59
	18,240.64
<u>less</u> receipts for cull sows and open gilts	4,408.00
	13,832.64
<u>less</u> labors, and interest on operating capital (these are all accounted for in the matrix)	5,944.51
operating costs per one 80-litter system	$ 7,888.13

$$\frac{\$7,888.13}{80 \text{ litters}} = \text{approx. } \$100/\text{litter}$$

A monetary cost for labor has been excluded in this figure. Also, a capital borrowing activity eliminates the cost on the investment capital (within the budget generator) of $768.89.

The labor requirements for this particular hog operation per litter were:

December-February	4.47 hrs/litter
March	1.49
April	1.49
May	1.49
June	1.49
July	1.49

August	1.49
September	1.49
October	1.49
November	1.49

These figures are average labor requirements broken down to match the labor-hours available to the whole-farm matrix.

Results

The results of this "fit" of a basic swine budget in a linear programming farm matrix reveals that all of the 80 litters were farrowed into the operation.[1] This particular matrix placed a higher livestock value on the swine farrowing enterprises than on the cow-calf operations. It was more feasible to raise feeder pigs than to maintain an extensive cow-calf operation; in fact, out of 192 calves that were fed out in feedlots, only 30 calves were farm-produced. No feeder pigs were sold, because the budget generator model dictated that only market hogs from the 80 litters were to be marketed.

As to the cropping and harvesting patterns of this typical Iowa farm program:

147 acres of corn harvested as grain (Nicollet/Webster soil type)

10 acres of corn harvested as grain (Clarion soil type)

8 acres of corn silage harvested (Nicollet/Webster)

110 acres of soybeans harvested

---

[1] A complete printout of the results matched to the complete matrix input forms is shown in Appendix A.

10 acres of oats harvested

20 acres of alfalfa grown and harvested

305 acres total (plus 5 acres were placed in improved pasture).

The marketing or storage patterns of this program were:

151.27	tons corn silage stored on the farm
4,672	bushels corn grain sold in the spring
23,415	bushels corn stored on the farm
4,180	bushels soybeans sold in the fall
750	bushels oats sold in the fall
48	tons alfalfa bought off the farm
67	tons of hay equivalents converted to pasture
5	acres of unimproved pasture maintained
602	bales of oat straw were sold.

The livestock programs, in addition to a full 80 litters farrowed and finished, included:

560 market weight, 220-lb. hogs sold (as in the budget model, 40 gilts were retained on the farm)

181 steer calves were purchased (@ 450 lb. each)

15 cow/calf units were kept for the April/October operation

15 cow/calf units were kept for the November/March operation

2 replacement heifers were raised and retained

2 cull cows were sold

188 steer calves were raised for a short-term finishing operation

4 heifer calves were raised for a long-term finishing operation.

The hired labor requirements varied according to the months in which it was most needed:

March	39 additional hours hired @ $3.50/hr.
April	110 additional hours hired @ $3.50/hr.
May	93 additional hours hired @ $3.50/hr.
June	77 additional hours hired @ $3.50/hr.
September	48 additional hours hired @ $3.50/hr.
October	111 additional hours hired @ $3.50/hr.
November	200 additional hours hired @ $3.50/hr.

These additional hired labor requirements are logical when viewed within the seasonal needs for outside help. Additional hours are needed for the spring planting and the fall harvesting; also, extra help is needed for the seasonal farrowings of March, June, September, and December -- months which conflict directly with busy fieldwork demands. Labor was not hired in the months of December, January, February, July or August. These are seasonal lulls in labor requirements and the operator's own labor is sufficient to meet the needs of the farm.

The final numbers within the matrix output pertain to the input cost per litter of pigs (farrow-to-finish) versus the last return or benefit that the final 80th litter generated to the profitability to the whole farming operation. This 80th litter cost approximately $100 to the farm, but it generated a return of $220.77. In other words, if an upper limit had not been placed on the number of litters available to the program, one could conceivably have continued to farrow and finish more litters until the cost of that last litter equaled the return it generated. The restraint placed on the matrix limiting the system to only 80 litters/year kept the farm from producing more litters, given the profitability and resource requirements of the basic hog system.

One last figure deserves mention. The question of profitability for the entire whole farm, with the introduction of the basic swine System #2, should be considered. This whole-farm analysis did register a return to the program of \$55,922.10. Whether this return is classified as gross profits or net returns depends on the purpose of the researcher and/or user. The swine budgets, as mentioned in previous chapters, dealt with net returns over both <u>fixed</u> and variable costs. This type of hog return or profitability (as depicted within System 2) is "fitted" with the whole-farm analysis. The linear programming matrix is considered as an ongoing enterprise that doesn't necessarily take note of fixed costs over a period of years of operation. The primary goal of this chapter was to fit a basic hog operation into the context of a working Iowa grain/ livestock farm - a farm presented with various management options. One result of this exercise was to show that one basic swine budget is a viable enterprise that can mesh quite easily into the scheme of an entire farm's operation.

CHAPTER IX. SUMMARY AND CONCLUSIONS

Several brief ideas may be considered within a summary of this study. As stated earlier, no attempt was made to exactly replicate an existing Iowa hog production operation. Actual swine budgets had been mentioned within the review of literature - studies which had suggested the obvious structure, size, and farrowing intensities of the swine systems budgeted within this present thesis. Also, this paper did not attempt to establish any economics of scale within the hog enterprises presented. These economics had been adequately dealt with in previous papers.

The purpose of this study (and to reemphasize the chapter entitled Objectives and Procedures) was to:

1. Characterize and identify representative swine production systems. The physical requirements for each system was selected, and the investment data corresponding to each system was obtained.

2. Budget twelve specific hog operations, identifying the returns to land, labor, capital, overhead, risk and management. Through the presentation of alternative swine enterprises, producers could develop ideas as to the modification of existing systems through either increased size, structures, or farrowing intensity.

3. Undertake an example hog operation within whole-farm analysis. The intent of this exercise was twofold. First, it had to be established if the hog operation would indeed fit comfortably within the framework of an existing, "typical" Iowa farm. Second, once fitted, to what extent

did the swine system compete for the input resources available to this entire farming operation.

The conclusions of the whole-farm analysis were encouraging. Not only did the hog enterprise "fit" into the farm, it also competed very favorably with cattle operations available to the farm's planning structure.

The procedures for implementing the previous objectives depended heavily on the usage of the Oklahoma State University Enterprise Budget Generator. This budgeting procedure was modified slightly to permit easy restructuring of different swine systems. The budget generator proved itself to be adaptable to a broad range of input data that included size, farrowing intensity, physical structure (or degree of confinement), and the physical restraints common to all different hog operations.

The cost estimation of the input requirements for each system were obtained through secondary data sources from state experiment stations, previous university swine production data, and private industry sources, both practicing hog producers and commercial building contractors.

This study could lead to further development of costs and returns budgeting for swine operation. One value of this paper would be to encourage other individuals or groups to expand on other questions concerning Iowa swine producers. For instance, swine budgets could be constructed to deal with feed comparison ratios among different confinement possibilities. Another budgeting technique could handle the problems of breeding successes or failures, and these impacts on the productivity of a specific confinement facility. Still other studies may direct themselves to finishing hogs to various market weights. These and other possibilities could be considered as logical extensions of this present paper.

The immediate value of this study could be directed towards extension and classroom applications. For the classroom, this study presents a concise and readable format from which to categorize and/or modify an existing hog system. Extension personnel may judge the convenience and organization of input data over many different hog systems as organized within readable forms of input and output. Through extension, an agricultural lender, as well as a producer, may see the best method to enlarge or modify an existing system, given the type of budget presented.

In conclusion, this study did identify existing swine production systems - systems which were in turn budgeted. These budgets were composed and analyzed according to predetermined classifications. A specific swine enterprise budget was then manipulated and "fitted" within a whole-farm analysis to best show the status of hog production on Iowa farms.

With this study, the many categories and diversifications present among practicing Iowa hog producers were "roughly" classified and brought within manageable definitions. These swine categories were budgeted, within the budget generator, to illustrate the potential and the resurgence of popularity of cost and returns budgeting among hog producers.

ACKNOWLEDGMENTS

I wish to thank the members of my graduate committee, and especially Dr. Sydney James, for the valuable and timely assistance given to me in completion of this thesis. His patience and understanding helped formulate the initial ideas into an understandable and concise study.

I am also grateful to Mr. Edward Pidgeon, a fellow graduate student at Iowa State University, who, through his diligence and persistence, aided me in the presentation of the whole-farm analysis.

Finally, I want to thank my wife, Paula, for her understanding through the long months of this endeavor. Her patience was greatly appreciated during the trials of this thesis.

BIBLIOGRAPHY

1. Bache, D. H. and J. R. Foster. Capital Requirements for Pork Production. Indiana Coop. Ext. Service, Research Bulletin Draft, 1975.

2. Bache, D. H. and J. R. Foster. Pork Production Systems with Business Analysis. Feeding Purchased Pigs. Indiana Coop. Ext. Service and the National Pork Producers Council, Des Moines, Iowa, 1975.

3. Bache, D. H. and J. R. Foster. Pork Production Systems with Business Analysis. The One-Litter System (Farrow-to-Finish). Indiana Coop. Ext. Service, Bulletin ID-103, 1975.

4. Bache, D. H. and J. R. Foster. Pork Production Systems with Business Analysis. The Two-Litter System (Farrow-to-Finish). Indiana Coop. Ext. Service, Bulletin ID-106, 1975.

5. Bache, D. H. and J. R. Foster. Producing Feeder Pigs. Indiana Coop. Ext. Service, Bulletin Research Draft, 1976.

6. Beneke, Raymond R. and Ronald Winterboer. Linear Programming Applications to Agriculture. Ames, Iowa: Iowa State University Press, 1973.

7. Blackie, M. J. and F. M. Anderson. A Planning and Control System for an Extension Farm Enterprise: Pig Production. Outlook on Agriculture 8(1974):1.

8. Blackie, M. J. and J. B. Dent. The Concept and Application of Skeleton Models in Farm Business Analysis and Planning. Journal of Agricultural Economics 25(1974): 165-173.

9. Boehlje, Michael and Larry Trede. Financing the Iowa Livestock Producer. Department of Economics, Iowa State University of Science and Technology in cooperation with the Iowa Development Commission, 1975.

10. Burnham, Nathan F. The Effect of the Hog-Corn Ratio on Swine Production in Iowa. Unpublished M.S. thesis. Library, Iowa State University of Science and Technology, Ames, Iowa, 1972.

11. Crall, Terry E. Economics of Size in Swine Production, A Normative Approach. Unpublished Ph.D. thesis. Library, Iowa State University of Science and Technology, Ames, Iowa, 1972.

12. Finley, Robert O., Noel Devisch and Robert Retzlaff. Economics of Size in Hog Production. Missouri Agricultural Experiment Station Research Bulletin Draft, 1975.

13. Galm, Timothy J. Production Systems of Iowa Swine Producers. Unpublished M.S. thesis. Library, Iowa State University of Science and Technology, Ames, Iowa, 1974.

14. Hinman, H. R. and R. F. Hutton. A General Simulation Model for Farm Firms. Agricultural Economic Research 22(1970): 69-73.

15. Hinton, R. A. The Economics of Labor and Choice of Swine Housing. Unpublished Ph.D. thesis. Library, University of Minnesota, Minneapolis, Minn., 1968.

16. Iowa Crop and Livestock Reporting Service. Des Moines, Iowa: Iowa Agricultural Statistics, 1975.

17. Iowa Development Commission. Swine Waste Management. Des Moines, Iowa: Author, 1975.

18. Iowa Farm Business Association. Iowa Farm Averages for 1975. Ames, Iowa: Author, 1975.

19. James, S. C., editor. Midwest Farm Planning Manual. 2nd edition. Ames, Iowa: Iowa State University Press, 1968.

20. James, Sydney C. and Raymond R. Beneke. Trends in the Quantity, Efficiency, and Costs of Iowa Swine Production. Iowa Coop. Ext. Service M-1154, 1974.

21. Kay, Ronald D. A Dynamic Linear Programming Model of Farm Firm Growth in North Central Iowa. Unpublished Ph.D. thesis. Library, Iowa State University of Science and Technology, Ames, Iowa, 1971.

22. Kletke, Darrel D. Operations Manual for the Oklahoma State University Enterprise Budget Generator. Oklahoma State Agricultural Experiment Station Research Report P-719, 1975.

23. Lanpher, Buel F. Management and Policy Implications of Costs and Return Budgets: Extension's Role in Formulation of Use. Southern Journal of Agricultural Economics 7(1975):1.

24. Meyer, Vernon M. Swine Farrowing Facilities. Iowa Coop. Ext. Service Pm-520, 1972.

25. Midwest Plan Service. Iowa State University of Science and Technology MWPS-8, 1972.

26. Muehling, A. J. and G. R. Carlisle. Farrowing Houses for Swine. Illinois Coop. Ext. Service Circular, 1973.

27. Mueller, A. G. and R. P. Kester. Hog Production Costs Affected by Prices for Feed, Labor and Buildings. Illinois Coop. Ext. Service FM-22 (Rev.), 1974.

28. National Hog Farmer. Swine Information Service: A Catalog of Swine Information Bulletins. St. Paul, Minnesota: Webb Publishing, 1975.

29. Palmer, Holdren, Vaughn C. Speer, Emmett J. Stevermer and Dean R. Zimmerman. Life Cycle Swine Nutrition. Iowa Coop. Ext. Service Pm-489 (Rev.), 1974.

30. Stoneberg, E. G. Suggested Farm Budgeting Costs and Returns. Iowa Coop. Ext. Service FM-1186 (Rev.), 1975.

31. Stoneberg, E. G. and William Edwards. Iowa Farm Costs and Returns, 1974. Iowa Coop. Ext. Service FM-1711, 1975.

32. Trede, Larry E. Swine Production Systems as Related to Business Management of North Central Iowa Farms. Unpublished M.S. thesis. Library, Iowa State University of Science and Technology, Ames, Iowa, 1968.

APPENDIX

This linear programming matrix was originally designed for the Agricultural Research Service study entitled "Energy Relationship for a 320-acre Iowa Farm." The key to the rows and columns (following pages) are applicable to the whole-farm analysis. The rows and columns particularly important to the swine system used within the whole-farm matrix are prefaced with an asterisk (*). Two changes have been introduced into this basic energy program which pertain to the specific hog operation:

1. R42, (p. 116), reflects the amount of corn consumed by or allocated to one litter of pigs from birth to market weight.

2. R58a is designated as the number of pigs produced in one litter.

The key, in the following pages, is to be used as a legend in the explanation of the complete whole-farm analysis printout.

Key to Rows and Columns Single Year Model

ROWS:

C	Economic costs and returns		
C1	Economic costs and returns for year one		
C5	000's of BTU's		
* R06	N.W. land restraint		
* R07	Clarion land restraint		
* R08	Pasture land restraint		
* R11		Labor restraint	December/February
* R12		Labor restraint	March
* R13		Labor restraint	April
* R14		Labor restraint	May
* R15		Labor restraint	June
* R16		Labor restraint	July
* R17		Labor restraint	August
* R18		Labor restraint	September
* R19		Labor restraint	October
* R20		Labor restraint	November
R32		Weather restraint	
R34	Manure transfer to fields		
R34 A	Manure transfer from cattle		January
R34 B	Manure transfer from cattle		February
R34 C	Manure transfer from cattle		March
R34 D	Manure transfer from cattle		April
R34 E	Manure transfer from cattle		May
R34 F	Manure transfer from cattle		June
R34 G	Manure transfer from cattle		July
R34 H	Manure transfer from cattle		August
R34 I	Manure transfer from cattle		September
R34 J	Manure transfer from cattle		October
R34 K	Manure transfer from cattle		November
R34 L	Manure transfer from cattle		December
R35	Nitrogen transfer to fields		
* R36	Standing corn transfer		N.W. - L.F.
* R37	Standing corn transfer		N.W. - H.F.
* R38	Standing corn transfer		C.L. - L.F.
* R39	Standing corn transfer		C.L. - H.F.
* R40	Standing corn transfer		N.W. - late
* R41	Corn grain to storage		
* R42	Corn grain from storage		
* R43	Corn silage to storage		
* R44	Corn silage from storage		
* R45	Standing soybean transfer		
* R46	Soybean to storage		

* R47	Soybean from storage	
R48	Standing out	
R49	Out to storage	
R50	Out from storage	
* R51	Standing meadow	
* R52	Hay transfer	
* R53	Standing pasture transfer	
* R54	Out straw transfer	
R55	Corn stalk for grazing transfer	
* R56	Residual alfalfa transfer	
* R57 A	Feeder pig transfer	December
* R57	Feeder pig transfer	June
* R58	Feeder pig transfer	March
* R58 A	Feeder pig transfer	September
* R60	Cow/calf transfer	
* R61	Steer/calf transfer	
* R62	Heifer/calf transfer	
* R63	Culled cow sell transfer	
* R64	Replacement cow transfer into herd	
R65	Beef cow capacity restraint	
R66	Calf raising capacity restraint	
R78 A	Energy (heat) transfer	December/January
R78 B	Energy (heat) transfer	February
R78 C	Energy (heat) transfer	October/November
R78 D	Energy (heat) transfer	March
R78 E	Transfer of gas from gas only generator	

R80
R81
R82 Labor transfer restraint rows to ensure only the labor
R83 in plowing is switched from November to October
R84
R85

Electrical Generating Capacity Restraint

R77 A	January
R77 B	February
R77 C	March
R77 D	April
R77 E	May
R77 F	June
R77 G	July
R77 H	August
R77 I	September
R77 J	October
R77 K	November
R77 L	December

R94	Capital transfer row	January/March
R95	Capital transfer row	April/June
R96	Capital transfer row	July/September
R97	Capital transfer row	October/December
R250	Gas generator capacity restraint	January
R251	Gas generator capacity restraint	February
R252	Gas generator capacity restraint	March
R253	Gas generator capacity restraint	April
R254	Gas generator capacity restraint	May
R255	Gas generator capacity restraint	June
R256	Gas generator capacity restraint	July
R257	Gas generator capacity restraint	August
R258	Gas generator capacity restraint	September
R259	Gas generator capacity restraint	October
R260	Gas generator capacity restraint	November
R261	Gas generator capacity restraint	December
R148A	Transfer of corn stover from field	
R148B	Transfer of stover from storage to mixer	
R420	Transfer of manure suitable for waste mix	January
R421	Transfer of manure suitable for waste mix	February
R422	Transfer of manure suitable for waste mix	March
R423	Transfer of manure suitable for waste mix	April
R424	Transfer of manure suitable for waste mix	May
R425	Transfer of manure suitable for waste mix	June
R426	Transfer of manure suitable for waste mix	July
R427	Transfer of manure suitable for waste mix	August
R428	Transfer of manure suitable for waste mix	September
R429	Transfer of manure suitable for waste mix	October
R430	Transfer of manure suitable for waste mix	November
R431	Transfer of manure suitable for waste mix	December

Transfer of Silage Mix Produced in the Following Months

R432	January
R433	February
R434	March
R435	April
R436	May
R437	June
R438	July
R439	August
R440	September
R441	October
R442	November
R443	December

R148A	Transfer of corn stover from field
R148B	Transfer stover from storage to mixer
R444	

COLUMNS:

Tillage Operations

* P01	CCC	N.W. - L.F.	
* P02	CCS	N.W. - L.F.	
* P03	CS	N.W. - L.F.	
* P04	COMM	Cl. - L.F.	
* P05	CCOM	Cl. - L.F.	
* P06	CCC	N.W. - H.F.	
* P07	CCS	N.W. - H.F.	
* P08	CS	N.W. - H.F.	
* P09	COMM	Cl. - H.F.	
* P10	CCOM	Cl. - H.F.	
* P11	CCC	N.W. - H.F.	Late
* P12	CCS	N.W. - H.F.	Late
* P13	CS	N.W. - H.F.	Late

<u>Harvest</u>:

* P13A	Corn stove	
* P14	Corn grain	Late
* P15	Corn grain	N.W. - L.F.
* P16	Corn grain	N.W. - H.F.
* P17	Corn grain	Cl. - L.F.
* P18	Corn grain	Cl. - H.F.
* P19	Corn silage	N.W. - L.F.
* P20	Corn silage	N.W. - H.F.
* P21	Soybeans harvest	
* P22	Oats harvest	
* P23	Alfalfa harvest	

<u>Selling and Storage</u>:

* P24	Corn silage store
* P25	Corn grain sell - fall
* P26	Corn grain sell - spring
* P27	Corn grain buy - spring
* P28	Corn grain store
* P29	Soybeans sell - fall
* P30	Soybeans sell - spring
* P31	Soybeans store
* P32	Oats sell - fall
* P33	Oats buy - spring
* P34	Oats store
* P35	Alfalfa sell

* P36 Alfalfa buy
* P37 Hay convert to pasture
* P38 Pasture improve
* P39 Unimproved pasture maintenance
* P40 Supplement of pasture with hay
* P41 Straw purchase
* P42 Straw sell
P43 Manure spread
P44 Nitrogen fertilizer purchase
P45 Conversion of hay to corn stover

Swine Activities:

* P46	Farrowing	March	
* P46A	Farrowing	September	
* P47	Farrowing	December	
* P47A	Farrowing	June	
* P48		Feeder pig sell	June
* P48A		Feeder pig sell	December
* P49		Feeder pig sell	March
* P49A		Feeder pig sell	September
P50		Feeder pig purchase	June
P50A		Feeder pig purchase	December
P51		Feeder pig purchase	March
P51A		Feeder pig purchase	September
P52		Hog finish	March
P52A		Hog finish	September
P53		Hog finish	
P53A		Hog finish	
P54		Market hog sell	

Cattle Activities:

* P55	Steer calf purchase	
* P56	Cow/calf operation	April/October
* P57	Cow/calf operation	November/March
* P58	Replacement cow raise	
* P59	Culled cow sell	
* P60	Calf selling - heifers	
* P61	Calf selling - steers	
* P62	Steer calf raise - long fed	
* P63	Steer calf raise - short fed	
* P64	Heifer calf raise - long fed	
* P65	Heifer calf raise - short fed	
* P66	Yearling steers - long fed	
* P67	Yearling steers - short fed (March - September)	
* P68	Yearling steers - short fed (October - February)	

Labor Hire:

* P68A	January/February/December
* P69	March
* P70	April
* P71	May
* P72	June
* P73	July
* P74	August
* P75	September
* P76	October
* P77	November

771, 772	March to April, and October transfer
773, 774	November to April, and October transfer

Land Rent:

P77	N.W. land rent
P78	Pasture

House Heating:

P80	December/January
P81	February
P82	October/November
P83	March

Gas Purchase:

P84	January/December
P85	February
P86	October/November
P87	March

Excess Manure Transfer to Fields:

P102	January
P103	February
P104	March
P105	April
P106	May
P107	June
P108	July
P109	August
P110	September
P111	October
P112	November
P113	December

Capital Transfer:

P122	January/March -- April/June	
P123	April/June -- July/September	
P124	July/September -- October/December	
P125	October/December -- to next year	
P126	Living expenses accounting	
P127	Fixed cost accounting	
P128	Capital borrowing	January
P129	Capital borrowing	April
P130	Capital borrowing	July
P131	Capital lending	January
P132	Capital lending	April
P133	Capital lending	July

Electricity Generation:

P90	January
P91	February
P92	March
P93	April
P94	May
P95	June
P96	July
P97	August
P98	September
P99	October
P100	November
P101	December
P136	Large digestor - electricity
P137	Small digestor - electricity

Methane Gas Generation:

P114A	January
P114B	February
P114C	March
P114D	April
P114E	May
P114F	June
P114G	July
P114H	August
P114I	September
P114J	October
P114K	November
P114L	December
P118	Small methane digestor - invest
P119	Large methane digestor - invest

Refeed Activities:

P350	Steer calves - waste mix first half	
P351	Yearlings - waste mix first half	
P352	Steer calves - waste mix second half	
P353	Steer calves - waste mix first half	
P354	Calves - full time grain	
P355	Yearlings - full time manure	
P356	Cow/calf fed recycled wastes	
P357	Steer calves - waste mix second half	
P358	Yearlings - waste mix second half	
P400	January	Mixing of silage/waste for refeed
P401	February	Mixing of silage/waste for refeed
P402	March	Mixing of silage/waste for refeed
P403	April	Mixing of silage/waste for refeed
P404	May	Mixing of silage/waste for refeed
P405	June	Mixing of silage/waste for refeed
P406	July	Mixing of silage/waste for refeed
P407	August	Mixing of silage/waste for refeed
P408	September	Mixing of silage/waste for refeed
P409	October	Mixing of silage/waste for refeed
P410	November	Mixing of silage/waste for refeed
P411	December	Mixing of silage/waste for refeed
P412	January	Manure mix storage in silo
P413	February	Manure mix storage in silo
P414	March	Manure mix storage in silo
P415	April	Manure mix storage in silo
P416	May	Manure mix storage in silo
P417	June	Manure mix storage in silo
P418	July	Manure mix storage in silo
P419	August	Manure mix storage in silo
P420	September	Manure mix storage in silo
P421	October	Manure mix storage in silo
P422	November	Manure mix storage in silo
P423	December	Manure mix storage in silo
P424	January	Excess manure disposed from
P425	February	Refeed operation to the fields
P426	March	Refeed operation to the fields
P427	April	Refeed operation to the fields
P428	May	Refeed operation to the fields
P429	June	Refeed operation to the fields
P430	July	Refeed operation to the fields
P431	August	Refeed operation to the fields
P432	September	Refeed operation to the fields
P433	October	Refeed operation to the fields
P434	November	Refeed operation to the fields
P435	December	Refeed operation to the fields

MBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
1	C	BS	55922.10409	55922.10409-	NONE	NONE	1.00000
2	C1	BS	103222.94228	103222.94228-	NONE	NONE	.
3	C2	BS	61309.10160-	61309.10160	NONE	NONE	.
4	C5	BS	1329050.07880	9998670948.92	NONE	9999999999.00	.
5	C6	BS	231770.00000	9989768229.98	NONE	9989999999.98	.
6	C7	BS	725787.06086	725787.06086-	NONE	NONE	.
7	C8	BS	387464.20769	998612535.789	NONE	998999999.997	.
8	C9	BS	603945.25995	9989396054.60	NONE	9989999999.86	.
9	C10	BS	147426.59130	998852573.399	NONE	998999999.990	.
10	C11	BS	186387.18448	9989813612.81	NONE	9989999999.99	.
11	R06	UL	265.00000	.	NONE	265.00000	119.44688-
12	R07	UL	40.00000	.	NONE	40.00000	124.93767-
13	R08	UL	5.00000	.	NONE	5.00000	96.04173-
14	R11	BS	659.71893	75.28107	NONE	735.00000	.
15	R12	UL	245.00000	.	NONE	245.00000	3.60579-
16	R13	UL	245.00000	.	NONE	245.00000	47.05261-
17	R14	UL	245.00000	.	NONE	245.00000	3.55605-
18	R15	UL	245.00000	.	NONE	245.00000	3.55605-
19	R16	BS	190.40520	54.59480	NONE	245.00000	.
20	R17	BS	172.95320	72.04680	NONE	245.00000	.
21	R18	UL	245.00000	.	NONE	245.00000	3.55250-
22	R19	UL	245.00000	.	NONE	245.00000	64.85261-
23	R20	UL	245.00000	.	NONE	245.00000	3.50350-
24	R32	BS	213.70000	286.30000	NONE	500.00000	.
25	R33	BS	170.55508	525.44492	NONE	696.00000	.
26	R34	UL	.	.	NONE	.	.47875-
27	R34A	UL	.	.	NONE	.	.00024-
28	R34B	UL	.	.	NONE	.	.00024-
29	R34C	UL	.	.	NONE	.	.00024-
30	R34D	UL	.	.	NONE	.	.00024-
31	R34E	UL	.	.	NONE	.	.00024-
32	R34F	UL	.	.	NONE	.	.00024-
33	R34G	UL	.	.	NONE	.	.00024-
34	R34H	UL	.	.	NONE	.	.00024-
35	R34I	UL	.	.	NONE	.	.00024-
36	R34J	UL	.	.	NONE	.	.00024-
37	R34K	UL	.	.	NONE	.	.00024-
38	R34L	UL	.	.	NONE	.	.00024-
39	R35	UL	.	.	NONE	.	.12395-
40	R36	UL	.	.	NONE	.	222.75687-
41	R37	UL	.	.	NONE	.	284.00758-
42	R38	UL	.	.	NONE	.	226.00012-
43	R39	UL	.	.	NONE	.	240.64754-
44	R40	UL	.	.	NONE	.	268.32656-
45	R41	UL	.	.	NONE	.	2.26160-
46	R42	UL	.	.	NONE	.	2.41073-
47	R43	UL	.	.	NONE	.	15.59798-
48	R44	UL	.	.	NONE	.	15.59798-
49	R45	UL	.	.	NONE	.	202.03262-

NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
50	R46	UL	.	.	NONE	.	6.00600-
51	R47	UL	.	.	NONE	.	4.60460-
52	R48	UL	.	.	NONE	.	168.75465-
53	R49	UL	.	.	NONE	.	1.45145-
54	R50	BS	.	.	NONE	.	.
55	R51	UL	.	.	NONE	.	170.03791-
56	R52	UL	.	.	NONE	.	45.04500-
57	R53	UL	.	.	NONE	.	47.07500-
58	R54	UL	.	.	NONE	.	1.01500-
59	R55	BS	82.50000-	82.50000	NONE	.	.
60	R56	BS	20.00000-	20.00000	NONE	.	.
61	R57A	UL	.	.	NONE	.	46.04600-
62	R57	UL	.	.	NONE	.	46.73069-
63	R58	UL	.	.	NONE	.	47.31975-
64	R56A	UL	.	.	NONE	.	46.69000-
65	R59	UL	.	.	NONE	.	108.29744-
66	R60	UL	.	.	NONE	.	106.52810-
67	R61	UL	.	.	NONE	.	214.30420-
68	R62	UL	.	.	NONE	.	177.42025-
69	R63	UL	.	.	NONE	.	210.31511-
70	R64	UL	.	.	NONE	.	356.03920-
71	R66	BS	192.36797	107.63203	NONE	300.00000	.
72	R77A	BS	.	.	NONE	.	.
73	R77B	BS	.	.	NONE	.	.
74	R77C	BS	.	.	NONE	.	.
75	R77D	BS	.	.	NONE	.	.
76	R77E	BS	.	.	NONE	.	.
77	R77F	BS	.	.	NONE	.	.
78	R77G	BS	.	.	NONE	.	.
79	R77H	BS	.	.	NONE	.	.
80	R77I	BS	.	.	NONE	.	.
81	R77J	BS	.	.	NONE	.	.
82	R77K	BS	.	.	NONE	.	.
83	R77L	BS	.	.	NONE	.	.
84	R78A	BS	.	.	NONE	.	.
85	R78B	BS	.	.	NONE	.	.
86	R78C	UL	.	.	NONE	.	.00000-
87	R78D	BS	.	.	NONE	.	.
88	R80	BS	40.25000-	40.25000	NONE	.	.
89	R81	BS	65.90000-	65.90000	NONE	.	.
90	R82	BS	70.42018-	70.42018	NONE	.	.
91	R83	BS	59.07982-	59.07982	NONE	.	.
92	R84	UL	28.50000	.	NONE	28.50000	43.44682-
93	R85	UL	200.00000	.	NONE	200.00000	61.34911-
94	R94	UL	25000.00000	.	NONE	25000.00000	.03023-
95	R95	UL	.	.	NONE	.	.01602-
96	R96	UL	.	.	NONE	.	.01500-
97	R97	UL	.	.	NONE	.	.00100-
98	R148A	BS	206.25000-	206.25000	NONE	.	.
99	R148B	BS	.	.	NONE	.	.
100	R420	BS	.	.	NONE	.	.

NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
101	R421	BS	.	.	NONE	.	.
102	R422	BS	.	.	NONE	.	.
103	R423	BS	.	.	NONE	.	.
104	R424	BS	.	.	NONE	.	.
105	R425	BS	.	.	NONE	.	.
106	R426	BS	.	.	NONE	.	.
107	R427	BS	.	.	NONE	.	.
108	R428	BS	.	.	NONE	.	.
109	R429	BS	.	.	NONE	.	.
110	R430	BS	.	.	NONE	.	.
111	R431	BS	.	.	NONE	.	.
112	R432	BS	.	.	NONE	.	.
113	R433	BS	.	.	NONE	.	.
114	R434	BS	.	.	NONE	.	.
115	R435	BS	.	.	NONE	.	.
116	R436	BS	.	.	NONE	.	.
117	R437	BS	.	.	NONE	.	.
118	R438	BS	.	.	NONE	.	.
119	R439	BS	.	.	NONE	.	.
120	R440	BS	.	.	NONE	.	.
121	R441	BS	.	.	NONE	.	.
122	R442	BS	.	.	NONE	.	.
123	R443	BS	.	.	NONE	.	.
124	R444	BS	.	.	NONE	.	.
125	P01	LL	.	63.29000-	.	NONE	49.81730-
126	P02	LL	.	147.76000-	.	NONE	82.04579-
127	P03	LL	.	88.72000-	.	NONE	43.47976-
128	P04	BS	.	91.03000-	.	NONE	.
129	P05	LL	.	143.40000-	.	NONE	44.06871-
130	P06	LL	.	69.78000-	.	NONE	2.59756-
131	P07	EQ	45.00000	161.39000-	45.00000	45.00000	11.73256
132	P08	EQ	65.00000	97.60000-	65.00000	65.00000	1.31043
133	P09	BS	10.00000	97.58000-	.	NONE	.
134	P10	LL	.	157.02000-	.	NONE	43.48676-
135	P11	LL	.	69.78000-	.	NONE	10.92752-
136	P12	BS	.	161.39000-	.	NONE	.
137	P13	LL	.	97.60000-	.	NONE	1.70101-
138	P13A	LL	.	11.28000-	.	NONE	11.29128-
139	P14	BS	.	16.05000-	.	NONE	.
140	P15	LL	.	15.54000-	.	NONE	5.93668-
141	P16	BS	147.43650	16.20000-	.	NONE	.
142	P17	LL	.	14.06000-	.	NONE	41.62250-
143	P18	BS	10.00000	14.33000-	.	NONE	.
144	P19	BS	.	20.59000-	.	NONE	.
145	P20	BS	7.56350	21.73000-	.	NONE	.
146	P21	BS	110.00000	5.59000-	.	NONE	.
147	P22	BS	10.00000	5.99000-	.	NONE	.
148	P23	BS	20.00000	6.70000-	.	NONE	.
149	P24	BS	151.26994	.	.	NONE	.
150	P25	LL	.	2.10000	.	NONE	.15950-
151	P26	BS	4671.60294	2.34000	.	NONE	.
152	P27	LL	.	2.59000-	.	NONE	.25756-
153	P28	BS	23415.47544	.	.	NONE	.

MBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
154	P29	BS	4180.00000	6.00000	.	NONE	.
155	P30	BS	.	4.60000	.	NONE	.
156	P31	LL	.	.	.	NONE	1.63163-
157	P32	BS	750.00000	1.43000	.	NONE	.
158	P33	LL	.	1.43000-	.	NONE	1.47322-
159	P34	LL	.	.01000-	.	750.00000	1.46146-
160	P35	LL	.	40.00000	.	NONE	4.44500-
161	P36	BS	47.79651	45.00000-	.	NONE	.
162	P37	BS	66.55102	2.00000-	.	NONE	.
163	P38	BS	5.00000	8.68000-	.	NONE	.
164	P39	LL	.	2.00000-	.	NONE	45.34773-
165	P40	LL	.	2.00000-	.	NONE	49.10500-
166	P41	LL	.	1.25000-	.	NONE	.23625-
167	P42	BS	602.00000	1.00000	.	NONE	.
168	P43	BS	1351.20913	.20000-	.	NONE	.
169	P44	BS	23318.34981	.12200-	.	NONE	.
170	P45	LL	.	.	.	NONE	22.52250-
171	P48	BS	.	46.00000	.	NONE	.
172	P48A	BS	.	46.00000	.	NONE	.
173	P49	BS	.	46.00000	.	NONE	.
174	P49A	BS	.	46.00000	.	NONE	.
175	P50	LL	.	48.00000-	.	NONE	2.03203-
176	P50A	LL	.	48.00000-	.	NONE	2.00200-
177	P51	LL	.	48.00000-	.	NONE	2.20164-
178	P51A	LL	.	48.00000-	.	NONE	2.03030-
179	P54	BS	560.00000	106.70000	.	NONE	.
180	P55	BS	181.26797	210.00000-	.	NONE	.
181	P56	EQ	15.00000	51.27000-	15.00000	15.00000	163.36686-
182	P57	BS	15.00000	.	.	NONE	.
183	P58	BS	2.40000	39.00000-	.	NONE	.
184	P59	BS	2.40000	207.00000	.	NONE	.
185	P60	LL	.	167.00000	.	NONE	7.91525-
186	P61	LL	.	198.25000	.	NONE	13.08045-
187	P62	LL	.	432.90000	.	NONE	2.57956+
188	P63	BS	188.01797	432.90000	.	NONE	.
189	P64	BS	4.35000	352.50000	.	NONE	.
190	P65	LL	.	352.50000	.	NONE	33.20514-
191	P66	LL	.	216.50000	.	NONE	.95379-
192	P67	LL	.	208.47000	.	NONE	41.16044-
193	P68	LL	.	208.20000	.	NONE	43.26106-
194	P68A	LL	.	3.50000-	.	NONE	3.60579-
195	P69	BS	39.15446	3.50000-	.	NONE	.
196	P70	UL	111.00000	3.50000-	.	111.00000	43.49656
197	P71	BS	92.95446	3.50000-	.	111.00000	.
198	P72	BS	76.65446	3.50000-	.	NONE	.
199	P73	LL	.	3.50000-	.	NONE	3.55250-
200	P74	LL	.	3.50000-	.	NONE	3.55250-
201	P75	BS	47.96074	3.50000-	.	111.00000	.

BER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
202	P76	UL	111.00000	3.50000-	.	111.00000	61.34911
203	P77	BS	200.22756	3.50000-	.	NONE	.
204	P771	BS	25.65000	.	.	NONE	.
205	P772	LL	.	17.80000-	.	NONE	.
206	P773	BS	61.37982	17.80000	.	NONE	.
207	P774	BS	72.72018	.	.	NONE	.
208	P78	EQ	.	100.00000-	.	.	19.34688
209	P79	EQ	.	35.00000-	.	.	61.00173
210	P84	LL	.	.33000-	.	NONE	.33515-
211	P85	LL	.	.33000-	.	NONE	.33997-
212	P86	BS	2019.36278	.33000-	.	NONE	.
213	P87	LL	.	.33000-	.	NONE	.33997-
214	P102	BS	141.77641	.	.	NONE	.
215	P103	BS	136.71781	.	.	NONE	.
216	P104	BS	163.39872	.	.	NONE	.
217	P105	BS	167.53028	.	.	NONE	.
218	P106	BS	183.32064	.	.	NONE	.
219	P107	BS	195.62615	.	.	NONE	.
220	P108	BS	.	.	.	NONE	.
221	P109	BS	.	.	.	NONE	.
222	P110	BS	.	.	.	NONE	.
223	P111	BS	112.06015	.	.	NONE	.
224	P112	BS	118.76258	.	.	NONE	.
225	P113	BS	132.01639	.	.	NONE	.
226	P122	LL	.	.	.	NONE	.01421-
227	P123	LL	.	.	.	NONE	.00101-
228	P124	LL	.	.	.	NONE	.01400-
229	P125	BS	18481.84884	.00100	.	NONE	.
230	P126	EQ	1.00000	.	1.00000	1.00000	90.24800-
231	P127	EQ	1.00000	54561.00000-	1.00000	1.00000	54615.56100-
232	P128	LL	.	.02300-	.	NONE	.00916-
233	P129	LL	.	.02300-	.	NONE	.02233-
234	P130	LL	.	.02300-	.	NONE	.00902-
235	P132	BS	38740.32658	.01500	.	NONE	.
236	P133	BS	42684.14706	.01500	.	NONE	.
237	P134	BS	52722.27504	.01500	.	NONE	.
238	P302	UL	80.00000	100.00000-	.	80.00000	220.76503