INFORMATION SYSTEMS ANALYSIS FOR THE COMPUTERIZATION OF A LONG RANGE FINANCIAL PLANNING MODEL: A CASE STUDY

by

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We accept this thesis as conforming
to the required standard

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ABSTRACT

Information systems analysis was done for the computerization of an existing long range financial planning model, in case study form. The model, that of Lockheed Petroleum Services Limited, was analyzed and recommendations for model sophistication were made. Computerization was justified by projected cost reduction and several other advantages which were judged to outweigh the disadvantages of computerization. Implications of computerization and difficulties of information systems analysis were described. Results of the study were the design of a detailed algorithm and of ancillary documents making future computer programming, verification, and implementation easily achievable.

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CHAPTER I

INTRODUCTION

The problem this study is concerned with is the computerization of a particular company's existing long range financial planning model. This thesis attempts to answer several questions in the process of solving the problem; these questions are listed below, together with the reasons for asking them.

1. What is the nature of the company? Because this is a case study, a description of the company is necessary.
2. What is the nature of the company's information system? The long range financial planning model should be studied in the context of the company's information system.
3. What is the company's present degree of computer use? Computerization of the model should be more readily accepted in an environment of present computer utilization.
4. What are the purposes of the model and does the model achieve its purposes? The existence and use of the model should be justified before its computerization is justified.
5. What are the methods by which the model achieves its purposes? The features of the model must be understood before design of the means of its computerization.
6. Are there potential areas for improvement of the model? The design process for means of computerization provides an opportunity for recommendations for the future.

7. What are the advantages, disadvantages, and implications of computerization of the model? Computerization should be justified - in terms of both current use of the model and also any different use of the model expected after computerization.
8. What difficulties were encountered during the information systems analysis phase? Brief mention of analysis difficulties helps explain how the problem was finally defined.
9. In what form should the means for computerization be designed? Documents prepared should make implementation of the computerized model straightforward; computer output should be easily comparable with similar output of the existing manually processed model.

This thesis attempts to answer the above questions in sequence, with a summary of the results appearing in the final chapter.

CHAPTER II

CASE DESCRIPTION OF THE COMPANY

A. The Company

A brief company description is necessary. The subject of this case study is Lockheed Petroleum Services Limited (LPS), a wholly-owned subsidiary of the American firm Lockheed Aircraft Corporation. LPS was incorporated in 1969 to exploit the technological skills of Lockheed's divisions and subsidiaries for the petroleum industry. "The Company is already working toward its ultimate goal of becoming a leader in the solution of a broad spectrum of environmental problems related to the petroleum industry."[1] Working from initial development at Lockheed Missile and Space Company in California, LPS has designed and successfully tested prototype components of a manned atmospheric subsea system for producing and servicing offshore oil wells.

> The Lockheed program utilizes a series of individual wellhead cellars, each with its pressure chamber capable of supporting Lockheed service personnel in a shirt-sleeves environment (atmospheric) for installation of wellhead hardware, and periodic servicing. Workmen are transported by a utility capsule, equipped with its own life support system, which operates from a surface support vessel and mates to the wellhead (or manifold center). Umbilicals supply electric power and fresh air from the support ship.

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[1]Untitled company leaflet prepared in 1970 as an insert for company brochures.

> The production of the various wells flows to the manifold centers where it is controlled and comingled. The manifold centers also contain the controls necessary to divert individual wells for testing. Initial production will utilize a fixed or floating surface platform for separation, although the manifold center will eventually accommodate separation and pumping equipment, containing the entire production system on the sea floor with either surface or deep water storage, or pipelines to shore facilities.[2]

Certain company characteristics affect the company's information system needs in the following ways:

1. LPS is in its initial growth stages;[3] prediction is difficult; a sophisticated model is not yet justified.
2. LPS is an offshoot of a larger company; its reporting requirements must be met by LPS' information system. Computerization might be justified by present planning model use.
3. The company expects rapid market growth and an eventual world-wide scale of operations. Therefore, the present information system should be easily expandable. Computerization is considered, because of the flexibility and economies of scale characteristic of computer use.

B. The Company's Information System: Description and Computer Use

This section presents observations on the company's information system and computer use; the following section (II C.) presents related conclusions and implications for the problem of model computerization.

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[2]Lockheed Missiles & Space Company, Subsea Petroleum: An Advanced Offshore Production System for Deeper Waters (Sunnyvale, Calif., 1968), p. 4.

[3]As of April 1971, 63 personnel were employed.

LPS' present information system consists of a reporting system stipulated by the parent company. These reports can be divided into three categories: financial reports, projected and comparative; accounting reports, actual and comparative; and activity reports, projected and actual. Only the financial reports will be considered here, as a framework for understanding the role of the long range financial planning model.

Table I on page 6 indicates the present financial reports, their frequency of preparation, the total period described by the report, and the period covered by each point estimate.

1. The Premises describe, in words, management's assumptions about the company's products and services and the relationships of critical variables describing the company's planned activities.

2. The Long Range Financial Planning Model translates the Premises into projected numerical data.

3. The Management Forecast restates several schedules derived in the Long Range Financial Planning Model, such as: Income Statement; Balance Sheet; Fixed Assets Schedule; Costs of New Business; Direct, Indirect, and Overhead Costs; and Receipts and Disbursements.

4. The Management Budget breaks down most of the schedules in the Management Forecast into monthly figures for the first year.

5. The Financial Forecast is similar to the Management Forecast but is prepared for potential lenders with more conservative sales estimates.

TABLE I

PRESENT FINANCIAL REPORTS

Title of Report	Frequency of Preparation	Total Period	Point Estimate Period
Premises	6 months	-	-
Long Range Financial Planning Model	6 months	10 years	1 year
Management Forecast	6 months	10 years	1 year
Management Budget	1 year	1 year	1 month
Financial Forecast	1 year	5 years	1 year
Some schedules:		years 1-2	3 months
		years 3-5	6 months
Fixed Assets Budget and Forecast	1 year	10 years	1 month
Mid-Year and Year-End Performance	6 months	1 year	1 month
Budget portion:		Remainder of year	
Comparative portion:		Elapsed portion of year	

6. The Fixed Assets Budget and Forecast complements the Management Forecast, which does not project fixed assets.

7. The Mid-Year and Year-End Performance Reports compare actual performance figures, combined with revised projections for the months remaining in the year, with the Management Budget figures.

The long range financial planning model, which may be referred to as "the model," is the most comprehensive of the reports and the most complex.

From interviews with the staff, it appeared to be a

common belief that preparing reports was occupying too much time, which could be devoted to more productive management tasks.

Proposals for information system changes should consider the company's present level of data processing skills. LPS has employed the computer in several applications, including:

1. Accounting cost ledger.
2. Parts listings and purchasing records.
3. Cash flow analysis.
4. Critical path scheduling.
5. Engineering analysis of stress.
6. Dynamic structure analysis.

This work has been done by personnel in different departments. There is at present no management information systems department.

C. Insights Gained

The following general conclusions can be drawn with relation to the problem of this study.

1. The reporting requirements must be met; reporting is sufficiently time-consuming that computerization should be considered.

2. While computerization involves personnel time, particularly initially, it will save time of personnel who would otherwise be planning and managing. The transferral of relatively routine duties away from managers could result in increased productivity and reduced costs.

3. The company's expected large-scale growth will require

a long range financial planning model which may be easily expanded and modified; a computerized model is more easily altered, especially if designed in modular fashion.

4. Because the long range financial planning model is the most comprehensive report, it is considered for computerization first. Although it is unsophisticated, it is complex enough to be difficult to process data through manually.

5. Although LPS has no management information systems department, the company's use of the computer in several applications provides an environment for acceptance of further computerization.

6. Although the model projects revenues on the basis of a required rate of return, prices justified from the customer's point of view were estimated previously to determine what rate of return LPS could reasonably expect to receive. Thus the product and service prices generated by the model serve to validate the previous marketing study.

The above are the major considerations prompting this study of the problem: the computerization of LPS' existing long range financial planning model.

CHAPTER III

THE LONG RANGE FINANCIAL PLANNING MODEL[4]

A. Purposes of the Model

The major purposes of the model are twofold: to satisfy reporting requirements; and to aid in making financial decisions. Both internal and external management (the parent company) review the model for the general picture it presents. Top management use the aggregate financial statements to make decisions on financing to be solicited.

There are two other benefits of model use. First, participation in the design of the model encouraged rigorous conceptual thinking about the business on the part of managers. Second, experimentation with the model provoked unexpected conclusions about the interactions of the model's variables.

Although these benefits of model use cannot be quantified, it was found that management considered the model worthwhile for the reasons outlined above.

B. General Model Features

The long range financial planning model is a record of the transformation of data inputs which describes mathematically the behaviour characteristics of the real system the model

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[4]The model was designed in mid-1970 at LPS.

represents. The model contains a series of tables of annual data over ten years, culminating in pro forma financial statements. Information on operations plans is collected informally by the financial planning and analysis personnel and is made into a financial plan twice per year. It is expected that further model development will lead to greater input formalization and standardization.

Model relationships are displayed graphically in Figure 1 on page 11. There are five functional classifications: product research and development is separated into Independent Research (I.R.) and Independent Development (I.D.); work related to the company's service contracts is divided into Service Operations (S.O.) and Service Hardware (S.H.), such as the utility capsules and surface support equipment; work related to the selling of hardware, such as wellhead cellars, pipeline connectors, and manifold modules, is classified under Hardware for Resale (H.R.).

The basis for most of the cost and revenue projections is the market estimate (number of fields and number of hardware units) and the per unit costs. Direct labour costs are based on numbers of personnel, which are derived in large part from the demands of the market forecast. Materials and direct labour cost are determined separately for each of the five corporate functions. Some of the indirect overhead costs are determined independently and allocated to the five functions on the basis of direct labour costs. The service operations function has also its own direct service overhead. New business (N.B.) revenue bears the independent research cost and the

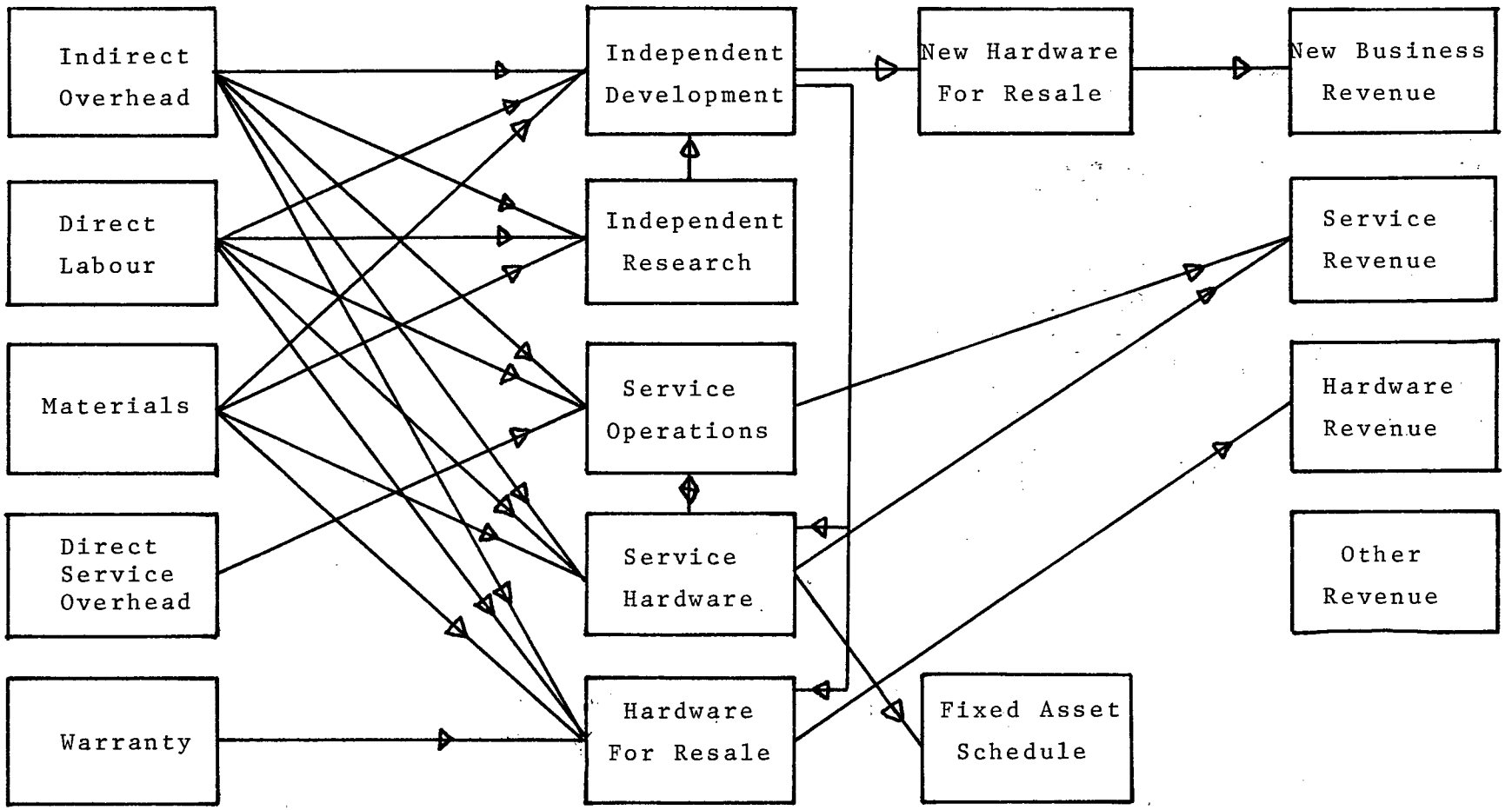

Figure 1 - Model Relationships

A figure taken from LPS' Long Range Financial Planning Model document.

independent development costs of presently undefined products. Independent development costs of currently defined products is apportioned between service hardware and hardware for resale. Fixed assets consist of service hardware and office furniture. Costs of service operations and service hardware determine, along with a required profit margin, the service revenue. Similarly, costs of hardware for resale determine hardware revenue. Revenues from new business, service contracts, hardware sold, and other sources combine with their separate costs to yield the aggregate revenue picture. The aggregate financial statements are regenerated with financing costs applied to the service function. This iteration is repeated until the desired accuracy is achieved.

C. Specific Model Parts

Model parts are described here within the framework of the algorithm (delineated in Chapter V) designed in the solution of the computerization problem. The algorithm is a translation of the model into a series of algebraic formulae which are easily computer programmable. The formulae are grouped in sections, such that the calculations within each section are performed in sequence, and such that the sections are executed in sequence. Figure 2 on page 29 shows a flow chart of these sections of the algorithm.

Preliminary Section. Certain input variables valued in year-zero dollars are translated, by compounding at a given rate of inflation, into annual values within the given time horizon.

Section A - Market Factors. Market variables are cumulated and totalled.

Section B - Labour. Total direct labour and total labour costs are found.

Section C - Indirect Overhead. Depreciation on office furniture is calculated according to a given depreciation method, with the capital expenditure on office furniture proportional to annual increases in non-field employees. Fringe benefits are a percentage of total labour cost classified as indirect overhead. Advertising and sales promotion are a percentage of sales; sales is the product of the number of employees and an arbitrary multiplier, because at this point in the model sales are not determined. Other indirect overhead is a percentage of home labour. These costs are combined with indirect labour cost and bid and proposal cost to obtain total indirect overhead. This is then allocated to the five corporate functions in proportion to their direct labour cost.

Section D - Independent Research and Independent Development. I.R. materials are defined as a percentage of labour cost. I.D. materials is an input. Total costs of I.R. and of I.D. are the sums of their materials, labour, and indirect overhead. When input data is prepared, it is not known what the total cost of I.D. will be in dollars; therefore percentages are given in input for allocation of I.D. to S.H. and to H.R., with the balance remaining going to new business.

Section E - New Business. New business income statement items are derived from costs of independent research and independent development. One year of independent research is

assumed to yield a given number of years of independent development and a given number of years of revenue for products researched.

Section F - Service Hardware. The service hardware - downwinch utility capsule (DUC), manoeuvrable utility capsule (MUC), and surface support equipment (SSE) - are to be built outside LPS. Costs of subcontracting, direct labour, indirect overhead, and independent development are combined and divided by the total number of service hardware units of each type to determine their unit cost.

Section G - Fixed Assets. Fixed assets consist of service hardware and office furniture. Service hardware, which is hardware used in the company's operations rather than being sold, includes the DUC, MUC, SSE, refurbishment DUC and MUC (major re-outfitting and alteration of a capsule), and DUC and MUC spares (spare parts). The numbers of each of these assets purchased in each year are multiplied by their compounded unit costs to obtain a schedule of service hardware additions in each year. A corresponding depreciation schedule is prepared using a depreciation calculation routine. This is combined with office furniture depreciation to yield total depreciation.

Section H - Service Hardware Depreciation per Field. Oil fields to be serviced by LPS are divided into U.S. fields and non-U.S. fields. Non-U.S. fields will generally involve greater depletion due to larger depletion allowances and to greater possibility of future government interference. Because non-U.S. fields will be in relatively diverse locations,

it is assumed that each field will require one set of spares. U.S. fields will share spares facilities. A percentage of non-U.S. fields are assumed to be partial-sized fields, while all U.S. fields are assumed to be full fields. The total depreciation is calculated for each of the three classifications: U.S. fields; non-U.S. full fields; and non-U.S. partial fields. This classification of fields is oversimplified due to the uncertainty about what will be the actual field sizes.

Section I - Vessel Rental. Annual rental to be paid for the vessels used on full fields is derived from a present value analysis of the vessel cost, depreciation tax saving, and salvage value.[5]

Section J - Direct Service Overhead. U.S., non-U.S., and total direct service overhead are derived from vessel rental and other direct service overhead costs (an input item).

Section K - Warranty. It is assumed that a given fraction of hardware for resale items will at some time need to be replaced. The corresponding fraction of the replacement cost is assumed by each hardware for resale item (wellhead cellar, pipeline connector, and manifold module) and is called warranty cost.

Section L - Hardware for Resale. Costs of direct labour, indirect overhead, independent development, and warranty are allocated to hardware for resale items in proportion to their subcontract costs. Total revenue and other hardware for resale

[5]Subsequent to the time of information systems analysis the author learned that vessel rental quotations were being received by the company, thus obviating the need for a vessel rental calculation procedure.

income statement items are calculated.

Section M - Cash Outflow Service (MUC). The present values of total investment, total costs, and total depreciation are calculated for a U.S. field (full), a non-U.S. field (full), and a non-U.S. field (partial). Investment is composed of capsule, refurbishment after a certain number of years, SSE, and spares. Total costs are the sum of shore support, crew, indirect overhead, vessel rental, and direct service overhead. (Section J)

Section N - Service Revenue and Pay-Out Analysis. The annual and daily service revenue for the three types of MUC field is averaged over the life of a contract based on a present value analysis of costs. For simplification, annual revenue is averaged for U.S. and non-U.S. fields. Annual and daily revenue schedules are generated over the contract life with periodic revenue increments. The year in which profit begins is shown in a pay-out analysis. Service income statement items are prepared.

Section O - Other Income and Aggregate Income Statement. Other income comes from three sources of governmental aid, some of which must be repaid after prototypes are used to derive revenue. Other income is combined with revenue and costs of service hardware, hardware for resale, and new business to produce the aggregate income statement, a tool commonly requested by management as a basis for making decisions.

Section P - Balance Sheet and Cash Flow Statement. Because accounts receivable and payable are paid some time after they are incurred, time lags are incorporated into accounts

payable, accounts receivable, and salaries payable to derive collections and payments for use in the cash flow statement. The balance sheet and cash flow statement are derived as the culmination of all the preceding calculations and provide information for management to evaluate different financing possibilities.

This concludes an outline of the methods by which the model achieves its purposes of satisfying reporting requirements and aiding in financial decision-making.

D. Recommendations

After the successful computerization of the present model, consideration should be given to sophistication which would allow the model to answer better the questions of management. The modular nature of the algorithm proposed in Chapter V allows sophistications to be implemented by changes to existing sections or additions of new sections. The following list of possible changes is presented with the realization that their costs and benefits would have to be evaluated before implementation.

1. Sensitivity analysis showing effects of incremental changes in certain variables, revealing key variables producing greatest effects.

2. Probabilistic analysis wherein alternative variable values (for example, three-point estimates) are assigned probabilities of occurrence and assumed to occur in various combinations according either to independent probabilities or to interdependency relationships.

3. Calculation of ranges within which prices may lie to yield acceptable rates of return for both the company and customers, thus indicating limits of contract negotiation.

4. Comparison of budgeted and actual figures or of results of various assumptions (within one computer run.)

5. Comparison of leasing and owning surface support vessel to determine relative profitability.

6. Comparison of subcontracted hardware production and of in-house hardware production, where capital resources might be made available for the latter innovation if justified by its profitability.

7. Generation of price schedules as a function of field, product, and service characteristics.

8. Introduction of the concept of risk, with higher profits required in areas of greater risk.

9. More realistic non-linear distribution over time of new business revenue.

10. Addition of graphic computer output where desired (and perhaps already being produced manually) for more easily understood presentation to internal or external management.

In deciding whether a certain model sophistication should be made, management has the possibly difficult task of estimating the value of the information to be yielded with relation to the predicted cost of model alteration. Another possibly difficult task for management is precise definition of the terms and complexity of the proposed alteration in communication with the management information systems persons involved.

CHAPTER IV

COMPUTERIZING THE MODEL

A. Advantages and Disadvantages of Computerization

This section considers the benefits and offsetting factors of computerization of LPS' long range financial planning model.

1. Cost Reduction. If computerization is combined with the semi-annual report preparation, the costs incurred in initial computerization will be offset by reduced requirements in personnel time. This is supported by the estimates in Table II on page 20, based on the mid-1970 reporting experience, in which input data reforecasts necessitated approximately eight model iterations.

2. Reduction in Calculation Time. Input data entry from an on-premises terminal to a central computer containing the stored program will generate computer output in minutes.

3. Ease of Experimentation. Multiple runthroughs, possibly in a single computer terminal session, allow various input data sets to be entered for comparison, and possible unexpected insights upon analysis of results.

4. Ease of Model Revision. A well-documented computer program will enable easier model revision than the non-computerized model. Alteration of one formula can be as simple as changing one statement in both program and algorithm

(which documents the formulae verbally and algebraically.) Both algorithm and program should be updated simultaneously. Very simple changes are sometimes more easily made manually, but these cases will be in the minority.

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TABLE II

NET COST SAVING BY COMPUTERIZATION

Computerization Cost[6]

Initial programming based on an algorithm with detailed documentation (such as the one proposed in Chapter V) for ease of testing and verification:

Task	Time	Cost
Programming (personnel time)	1 month	$1000
Computer (costs incurred)		500
Total:		1500

Cost Saving due to Reduced Personnel Time[7]

Task	Time	Cost
Financial analyst: manual calculation and checking time saved	1 month	$1000
Managers: checking time saved	1 month	1500
Typists: typing and checking time saved	2 months	1000
Total:		3500
Less:		1500
Net saving:		$2000

[6]Estimated by the author.

[7]Estimated by LPS' financial analyst, T. M. Symes.

5. Elimination of Typing Problems. When numerical reports are typed, errors in transcription might be difficult to find and inconsistencies in format difficult to overcome. With computerization, human fallibility in transcription is avoided and all financial and intermediate schedules can be produced in standard format, automatically consistent on each runthrough. Manual typing may be needed only for finalized reports required externally. It is conceivable that a manager might dislike the appearance of computer output, but confidence in the new format should result from familiarity and appreciation of computerization benefits.

6. Use by Various Personnel. Education of personnel in using the computer program at an on-premises terminal will be faster than education in using the manual model. In both cases, meaning of input variables must be understood. In the case of the manual model, model formulae must be understood and calculation and checking time can take several hours or days.

7. Model Crudeness. It is possible that management might feel the existing model is too crude to justify computerization. However, the model is complex enough that following it through manually to make alterations or calculations is a very monotonous and error-prone process.

8. Uncertainty of Computerization Step. Management may be reluctant to computerize because of the uncertainty inherent in system change. This is the major drawback to computerization.

It is concluded by the author that model computerization

is justified sufficiently, as supported by the points presented above, to offset the uncertainty of change.

B. Implications of Computerization

In addition to the advantages and disadvantages covered in the previous section, several implications of computerization should be considered.

1. Organizational Factors. If model computerization is performed by present or newly-hired company personnel, this work could form a base of experience from which a management information systems department could be formed. Also, persons freed of monotonous manual calculation should be able to devote more time to analysis of the financial statements and thought toward innovations in financial management.

2. Systems Analysis. In computerizing from an algorithm such as the one documented in Chapter V, the company can take advantage of the algorithm's streamlining, modularity, and sequentially executable design.

3. Model Formalization. Expression of the model's relationships in a series of very specific algebraic formulae, with supporting documentation, might not have been initiated were it not for the motivation of future computerization.

The above implications are all benefits which accompany the computerization process.

C. Difficulties Encountered During the Analysis Phase

Some difficulties were encountered during the process of solving the computerization problem. It was initially the

intention of the author that the computerization algorithm could be designed in an extremely generalized form. This would have meant that the algorithm could be used for long range financial planning by other companies. However, it was found that the majority of the model's variables and relationships described corporate functions and market classifications which would not be duplicated, or even approximated, by another company. Only the portion of the model dealing with the financial statements describes generally accepted variables and relationships. Therefore, a generalized algorithm was not designed.[8]

One difficulty of the analysis phase can be considered of benefit in the computerization phase. This is the fact that the company felt changes in the model were not yet needed. Therefore, potential changes are proposed at the end of Chapter III but not incorporated into the algorithm.[9] This means that the output after computerization can be compared directly to the manual model to verify that the algorithm and computer program are correct. The algorithm improves on the model in ways other than sophistication, as described in Chapter V, Section B.

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[8]The price of generalization is high: the computer program must provide capacity for the maximum number of variables desired by any user; the program must contain formulae for all relationships possibly needed; program input specifications must include options for relationships needed; and a variety of output schedules must be provided for in the program and requested in the input specifications.

[9]This company's long range financial planning model is "as simple as possible and as complex as necessary." (The source of this quotation is unknown.)

During the analysis phase, some errors were discovered and corrected, with the help of the company's financial analyst. At some places in the model, it was difficult to determine exactly how a variable was derived. The help of company personnel was needed to obtain formalized definitions of all the variables and relationships between variables.

In summary, it was difficult at first to define the problem to be solved in this study. The solution could be attempted once the problem was defined as the computerization of a particular company's long range financial planning model.

CHAPTER V

THE ALGORITHM

A. Model-to-Algorithm Methodology

The central document necessary for computerization is the algorithm, which is a set of formulae describing the data transformations in the model. It was designed with the goal in mind of being convertible into a computer program with a minimum of education time for the programmer.

The algorithm was written with reference primarily to the long range financial planning model document and, secondarily, to flow diagrams drawn up to help picture variable relationships in modular form. In several instances, relationships were streamlined, and the numbers of variables and tables to be printed out were reduced. Therefore, computer output schedules will not be identical to model schedules, but will provide sufficient information to enable verification of the correctness of the data transformations.

B. Algorithm Features

The following algorithm features are the results of the rigorous model re-definition which is the result of information systems analysis for computerization purposes.

1. Precision. The model relationships are expressed in precise formulae which can be easily referred to or altered.

2. Modularity. The model is separated into discrete sections, or modules, which can be easily referred to or altered.

3. Sequentiality. Calculations appear in the sequence in which they are performed, making it more obvious which variables affect other variables.

4. Variable Names. Variables are given mnemonic names and explicit definitions, preventing confusion as to identity of variables.

5. Exogeneous and Endogeneous Variables. Variables are separated into exogeneous (external) and endogeneous (internal) variables, thus distinguishing between environmental parameters, which must be quantified by the model user, and model parameters, which are quantified within the model.

6. Routines. Commonly used sets of calculations, referred to here as "routines," are not repeated within the algorithm, but are merely referenced where needed. Routines are separated from the rest of the algorithm, and, as program subroutines, can be altered at less computer expense.

C. Algorithm and Ancillary Documents

This section contains introductory remarks on the documents which define the algorithm, followed by the documents themselves.

1. Algorithm Formulation. The modules of the algorithm are called "Sections," labelled A to Q, and are preceded by the Preliminary Section. These sections are shown in flow chart form in Figure 2 on page 29. The variables used in each

section are classified at the beginning of each section into Exogeneous Variables Required, Endogeneous Variables Required, Variables Used Elsewhere, and Other Variables Used. Exogeneous variables are given in the input (Document 5); endogeneous variables are derived within the algorithm. The section of origin of each endogeneous variable required and the section of destination of each variable used elsewhere appear in parentheses after the variable name. The formulae in each section are to be executed sequentially and are preceded by a description in English. The sections themselves are also to be executed sequentially. Each output schedule is named at the point in the section where all variables needed have been defined. All output schedules are described in Document 6. Calculation routines are in Document 2, definition of variables in Document 3, and definition of variable subscripts in Document 4.

2. Formulation of Routines. Routines are sets of calculations employed in various sections of the algorithm.

3. Dictionary of Variables. This is an alphabetic list of the mnemonic variable symbols, or variable names, and their meanings. Where a variable is an "array," that is, a set of variables having the same name and same general meaning, the variable's subscript range is given. The algorithm section in which a variable is defined is shown with a slash (/) referring to the input data or Preliminary Section. Where the members of an array are not all defined in the same algorithm section, the subscript values are shown in parentheses after the section in which they are defined.

4. Dictionary of Variable Subscripts. The meanings assigned to individual subscripts are shown, together with the variables taking on these meanings.

5. Input Required. The input variables are separated into three input tables: (1) decimal fractions and integer numbers; (2) dollar figures; and (3) data arrays over time. Based on these tables, sophistication can be undertaken to divide them according to the person responsible for submitting the input data. This division can be reworked whenever management responsibilities are transferred from one person to another.

6. Output Produced. These output schedules are streamlined with relation to those in the Long Range Financial Planning Model, and adapted to the algorithm's sequence of operations. The schedules are described in terms of the variable names and subscripts, the ranges over which the subscripts vary, and the headings identifying the variables' meanings within the context of the table.

These six documents appear below.

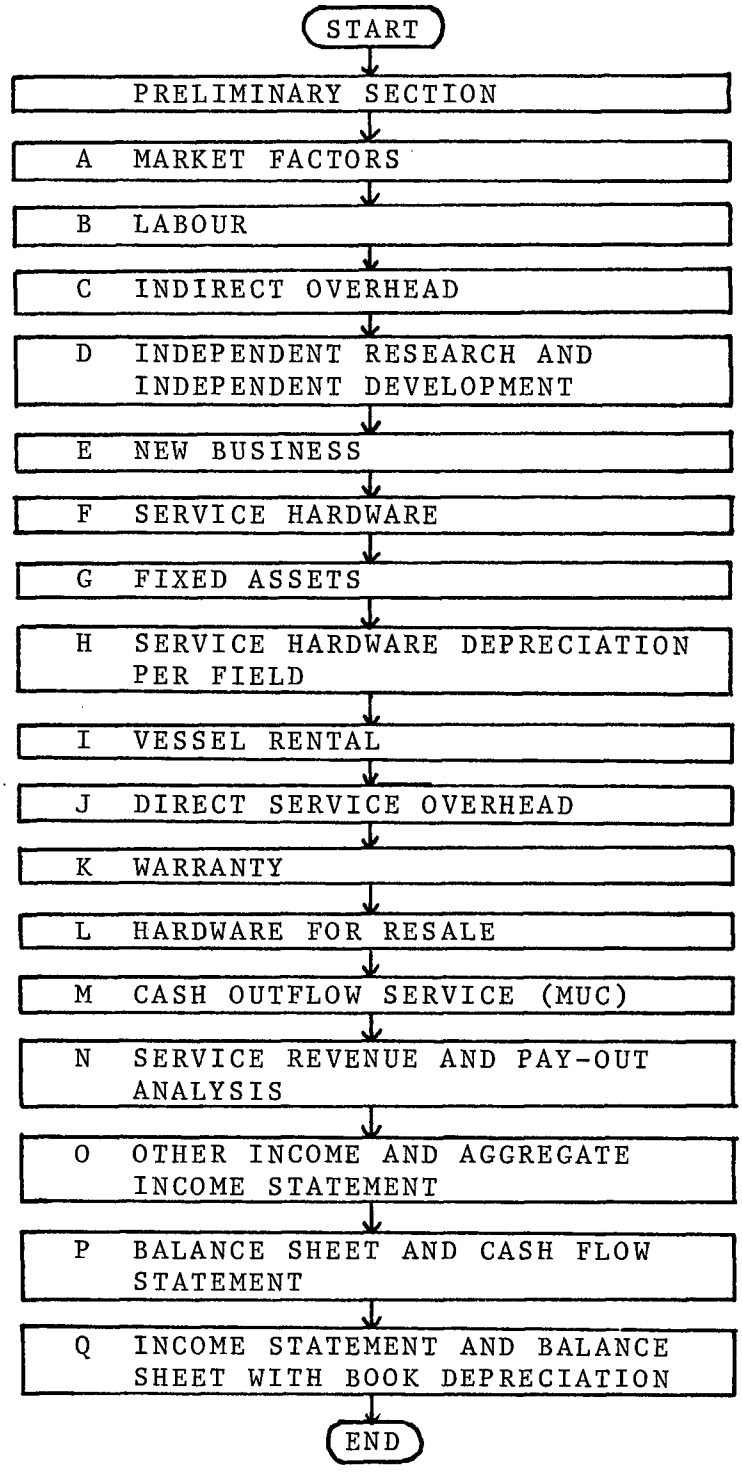

Figure 2

Flow Chart of the Sections of the Algorithm

Document 1 - Algorithm Formulation

Preliminary Section

Input: All variables (Input Tables 1,2,3).

Calculations:

Number of year.
$N_i=i$, $i=-1,\ldots,T$

Year.
$Y_i=YZ+i$, $i=-1,\ldots,T$

Compunding Inputs.

$OI_{ki}=C(OI_{ki},RI)$, $i=0,\ldots,T$, $k=1,\ldots,3$

$SCSH_{ki}=CBASE(SCSHB_k,RI)$, $i=0,\ldots,T$, $k=1,\ldots,3$

$UCSH_{ki}=CBASE(UCSHB_k,RI)$, $i=0,\ldots,T$, $k=4,\ldots,7$

$SCWHC_{ki}=CBASE(SCWHCB_k,RI)$, $i=0,\ldots,T$, $k=1,2$

$SCHR_{ki}=CBASE(SCHRB_k,RI)$, $i=0,\ldots,T$, $k=2,3$

$DSOHF_{ki}=CBASE(DSOHFB_k,RI)$, $i=0,\ldots,T$, $k=1,\ldots,3$

$SS_i=CBASE(SSB,RI)$, $i=0,\ldots,T$

$CF_{1i}=CBASE(CFB,RI)$, $i=0,\ldots,T$

$S_{ki}=CBASE(SB_k,RI)$, $i=-1,\ldots,T$, $k=1,\ldots,6$

$RH_i=CBASE(RHB,RI)$, $i=0,\ldots,T$

$OFNFE_i=CBASE(OFNFEB,RI)$, $i=0,\ldots,T$

$DUCD_i=CBASE(DUCDB,RI)$, $i=0,\ldots,T$

$W_i=CBASE(WB_k,RI)$, $i=0,\ldots,T$, $k=1,\ldots,3$

Section Execution:

Execute Sections A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q (in order, once each).

Section A - Market Factors

Exogeneous Variables Required: NF_{ki}, k=1,2, NHR_{kji}, k=1,...,3, j=1,2, NSH_{kji}, k=1,2,4,5, j=1,2, $TNSH_{ki}$, k=3,6,7,8, Y_i, all i=0,...,T, T.

Endogeneous Variables Required: None.

Variables Used Elsewhere: NFY_{1T}(H,M), NFY_{2T}(M), NFC_{ki}, k=1,2(J,N), $TNSH_{1i}$(F,G,N), $TNSH_{2i}$(F), $TNSH_{4i}$(G), $TNSH_{5i}$(G), $TNHR_{1i}$(K), $TNHR_{ki}$, k=2,3(K, L), all i=0,...,T.

Other Variables Used: $TNSH_{2i}$.

Calculations:

Cumulative number of fields.
$NFC_{ki}=CUM(NF_{ki})$, k=1,2, i=0,...,T

Number of field-years.
$NFY_{ki}=CUM(NFC_{ki})$, k=1,2, i=0,...,T

Total numbers of hardware.
$TNHR_{ki}=A(NHR_{kji}$, j=1,2), k=1,...,3, i=0,...,T
$TNSH_{ki}=A(NSH_{kji}$, j=1,2), k=1,2,4,5, i=0,...,T

Output 1 - Market

Section B - Labour

Exogeneous Variables Required: S_{ki}, k=1,...,6, i=-1,...,T, NE_{ki}, k=1,...,6, i=-1,...,T, RLCA, Y_i, i=0,...,T, T.

Endogeneous Variables Required: None.

Variables Used Elsewhere: $TL_i(C,P)$, $TNE_i(C)$, $TDL_i(C)$, $LC_{1i}(C,D)$, $LC_{2i}(C,D)$, $LC_{3i}(C,F)$, $LC_{4i}(C,N)$, $LC_{5i}(C,L)$, $LC_{6i}(C)$, all i=0,...,T.

Other Variables Used: LCB_{ki},i=0,...,T.

Calculations:

Labour cost base (100%).
$LCB_{ki}=(S_{ki}xNE_{ki}+S_{k,i-1}xNE_{k,i-1})/2$, k=1,...,6, i=0,...,T
$TNE_i=A(NE_{ki})$

Labour cost.
$LC_{ki}=RLCAxLCB_{ki}$

Total direct labour cost.
$TDL_i=A(LC_{ki}, k=1,...,5)$

Total labour cost.
$TL_i=TDL_i+LC_{6i}$

Output 2 - Labour

Section C - Indirect Overhead

Exogeneous Variables Required: $NENF_i$, i=-1,...,T, $OFNFE_i$, i=0,...,T, DMOF, OFOB, RDOF, RFTTLC, BP_i, i=0,...,T, RATR, RH_i, i=0,...,T, ROIOH, Y_i, i=0,...,T, T.

Endogeneous Variables Required: $TL_i(B)$, $TNE_i(B)$, $TDL_i(B)$, LC_{ki}, k=1,...,6, all i=0,...,T.

Variables Used Elsewhere: $DOF_i(G)$, $IOH_{1i}(D)$, $IOH_{2i}(D)$, $IOH_{3i}(F)$, $IOH_{4i}(M,N)$, $IOH_{5i}(L)$, all i=0,...,T.

Other Variables Used: $NENFI_i$, OFI_i, F_i, $OIOH_i$, ASP_i, $TIOH_i$, all i=0,...,T.

Calculations:

Depreciation on office furniture as a function of annual increases in number of non-field employees.

$NENFI_i=INCR(NENF_i)$, i=0,...,T

$OFI_i=OFNFE_i \times NENFI_i$, i=0,...,T

$DOF_i=D(DMOF,OFOB,OFI_i,RDOF)$, i=0,...,T

Output 3 - Depreciation On Office Furniture

Fringe as a percentage of total labour cost.

$F_i=RFTTLC \times TL_i$, i=0,...,T

Advertising and sales promotion as a function of a rule-of-thumb amount of sales per head.

$ASP_i=RATR \times RH_i \times TNE_i$, i=0,...,T

Other indirect overhead as a percentage of home labour.

$OIOH_i=ROIOH \times (LC_{1i}+LC_{2i}+LC_{3i}+LC_{6i})$, i=0,...,T

Total indirect overhead

$TIOH_i=LC_{6i}+F_i+BP_i+DOF_i+ASP_i+OIOH_i$, i=0,...,T

Allocated to the corporate functions according to their direct labour cost.

$IOH_{ki}=LC_{ki} \times TIOH_i/TDL_i$, k=1,...,5, i=0,...,T

Output 4 - Indirect Overhead

Section D - Independent Research And Independent Development

Exogeneous Variables Required: RMTLIR, M_{2i}, $RIDASH_{ki}$, k=1,2,3, $RIHAHR_{ki}$, k=1,2,3, Y_i, all i=0,...,T, T.

Endogeneous Variables Required: LC_{ki}, k=1,2(B), IOH_{ki}, k=1,2(C), all i=0,...,T.

Variables Used Elsewhere: $TIDANB_i$(E), TC_{1i}(E), $IDASH_{ki}$, k=1,...,3(F), $TIDAHR_i$(L), M_{1i}(P), $TIDASH_i$(N), all i=0,...,T.

Other Variables Used: TC_{2i}, $IDAHR_{ki}$, k=1,...,3, all i=0,...,T.

Calculations:

I. R. materials as a percentage of labour cost.
$M_{1i}=RMTLIR \times LC_{1i}$, i=0,...,T

Total cost of I. R. and I. D. as the sum of materials, labour, and indirect overhead.
$TC_{ki}=M_{ki}+LC_{ki}+IOH_{ki}$, k=1,2, i=0,...,T

I. D. allocation to service hardware according to percentages inputted.
$IDASH_{ki}=RIDASH_{ki} \times TC_{2i}$, k=1,...,3, i=0,...,T
$TIDASH_i=A(IDASH_{ki}$, k=1,...,3), i=0,...,T

I. D. allocation to hardware for resale according to percentages inputted.
$IDAHR_{ki}=RIDAHR_{ki} \times TC_{2i}$, k=1,...,3, i=0,...,T
$TIDAHR_i=A(IDAHR_{ki}$, k=1,...,3)

I. D. allocation (balance remaining) to new business.
$TIDANB_i=TC_{2i}-TIDASH_i-TIDAHR_i$, i=0,...,T

Output 5 - Independent Research And Independent Development

Section E - New Business

Exogeneous Variables Required: NYNPID, NYNPP, NTNBP, RNBSCR, RR, RT, ONE, Y_i, i=0,...,T,T.

Endogeneous Variables Required: $TC_{1i}(D)$, $TIDANB_i(D)$, both i=0,...,T.

Variables Used Elsewhere: $R_{3i}(O)$, $COS_{3i}(O)$, both i=0,...,T.

Other Variables Used: NBA_{ji}, j=1,...,n+1, $TPNB_i$, $COSST_{3i}$, PBT_{3i}, FT_{3i}, NP_{3i}, all i=0,...,T, $PVNB_i$, $NBAP_i$, both i=0,...,T-n-1.

Calculations:

Each year of Independent Research yields n years of Independent Development and m years of profit.
n=NYNPID
m=NYNPP

New business allocation NBA_{1i} is the I. R. cost in year i.
$NBA_{1i}=TC_{1i}$, i=0,...,T

I. D. costs allocated to new business in year i, $TIDANB_i$, are divided into NBA_{2i},..., $NBA_{n+1,i}$ according to I. R. investments $NBA_{1,i-1}$,...,$NBA_{1,i-n}$.
$NBA_{ji}=NBA_{1,i-j+1}xTIDANB_i/A(NBA_{1k}$, k=i-n*,...,i-1), j=2,...,n+1
*or k=0 if i is less than n

The cost of the projects researched in year i is equal to the sum of NBA_{1i}, $NBA_{2,i+1}$, up to $NBA_{n+1,n+1}$.
$PVNB_i=A(PV(NBA_j,RR,m)$, j=1,...,n+1), i=0,...,T-n-1

$NBAP_i$ is the annual profit which will start coming in the year after the stream of one year of I. R. in year i and n years of I. D. $NBAP_i$ is the same every year for m years and it produces the firm's required rate of return with respect to the present value of the expenditures (the NBA's).
$NBAP_i=PVNB_i/A(PV(ONE,RR,j)$, j=i+n+1,...,i+n+m), i=0,...,T-n-1

The total profit from new business investment in each year is the sum of the annual profits from the research and development streams ended within the last m yars.
$TPNB_i=0$
$TPNB_i=A(NBAP_k$, k=i-n-1,...,i-n-m)

Revenue is a multiple of profit generated from investment.
$R_{3i}=NTNBPxTPNB_i$

Cost of sales as a percentage of sales revenue.
$COSST_{3i}=RNBSCRxR_{3i}$

Other income statement calculations.
$COS_{3i}=COSST_{3i}+TC_{1i}+TIDANB_i$
$PBT_{3i}=R_{3i}-COS_{3i}$
$FT_{3i}=RTxPBT_{3i}$
$NP_{3i}=PBT_{3i}-FT_{3i}$

Output 6 - New Business Profit And Income Statement

Section F - Service Hardware

Exogeneous Variables Required: $TNSH_{ki}$, k=3,8, $SCSH_{ki}$, k=1,...,3, Y_i, all i=0,...,T, T.

Endogeneous Variables Required: LC_{3i}(B), IOH_{3i}(C), $TNSH_{1i}$(A), $TNSH_{2i}$(A), $IDASH_{ki}$, k=1,...,3(D), all i=0,...,T.

Variables Used Elsewhere: $UCSHB_k$, k=1,2(G), $UCSHB_3$(G,M), $TNMIS_i$(G,N), M_{3i}(P), both i=0,...,T, TNMISS(H).

Other Variables Used: $MCSH_{ki}$, k=1,...,3, $MCSHD_{ki}$, k=1,...,3, LCD_i, $IOHD_i$, $IDASHD_{ki}$, k=1,...,3, $TNSHS_k$, k=1,3, all i=0,...,T, $MCSHS_k$, k=1,...,3, MS_3, LCS_3, $IOHS_3$, LCA_{3k}, k=1,...,3, $IOHA_{3k}$, k=1,...,3, $IDASHS_{3k}$, k=1,...,3, $TCSH_k$, k=1,...,3.

Calculations:

Total number of MUCs including spares.
$TNMIS_i=TNSH_{2i}+TNSH_{8i}$, i=0,...,T

Material cost for service hardware.
$MCSH_{ki}=SCSH_{ki}xTNSH_{ki}$, k=1,3, i=0,...,T
$MCSH_{2i}=SCSH_{2i}xTNMIS_i$, i=0,...,T

"De-compounded" or "discounted" material cost summed over time forms basis for allocation of other costs to service hardware items.
$MCSHD_{ki}=PV(MCSH_{ki},RI,i)$, i=0,...,T, k=1,...,3
$LCD_i=PV(LC_{3i},RI,i)$, i=0,...,T
$IDASHD_{ki}=PV(IDASH_{ki},RI,i)$, i=0,...,T, k=1,...,3
$MCSHS_k=A(MCSHD_{ki},k=1,...,3)$, i=0,...,T

Discounted material costs for all service hardware, summed.
$MS_3=A(MCSHS_k$, k=1,...,3)

Total number of service hardware items summed over time.
$TNSHS_k=A(TNSH_{ki}$, i=0,...,T), k=1,3
$TNMISS=A(TNMIS_i$, i=0,...,T)

Discounted labour costs summed over time.
$LCS_3=A(LCD_i$, i=0,...,T)

Discounted indirect overhead summed over time.
$IOHS_3=A(IOHD_i$, i=0,...,T)

Allocation of costs to service hardware.
$LCA_{3k}=MCSHS_kxLCS_3/MS_3$, k=1,...,3
$IOHA_{3k}=MCSHS_kxIOHS_3/MS_3$, k=1,...,3
$IDASHS_{3k}=A(IDASHD_{ki}$, i=0,...,T), k=1,...,3
$TCSH_k=MCSHS_k+LCA_{3k}+IOHA_{3k}+IDASHS_{3k}$, k=1,...,3

Unit cost of service hardware items.
$UCSHB_k=TCSH_k/TNSHS_k$, k=1,3
$UCSHB_2=TCSH_2/TNMISS$

Output 7 - Allocation of Capital Expense to Service Hardware

Section G - Fixed Assets

Exogeneous Variables Required: $UCSH_{ki}$, k=4,...,7, OB_k, k=1,...,7, $TNSH_{ki}$, k=3,6,7, $DMSH_k$, $RDSH_k$, both k=1,...,7, RRS, Y_i, all i=0,...,T, T.

Endogeneous Variables Required: $UCSHB_k$, k=1,...,3(F), $TNMIS_i$, i=0,...,T(F), $TNSH_{ki}$, k=1,4,5, i=0,...,T(A), DOF_i, i=0,...,T(C).

Variables Used Elsewhere: $FAI_i(P,Q)$, $TD_i(P,Q)$, $SD_i(N)$, all i=0,...,T.

Other Variables Used: $UCSH_{ki}$, k=1,...,3, DSH_{ki}, k=1,...,7, SHI_{ki}, k=1,..., 7, RSC_{ki}, all i=0,...,T.

Calculations:

Service Hardware increase (fixed assets acquired).
$UCSH_{ki}=C(UCSHB_k)$, i=0,...,T, k=1,...,3
$SHI_{2i}=TNMIS_i \times UCSH_{2i}$, i=0,...,T
$SHI_{ki}=TNSH_{ki} \times UCSH_{ki}$, i=0,...,T, k=1,3,4,5,6,7

Fixed assets increase
$FAI_i=A(SHI_{ki},k=1,...,7)$, i=0,...,T

Depreciation on service hardware assets.
$DSH_{ki}=D(DMSH_k, OB_k, SHI_{ki}, RDSH_,)$, i=0,...,T, k=1,...,5
$DSH_{ki}=DR(DMSH_k, OB_k, SHI_{ki}, RDSH_k, RRS, RSC_{ki})$, i=0,...,T, k=6,7
$SD_i=A(DSH_{ki}, k=1,...,7)$, i=0,...,T

Total depreciation including depreciation on office furniture.
$TD_i=SD_i+DOF_i$

Output 8 - Fixed Assets

Section H - Service Hardware Depreciation Per Field

Exogeneous Variables Required: NYCR, NSSUS, $UCSHB_7$, RT, RU_k, k=1,...,3, $UCSH_{5,NYCR+1}$, $DMSH_k$, k=2,3,5,7, $RDSH_k$=2,3,5,7, RDPF, Y_i, i=0,...,T, T.

Endogeneous Variables Required: NFY_{1T}(A), $UCSH_{2,0}$(G), TNMISS(F).

Variables Used Elsewhere: RSF_{ki}, k=1,...,3(M), TDF_{ki}, k=1,...,3(M), both i=0,...,T, UCC(M).

Other Variables Used: RSB, DF_{kji}, k=1,...,3, j=1,...,3, DC_i, OBC, CV_i, OBR, RV_i, OBSSE, $SSEV_i$, OBS, SV_i, all i=0,...,T.

Calculations:

n=NYCR

While non-U.S. fields have one set of spares per field, the cost of spares replenishment per U.S. field is determined by allocating total cost according to the number of spares (MUC) shared for all U.S. field years.
$RSB=NSSUSx(UCSHB_7+RTxRU_1xUCSHB7)/NFY_{1T}$
$RSF_{1i}=C(RSB_1)$, i=0,...,T

Depreciation on spares per U.S. field.
$DF_{1,3,0}=NSSUSx(RTxRU_1xUCSHB_7)/NFY_{1T}$
$DF_{1,3,i}=C(DF_{1,3,0})$, i=0,...,T

Cost of spare capsule is included in determining unit cost of capsule.
$UCC=UCSH_{2,0}xTNMISS/TNSHS_2$

Depreciation on capsule, not including refurbishment.
OBC=0
CV_i=0, i=0,...,T
CV_1=UCC
$DC_i=D(DMSH_2,OBC,CV_i,RDSH_2)$, i=0,...,T

Depreciation on refurbishment of capsule.
OBR=0
RV_i=0, i=0,...,T
$RV_{n+1}=UCSH_{5,n+1}$
$DR_i=D(DMSH_5,OBR,RV_i,RDSH_5)$, i=0,...,T

Depreciation on capsule and refurbishment is same for U.S. and non-U.S., full and partial.
$DF_{k1i}=DR_i+DC_i$, k=1,...,3, i=0,...,T

Depreciation on SSE.
OBSSE=0
$SSEV_i$=0, i=0,...,T
$SSEV_1=UCSH_{3,0}$
$DF_{1,2,i}=D(DMSH_3,OBSSE,SSEV_i,RDSH_3)$, i=0,...,T
$DF_{k,2,i}=DF_{1,2,i}$, k=2,3

Depreciation on spares
OBS=0

$SV_i=0,\ i=0,\ldots,T$
$SV_1=UCSH_7$
$DF_{2,3,i}=DR(DMSH_7,OBS,SV_i,RDSH_7,RU_2,\ RSF_{2i}),\ i=0,\ldots,T$
$DF_{3,3,i}=DR(DMSH_7,OBS,SV_i,RDPF,RU_3,RSF_{3i}),\ i=0,\ldots,T$

Total depreciation on each type of field.
$TDF_{ki}=A(DF_{kji},\ j=1,\ldots,3),\ k=1,\ldots,3,\ i=0,\ldots,T$

Output 9 - Service Hardware Depreciation Per Field

Section I - Vessel Rental

Exogeneous Variables Required: V, DMV, RDV, RT, RR, T, Y_i, i=0,...,T.

Endogeneous Variables Required: None.

Variables Used Elsewhere: AVR(J,M).

Other Variables Used: VI_i, DV_i, VTS_i, $PVVTS_i$, i=0,...,T, OBV, DVS, PVVTSS, PVVR, VSV.

Calculations:

Depreciation on vessel (purchased at beginning of year 1).
OBV=0
VI_i=0, i=0,...,T
VI_1=V
DV_i=D(DMV,OBV,VI_i,RDV), i=0,...,T
DVS=A(DV_i, i=0,...,T)

Tax saving due to vessel depreciation.
VTS_i=RTxDV_i, i=0,...,T

Present value of vessel tax saving.
$PVVTS_i$=PV(VTS_i,RR,i), i=0,...,T
PVVTSS=A($PVVTS_i$, i=0,...,T)

Vessel salvage value.
$VSV=(V-DVS)/(1+RR)^T$

Present value of vessel rental is equal to cost less tax saving and salvage value.
PVVR=V-PVVTSS-VSV

Annual vessel rental.
$AVR=PVVR/A((1+RR)^{-i}$, i=0,...,T)

Output 10 - Vessel Rental

Section J - Direct Service Overhead

Exogeneous Variables Required: T, $DSOHF_{ki}$, k=1,...,3, NF_{ki}, k=1,2, Y_i, i=0,...,T, RPF, RFYS.

Endogeneous Variables Required: AVR(I), NFC_{ki}, k=1,2, i=0,...,T(A).

Variables Used Elsewhere: $TDSOH_i$, i=0,...,T(N).

Other Variables Used: $ADSF_{ki}$, k=1,2, $DSOH_{ki}$, k=1,2, $DSOHST_{kji}$, k=1,2, j=1,2, i=0,...,T.

Calculations:

Average direct service overhead per field - includes vessel rental and other items.

$ADSF_{1i}=AVR+DSOHF_{1i}$, i=0,...,T.

$ADSF_{2i}=(1-RPF)x(AVR+DSOHF_{2i})+RPFxDSOHF_{3i}$, i=0,...,T.

Direct service overhead subtotal for first years of fields.

$DSOHST_{k1i}=NF_{ki}xRFYSxADSF_k$, k=1,2, i=0,...,T

Direct service overhead subtotal for other years of fields.

$DSOHST_{k2i}=(NFC_{ki}-NF_{ki})xADSF_k$, k=1,2, i=0,...,T

Total direct service overhead.

$DSOH_{ki}=A(DSOHST_{kji},j=1,2)$

$TDSOH_i=A(DSOH_{ki}, k=1,2)$

Output 11 - Direct Service Overhead

Section K - Warranty

Exogeneous Variables Required: W_{ki}, k=1,...,3, T, Y_i, i=0,...,T.

Endogeneous Variables Required: $TNHR_{ki}$, k=1,...,3, i=0,...,T(A).

Variables Used Elsewhere: TW_i, i=0,..,,T(L).

Other Variables Used: WC_{ki}, k=1,...,3, i=0,...,T.

Calculations:

Cost of warranties is derived from numbers of items of hardware for resale.
$WC_{ki}=W_{ki}xTNHR_{ki}$, k=1,...,3, i=0,...,T
$TW_i=A(WC_{ki},k=1,...,3)$

Output 12 - Warranty

Section L - Hardware For Resale

Exogeneous Variables Required: T, RR, RT, $NWHC_{ki}$, $SCWHC_{ki}$, k=1,2, $SCHR_{ki}$, k=2,3, Y_i, i=0,...,T.

Endogeneous Variables Required: $TNHR_{ki}$, k=2,3(A), LC_{5i}(B), IOH_{5i}(C), $TIDAHR_i$(D), TW_i(K), i=0,...,T.

Variables Used Elsewhere: M_{5i}(P), R_{2i}(O), COS_{2i}(O), i=0,...,T.

Other Variables Used: HRC_{ki}, $HRCS_k$, $LCAHR_k$, $IOHAHR_k$, $IDHR_k$, $TWAHR_k$, $TCHR_k$, $NWHCS_k$, k=1,2, $TNHRS_k$, k=2,3, UC_k, $UPBT_k$, UT_k, UP_k, $USPB_k$, USP_{ki}, RP_{ki}, k=1,...,4, $COSST_{2i}$, PBT_{2i}, FT_{2i}, NP_{2i}, i=0,....,T, MS_5, LCS_5, $IOHS_5$, TIDHRS, TWS.

Calculations:

Subcontract cost of hardware for resale (H. R.).
$HRC_{ki}=NWHC_{ki}xSCWHC_{ki}$, k=1,2, i=0,...,T
$HRC_{ki}=TNHR_{k-1,i}xSCHR_{k-1,i}$, k=3,4, i=0,...,T

Subcontract costs become a cost of sales subtotal.
$COSST_{2i}=A(HRC_{ki}, k=1,...,4)$, i=0,...,T

Cost of sales of H. R.
$COS_{2i}=COSST_{2i}+LC_{5i}+IOH_{5i}+TIDAHR_i+TW_i$, i=0,...,T

Subcontract costs, summed for each H. R. item.
$HRCS_k=A(HRC_{ki},i=0,...,T)$, k=1,...,4
$MS_5=A(M_{5i}, i=0,...,T)$

Other costs, summed for all H. R. items.
$LCS_5=A(LC_{5i}, i=0,...,T)$
$IOHS_5=A(IOH_{5i}, i=0,...,T)$
$TIDHRS=A(TIDAHR_i, i=0,...,T)$
$TWS=A(TW_i, i=0,...,T)$

Allocation of costs to H. R. items in proportion to subcontract costs.
$LCAHR_k=HRCS_kxLCS_5/MS_5$, k=1,...,4
$IOHAHR_k=HRCS_kxIOHS_5/MS_5$, k=1,...,4
$IDHR_k=HRCS_kxTIDHRS/MS_5$, k=1,...,4
$TWAHR_k=HRCS_kxTWS/MS_5$, k=1,...,4

Total cost of H. R. items.
$TCHR_k=HRCS_k+LCAHR_k+IOHAHR_k+IDHR_k+TWAHR_k$, k=1,...,4

Unit cost of H. R. items.
$NWHCS_k=A(NWHC_{ki}, i=0,...,T)$, k=1,2
$TNHRS_k=A(TNHR_{ki}, i=0,...,T)$, k=2,3
$UC_k=TCHR_k/NWHCS_k$, k=1,2
$UC_k=TCHR_k/TNHRS_{k-1}$, k=3,4
$UPBT_k=(UC_kxRR)/(1-RR-RT)$, k=1,...,4
$UT_k=RTxUPBT_k$, k=1,...,4
$UP_k=UPBT_k-UT_k$, k=1,...,4

Unit selling price (base) for H. R. items.
$USPB_k=UC_k+UT_k+UP_k$, k=1,...,4

Output 13 - Hardware for Resale

Revenue from each H. R. item as a function of unit price and number of items produced.
$USP_{ki}=CBASE(USPB_k)$, k=1,...,4, i=0,...,T
$RP_{ki}=USP_{ki}xNWHC_{ki}$, k=1,2, i=0,...,T
$RP_{ki}=USP_{ki}xTNHR_{k-1,i}$, k=3,4, i=0,...,T

Total revenue from H. R.
$R_{2i}=A(RP_{ki}$, k=1,...,4), i=0,...,T

Other income statement calculations.
$PBT_{2i}=R_{2i}-COS_{2i}$, i=0,...,T
$FT_{2i}=RTxPBT_{2i}$, i=0,...,T
$NP_{2i}=PBT_{2i}-FT_{2i}$, i=0,...,T

Output 14 - H. R. Income Statement

Section M - Cash Outflow Service (MUC)

Exogeneous Variables Required: T, NYCR, $UCSH_{5i}$, RR, RPF, RPFITF, AVR, CF_{1i}, SS_i, $DSOHF_{ki}$, k=1,...,3, Y_i, i=0,...,T.

Endogeneous Variables Required: UCC(H), $UCSHB_3$(F), RSF_{ki}, k=1,...,3(H), NFY_{1T}(A), NFY_{1T}(A), NFY_{2T}(A), IOH_{4i}(C), AVR(I), TDF_{ki}, k=1,...,3(H), i=0,...,T.

Variables Used Elsewhere: $PVCFS_k$(N), $PVTDFS_k$(N), $PVTIFS_k$(N), k=1,...,3, TCF_{1i}(N), TDF_{1i}(N), i=0,...,T.

Other Variables Used: IC_{ki}, $ISSE_{ki}$, TIF_{ki}, $PVTIF_{ki}$, $IOHF_{ki}$, $PVCF_{ki}$, $PVTDF_{ki}$, all k=1,...,3, TCF_{ki}, CF_{ki}, VR_i, all i=0,...,T, $IOHFB_k$, k=1,...,3, NPF, NFF, $IOHS_4$.

Calculations:

n=NYCR

Investment in capsule and refurbishment.
$IC_{ki}=0$, i=1,...,T, k=1,...,3
$IC_{k0}=UCC$, k=1,...,3
$IC_{k,n+1}=UCSH_{5,n+1}$, k=1,...,3

Investment in SSE.
$ISSE_{ki}=0$, i=1,...,T, k=1,...,3
$ISSE_{k0}=UCSHB_3$, k=1,...,3

Total investment per field.
$TIF_{1i}=IC_{1i}+ISSE_{1i}+RSF_{1i}$, i=1,...,T
$TIF_{ki}=IC_{ki}+ISSE_{ki}+RSF_{ki}$, k=2,3, i=1,...,T

Present value of total investment per field.
$PVTIF_{ki}=PV(TIF_{ki},RR,T)$, i=0,...,T, k=1,...,3
$PVTIFS_k=A(PVTIF_{ki}$, i=0,...,T), k=1,...,3

Number of partial fields.
$NPF=RPF \times NFY_{2T}$

Number of full fields (all U.S. fields are full fields).
$NFF=NFY_{1T}+NFY_{2T}-NPF$

The indirect overhead costs of a partial field are a certain ratio of that of a full field.
$IOHS_4=A(IOH_{4i}$, i=0,...,T)
$IOHFB_1=IOHS_4/(NFF+RPFITF \times NPF)$
$IOHFB_2=RPFITF \times IOHFB_1$
$IOHF_{ki}=CBASE(IOHFB_k,T)$, k=1,...,3, i=0,...,T

Other costs of service to a field include vessel rental, crew, shore support.
$VR_i=AVR$, i=0,...,T
$CF_{2i}=CF_{1i}$, i=0,...,T
$TCF_{ki}=SS_i+CF_{ki}+DSOHF_{ki}+IOHF_{ki}+VR_i$, k=1,2, i=0,...,T

Partial fields bear no shore support or vessel rental costs.

$CF_{3i}=RPFITFxCF_{1i}$, $i=0,\ldots,T$

$TCF_{3i}=CF_{3i}+DSOHF_{3i}+IOHF_{3i}$, $i=0,\ldots,T$

Present value.

$PVCF_{ki}=PV(TCF_{ki},RR,T)$, $i=0,\ldots,T$

$PVCF_{k0}=0$

$PVCFS_{k}=A(PVCF_{ki}, i=0,\ldots,T)$, $k=1,\ldots,3$

Service hardware depreciation over field was calculated in a previous section.

$PVTDF_{ki}=PV(TDF_{ki},RR,i)$, $i=0,\ldots,T$, $k=1,\ldots,3$

$PVTDF_{k0}=0$

$PVTDFS_{k}=A(PVTDF_{ki}, i=0,\ldots,T)$, $k=1,\ldots,3$

Output 15 - Cash Outflow Service (MUC)

Section N - Service Revenue and Pay-Out Analysis

Exogeneous Variables Required: T, RR, $TNSH_{3i}$, Y_i, i=0,...,T, RPF, NYSC, NF_{ki}, k=1,2, i=1,...,T, RFYSRF, RFYSR, RT, $DUCD_i$, i=1,...,T, NFDD.

Endogeneous Variables Required: $PVCFS_k(M)$, $PVTDFS_k(M)$, $PVTIFS_k(M)$, k=1,...,3, NFC_{ki}, k=1,2(A), $TCF_{1i}(M)$, $TDF_{1i}(M)$, all i=1,...,T, $LC_{4i}(B)$, $IOH_{4i}(C)$, $TDSOH_i(J)$, $TIDASH_i(D)$, $SD_i(G)$, all i=0,...,T, $TNMIS_i(F)$, $TNSH_{1i}$ (A), i=0,...,T.

Variables Used Elsewhere: $R_{1i}(O)$, $COS_{1i}(O)$, both i=0,...,T.

Other Variables Used: ONE, PVOS, ARF_k, $ARFD_k$, both k=1,...,3, $ARFA_k$, k=1,2, RFM_{ki}, $RFMD_{ki}$, $SRFY_{ki}$, $SROY_{ki}$, all k=1,2, TR_i, D_i, P_i, PC_i, PVP_i, all i=1, ...,T, PVPS, $COSST_{1i}$, TIDSHS, AID_i, PBT_{1i}, FT_{1i}, NP_{1i}, all i=0,...,T.

Calculations:

Annual revenue per field (MUC) averaged over life of contract.
ONE=1
PVOS=A(PV(ONE,RR,i), i=1,...,T)
$ARF_k=((1-RT)xPVCFS_k-RTxPVTDFS_k+PVTIFS_k)/((1-RT)xPVOS)$, k=1,...,3

Annual revenue per field per day based on 365 days.
$ARFD_k=ARF_k/365$

Annual revenue per field per year - average for U. S. fields.
$ARFA_1=ARF_1$

Annual revenue per field - average for non-U.S. fields.
$ARFA_2=RPFxARF_2+(1-RPF)xARF_3$

Revenue is level for a certain number of years, is incremented, and then is level for the same number of years, and so on.
n=NYSC
$RFM_{k1}=ARFA_k$, k=1,2
$RFM_{k,hxn+i}=RFM_{k1}(1+RI)^{2h}$, k=1,2, h=0,...,NCRI, i=1,...,n

Revenue per field (MUC) per day based on 365 days.
$RFMD_{ki}=RFM_{ki}/365$, i=1,...,T

Service revenue, first year of a field is a certain portion of revenue for other years, and is a different portion in the case of the first fields in year 1.
$SRFY_{k1}=RFYSRFxNF_{k1}xRFM_{ki}$, k=1,2
$SRFY_{ki}=RFYSRxNF_{ki}xRFM_{ki}$, k=1,2, i=2,...,T
$SROY_{ki}=(NFC_{ki}-NF_{ki})xRFM_{ki}$, k=1,2, i=1,...,T

Total revenue from all fields.
$TR_i=A(SRFY_{ki}+SROY_{ki}$, k=1,2), i=1,...,T

Discount on DUC rental begins in a certain year and is a function of the number of DUC fields.
$D_i=0$, i=1,...,NYBDD-1
$D_i=DUCD_ixNFDD$, i=NYBDD,...,T

Net revenue after discount.

$R_{1i}=TR_i-D_i$, i=1,...,T

$R_{1,0}=0$

Pay-out analysis of the net cash flow after tax for a U.S. field.

$P_i=(1-RT)x(RFM_{1i}-TCF_{1i})+RTxTDF_{1i}$, i=1,...,T

$PC_i=CUM(P_i)$, i=1,...,T

$PVP_i=PV(P_i)$, i=1,...,T

$PVPS=A(PVP_i,i=1,...,T)$

Output 16 - Service Revenue and Pay-Out Analysis

Cost of sales subtotal before depreciation and adjustment of I. D.

$COSST_{1i}=LC4_i+IOH4_i+TDSOH_i$, i=0,...,T

$TIDSHS=A(TIDASH_i$, i=0,...,T), i=0,...,T

Adjustment of I. D. according to number of units as products developed come on stream.

$AID_i=(TNMIS_i+TNSH_{1i}+TNSH_{3i})xTIDASH_i/TIDSHS$, i=0,...,T

Cost of sales

$COS_{1i}=COSST_{1i}+SD_i+TIDASH_i-AID_i$, i=0,...,T

Other income statement calculations.

$PBT_{1i}=R_{1i}-COS_{1i}$, i=0,...,T

$FT_{1i}=RTxPBT_{1i}$, i=0,...,T

$NP_{1i}=PBT_{1i}-FT_{1i}$, i=0,...,T

Output 17 - Service Income Statement

Section O - Other Income and Aggregate Income Statement

Exogeneous Variables Required: T, RT, RRP, Y_i, OI_{ki}, k=1,...,3, both i=0, ...,T, SL_{-1}.

Endogeneous Variables Required: $R_{1i}(N)$, $R_{2i}(L)$, $R_{3i}(E)$, $COS_{1i}(N)$, $COS_{2i}(L)$, $COS_{3i}(E)$, i=0,...,T.

Variables Used Elsewhere: $RA_i(P)$, $COSA_i(P)$, $FTA_i(P,Q)$, $RST_i(P)$, $SL_i(P)$, $NPA_i(P)$, $PBTA_i(Q)$, all i =0,...,T.

Other Variables Used: TOI_i, $PAITR_i$, NOI_i, TPA_i, all i=0,...,T.

Calculations:

Three sources of other income.
$TOI_i=A(OI_{ki}, k=1,...,3)$, i=0,...,T

PAIT repayment for use of prototypes.
$PAITR_i=0$, i=0,...,NYLRP-1
$PAITR_i=OI_1 x RRP$, i=NYLRP,...,T

Net other income after PAIT repayment.
$NOI_i=TOI_i-PAITR_i$, i=0,...,T

Output 18 - Other Income

Sales revenue forms revenue subtotal.
$RST_i=A(R_{ki}, k=1,...,3)$, i=0,...,T

Revenue aggregate after other income.
$RA_i=RST_i+NOI_i$, i=0,...,T

Cost of sales aggregate.
$COSA_i=A(COS_{ki}, k=1,...,3)$, i=0,...,T

Other income statement calculations.
$PBTA_i=RA_i-COSA_i$, i=0,...,T

Surplus or loss.
$SL_i=SLi-1+PBTA_i$, i=0,...,T

Taxable profit is equal to surplus.
$TPA_i=0$, i=0,...,T
If SL_i is greater than 0, $TPA_i=SL_i$, i=0,...,T
$FTA_i=RTxTPA_i$, i=0,...,T
$NPA_i=TPA_i-FTA_i$, i-0,...,T

Output 19 - Aggregate Income Statement

Section P - Balance Sheet and Cash Flow Statement

Exogeneous Variables Required: T, NDLAR, M_{2i}, i=0,...,T, NDLAP, NDIHR, NDLSP, PE_i, i=-1,...,T, Y_i, i=0,...,T, AR_{-1}, AP_{-1}, RCTS, C_{-1}, I_{-1}, SL_{-1}, FAI_{-1}, TD_{-1}, SA_{-1}, EI_i, i=-1,...,T.

Endogeneous Variables Required: $RA_i(O)$, $M_{1i}(D)$, $M_{3i}(F)$, $M_{5i}(L)$, $NFA_i(O)$, $TL_i(B)$, $COSA_i(O)$, $FTA_i(O)$, $FAI_i(G)$, $TD_i(G)$, $RST_i(O)$, $SL_i(O)$, all i=0,...,T.

Variables Used Elsewhere: $FAC_i(Q)$, i=-1,...,T, $CA_i(Q)$, $TCL_i(Q)$, $C_i(Q)$, $AR_i(Q)$, $I_i(Q)$, $AP_i(Q)$, $SA_i(Q)$, i=0,...,T.

Other Variables Used: CAR_i, CCR_i, TRC_i, MP_i, PAP_i, PCP_i, all i=0,...,T, TDC_i, NFA_i, TA_i, E_i, DR_i, all i=-1,...,T, II_i, PEI_i, CP_i, API_i, SAI_i, ST_i, NCP_i, NCF_i, CI_i, NCR_i, CRC_i, all i=0,...,T, CA_{-1}, TCL_{-1}.

Calculations:

Accounts receivable are expressed in terms of number of days lag.
$AR_i=RA_i$x NDLA /365, i=0,...,T

Collections of accounts receivable.
$CAR_i=AR_{i-1}$, i=0,...,T

Collections of current receivables.
$CCR_i=RA_i-AR_i$, i=0,...,T

Total revenue collections is the sum of current collections and collections of accounts receivable from the previous year.
$TRC_i=CCR_i+CAR_i$, i=0,...,T

Materials purchases.
$MP_i=M_{1i}+M_{2i}+M_{3i}+M_{5i}$, i=0,...,T

Accounts payable are expressed in terms of number of days lag.
$AP_i=MP_i$xNDLAP/365, i=0,...,T

Payments of accounts payable.
$PAP_i=AP_{i-1}$, i=0,...,T

Payments for current purchases.
$PCP_i=MP_i-AP_i$, i=0,...,T

Inventory is expressed in terms of number of days of H. R. purchases.
$I_i=M_{5i}$xNDIHR/365, i=0,...,T

Salaries accrued are expressed in terms of number of days of total labour cost.
$SA_i=TL_i$xNDLSP/365, i=0,...,T

Output 20 - Notes on Cash Flow

Cash is a percentage of sales revenue.

C_i=RCTSxRST$_i$, i=0,...,T

Current assets.
$CA_i=C_i+AR_i+I_i+PE_i$, i=-1,...,T

Fixed assets and depreciation are cumulated annual amounts.
FAC_i=CUM(FAI_i), i=-1,...,T
TDC_i=CUM(TD_i), i=-1,...,T

Net fixed assets (after depreciation).
$NFA_i=FAC_i-TDC_i$, i=-1,...,T

Total assets.
$TA_i=CA_i+NFA_i$, i=-1,...,T

Total current liabilities.
$TCL_i=AP_i+SA_i$, i=-1,...,T

Set surplus/loss equal to net profit (aggregate) if NPA is greater than 0.
If NPA_i is greater than 0, SL_i=NPA_i, i=0,...,T

Equity.
$E_i=EI_i+SL_i$, i=-1,...,T

Debt required is balancing item to make total liabilities and equity equal to total assets.
$DR_i=TA_i-TCL_i-E_i$, i=-1,...,T

Output 21 - Balance Sheet

Inventory increment.
$II_i=I_i-I_{i-1}$, i=0,...,T

Prepaid expenses increment.
$PEI_i=PE_i-PE_{i-1}$, i=0,...,T

Cash payments.
$CP_i=COSA_i+FTA_i+FAI_i+II_i+PE_i$, i=0,...,T

Accounts payable increment.
$API_i=AP_i-AP_{i-1}$, i=0,...,T

Salaries accrued increment.
$SAI_i=SA_i-SA_{i-1}$, i=0,...,T

Subtotal.
$ST_i=TD_i+API_i+SAI_i$, i=0,...,T

Net payments.
$NCP_i=CP_i-ST_i$, i=0,...,T

Net cash flow.
$NCF_i=TRC_i-NCP_i$, i=0,...,T

Cash increment.

$CI_i=-(C_i-C_{i-1})$, i=0,...,T

Net cash required.
$NCR_i=NCF_i+CI_i$, i=0,...,T

Cumulative cash required.
$CRC_i=CUM(NCR_i)$, i=0,...,T

Output 22 - Aggregate Cash Flow Statement

Section Q - Income Statement and Balance Sheet With Book Depreciation

Exogeneous Variables Required: T, RBD, SL_{-1}, RT, EI_i, Y_i, PE_i, i=0,...,T.

Endogeneous Variables Required: $FAI_i(G)$, $PBTA_i(O)$, $TD_i(G)$, $FAC_i(P)$, $CA_i(P)$, $FTA_i(O)$, $TCL_i(P)$, $C_i(P)$, $AR_i(P)$, $AP_i(P)$, $I_i(P)$, $SA_i(P)$, i=0,...,T, $FAC_{-1}(P)$.

Variables Used Elsewhere: None.

Other Variables Used: TPA_i, NPA_i, NFA_i, TA_i, E_i, DR_i (all redefined here), BD_i, $FTABD_i$, BDC_i, DT_i, DTC_i, i=0,..,T.

Calculations:

BDM=1

Book depreciation.
$BD_i=D(BDM,FAC_{-1}, FAI_i, RBD)$, i=0,...,T

Profit before tax (aggregate).
$PBTA_i=PBTA_i+TD_i-BD_i$, i=0,...,T

Surplus or loss.
$SL_i=SL_{i-1}+PBTA_i$, i=0,...,T

Taxable profits is equal to surplus.
$TPA_i=0$, i=0,...,T
If SL is greater than 0, $TPA_i=SL_i$, i=0,...,T
$FTABD_i=RTxTPA_i$, i=0,...,T
$NPA_i=TPA_i-FTABD_i$, i=0,...,T

Output 23 - Income Statement with Book Depreciation

Book depreciation cumulated.
$BDC_i=CUM(BD_i)$, i=0,...,T

Net fixed assets.
$NFA_i=FAC_i-BDC_i$, i=0,...,T

Total assets.
$TA_i=CA_i+NFA_i$, i=0,...,T

Deferred taxes.
$DT_i=FTABD_i-FTA_i$, i=0,...,T

Deferred taxes cumulated.
$DTC_i=CUM(DT_i)$, i=0,...,T

Set surplus/loss equal to net profit (aggregate) if NPA_i is greater than 0.
If NPA_i is greater than 0, $SL_i=NPA_i$, i=0,...,T

Equity.
$E_i=EI_i+SL_i$, i=0,...,T

Debt Required.
$DR_i=TA_i-TCL_i-DTC_i-E_i$, i=0,...,T

Output 24 - Balance Sheet with Book Depreciation

Document 2 - Formulation of Routines

Sample Formula	Definition
$Z=A(X_k,\ k=1,\ldots,n)$	Addition: $Z=X_1+X_2+\ldots+X_n$
$Z=C(X_i,RC)$	Compounding: $Z=X_i x(1+RC)^i$
$Z_i=CBASE(X,RC)$	Compounding a base: $Z_i=Xx(1+RC)^i$
$Z=CUM(X_i)$	Cumulation: $Z=X_i+X_{i-1}+\ldots+X_0$
$Z_i=D(DM,B,AI_i,RD)$	Depreciation: If DM=1 (straight line): $Z_i=RDx(A(AI_i,\ j=0,\ldots,i)+B)$ If DM=2 (diminishing balance): If i=0: $UDA_0=AI_0+B$ $Z_0=RDxUDA_0$ If i is greater than 0: $UDA_i=UDA_{i-1}+AI_i-Z_{i-1}$ $Z_i=RDxUDA_i$
$Z_i=DR(DM,B,AI_i,RD,ROR,RS)$	Depreciation with replenishment (assume DM=2 for diminishing balance): If i=0: $RS=RORx(AI_0+B)$ $UDA_0=AI_0+B+RS$ $Z_0=RDxUDA_0$ If i is greater than 0: $RS=RORx(UDA_{i-1}+AI_i-Z_{i-1})$ $UDA_i=UDA_{i-1}+AI_i-Z_{i-1}+RS$ $Z_i=RDxUDA_i$
$Z=INCR(X_i)$	Increment: $Z=X_i-X_{i-1}$
$Z=PV(X_i,RR)$	Present value: $Z=X_i x(1+RR)^{-i}$

Document 3 - Dictionary of Variables

Value Set in Section	Variable Symbol	Variable Definition
J	$ADSF_{ki}$ $k=1,2$ $i=0,\ldots,T$	Average direct service cost per field in market location k
Routines D, DR	AI_i	Asset increment
N	AID_i $i=0,\ldots,T$	Adjustment of Independent Development
/(-1), P(0-T)	AP_i $i=-1,\ldots,T$	Accounts payable
P	API_i $i=-1,\ldots,T$	Accounts payable increment
/(-1), P(0-T)	AR_i $i=-1,\ldots,T$	Accounts receivable
N	ARF_k $k=1,\ldots,3$	Annual revenue per field, field type k
N	$ARFA_k$ $k=1,2$	Annual revenue per field, averaged, market location k
N	$ARFD_k$ $k=1,\ldots,3$	Annual revenue per field, per day, field type k
C	ASP_i $i=0,\ldots,T$	Advertising and sales promotion
I	AVR	Annual vessel rental
Routines D, DR	B	Opening balance
Q	BD_i $i=0,\ldots,T$	Book depreciation
Q	BDC_i $i=0,\ldots,T$	Book depreciation, cumulated
Q	BDM	Book depreciation method
/	BP_i $i=0,\ldots,T$	Bid and proposal cost
/(-1), P(0-T)	C_i $i=-1,\ldots,T$	Cash
P	CA_i $i=-1,\ldots,T$	Current assets

P	CAR_i i=0,...,T	Collections of accounts receivable
P	CCR_i i=0,...,T	Collections of current receivables
/(1), M(2,3)	CF_{ki} k=1,...,3 i=0,...,T	Crew cost per field, field type k
/	CFB	Crew cost per field, base
P	CI_i i=0,...,T	Cash increment
N(1), L(2), E(3)	COS_{ki} k=1,...,3 i=0,...,T	Cost of sales for income statement k
O	$COSA_i$ i=0,...,T	Cost of sales, aggregate
N(1), L(2), E(3)	$COSST_{ki}$ k=1,...,3 i=0,...,T	Cost of sales sub-total, income statement k
L	COSSTS	Cost of sales subtotal, summed
P	CP_i i=0,...,T	Cash payments
P	CRC_i i=0,...,T	Cumulative cash required
H	CV_i i=0,...,T	Capsule value, for depreciation calculation
N	D_i i=1,...,T	Discount per DUC field, post-MUC
H	DC_i i=0,...,T	Depreciation per capsule
H	DF_{kji} k=1,...,3 j=1,...,3 i=0,...,T	Depreciation per field, field type k, S.H. depreciation category j
Routine D	DM	Depreciation method
/	DMOF	Depreciation method, office furniture
/	$DMSH_k$ k=1,...,7	Depreciation method, S.H. type k
/	DMV	Depreciation method, vessel

C	DOF_i $i=0,\ldots,T$	Depreciation on office furniture
P	DR_i $i=-1,\ldots,T$	Debt required
G	DSH_{ki} $k=1,\ldots,7$ $i=0,\ldots,T$	Depreciation on S.H. type k
J	$DSOH_{ki}$ $k=1,2$ $i=0,\ldots,T$	Direct service overhead, market location k
/	$DSOHF_{ki}$ $k=1,\ldots,3$ $i=0,\ldots,T$	Direct service overhead per field (other than vessel rental), field type k
/	$DSOHFB_k$ $k=1,\ldots,3$	Direct service overhead per field (other than vessel rental), field type k, base
J	$DSOHST_{kji}$ $k=1,2$ $j=1,2$ $i=0,\ldots,T$	Direct service overhead subtotal, market location k, first years (j=1) and other years(j=2)
Q	DT_i $i=0,\ldots,T$	Deferred taxes
Q	DTC_i $i=0,\ldots,T$	Deferred taxes, cumulated
/	$DUCD_i$ $i=0,\ldots,T$	DUC discount per year
/	DUCDB	DUC discount per year, base
I	DV_i $i=0,\ldots,T$	Depreciation on vessel
I	DVS	Depreciation on vessel, summed
P	E_i $i=-1,\ldots,T$	Equity
/	EI_i $i=-1,\ldots,T$	Equity investment
C	F_i $i=0,\ldots,T$	Fringe cost
P	FAC_i $i=-1,\ldots,T$	Fixed assets, cumulated

/(-1), G(0-T)	FAI_i $i=-1,\ldots,T$	Fixed assets increment
N(1), L(2), E(3)	FT_{ki} $k=1,\ldots,3$ $i=0,\ldots,T$	Federal taxes, income statement k
O	FTA_i $i=0,\ldots,T$	Federal tax, aggregate
Q	$FTABD_i$ $i=0,\ldots,T$	Federal tax, aggregate, with book depreciation
L	HRC_{ki} $k=1,\ldots,4$ $i=0,\ldots,T$	H.R. subcontract cost, H.R. type IIk
L	$HRCS_k$ $k=1,\ldots,4$	H.R. subcontract cost, H.R. type IIk, summed
/(-1), P(0-T)	I_i $i=-1,\ldots,T$	Inventory
M	IC_{ki} $k=1,\ldots,3$ $i=0,\ldots,T$	Investment in capsule, market location k
D	$IDAHR_{ki}$ $k=1,\ldots,3$ $i=0,\ldots,T$	I.D. allocated to H.R. type Ik
D	$IDASH_{ki}$ $k=1,\ldots,3$ $i=0,\ldots,T$	I.D. allocated to S.H. type k
F	$IDASHD_{ki}$ $k=1,\ldots,3$ $i=0,\ldots,T$	I.D. allocated to S.H. type k, de-compounded
F	$IDASHS_{3k}$ $k=1,\ldots,3$	I.D. allocated to S.H. type k, summed
L	$IDHR_k$ $k=1,\ldots,4$	I.D. allocated to H.R. type IIk
P	II_i $i=0,\ldots,T$	Inventory increment
C	IOH_{ki} $k=1,\ldots,5$ $i=0,\ldots,T$	Indirect overhead allocated to function k
F	$IOHA_{3k}$ $k=1,\ldots,3$	Indirect overhead allocated to function 3 for S.H. type k

L	$IOHAHR_k$ $k=1,\ldots,4$	Indirect overhead allocated to H.R. type IIk
F	$IOHD_i$ $i=0,\ldots,T$	Indirect overhead allocated to function 3, de-compounded
M	$IOHF_{ki}$ $k=1,\ldots,3$ $i=0,\ldots,T$	Indirect overhead per field, field type k
M	$IOHFB_k$ $k=1,\ldots,3$ $i=0,\ldots,T$	Indirect overhead per field, field type k, base
F(3), M(4), L(5)	$IOHS_k$ $k=3,4,5$	Indirect overhead cost, summed, for function k
M	$ISSE_{ki}$ $k=1,\ldots,3$ $i=0,\ldots,T$	Investment in SSE, field type k
B	LC_{ki} $k=1,\ldots,6$ $i=0,\ldots,T$	Labour cost, function k
F	LCA_{3k} $k=1,\ldots,3$	Labour cost allocated to function 3, S.H. item k
L	$LCAHR_k$ $k=1,\ldots,4$	Direct labour cost allocated to H.R. type IIk
B	LCB_{ki} $k=1,\ldots,6$ $i=0,\ldots,T$	Labour cost base, function k
F	LCD_i $i=0,\ldots,T$	Labour cost, de-compounded
F(3), L(5)	LCS_k $k=3,5$	Labour cost, summed, function k
D(1), /(2), F(3), L(5)	M_{ki} $k=1,2,3,5$ $i=0,\ldots,T$	Materials cost, function k
F	$MCSH_{ki}$ $k=1,\ldots,3$ $i=0,\ldots,T$	Materials cost, S.H. type k
F	$MCSHD_{ki}$ $k=1,\ldots,3$ $i=0,\ldots,T$	Materials cost, S.H. type k, de-compounded
F	$MCSHS_k$ $k=1,\ldots,3$	Materials cost, S.H. type k, summed

P	MP_i i=0,...,T	Materials purchases
F(3), L(5)	MS_k k=3,5	Materials, summed, function k
/	N_i i=-1,...,T	Number of year
E	NBA_{ji} j=1,...,n+1 i=0,...,T	New business allocation (of I.R. and I.D.)
E	$NBAP_i$ i=0,...,T-n-1	New business annual profit of projects starting in year i
P	NCF_i i=0,...,T	Net cash flow
P	NCP_i i-0,..., T	Net cash payments
/(-1), P(0-T)	NCR_i i=-1,...,T	Net cash required
/	NDIHR	No. days inventory, of H.R.
/	NDLAR	No. days lag on accounts receivable collections
/	NDLAP	No. days lag on accounts payable
/	NDLSP	No. days lag on salaries payable
/	NE_{ki} k=1,...,6 i=-1,...,T	No. employees, function k
/	$NENF_i$ i=-1,...,T	No. employees, non-field
C	$NENFI_i$ i=0,...,T	No. employees, non-field, increment
/	NF_{ki} k=1,2 i=0,...,T	No. fields, market location k
P	NFA_i i=-1,...,T	Net fixed assets
A	NFC_{ki} k=1,2 i=0,...,T	No. fields, cumulated, market location k
/	NFDD	No. of fields to receive DUC discount

M	NFF	No. of full fields
A	NFY_{ki} k=1,2 i=0,...,T	No. of field years, market location k
/	NHR_{kji} k=1,...,3 j=1,2 i=0,...,T	No. units of hardware for resale type Ik, market location j
O	NOI_i i=0,...,T	Net other income
N(1),L(2),E(3)	NP_{ki} k=1,...,3 i=0,...,T	Net profit, income statement k
O	NPA_i i=0,...,T	Net profit, aggregate
M	NPF	No. partial fields
/	NSH_{kji} k=1,2,4,5 j=1,2 i=0,...,T	No. units of S.H. type k, market location j
/	NSSUS	No. sets of spares for all U.S. fields
/	NTNBP	Sales revenue: No. times N.B. profit
/	$NWHC_{ki}$ k=1,2 i=0,...,T	No. wellhead cellars, WHC type k
L	$NWHCS_k$ k=1,2	No. wellhead cellars, WHC type k, summed
/	NYBDD	No.years to begin DUC discount
/	NYCR	No. years before capsule refurbishments
/	NYLRP	No. years lag to PAIT repayment
/	NYNPID	No. years new projects' I.D.
/	NYNPP	No. years new projects' profit
/	NYSC	No. years to service contract at level price
/	OB_k k=1,...,7	Opening balance (for depreciation), S.H. type k

H	OBC	Opening balance for one capsule
H	OBR	Opening balance for one refurbishment capsule
H	OBS	Opening balance for spares
H	OBSSE	Opening balance for SSE
I	OBV	Opening balance for vessel
C	OFI_i $i=0,\ldots,T$	Office furniture increment
/	$OFNFE_i$ $i=0,\ldots,T$	Office furniture per non-field employee
/	OFNFEB	Office furniture per non-field employee, base
/	OFOB	Office furniture opening balance
/	OI_{ki} $k=1,\ldots,3$ $i=0,\ldots,T$	Other income, source k
C	$OIOH_i$ $i=0,\ldots,T$	Other indirect overhead
N	ONE	The value 1
N	P_i $i=1,\ldots,T$	Net cash flow after tax
O	$PAITR_i$ $i=0,\ldots,T$	PAIT repayment
P	PAP_i $i=0,\ldots,T$	Payments of accounts payable
N(1), L(2), E(3)	PBT_{ki} $k=1,\ldots,3$ $i=0,\ldots,T$	Profit before taxes, income statement k
O	$PBTA_i$ $i=0,\ldots,T$	Profit before taxes, aggregate
N	PC_i $i=1,\ldots,T$	Net cash flow, cumulated
P	PCP_i $i=0,\ldots,T$	Payments for current purchases
/	PE_i $i=-1,\ldots,T$	Prepaid expenses

P	PEI_i i=0,...,T	Prepaid expenses increment
M	$PVCF_{ki}$ k=1,...,3 i=0,...,T	Present value of total costs per field, field type k
M	$PVCFS_k$ k=1,...,3	Present value of total costs per field, field type k
E	$PVNB_i$ i=0,...,T-n-1	Present value of new business for project beginning in year i
N	PVOS	Present value of one (1), summed
N	PVP_i i=1,...,T	Present value of net cash flow
N	PVPS	Present value of net cash flow, summed
M	$PVTDF_{ki}$ k=1,...,3 i=0,...,T	Present value of total depreciation per field, field type k
M	$PVTDFS_k$ k=1,...,3	Present value of total depreciation per field, field type k, summed
M	$PVTIF_{ki}$ k=1,...,3 i=0,...,T	Present value of total investment in a field, field type k
M	$PVTIFS_k$ k=1,...,3	Present value of total costs, field type k, summed
I	PVVR	Present value of vessel rental
I	$PVVTS_i$ i=0,...,T	Present value of vessel tax saving
I	PVVTSS	Present value of vessel tax saving, summed
N(1), L(2), E(3)	R_{ki} k=1,...,3 i=0,...,T	Revenue, income statement k
O	RA_i i=0,...,T	Revenue, aggregate
/	RATR	Ratio of advertising to revenue
/	RBD	Rate of book depreciation
Routines C, CBASE	RC	Rate of compounding

/	RCTS	Ratio of cash to sales
Routines D, DR	RD	Rate of depreciation
/	RDOF	Rate of depreciation on office furniture
/	RDPF	Rate of depreciation on non-U.S. partial fields
/	$RDSH_k$ $k=1,\ldots,7$	Rate of depreciation on S.H. type k
/	RDV	Rate of depreciation on vessel
N	RFM_{ki} $k=1,2$ $i=1,\ldots,T$	Revenue per field, MUC, market location k
N	$RFMD_{ki}$ $k=1,2$ $i=1,\ldots,T$	Revenue per field, MUC, market location k, per day
/	RFTTLC	Ratio of fringe to total labour costs
/	RFYS	Ratio of first year direct service costs
/	RFYSR	Ratio of first year direct service revenue
/	RFYSRF	Ratio of first year direct service revenue, first field(s)
/	RH_i $i=0,\ldots,T$	Revenue per head
/	RHB	Revenue per head, base
/	RI	Rate of inflation
/	$RIDAHR_{ki}$ $k=1,\ldots,3$ $i=0,\ldots,T$	Ratio I.D. allocation to H.R. type Ik
/	$RIDASH_{ki}$ $k=1,\ldots,3$ $i=0,\ldots,T$	Ratio I.D. allocation to S.H. type k
/	RLCA	Ratio of labour cost allocated
/	RMTLIR	Ratio of materials to labour for I.R.
/	RNBSCR	Ratio of new business selling costs to revenue

/	ROIOH	Ratio of other indirect overhead to home labour
Routine DR	ROR	Rate of replenishment
L	RP_{ki} $k=1,\ldots,4$ $i=0,\ldots,T$	Revenue, as a function of price, from H. R. type IIk
/	RPF	Ratio of partial fields to non-U.S. fields
/	RPFITF	Ratio of partial fields' indirect overhead to that of full fields
/, Routine PV	RR	Rate of return
/	RRP	Ratio of repayment of PAIT
/	RRS	Rate of replenishment of spares
Routine DR	RS	Replenishment of spares per field
H	RSB	Replenishment of spares, per field, base
G	RSC_{ki} $k=6,7$ $i=0,\ldots,T$	Replenishment of S.H. type k
H	RSF_{ki} $k=1,\ldots,3$ $i=0,\ldots,T$	Replenishment of spares, per field, field type k
O	RST_i $i=0,\ldots,T$	Revenue subtotal
/	RT	Rate of taxation
/	RU_k $k=1,\ldots,3$	Rate of usage, field type k
H	RV_i $i=0,\ldots,T$	Refurbishment value, for depreciation calculation
/	S_{ki} $k=1,\ldots,6$ $i=-1,\ldots,T$	Salary (base, compunded), function k
/(-1), P(0-T)	SA_i $i=-1,\ldots,T$	Salaries accrued
P	SAI_i $i=0,\ldots,T$	Salaries accrued increment
/	SB_k $k=1,\ldots,6$	Salary base, function k

/	$SCHR_{ki}$ $k=2,3$ $i=0,\ldots,T$	Subcontract cost, H.R. type Ik
/	$SCHRB_k$ $k=2,3$	Subcontract cost, H.R. type Ik, base
/	$SCSH_{ki}$ $k=1,\ldots,3$ $i=0,\ldots,T$	Subcontract cost, S.H. type k
/	$SCSHB_k$ $k=1,\ldots,3$	Subcontract cost, S.H. type k, base
/	$SCWHC_{ki}$ $k=1,2$ $i=0,\ldots,T$	Subcontract cost, WHC type k
/	$SCWHCB_k$ $k=1,2$	Subcontract cost, WHC type k, base
G	SD_i $i=0,\ldots,T$	Service depreciation
G	SHI_{ki} $k=1,\ldots,7$ $i=0,\ldots,T$	Service hardware increment, type k
/(-1), 0(0-T)	SL_i $i=-1,\ldots,T$	Surplus or loss
N	$SRFY_{ki}$ $k=1,2$ $i=1,\ldots,T$	Service revenue, first years of a field, market location k
N	$SROY_{ki}$ $k=1,2$ $i=1,\ldots,T$	Service revenue, other years of a field, market location k
/	SS_i $i=0,\ldots,T$	Shore support
/	SSB	Shore support, base
H	$SSEV_i$ $i=0,\ldots,T$	SSE value, for depreciation calculation
P	ST_i $i=0,\ldots,T$	Subtotal of deductions from cash payments
H	SV_i $i=0,\ldots,T$	Spares value, for depreciation calculation
/	T	Time horizon in years

P	TA_i i=-1,...,T	Total assets
D	TC_{ki} k=1,2 i=0,...,T	Total costs of function k
M	TCF_{ki} k=1,...,3 i=0,...,T	Total costs per field, field type k
L	$TCHR_k$ k=1,...,4	Total costs of H.R. allocated to H.R. type IIk
P	TCL_i i=-1,...,T	Total current liabilities
F	$TCSH_k$ k=1,...,3	Total cost of S.H. type k
/(-1), G(0-T)	TD_i i=-1,...,T	Total depreciation
P	TDC_i i=-1,...,T	Total depreciation, cumulated
H	TDF_{ki} k=1,...,3 i=0,...,T	Total depreciation per field, field type k
B	TDL_i i=0,...,T	Total direct labour cost
J	$TDSOH_i$ i=0,...,T	Total depreciation, service overhead
D	$TIDAHR_i$ i=0,...,T	Total I.D. allocated to H.R.
D	$TIDANB_i$ i=0,...,T	Total I.D. allocated to N.B.
D	$TIDASH_i$ i=0,...,T	Total I.D. allocated to S.H.
L	TIDHRS	Total I.D. allocated to H.R., summed
N	TIDSHS	Total I.D. allocated to S.H., summed
M	TIF_{ki} k=1,...,3 i=0,...,T	Total investment in a field, field type k
C	$TIOH_i$ i=0,...,T	Total indirect overhead

B	TL_i $i=0,\ldots,T$	Total labour cost
B	TNE_i $i=0,\ldots,T$	Total no. employees
A	$TNHR_{ki}$ $k=1,\ldots,3$ $i=0,\ldots,T$	Total numbers of H.R. type Ik
L	$TNHRS_k$ $k=2,3$	Total numbers of H.R. type Ik, summed
F	$TNMIS_i$ $i=0,\ldots,T$	Total no. MUCs including spare MUCs
F	TNMISS	Total no. MUCs including spare MUCs, summed
A(2,3,4,5),/(3,6,7,8)	$TNSH_{ki}$ $k=1,\ldots,8$ $i=0,\ldots,T$	Total numbers of S.H. type k
F	$TNSHS_k$ $k=1,\ldots,3$	Total numbers of S.H. type k, summed
O	TOI_i $i=0,\ldots,T$	Total other income
O	TPA_i $i=0,\ldots,T$	Taxable profit, aggregate
E	$TPNB_i$ $i=0,\ldots,T$	Total profit on N.B.
N	TR_i $i=1,\ldots,T$	Total service revenue
P	TRC_i $i=0,\ldots,T$	Total revenue collections
K	TW_i $i=0,\ldots,T$	Total warranty
L	$TWAHR_k$ $k=1,\ldots,4$	Total warranty allocated to H.R. type IIk
L	TWS	Total warranty, summed
L	UC_k $k=1,\ldots,4$	Total cost of H.R. type IIk
H	UCC	Unit cost of capsule
G(1-3),/(4-7)	$UCSH_{ki}$ $k=1,\ldots,7$ $i=0,\ldots,T$	Unit cost of S.H. item k, base

F(1-3), /(4-7)	$UCSHB_k$ $k=1,\ldots,7$	Unit cost of service hardware type k, base
Routines D, DR	UDA_i	Undepreciated asset
L	UP_k $k=1,\ldots,4$	Unit profit on H.R. item IIk
L	$UPBT_k$ $k=1,\ldots,4$	Unit profit before tax on H.R. item IIk
L	USP_{ki} $k=1,\ldots,4$ $i=0,\ldots,T$	Unit selling price on H.R. item IIk
L	$USPB_k$ $k=1,\ldots,4$	Unit selling price on H.R. item IIk, base
L	UT_k $k=1,\ldots,4$	Unit tax
/	V	Vessel cost
I	VI_i $i=0,\ldots,T$	Vessel increase
M	VR_i $i=0,\ldots,T$	Vessel rental
I	VSV	Vessel salvage value
I	VTS_i $i=0,\ldots,T$	Vessel tax saving
/	W_{ki} $k=1,\ldots,3$ $i=0,\ldots,T$	Warranty cost, for H.R. type Ik
/	WB_k $k=1,\ldots,3$	Warranty cost, base, for H.R. type Ik
K	WC_{ki} $k=1,\ldots,3$ $i=0,\ldots,t$	Warranty cost, H.R. type Ik
Routines	X_i	Dummy variable
/	Y_i $i=-1,\ldots,T$	Year
/	YZ	Year zero (base year)
Routines	Z, Z_i	Dummy variables used to define values

Document 4 - Dictionary of Variable Subscripts

Subscript Definition	k*	Meaning	Variables Typed
Field Type	1	U.S. (Full)	ARF_k, $ARFD_k$, CF_{ki}, DF_{kji}, $DSOHF_{ki}$, $DSOHFB_k$, IC_{ki}, $IOHF_{ki}$, $IOHFB_k$, $ISSE_{ki}$, $PVCF_{ki}$, $PVCFS_k$, $PVTDF_{ki}$, $PVTFS_k$, $PVTIF_{ki}$, $PVTIFS_k$, RSF_{ki}, RU_k, TCF_{ki}, TDF_{ki}, TIF_{ki}
	2	Non-U.S. (Full)	
	3	Non-U.S. (Partial)	
Function	1	I.R.	IOH_{ki}, $IOHS_k$, LC_{ki}, LCB_{ki}, LCS_k, M_{ki}, MS_k, NE_{ki}, S_{ki}, SB_k, TC_{ki}
	2	I.D.	
	3	S.H.	
	4	S.O.	
	5	H.R.	
	6	Indirect Overhead	
Hardware for Resale Type I	1	WHC	$IDAHR_{ki}$, NHR_{kji}, $RIDAHR_k$, $SCHR_{ki}$, $SCHRB_k$, $TNHR_{ki}$, $TNHRS_k$, W_{ki}, WC_{ki}
	2	PC	
	3	MM	
Hardware for Resale Type II	1	WHC Pre-MUC	HRC_{ki}, $HRCS_k$, $IDHR_k$, $IOHAHR_k$, $LCAHR_k$, RP_{ki}, $TCHR_k$, $TWAHR_k$, UC_k, UP_k, $UPBT_k$, USP_{ki}, $USPB_k$, UT_k
	2	WHC Post-MUC	
	3	PC	
	4	MM	
Income Statement	1	Service	COS_{ki}, $COSST_{ki}$, FT_{ki}, NP_{ki}, PBT_{ki}, R_{ki}
	2	Hardware	
	3	New Business	
Market Location	1	U.S.	$ADSF_{ki}$, $ARFA_k$, $DSOH_{ki}$, $DSOHST_{kji}$, IC_{ki}, NF_{ki}, NFC_{ki}, NFY_{ki}, $NHR_{kji}(j)$, $NSH_{kji}(j)$, RFM_{ki}, $RFMD_{ki}$, $SRFY_{ki}$, $SROY_{ki}$
	2	Non-U.S.	
Other Income Source	1	PAIT	OI_{ki}
	2	IRDIA	
	3	IRAP	
S.H. Depreciation Category	1	Capsule	$DF_{kji}(j)$
	2	SSE	
	3	Spares	
Service Hardware Type	1	DUC	$DMSH_k$, DSH_{ki}, $IDASH_{ki}$, $IDASHD_{ki}$, $IDASHS_{3k}$, $IOHA_{3k}$, LCA_{3k}, $MCSH_{ki}$, $MCSHD_{ki}$, $MCSHS_k$, NSH_{kji}, OB_k, $RDSH_k$, $RIDASH_{ki}$, RSC_{ki}, $SCSH_{ki}$, $SCSHB_k$, SHI_{ki}, $TCSH_k$, $TNSH_{ki}$, $TNSHS_k$, $USSH_{ki}$, $UCSHB_k$
	2	MUC	
	3	SSE	
	4	Refurbishment DUC	
	5	Refurbishment MUC	
	6	DUC Spares	
	7	MUC Spares	
	8	Spare MUCs	

*The subscript is k unless j is in parentheses. Subscript i refers to year.

WHC Type	1	Pre-MUC	$NWHC_k$, $NWHCS_k$, $SCWHC_{ki}$,
	2	Post-MUC	$SCWHB_k$
Year Category	1	First year	$DSOHST_{kji}(j)$
	2	Other years	

Document 5 - Input Required

Input Table 1 - Decimal Fractions and Integer Numbers

Variable Name	Variable Description
	Decimal Fractions:
RI	Rate of inflation
RR	Rate of return
RT	Rate of taxation
RRS	Rate of replenishment of spares
RBD	Rate of book depreciation
$RDSH_1$	Rate of depreciation on S.H.: DUC
$RDSH_2$	MUC
$RDSH_3$	SSE
$RDSH_4$	Refurbishment DUC
$RDSH_5$	Refurbishment MUC
$RDSH_6$	Spares DUC
$RDSH_7$	Spares MUC
RU_1	Rate of usage: full field - U.S.
RU_2	full field - Non-U.S.
RU_3	partial field - Non-U.S.
RDOF	Rate of depreciation: office furniture
RDV	Rate of depreciation: vessel
RLCA	Ratio of labour cost allocated
RATR	Ratio of advertising to revenue
ROIOH	Ratio of other indirect overhead to home labour
RFTTLC	Ratio of fringe to total labour cost
RFYS	Ratio of first year direct service costs
RFYSRF	Ratio of first year direct service revenue first field(s)
RFYSR	Ratio of first year direct service revenue
RRP	Ratio of repayment of PAIT
RNBSCR	Ratio of new business selling costs to revenue
RPF	Ratio of partial fields to non-U.S. fields
RPFITF	Ratio of partial fields' indirect overhead to full
RMTLIR	Ratio of materials to labour for I.R.
RCTS	Ratio of cash to sales
RDPF	Rate of depreciation on non-U.S. partial fields
	Integer Numbers:
T	Time horizon in years
YZ	Year zero (base year)
NSSUS	No. sets of spares for all U.S. fields
NYSC	No. years to service contract at level price
NYCR	No. years before capsule refurbishment
NYNPID	No. years new project's I.D.
NYNPP	No. years new project's profit
NYLRP	No. years lag to PAIT repayment
NYBDD	No. years to begin DUC discount
NDLAR	No. days lag on accounts receivable collections
NDLAP	No. days lag on accounts payable
NDLSP	No. days lag on salaries payable
NDIHR	No. days inventory, of hardware for resale
NTNBP	Sales revenue: number of times new business profit
NFDD	No. of fields to receive DUC discount

$NENF_{-1}$	In year previous to base year: no. employees non-field
$NE_{1,-1}$	I.R.
$NE_{2,-1}$	I.D.
$NE_{3,-1}$	S.H.
$NE_{4,-1}$	S.O.
$NE_{5,-1}$	H.R.
$NE_{6,-1}$	Indirect Overhead

Depreciationmethods: 1=straight line, 2=declining balance

$DMSH_1$	DUC
$DMSH_2$	MUC
$DMSH_3$	SSE
$DMSH_4$	Refurbishment DUC
$DMSH_5$	Refurbishment MUC
$DMSH_6$	DUC spares
$DMSH_7$	MUC spares
DMOF	Office furniture
DMV	Vessel

Input Table 2 - Dollar Figures

Variable Name	Variable Description		
PE_{-1}	Costs in year previous to base year:	Prepaid expenses	
EI_{-1}		Equity investment	
C_{-1}		Cash	
AR_{-1}		Accounts receivable	
I_{-1}		Inventory	
FAI_{-1}		Fixed assets	
TD_{-1}		Depreciation	
AP_{-1}		Accounts payable	
SA_{-1}		Salaries accrued	
NCR_{-1}		Cash required	
SL_{-1}		Surplus or loss	
	All other costs are costs in base year:		
$SCSHB_1$	Subcontract cost, S.H., base:	DUC	
$SCSHB_2$		MUC	
$SCSHB_3$		SSE	
$SCWHCB_1$	Subcontract cost, WHC, base:	Pre-MUC	
$SCWHCB_2$		Post-MUC	
$SCHRB_2$	Subcontract cost, H.R., base:	PC	
$SCHRB_3$		MM	
$UCSHB_4$	Unit cost of S.H., base:	DUC refurbishment	
$UCSHB_5$		MUC refurbishment	
$UCSHB_6$		DUC spares	
$UCSHB_7$		MUC spares	
$DSOHFB_1$	Direct service overhead per field other than vessel rental:		U.S.
$DSOHFB_2$			Non-U.S. (full)
$DSOHFB_3$			Partial
SSB	Shore support, base		
V	Vessel		
CFB	Crew (per field), base		
SB_1	Salary base:	I.R.	
SB_2		I.D.	
SB_3		S.H.	
SB_4		S.O.	
SB_5		H.R.	
SB_6		Indirect overhead	
RHB	Revenue per head, base (for estimation of advertising cost)		
OFNFEB	Office furniture per non-field employee, base		
DUCDB	DUC discount per year, base		
WB_1	Warranty cost, base:	WHC	
WB_2		PC	
WB_3		MM	
OB_1	Opening balance (for depreciation):	DUC	
OB_2		MUC	
OB_3		SSE	
OB_4		DUC refurbishment	
OB_5		MUC refurbishment	
OB_6		DUC spares	
OB_7		MUC spares	
OFOB	Office furniture opening balance		

Input Table 3 - Data Arrays Over Time

In the variable name, i=0,...,T and refers to year.

Variable Name	Variable Description
NF_{1i}	No. fields: U.S.
NF_{2i}	Non-U.S.
$NWHC_{1i}$	No. WHC: Pre-MUC
$NWHC_{2i}$	Post-MUC
$NHR_{1,1i}$	No. WHC: U.S.
$NHR_{1,2i}$	Non-U.S.
$NHR_{2,1i}$	No. connectors: U.S.
$NHR_{2,2i}$	Non-U.S.
$NHR_{3,1i}$	No. MMs: U.S.
$NHR_{3,2i}$	Non-U.S.
$NSH_{1,1i}$	No. DUCs: U.S.
$NSH_{1,2i}$	Non-U.S.
$NSH_{2,1i}$	No. MUCs: U.S.
$NSH_{2,2i}$	Non-U.S.
$NSH_{4,1i}$	No. Refurbishment DUCs: U.S.
$NSH_{4,2i}$	Non-U.S.
$NSH_{5,1i}$	No. Refurbishment MUCs: U.S.
$NSH_{5,2i}$	Non-U.S.
NSH_{3i}	No. SSEs
NSH_{6i}	No. Spares DUC
NSH_{7i}	No. Spares MUC
NSH_{8i}	No. Spare MUCs
NE_{1i}	No. employees: I.R.
NE_{2i}	I.D.
NE_{3i}	S.H.
NE_{4i}	S.O.
NE_{5i}	H.R.
NE_{6i}	Indirect overhead
$NENF_i$	Non-field
$RIDASH_{1i}$	Ratio I.D. allocation to S.H.: DUC
$RIDASH_{2i}$	MUC
$RIDASH_{3i}$	SSE
$RIDAHR_{1i}$	Ratio I.D. allocation to H.R.: WHC
$RIDAHR_{2i}$	PC
$RIDAHR_{3i}$	MM
M_{2i}	Cost of materials, I.D.
BP_i	Cost of bid and proposal
OI_{1i}	Other income: PAIT
OI_{2i}	IRDIA
OI_{3i}	IRAP
PE_i	Prepaid expenses
EI_i	Equity investment

Document 6 - Output Produced

List of Output Schedules

Section	Schedule	Title
A	1	Market
B	2	Labour
C	3	Depreciation on Office Furniture
C	4	Indirect Overhead
D	5	Independent Research and Independent Development
E	6	New Business Profit and Income Statement
F	7	Allocation of Capital Expense to Service Hardware
G	8	Fixed Assets
H	9	Service Hardware Depreciation per Field
I	10	Vessel Rental
J	11	Direct Service Overhead
K	12	Warranty
L	13	Hardware for Resale
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Schedule 1 - Market

	All i=0,...,T
Year	Y_i
Fields	
U.S.	NF_{1i}
Non-U.S.	NF_{2i}
Cumulative - U.S.	NFC_{1i}
Cumulative - Non-U.S.	NFC_{2i}
Field-years - U.S.	NFY_{1i}
Field-years - Non-U.S.	NFY_{2i}
Hardware - U.S.	
Wellhead cellars	$NHR_{1,1i}$
Pipeline connectors	$NHR_{2,1i}$
Manifold modules	$NHR_{3,1i}$
DUCs	$NSH_{1,1i}$
MUCs	$NSH_{2,1i}$
Refurbishment DUCs	$NSH_{4,1i}$
Refurbishment MUCs	$NSH_{5,1i}$
Hardware - Non-U.S.	
Wellhead cellars	$NHR_{1,2i}$
Pipeline connectors	$NHR_{2,2i}$
Manifold modules	$NHR_{3,2i}$
DUCs	$NSH_{1,2i}$
MUCs	$NSH_{2,2i}$
Refurbishment DUCs	$NSH_{4,2i}$
Refurbishment MUCs	$NSH_{5,2i}$
Hardware - Total	
Wellhead cellars	$TNHR_{1i}$
Pipeline connectors	$TNHR_{2i}$
Manifold modules	$TNHR_{3i}$
DUCs	$TNSH_{1i}$
MUCs	$TNSH_{2i}$
Refurbishment DUCs	$TNSH_{4i}$
Refurbishment MUCs	$TNSH_{5i}$
Spares DUC	$TNSH_{6i}$
Spares MUC	$TNSH_{7i}$
Spare MUCs	$TNSH_{8i}$
SSEs	$TNSH_{3i}$

Schedule 2 - Labour

	All i=0,...,T
Year	Y_i
Number of employees	
Independent Research	NE_{1i}
Independent Development	NE_{2i}
Service Hardware	NE_{3i}
Service Operations	NE_{4i}
Hardware for Resale	NE_{5i}
Indirect	NE_{6i}
Total	TNE_i
Labour cost base (100%)	
I.R.	LCB_{1i}
I.D.	LCB_{2i}
S.H.	LCB_{3i}
S.O.	LCB_{4i}
H.R.	LCB_{5i}
Indirect	LCB_{6i}
Labour Cost	
I.R.	LC_{1i}
I.D.	LC_{2i}
S.H.	LC_{3i}
S.O.	LC_{4i}
H.R.	LC_{5i}
Total Direct	TDL_i
Indirect	LC_{6i}
Total Labour Cost	TL_i

Schedule 3 - Depreciation on Office Furniture

	All $i=0,\ldots,T$
Year	Y_i
Number of non-field employees	$NENF_i$
Increase per year	$NENFI_i$
Office furniture increase	OFI_i
Depreciation on office furniture	DOF_i

Schedule 4 - Indirect Overhead

	All i=0,...,T
Year	Y_i
Indirect labour cost	LC_{6i}
Fringe	F_i
Bid and proposal	BP_i
Depreciation on office furniture	DOF_i
Advertising and sales promotion	ASP_i
Other indirect overhead	$OIOH_i$
Total indirect overhead	$TIOH_i$
Allocation to corporate functions	
I.R.	IOH_{1i}
I.D.	IOH_{2i}
S.H.	IOH_{3i}
S.O.	IOH_{4i}
H.R.	IOH_{5i}

Schedule 5 - Independent Research and Independent Development

	All i=0,...,T
Year	Y_i
I.R.	
Materials	M_{1i}
Labour	LC_{1i}
Indirect overhead allocated	IOH_{1i}
Total I.R.	TC_{1i}
I.D.	
Materials	M_{2i}
Labour	LC_{2i}
Indirect overhead allocated	IOH_{2i}
Total I.D.	TC_{2i}
Applied to:	
DUC	$IDASH_{1i}$
MUC	$IDASH_{2i}$
SSE	$IDASH_{3i}$
Total applied to S.H.	$TIDASH_i$
WHC	$IDAHR_{1i}$
PC	$IDAHR_{2i}$
MM	$IDAHR_{3i}$
Total applied to H.R.	$TIDAHR_i$
Remainder applied to N.B.	$TIDANB_i$

Schedule 6 - New Business Profit and Income Statement

	Both i=0,...,T-n-1
Year of I.R.	Y_i
Present value of I.R. and I.D.	$PVNB_i$
Annual profit equivalent	$NBAP_i$
	All i=0,...,T
Year	Y_i
Profit generated from investment	$TPNB_i$
Sales revenue	R_{3i}
Less: Cost of sales subtotal	$COSST_{3i}$
Cost of I.R.	TC_{1i}
Cost of I.D.	$TIDANB_i$
Total cost of sales	COS_{3i}
Profit before tax	PBT_{3i}
Federal tax	FT_{3i}
Net profit	NP_{3i}

Schedule 7 - Allocation of Capital Expense to Service Hardware

	All i=0,...,T
Year	Y_i
No. DUCs (including prototype)	$TNSH_{1i}$
No. MUCs plus spare MUCs	$TNMIS_i$
No. SSEs	$TNSH_{3i}$
Subcontract costs	
DUC	$MCSH_{1i}$
MUC (less subsidy)	$MCSH_{2i}$
SSE	$MCSH_{3i}$
Total material cost	M_{3i}

Allocation of capital costs on basis of subcontract costs:

	Number	Subcontract Cost	Direct Labour	Indirect Overhead	Independent Development	Total Cost	Unit Cost
DUC	$TNSHS_1$	$MCSHS_1$	$LCA_{3,1}$	$IOHA_{3,1}$	$IDASHS_{3,1}$	$TCSH_1$	$UCSHB_1$
MUC	TNMISS	$MCSHS_2$	$LCA_{3,2}$	$IOHA_{3,2}$	$IDASHS_{3,2}$	$TCSH_2$	$UCSHB_2$
SSE	$TNSHS_3$	$MCSHS_3$	$LCA_{3,3}$	$IOHA_{3,3}$	$IDASHS_{3,3}$	$TCSH_3$	$UCSHB_3$
Total		MS_3	LCS_3	$IOHS_3$			

Schedule 8 - Fixed Assets

	All i=0,...,T
Year	Y_i
Unit cost	
DUC	$UCSH_{1i}$
MUC	$UCSH_{2i}$
SSE	$UCSH_{3i}$
Refurbishment DUC	$UCSH_{4i}$
Refurbishment MUC	$UCSH_{5i}$
Spares DUC	$UCSH_{6i}$
Spares MUC	$UCSH_{7i}$
Numbers	
DUC	$TNSH_{1i}$
MUC	TNMIS
SSE	$TNSH_{3i}$
Refurbishment DUC	$TNSH_{4i}$
Refurbishment MUC	$TNSH_{5i}$
Spares DUC	$TNSH_{6i}$
Spares MUC	$TNSH_{7i}$
S.H. Increase	
DUC	SHI_{1i}
MUC	SHI_{2i}
SSE	SHI_{3i}
Refurbishment DUC	SHI_{4i}
Refurbishment MUC	SHI_{5i}
Spares DUC	SHI_{6i}
Spares MUC	SHI_{7i}
Fixed assets increase	FAI_i
Depreciation on S.H.	
DUC	DSH_{1i}
MUC	DSH_{2i}
SSE	DSH_{3i}
Refurbishment DUC	DSH_{4i}
Refurbishment MUC	DSH_{5i}
Spares DUC with repenishment	DSH_{6i}
Spares MUC with replenishment	DSH_{7i}
Service Depreciation	SD_i
Office Furniture Depreciation	DOF_i
Total Depreciation	TD_i

Schedule 9 - Service Hardware Depreciation Per Field

Unit costs	
Capsule	UCC
Refurbishment (compounded)	$UCSH_{5,n+1}$
SSE	$UCSH_{3,0}$
Spares	$UCSH_{7,0}$
	All i=0,...,T
Year	Y_i
Costs per U.S. full field	
Depreciation on capsule	$DF_{1,1i}$
Depreciation on SSE	$DF_{1,2i}$
Depreciation on spares	$DF_{1,3i}$
Total depreciation	TDF_{1i}
Costs per non-U.S. full field	
Depreciation on capsule	$DF_{2,1i}$
Depreciation on SSE	$DF_{2,2i}$
Depreciation on spares	$DF_{2,3i}$
Total depreciation	TDF_{2i}
Costs per non-U.S. partial field	
Depreciation on capsule	$DF_{3,1i}$
Depreciation on SSE	$DF_{3,2i}$
Depreciation on spares	$DF_{3,3i}$
Total depreciation	TDF_{3i}

Schedule 10 - Vessel Rental

	All i=0,...,T
Year	Y_i
Depreciation	DV_i
Tax saving	VTS_i
Present value of tax saving	$PVVTS_i$
Vessel cost	V
Less: present value of tax saving	PVVTSS
Less: salvage value (book)	VSV
Equals: present value of rentals	PVVR
Annual rental	AVR

Schedule 11 - Direct Service Overhead

	All i=0,...,T
Year	Y_i
Direct service overhead per field	
U.S.	$ADSF_{1i}$
Non-U.S.	$ADSF_{2i}$
Direct service overhead costs:	
U.S.	
Fist years of fields	$DSOHST_{1,1i}$
Other years	$DSOHST_{1,2i}$
Total U.S.	$DSOH_{1i}$
Non-U.S.	
First years of fields	$DSOHST_{2,1i}$
Other years	$DSOHST_{2,2i}$
Total Non-U.S.	$DSOH_{2i}$
Plus: Total U.S.	$DSOH_{1i}$
Total direct service overhead	$TDSOH_i$

Schedule 12 - Warranty

	All i=0,...,T
Year	Y_i
Number of items	
WHC	$TNHR_{1i}$
PC	$TNHR_{2i}$
MM	$TNHR_{3i}$
Unit cost of warranty	
WHC	W_{1i}
PC	W_{2i}
MM	W_{3i}
Costs of warranty	
WHC	WC_{1i}
PC	WC_{2i}
MM	WC_{3i}
Total cost	TW_i

Schedule 13 - Hardware for Resale

	All i=0,...,T
Year	Y_i
Subcontract cost	
WHC Pre-MUC	HRC_{1i}
WHC Post-MUC	HRC_{2i}
PC	HRC_{3i}
MM	HRC_{4i}
Total subcontract cost	M_{5i}
Direct labour	LC_{5i}
Indirect overhead	IOH_{5i}
Independent development	$TIDAHR_i$
Warranty	TW_i
Total cost	COS_{2i}

Allocation of H.R. costs to H.R. items:

	Sub. Cost	Direct Labour	Ind. O.H.	I. D.	War- ranty	Total Cost	Number	U. C.	U. Tax	U. P.	Sell. Price
WHC Pre-MUC	$HRCS_1$	$LCAHR_1$	$IOHAHR_1$	$IDHR_1$	$TWAHR_1$	$TCHR_1$	$NWHCS_1$	UC_1	UT_1	UP_1	$USPB_1$
WHC Post-MUC	$HRCS_2$	$LCAHR_2$	$IOHAHR_2$	$IDHR_2$	$TWAHR_2$	$TCHR_2$	$NWHCS_2$	UC_2	UT_2	UP_2	$USPB_2$
PC	$HRCS_3$	$LCAHR_3$	$IOHAHR_3$	$IDHR_3$	$TWAHR_3$	$TCHR_3$	$TNHRS_3$	UC_3	UT_3	UP_3	$USPB_3$
MM	$HRCS_4$	$LCAHR_4$	$IOHAHR_4$	$IDHR_4$	$TWAHR_4$	$TCHR_4$	$TNHRS_4$	UC_4	UT_4	UP_4	$USPB_4$
Total (100%)	MS_2	LCS_5	$IOHS_5$	$TIDHRS_5$	TWS	$COSS_2$					

Schedule 14 - Hardware for Resale Income Statement

	All i=0,...,T
Year	Y_i
Revenue	
Sales WHC Pre-MUC	RP_{1i}
Sales WHC Post-MUC	RP_{2i}
Sales PC	RP_{3i}
Sales MM	RP_{4i}
Total revenue	R_{2i}
Less: Cost of sales	COS_{2i}
Profit before tax	PBT_{2i}
Federal tax	FT_{2i}
Net profit	NP_{2i}

Schedule 15 - Cash Outflow Service (MUC)

	All i=0,...,T	
Year	Y_i	Summation
U.S. field (full)		
Capsule	IC_{1i}	
SSE	$ISSE_i$	
Spares	RSF_{1i}	
Total Investment	TIF_{1i}	
P.V. total investment	$PVTIF_{1i}$	$PVTIFS_1$
Shore support	SS_i	
Crew	CF_{1i}	
Indirect overhead	$IOHF_{1i}$	
Vessel rental	VR_i	
Direct service overhead	$DSOHF_{1i}$	
Total costs	TCF_{1i}	
P.V. total costs	$PVCF_{1i}$	$PVCFS_1$
Total depreciation	TDF_{1i}	
P.V. total depreciation	$PVTDF_{1i}$	$PVTDFS_1$
Non-U.S. field (full)		
Capsule	IC_{2i}	
SSE	$ISSE_i$	
Spares	RSF_{2i}	
Total investment	TIF_{2i}	
P.V. total investment	$PVTIF_{2i}$	$PVTIFS_2$
Shore support	SS_i	
Crew	CF_{2i}	
Indirect overhead	$IOHF_{2i}$	
Vessel rental	VR_i	
Direct service overhead	$DSOHF_{2i}$	
Total costs	TCF_{2i}	
P.V.total costs	$PVCF_{2i}$	$PVCFS_2$
Total depreciation	TDF_{2i}	
P.V. total depreciation	$PVTDF_{2i}$	$PVTDFS_2$
Non-U.S. field (partial)		
Capsule	IC_{3i}	
SSE	$ISSE_i$	
Spares	RSF_{3i}	
Total investment	TIF_{3i}	
P.V. total investment	$PVTIF_{3i}$	$PVTIFS_3$
Crew	CF_{3i}	
Indirect overhead	$IOHF_{3i}$	
Direct service overhead	$DSOHF_{3i}$	
Total costs	TCF_{3i}	
P.V. total costs	$PVCF_{3i}$	$PVCFS_3$
Total depreciation	TDF_{3i}	
P.V. total depreciation	$PVTDF_{3i}$	$PVTDFS_3$

Schedule 16 - Service Revenue and Pay-Out Analysis

Annual Revenue Per Field	Per Year	Per Day(365 Days)
U.S. (full)	ARF_1	$ARFD_1$
Non-U.S. (full)	ARF_2	$ARFD_2$
Non-U.S. (partial)	ARF_3	$ARFD_3$
Annual Revenue, Averaged		
U.S.	$ARFA_1$	
Non-U.S.	$ARFA_2$	
Revenue Schedule (MUC):	All i=1,...,T	
Year	Y_i	Summation
Per year		
U.S.	RFM_{1i}	
Non-U.S. (average)	RFM_{2i}	
Per day		
U.S.	$RFMD_{1i}$	
Non-U.S. (average)	$RFMD_{2i}$	
Service revenue		
U.S.		
First years	$SRFY_{1i}$	
Other years	$SROY_{1i}$	
Non-U.S.		
First years	$SRFY_{2i}$	
Other years	$SROY_{2i}$	
Total revenue	TR_i	
Discount on DUCs	D_i	
Net revenue	R_{1i}	
Pay-Out Analysis		
Net cash flow after tax	P_i	
Cumulative net cash flow	PC_i	
P.V. of net cash flow	PVP_i	PVPS

Schedule 17 - Service Income Statement

	All i=0,...,T
Year	Y_i
Revenue:	
Less cost of sales:	
Labour	LC_{4i}
Indirect overhead	IOH_{4i}
Direct overhead	$TDSOH_i$
Cost of sales subtotal	$COSST_i$
Plus: service depreciation	SD_i
Plus: I.D.	$TIDASH_i$
Less: adjustment of I.D.	AID_i
Cost of sales	COS_{1i}
Profit before tax	PBT_{1i}
Federal tax	FT_{1i}
Net profit	NP_{1i}

Schedule 18 - Other Income

	All i=0,...,T
Year	Y_i
Income from PAIT	OI_{1i}
Income from IRDIA	OI_{2i}
Income from IRAP	OI_{3i}
Total other income	TOI_i
Less: repayment of PAIT	$PAITR_i$
Net other income	NOI_i

Schedule 19 - Aggregate Income Statement

	All i=0,...,T
Year	Y_i
Sales revenue	
S.H.	R_{1i}
H.R.	R_{2i}
N.B.	R_{3i}
Revenue subtotal	RST_i
Other income	NOI_i
Total revenue	RA_i
Less: cost of sales	
S.H.	COS_{1i}
H.R.	COS_{2i}
N.B.	COS_{3i}
Total cost of sales	$COSA_i$
Profit before tax - aggregate	$PBTA_i$
Surplus/loss (carry forward)	SL_i
Taxable profits - aggregate	TPA_i
Federal tax - aggregate	FTA_i
Net profit - aggregate	NPA_i

Schedule 20 - Notes on Cash Flow

	All $i=0,\ldots,T$
Year	Y_i
Revenue collections	
Collections of current receivables	CCR_i
Collections of accounts receivable	CAR_i
Total revenue collections	TRC_i
Accounts receivable	AR_i
Materials purchases	
I.R.	M_{1i}
I.D.	M_{2i}
S.H.	M_{3i}
H.R.	M_{5i}
Total materials purchases	MP_i
Payments for current purchases	PCP_i
Payments for outstanding accounts receivable	PAP_i
Accounts payable	AP_i
Inventory	I_i
Salaries accrued	SA_i

Schedule 21 - Balance Sheet

	All $i=-1,\ldots,T$
Year	Y_i
Assets	
Cash	C_i
Accounts receivable	AR_i
Inventory	I_i
Prepaid expenses	PE_i
Total current assets	CA_i
Fixed assets	FAC_i
Less: depreciation	TDC_i
Net fixed assets	NFA_i
Total assets	TA_i
Liabilities	
Accounts payable	AP_i
Salaries accrued	SA_i
Total current liabilities	TCL_i
Debt required	DR_i
Equity	
Investment	EI_i
Surplus/Loss	SL_i
Net equity	E_i
Total liabilities and equity	TA_i

Schedule 22 - Aggregate Cash Flow Statement

	All $i=0,\ldots,T$
Year	Y_i
Cash collections	
Revenue collections	TRC_i
Cash payments	
Cost of sales	$COSA_i$
Taxes	FTA_i
Fixed assets increment	FAI_i
Inventory increment	II_i
Prepaid expenses increment	PEI_i
Total cash payments	CP_i
Less:	
Depreciation	TD_i
Accounts payable increase	API_i
Salaries accrued increase	SAI_i
Subtotal	ST_i
Net cash payments	NCP_i
Net cash flow	NCF_i
Cahs increment	CI_i
Net cash required	NCR_i
Cumulative cash required	CRC_i

Schedule 23 - Income Statement with Book Depreciation

	All i=0,...,T
Year	Y_i
Profit before tax - aggregate	$PBTA_i$
Surplus/loss (carry forward)	SL_i
Taxable profits - aggregate	TPA_i
Federal tax - aggregate	$FTABD_i$
Net profit - aggregate	NPA_i

Schedule 24 - Balance Sheet with Book Depreciation

	All i=0,...,T
Year	Y_i
Assets	
Cash	C_i
Accounts receivable	AR_i
Inventory	I_i
Prepaid expenses	PE_i
Total current assets	CA_i
Fixed assets	FAC_i
Less: book depreciation	BDC_i
Net fixed assets	NFA_i
Total assets	TA_i
Liabilities	
Accounts payable	AP_i
Salaries accrued	SA_i
Total current liabilities	TCL_i
Debt required	DR_i
Deferred taxes	DTC_i
Equity	
Investment	EI_i
Surplus/loss	SL_i
Net equity	E_i
Total liabilities and equity	TA_i

D. Algorithm Limitations

The potential user of the algorithm should be aware of the limitations listed below.

1. The algorithm does not allow substitution of externally set values for variables derived in algorithm formulae. If this is desired for comparison of actual values with model-generated values, it would probably be for only one year's values. Because the algorithm is designed to handle a number of years, it would be better to design a separate comparison model. As a computer program, it would take as input the set of actual values of variables, and the set of values derived from the long range financial planning model, and merely compare the two sets rather than mix the comparison feature with the value-generation feature.

2. The algorithm handles only the number of subscript categories which were used in the model. New subscripts can be added, with careful attention to their validity with respect to all the variables for which the new subscripts will be used.

3. The algorithm does not have built-in editing of the input data for invalid or inconsistent figures. Therefore, calculation results will be only as good as the input data.

4. The algorithm is based on time units of one year and would have to be revised to handle divisions into parts of a year.

These limitations could be overcome if it were decided that the increased flexibility warranted making the changes.

CHAPTER VI

CONCLUSIONS

Several questions were asked in the process of solving the problem of computerization of a particular company's long range financial planning model. The conclusions of this study can be summarized in terms of the answers to these questions (posed in Chapter I.)

1. The company, Lockheed Petroleum Services Limited, needs to meet present reporting requirements and is planning for further requirements accompanying expected large-scale growth.

2. The company's long range financial planning model is the most complex and comprehensive report; therefore, it was the one considered for computerization.

3. Although LPS has no management information systems department, the company's use of the computer in several applications provides an environment for acceptance of further computerization.

4. The company's long range financial planning model satisfies general reporting requirements and aids in making financial decisions.

5. The model projects aggregate financial statements based on market factors, costs allocated among corporate functional areas, and a required profit margin.

6. There are several areas of potential model sophistication, evident from the nature of the model and its limitations.

7. Model computerization is justified by projected cost reductions and improved information system, despite uncertainty inherent in making system change.

8. Difficulties were encountered in defining the problem of the study; a generalized algorithm usable by other companies was not designed; potential model sophistications were not incorporated into the algorithm.

9. An algorithm was designed with features (not present in the model) making future computer programming and alteration possible with a minimum of education time for the programmer. Computer output is simplified with respect to the schedules of the existing manually-processed model. Yet both sets of schedules will be easily comparable for program verification purposes.

In summary, information systems analysis was performed, resulting in design of the means for computerization of the company's long range financial planning model.

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