BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

RECORD 1988/4

SEAPUP: A COMPUTER PROGRAM FOR ESTIMATING FUTURE PRODUCTION OF CRUDE OIL FROM UNDISCOVERED RESOURCES

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SUMMARY

SEAPUP is a Monte Carlo type computer program that simulates drilling the fields within an exploration/ field size model several thousand times and each time it selects a drilling profile, a range of petroleum prospects, an order of drilling, an order of discovery, and appropriate lead times and production profiles for the various undiscovered fields. Each of the several thousand iterations provides an estimate of crude oil production from undiscovered fields during each year from 1987 to 2000. These annual estimates of production are combined into histograms and converted into probability distributions to provide estimates at the 5, 10, 20, 50, 80, 90, and 95 percent probability levels and to provide an average estimate. The estimates are consistent with assessments of Australia's undiscovered crude oil resources prepared using area of closure and resources per unit area in program VALAL, because the same exploration/ field size model is used in both programs.

INTRODUCTION

Computer program SEAPUP simulates repeated drilling of all Australia's petroleum prospects and when discoveries are simulated it estimates their sizes, the year of discovery, the lead time from discovery to production, and the annual production (Forman & Hinde, 1987). Figure 1 shows the seven steps used in the estimate.

The starting point for the estimate is the Australian field discovery model which has already been used to assess Australia's undiscovered petroleum resources using the methods outlined by Forman & Hinde (1986) and Forman & others (1988). The average amount of petroleum that each prospect could contain is estimated using information within the model such as estimates of the closure area of each prospect and of the resources per unit area of closure. The individual probability that each prospect does contain petroleum is then estimated using other types of information, such as existence risk, success rate, and the smallest size of field included as a resource. The average prospect sizes are then multiplied by the probabilities to estimate the risked average prospect sizes.

The exploration drilling model provides probability distributions of the number of new-field wildcat wells that could be drilled in each year from 1987 to 2000. These may be input directly or they may be estimated using another Monte Carlo simulation program which simulates the uptrends and downtrends of past drilling and projects them into the future (Forman & Hinde, 1987). Separate drilling profiles are provided for onshore and offshore drilling.

Unlimited drilling of prospects within the Australian field discovery model would simulate the discovery of all Australia's undiscovered crude oil resources and would supply a probabilistic assessment, as shown diagrammatically in figure 1. Such an assessment requires none of the other assumptions regarding efficiency of exploration, economic field sizes, lead times, or production rates that are required for estimating future annual crude oil production.

The efficiency of exploration model determines the order in which Australia's prospects might be drilled probabilistically. The order is determined using estimates of the average amount of petroleum that each prospect could contain, the probability that it does contain petroleum, an estimate of the smallest size of field to be included as a resource, and historical information concerning the tendency to discover the large fields early. The probabilities and the order of drilling are changed automatically by the computer program if discoveries are simulated in a new area.

The year in which each field might be discovered is determined probabilistically by matching the prospects in their drilling order with the number of wells drilled each year. Then the likelihood of bringing a field into economic production is determined by comparing the estimated size of the field with a field size selected at random from a distribution of field sizes that could be brought into production during the period 1987 to 2000. A distribution, called an economic field size model, has been prepared for each onshore and offshore region throughout Australia.

The lead time between discovery and production of each undiscovered oil field is determined by random selection from a distribution of likely lead times, either onshore or offshore, which has been prepared using a combination of historic data and expert opinion within BMR.

Probabilistic production profiles for each onshore and offshore field, (whether by platforms or floating production systems) have been estimated by Monte Carlo techniques using distributions for the time taken to reach maximum production, the time for which maximum production is maintained, the rate of maximum production, and the rate of the decline from the level of maximum production, based on a combination of historic production data and expert opinion within BMR.

Part of Australia's future production from undiscovered oil fields could depend on resolution of the seabed boundary dispute with Indonesia in time to allow for the possibility of discovery and development of an oil field before 2000. The estimate of possible future production from this area has been prepared using a number of special assumptions:

. when drilling and discovery of a field could occur;
. the minimum economic field size in the area; and
. the percentage of the total production that may be included in the Australian estimate.

The amounts of economic and subeconomic oil that may be discovered onshore and offshore Australia between 1987 and 2000 and the amount that might be brought into production during that period are also estimated probabilistically.

INPUT DATA

General data

The following general data are read in:

- title;
- the number of iterations for the Monte Carlo simulation;
- start year of the production profile;

Australian field discovery model

The following data are read in for each play or independent petroleum system (Ulmishek, 1986):

- basin and sub-basin, whether offshore or onshore, trap type, sequence level;
- the number of future wells to be drilled;

- the triangular distribution for the success rate;
- the probability (one minus the risk) that hydrocarbons have been generated within or have migrated into the stratigraphic sequence;
- the probability that traps of the type specified contain petroleum;
- the proportion of oil, gas, and oil and gas fields and a triangular distribution for the proportion of oil to oil plus gas in the fields containing both oil and gas;
- the value of the conversion factor, G, used to convert gas to the equivalent volume of oil in the reservoir;
- a triangular distribution for the ratio of condensate to gas;
- the parameters of the linear model of log area of closure (log A) versus drilling sequence number (N): slope; intercept; standard deviation of the residuals; lambda; standard deviation of lambda; and the drilling sequence number of the last well drilled. The intercept is input as a value in km^2 and the slope is calculated by dividing the change in log A by the corresponding change in drilling sequence number. If the value of lambda is ommitted (and the slope is non-zero), the computer will calculate and use an average value; this value is the smallest allowed by the model. When the value for the standard deviation of lambda is ommitted, the program uses the value $1/N^{1/2}$;
- the parameters of the straight-line model of log resources per unit area (log V_A) versus discovery sequence number (N_d): slope; intercept in metres; standard deviation of the residuals; lambda; standard deviation of lambda; and the discovery sequence number of the last accumulation discovered. Resources per unit area (V_A) is given in metres of oil equivalent;
- a cut-off for the closure area (A). This is specified as a maximum value for the next well to be tested and the values for subsequent wells are determined using the logarithm of this value as the intercept (at the next well) of a line with slope parallel to that of the simulated slope of the log A plot. When values greater than the cut-off are generated, another value is generated to replace it. All values of A are allowed if no cut-off is specified;
- a cut-off for the values of resources per unit area of closure (V_A). This is specified as a maximum value for the next discovery number and the values for subsequent discoveries are determined using the logarithm of this value as the intercept (at the next discovery number) of a line with slope parallel to that of the simulated slope of the log V_A versus discovery sequence number plot. When values greater than the cut-off are generated, they are replaced with the cut-off (this results in a truncated lognormal distribution with a spike at the truncation point for V_A. If no cut-off is specified, a default value of 6 is used;
- a triangular distribution for the intercept of the cut-off line for log V_A. If not specified, the single value supplied above is used.
- cut-offs specifying the smallest size of field to be included as a resource and the maximum field size to be accepted in the Monte Carlo simulation. When a field larger than the maximum cut-off is generated, another field size is selected to

replace it. The maximum field size cut-off may be left blank as cut-offs on area of closure and resources per unit area normally achieve the same purpose;

Exploration drilling model

Triangular distributions for the number of new-field wildcat wells to be drilled in each year of the estimate are read in from the input data file. The following data are built into subroutine FDRILL which may be used as an option instead of the triangular distributions:

- a uniform distribution for the duration of each uptrend or downtrend in offshore drilling;
- the length of time (either one or two years) for which the initial offshore downtrend should continue before changing to an uptrend;
- a uniform distribution of the lag time (between -1 and 2 years inclusive) between offshore and onshore trends. The first onshore lag is at least one year;
- cumulative probability distributions showing the changes in the amount of annual drilling in each year of each trend, onshore and offshore.

Efficiency of exploration model

- the partially risked average field sizes derived from program VALAL (version 8.4) are read from the input data file.
- distributions for the alpha factor, onshore and offshore, are read in from the input data file. The distributions determine the tendency to drill the prospects with the highest risked average field size early.

Economic field size model

- a distribution of the smallest size of field that can be brought into economic production in each Sub-basin are read in from the input data file.

Lead time model

- distributions for lead times, onshore and offshore, are read in from the input data file.

Field production rate model

The following parameters of the field production model are built into the program:

(1) Floating production systems (Fig. 2)

- a uniform distribution (between 0.6 and 0.8) of the proportion of the resources produced during the period of initial production (a)
- a uniform distribution (either two or three years) showing the period of initial production in years (c);

(2) Offshore platforms (Fig. 2)

- a uniform distribution (between 0 and 2 inclusive) for the length of the production build-up in years (a);
- a uniform distribution (between 5 and 20 inclusive) for the percent of the resources produced during each year of plateau production (b);
- a uniform distribution (between 1 and 4 inclusive) for the length of plateau production in years (c);
- a uniform distribution (between 5 and 20 inclusive) for the percent fall in annual production during each year of the production decline (d);

(3) Onshore fields (Fig. 2)

- a uniform distribution (between 0 and 2 inclusive) for the length of the production build-up in years (a);

- a uniform distribution (between 7 and 15 inclusive) for the percent of the resources produced during each year of plateau production (b);
- a uniform distribution (between 3 and 9 inclusive) for the length of plateau production in years (c);
- a uniform distribution (between 5 and 20 inclusive) for the percent fall in production in each year of the production decline (d).

CHECKING THE DATA

The computer checks each set of input data. If no errors are detected, the next set of data is read. If an error or inconsistency is detected, it prints out a message, ignores the set of data, and reads the next set. The error messages are printed out to a special file called ERRORS.

Subroutine GBMAX, described previously (Hinde, 1986), is called to calculate constants used for the extrapolation of the simulated straight lines for log A and log V/A. Subroutine GBMAX checks the input values of lambda and if any is below the (minimum) average value allowed by the model, it calculates and substitutes the (minimum) average value.

DESCRIPTION OF PROGRAM SEAPUP

Each iteration of program SEAPUP simulates drilling, discovery, and production of crude oil from each independent petroleum system (IPS) during the period 1987 to 2000. The following steps are carried out by the computer during each iteration:
(1) The number of offshore and onshore wells drilled each year is estimated, according to the drilling model in subroutine FDRILL;
(2) The presence or absence of hydrocarbons within each IPS is determined by comparing random numbers with the input probabilities for the existence of hydrocarbons and for the adequacy of trap and seal;
(3) The parameters of the linear model of log A versus new-field wildcat number are determined.

(a) if slope = 0,

A random value of the intercept is selected from a normal distribution with a mean equal to the value of the intercept in the input data and a standard deviation equal to the input standard deviation of residuals divided by the square root of the number of new-field wildcat wells. A random value of the standard deviation of the residuals is selected from a normal distribution with a mean equal to the value of the standard deviation of the residuals in the input data and a standard deviation equal to the input standard deviation of residuals divided by the square root of twice the number of new-field wildcat wells.

(b) if slope is < 0,

A random value of lambda is selected from a normal distribution with a mean equal to the input value of lambda and a standard deviation equal to the input value of the standard deviation of lambda. This value of lambda is used to calculate the corresponding values of slope, intercept, and standard deviation of residuals as described by Forman & Hinde (1985, 1986) and Forman & others (1988);

(4) The parameters of the linear model for log V/A versus discovery sequence number are determined in a similar way;

(5) A value for the success rate is selected at random from the triangular distribution of success rate;

(6) For each undrilled prospect in the model.

(a) A random value of log A is selected by extrapolation and random sampling of the linear model of log A versus drilling sequence number. A cut-off for log A is calculated using the input value for the intercept of the cut-off line, and the slope of the linear model of log A versus drilling sequence number. If log A is greater than the cut-off, repeat the selection of log A.

(b) A random value of log V/A is selected by extrapolation and random sampling of the linear model of log V/A versus discovery sequence number. A cut-off for log V/A is calculated using the input value for the intercept of the cut-off line, or the triangular distribution for this value if it was supplied, and the slope of the linear model of log V/A versus discovery sequence number. If the value of log V/A is greater than the cut-off, the cut-off value is used.

(c) The log field size is calculated using the values of log A and log V/A selected above (log V = log V/A + log A). If the value of log V is greater than a limit of SDMAX standard deviations above the average value, return three steps to where a value of log A is selected (The value of SDMAX is normally set at four standard deviations and the instruction that does this is a data statement at the top of the program).

(d) The field size is calculated using: V = exp(log V). If the field size exceeds the maximum value specified in the input, return five steps to where a value of log A is selected. If the field size is less than the smallest size of field to be included as a resource, the field is excluded from the assessment and the estimate.

(e) The amount of oil in the field is calculated using the field size in MOE and the proportion of oil to oil and gas;

(7) For each field in the model.

(a) A random value is selected for the lead time from discovery to start of production (for discoveries in disputed territory, an additional random number, selected from a uniform distribution between two and 15 inclusive, is added to the lead time, and the field size is divided by two);

(b) A minimum economic field size cut-off is selected at random to determine whether or not the field will be produced.

(8) The total amount of simulated oil discoveries in each IPS is summed for later printout of the total risked average amount;

(9) Random values of alpha, onshore and offshore, are selected from the input distributions;

(10) The offshore and onshore prospects and associated fields are ordered according to the discovery order model in subroutine FDISC;

(11) The annual production from economic oil fields is calculated using subroutine PRODN and stored in histograms.

Upon completion of the iterations:

(1) Each histogram of annual crude oil production is written onto a disc file;

(2) The risked means of the undiscovered petroleum resources of each IPS and the total for all the IPS's are written onto a print file;

(3) The input data for each IPS is written onto a second print file.

Subroutine GBMAX

Subroutine GBMAX takes as input the slope (b), intercept (a), standard deviation of residuals (σ_{res}), and number of data points (n) of a linear regression, as well as the corresponding value of lambda, and calculates the maximum (most negative) slope (B_{max}), the standard deviation of the y-values (σ_y), and the sum of the y-values (S_y). The following equations are used (Hinde, 1986):

$$S_y = n(a + B(n+1)/2) \tag{1}$$

$$\sigma^2_y = \sigma^2_{res}(n-2)/n + b^2(n^2-1)/12 \tag{2}$$

$$B_{max} = b/(1 - \exp(-\sigma_y\lambda)) \tag{3}$$

Subroutine FDRILL

Subroutine FDRILL uses either triangular distributions of annual drilling or probability distributions to estimate future annual new-field wildcat drilling, onshore and offshore, from 1987 to 2000.

Subroutine FDISC

The prospects and fields simulated during an iteration are arranged in drilling and discovery order by subroutine FDISC according to the hypothesis that the probability of a prospect being drilled next is proportional to its risked average field size raised to the power alpha. Separate values of alpha are used for onshore and offshore drilling.

Risked average field size is determined by multiplying the partially risked average field sizes (read from VALAL) by the corresponding trap and horizon risks (the probability of adequate trap and seal and the probability that hydrocarbons are present in the sequence).

Whenever the presence of hydrocarbons is established within an horizon or IPS by risking, the probability that hydrocarbons have been generated is set at one. Whenever the adequacy of a trap type within an horizon or IPS is established by risking, the trap risks are set at one. The order of drilling is changed using the new risks after the first discovery is made in an horizon or IPS.

Upon exiting the subroutine, the prospects and associated fields are arranged in order of drilling ready for processing by subroutine PRODN. Prospects within disputed territory are always brought to the begining to be the first drilled.

Subroutine PRODN

Subroutine PRODN uses the estimated field sizes, the selected lead times, and appropriate production profiles to estimate the amount of oil produced in each year from 1987 to 2000. A separate production profile, showing the percent of the undiscovered resource produced each year, is estimated probabilistically for each field.

Three types of production profiles are used:

(1) Floating production systems (subroutine PRODFP) which are likely to be used for any offshore fields in the Arafura, Bonaparte, Browse, or Money Shoal Basins that contain less than 50 million barrels of oil. The production profile (Fig.2) is determined by selecting random values for a and c from the input distributions. The value for d is determined from the values of a and c: d=-ln[(1-a)/(1-a+a/c)]. The values of a and c are

correlated by using the same random number to select them from their distributions;

(2) Offshore platforms (subroutine PRODOP) which are used for all other offshore fields. The production profile (Fig. 2) is determined by selecting random values for a, b, c, and d from the input distributions. The values of c and d are correlated by using the same random number to select them from their distributions.

(3) Onshore fields (subroutine PRODON) are all produced using the same type of production profile (Fig. 2). The production profile is determined by selecting values for a, b, c, and d from the input distributions. The values of c and d are correlated by using the same random number to select them from their distributions.

Subroutine PRODN considers each simulated discovery. It first checks to see if the field size is greater than the minimum economic size. If so, it determines the year in which the discovery was made, selects an appropriate production profile, and determines the annual crude oil production using the lead time that has already been determined. The annual production from the field is totalled together with that from all other fields and the totals are used to produce histograms of annual production.

The total amount of oil discovered during the production period, the amount of economic oil discovered during the production period, the amount of uneconomic oil discovered during the production period, and the amount of oil contained within fields that are discovered and brought into production during the production period are also calculated and are accumulated into histograms.

STRUCTURE OF INPUT DATA

The input data for program SEAPUP (version 4.0) are typed into a file in the following format.

Line	Cols	Variable	Description	Format
1	1-60	ITITLE	Title of project.	(A60)
2	6-10	NRUNS	Number of iterations.	(5X,2I5)
	11-15	NSTART	Start year of production estimate.	
3	1	TYPE (5)	Type of distribution for value of alpha (offshore). (K-constant, E-truncated exponential, U-uniform, blank-frequency histogram, C-cumulative, T-triangular, B-binomial).	(A1,I5, (6F10.3))
	2-6	NUM (5)	Number of points specifying the distribution for alpha (offshore).	
	7-16	VAL (5,1)	X-value of the first point in the distribution for offshore alpha.	
	17-26	FREQ (5,1)	Corresponding probability or relative frequency of the first point in the distribution for alpha.	
	27-36	VAL (5,2)	X-value of the second point.	
	37-46	FREQ (5,2)	Corresponding probability or relative frequency of the second point.	
	47-56	VAL (5,3)	Parameter value of the third point.	

	57-66	FREQ (5,3)	Corresponding probability or relative frequency of the third point.	
4		TYPE (6) etc	Type of distribution for value of alpha (onshore).	(A1,I5, (6F10.3))
5		TYPE (3) etc	Type of distribution for lead time (offshore).	(A1,I5, (6F10.3))
6		TYPE (4) etc	Type of distribution for lead time (onshore).	(A1,I5, (6F10.3))

If more than 3 points are required to specify these distributions, up to four continuation lines may be added. Up to three points can be entered per continuation line, 20 columns per point, starting in column 1 (each number has F10.3 format).

7	1-10	OFFMIN	Minimum value of the number of offshore wells drilled per year (triangular distribution).	(6F10.0)
	11-20	OFFML	Most likely value of the number of offshore wells drilled per year.	
	21-30	OFFMAX	Maximum value of the number of offshore wells drilled per year.	
	31-40	ONMIN	Minimum value of the number of onshore wells drilled per year.	
	41-50	ONML	Most likely value of the number of onshore wells drilled per year.	
	51-60	ONMAX	Maximum value of the number of onshore wells drilled per year.	

If line 7 is left blank, the inbuilt drilling model is used.

Lines 8 to 12 are repeated for each basin/sub-basin/trap/sequence level combination as required.

8	1-20	BASIN	Name of basin and sub-basin.	(A20,A1,A4,
	21	ONOFF	location (F = offshore; N-onshore).	I5,5F10.0)
	22-25	TRAPH	Trap type and sedimentary sequence. (I = lower part of sequence, T = top part of sequence).	
	26-30	MDRILL	Number of future wells to be drilled.	
	31-40	XTH1	Minimum value of the success rate (triangular distribution).	
	41-50	XTH2	Most likely value of the success rate.	
	51-60	XTH3	Maximum value of the success rate.	
	61-70	FLDMIN	A cut-off specifying the smallest size of field to be included in the estimate. If not required, leave blank (Units are MOE).	
	71-80	FLDMAX	A cut-off specifying the maximum size for future generated fields. If not required, leave blank.	
9	1-10	POIL	Proportion of fields containing only oil.	(5F10.0, 10X,2F10.0)
	11-20	PGAS	Proportion of fields containing only gas.	
	21-30	OOGMIN	Minimum value (triangular distrib-	

			ution) for the proportion of oil to oil plus gas in the oil and gas fields.	
	31-40	OOGML	Most likely value for this distribution.	
	41-50	OOGMAX	Maximum value for this distribution.	
	61-70	AAMAX	Specifies a cut-off line for generated values of A. Log(AAMAX) is the intercept of the line (at the next well) with a slope equal to the generated value of slope for log A vs NFW number. If a value is generated higher than the cut-off, another value is generated. If not specified, no cut-off is used (units are sq km.)	
	71-80	VAMAX	Specifies a cut-off line for maximum values of future generated values of V/A. Log (VAMAX) is the the intercept of the line, (at the next field), and the slope is the generated value of slope for log V/A vs discovery number. If a value is generated higher than the cut-off, it is replaced with the cut-off (default value is 6; units are metres).	
10	1-10	RHORIZ	Probability that hydrocarbons have been generated and have migrated in this stratigraphic sequence.	(5F10.0, 4F5.0)
	11-20	RTRAP	Probability that trap is adequate.	
	21-30	GBOE	A constant value for converting gas in BCM's to an equivalent volume of oil in MCM's. If not specified, a default value is used.	
	31-40	CONDMN	Minimum value (triangular distribution) for the ratio of condensate (in MCM) to gas (BCM).	
	41-50	CONDML	Most likely value for this distribution.	
	51-55	CONDMX	Maximum value for this distribution.	
	56-60	CUTMIN	Minimum value (triangular distribution) for minimum economic field size. (Oil-MCM, Gas-BCM, Con-MCM).	
	61-65	CUTML	Most likely value for this distribution.	
	66-70	CUTMAX	Maximum value for this distribution.	
11	1-10	SLOPE (1)	Slope of the line fitted to log A vs NFW number model.	(5F10.0,I5)
	11-20	AINTA1	Intercept of the line fitted to log A vs NFW number model (in sq. km)	
	21-30	SDRES (1)	Standard deviation of the residuals to the line fitted to the log A vs NFW number model.	
	31-40	ALAM (1)	Lambda value for the log A vs NFW number model. If this value is less than the theoretical minimum value allowed by the model, the theoretical	

			value is used.	
	41-50	SDLAM (1)	Standard deviation of lambda for the log A vs NFW number model.	
	51-55	NAREA	Number of new-field wildcat wells drilled to date.	
12	1-10	SLOPE (2)	Slope of the line fitted to the log V/A vs discovery number model.	(5F10.0,I5, 3F5.0)
	11-20	AINTV1	Intercept of the line fitted to the log V/A vs discovery number model (metres).	
	21-30	SDRES (2)	Standard deviation of the residuals to the fitted line to the log V/A vs discovery number model.	
	31-40	ALAM (2)	Lambda value for the log V/A vs discovery number model. If this value is less than the theoretical minimum value allowed by the model, the theoretical value is used.	
	41-50	SDLAM (2)	Standard deviation of lambda for the log V/A vs discovery number model.	
	51-55	NDIS	Number of discoveries made to date.	
	56-60	VAXMIN	Minimum value for the intercept, VAMAX, of the cut-off line for V/A (triangular distribution).	
	61-65	VAXML	Most likely value for this distribution.	
	66-70	VAXMAX	Maximum value for this distribution (This distribution, if present, overrides the value of VAMAX input above.)	

RUNNING PROGRAM SEAPUP

Version 4.0 of SEAPUP is stored in directory SEAPUP2 of ALAN.RESAS on the BMR's DG computer. SEAPUP may be run either at the terminal or in batch mode. To run SEAPUP at the terminal type the command, SEAPUP data p, where 'data' is the name of the input data file. Type a '1' instead of 'p' if the printout file is to be printed. To run SEAPUP in batch mode type, SEAPUP/AFTER=+n BATCH data p, where 'n' is the number of hours delay before SEAPUP is to run and 'data' is the name of the input data file. Type a '1' instead of 'p' if the printout file is to be printed.

The command, SEAPUP, may be typed at the terminal to get a list of the above instructions.

OUTPUT FROM THE PROGRAM

Assuming that the input data file for a SEAPUP run is called DATA, the following files are produced by the program.

File DATA_LS0

This print file lists the risked average undiscovered crude oil resources for each set of input data and the average total undiscovered resources for all the data sets.

FIle DATA_LS1

This print file contains a list of the data values for each of the sets of input data as well as the input distributions for alpha, the lead times, and the production profiles.

File ERRORS

This input file contains a list of any errors or anomalies detected in the input data.

FIle DATA_Q

This disc file contains the histograms of the annual crude oil production estimate and is used by program PROFILE to obtain printouts of the annual crude oil production profile at the required levels of probability.

OBTAINING THE PRODUCTION PROFILE

Program PROFILE reads file DATA_Q and creates a print file, called DATA_LSQ, containing the average production profile and production profiles at the 10, 50, and 90 percent probability levels. The program runs automatically when the above 'SEAPUP' commands are used. PROFILE can be run independently with the command, PROFILE DATA p, where DATA is the name of the original SEAPUP data file. A 'l' is typed instead of 'p' if the print file DATA_LSQ is to be printed.

ACKNOWLEDGEMENTS

L. Darke gave assistance with the compilation of annual production figures for Australian oil fields and V. Vukovic helped interpret the data so that generalised production profiles could be designed for Australia's undiscovered fields. Special thanks are due to D. Downie for suggesting a method of reducing the time taken to run the program.

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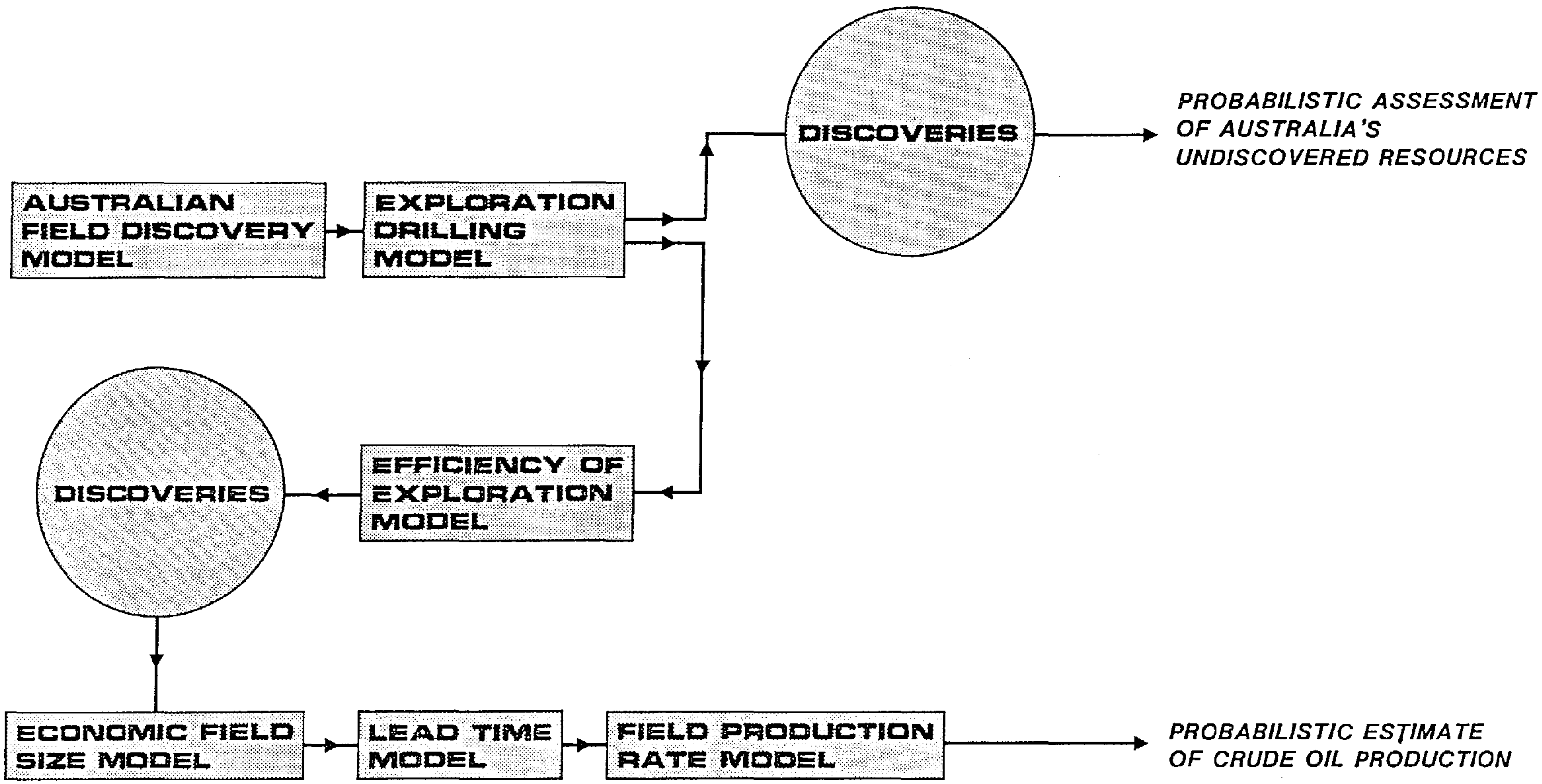

Fig 1 Diagrammatic illustration of the steps involved in assessing future discovery and production of undiscovered crude oil

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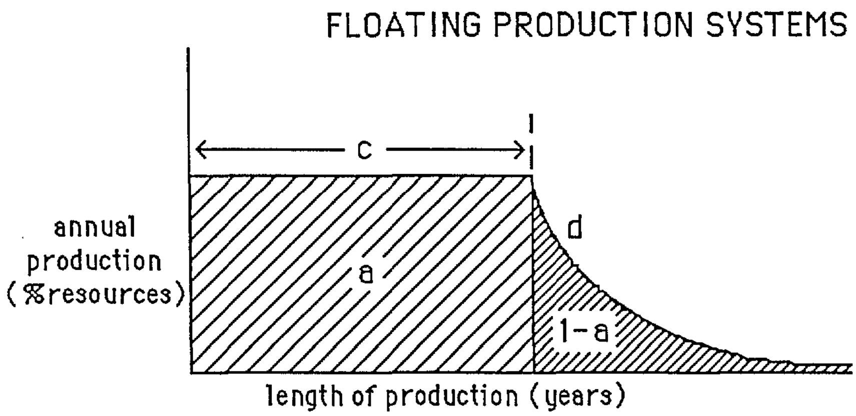

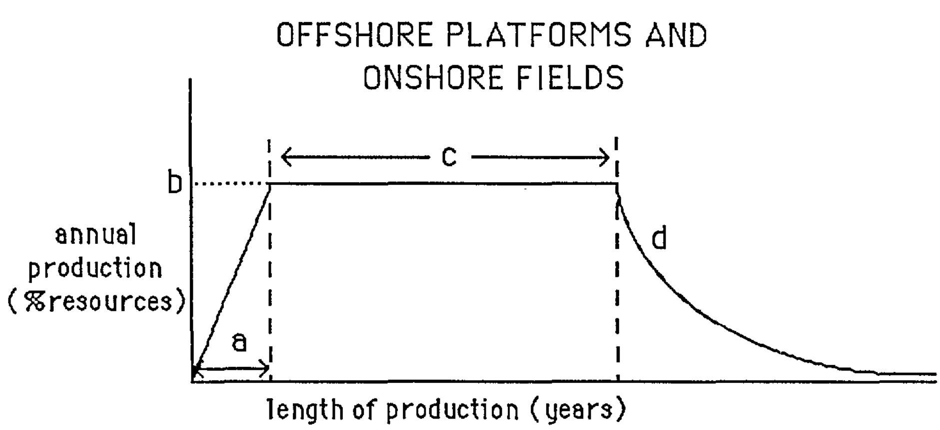

FIGURE 2. Diagrams showing the annual production of an undiscovered field according to three alternative production systems.