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THE EVALUATION OF A PETROCHEMICAL PROJECT INCLUDING METHODS BASED ON DISCOUNTED CASH FLOW[1/]

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[illegible] expressed in this paper are those of the author [illegible] the views of the Secretariat of UNIDO.

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A sound investment policy should be based on careful forecasting and planning, to ensure that scarce capital resources be employed so as to contribute in the most effective way to the company's objectives for profitability and growth. A yardstick, with which to measure profitability is essential for investment projects, therefore, for ranking purposes when comparing alternative and conflicting investment opportunities, [illegible] possible screening and ranking of investment projects according to the company's funds.

2. Before such yardsticks may be applied, a detailed analysis of income and expenditure flows given by the project should be made. This should take into account - over the life of the project - the market effects and prices, variable and fixed costs to be met in the manufacturing and marketing spheres, together with the expenditure on fixed and current assets. This analysis results in a detailed picture of the cash flows, both incoming and outgoing, associated with the project.

3. Several methods exist to derive from the cash flows for a project over its lifetime a profitability measure for profitability assessment. Three of these, i.e. the pay-out time method, the financial statements method and the discounted cash flow, will be discussed in the following. In particular, it will be studied to what extent these methods satisfy the basic requirements of applicability for screening and ranking purposes. The pay-out time indicates the length of time between the start of the project and the point where the cumulative cash inflows are broken even with the cumulative expenditures. The shorter the pay-out period, the quicker the money at stake is turned over and so lowers the risk of the company. It is thought, therefore, that pay-out time as a guide to ranking of projects this method could have some value, but as profitability yardstick for screening purposes the method fails completely. Because the flows over the lifetime of the project are not taken into consideration. Both the cash after the break-even point is neglected.

The financial statements method is open to several of these criticisms. Not the whole cash flow is applied, only the one related over the full economic life. Yearly gross returns as well as average annual return over the lifetime of

the project can be regarded. Although the method has the advantage of
clear simplicity to the basis of the theory on which it is, however,
short and still valid. The "time value of money" is not taken into
account by this method.

It is only the rate at which cash flows should be taken account of in the full economic life of the project. The "earning power" and "net present values" derived by this method can be used as indicators for screening major expenditures respectively.

Major profitability assessment, however, can be regarded as complete without sensitivity analysis. The decision maker has to be aware of the weak points of the project. Is the profitability of the planned investment sensitive to increases in the costs of labour, a rise in prices of the bought-in raw materials? What percentage by which prices will reduce the profitability of the project to the acceptable minimum and how safely can we assume that this drop in prices will not occur? What will be the position if the capital cost of the project requires substantially more capital or if the start of commercial operations is seriously delayed? Questions of this character should be examined as the analysis and enable management to regard each individual project in the right perspective.

NEED FOR A YARDSTICK [illegible]

The decision to invest a substantial sum of money in a new plant is one of the most important [illegible] therefore, one of the most challenging decisions [illegible] management has to make [illegible] investing capital in [illegible] facilities, a company commits itself for many years to a specific range of products and markets. In particular in the petrochemical industry facilities are designed for one or a few specific products, and the possibilities of reaction afterwards are very limited once the [illegible] decision to invest has been made irrevocable. The challenge to management, therefore, is to cope [illegible] with its risks and uncertainties

[illegible] investment in new plant can be based upon a great number of [illegible] but they all should have in common the [illegible] the investment will contribute to the ultimate objectives of the enterprise [illegible] seems useful, therefore, before going [illegible] one of investment procedures, to have a close look at the objectives of an industrial enterprise.

[illegible] the broad concept of human activity, expressed in the most general terms, the purpose of the enterprise is to [illegible] well-being, for all parties involved in the [illegible] shareholders, customers, creditors as well as the [illegible] to [illegible] seen as a conglomerate of [illegible] [illegible] might [illegible] functioning of the company and. [illegible] derive from the company as long as [illegible] [illegible] and claims on the [illegible] of the company's [illegible] to any one of them [illegible] and the pursuit of [illegible] [illegible]

[illegible], this broad [illegible] objective is not an immediately [illegible] [illegible] [illegible] numerical terms [illegible] [illegible] [illegible] decisions, including [illegible] [illegible] industrial [illegible] [illegible]

[illegible] [illegible] [illegible] but growing competition [illegible] [illegible] technological progress and [illegible] [illegible], [illegible] including the utilisation [illegible] [illegible] [illegible] keep pace with those developments, [illegible] [illegible] [illegible], its margin between [illegible] [illegible] and its continuity [illegible]

[illegible] must invest in new plant to enter [illegible] remain competitive and retain, if [illegible] [illegible] for existing products.

The funds required for investment in new plant and also for research and development will largely have to be generated by the business itself. The company, therefore, has to watch permanently its level of cash generation, or to use the more general term, its profitability. This not only applies to its present activities, but in particular also to the additional activities resulting from new investments. It is for this reason that the expected profit potential of a new project is a major point of consideration for management when taking a decision on investment proposals.
At the same time, it will be appreciated that a company's investment programme will not only embrace projects which will in a direct way generate additional income or produce savings on cost. As is the case with successful manufacturing projects new office buildings and overhead facilities at the plant's site for example will have to be assessed on an urgency or social necessity basis, instead of on a basis of profitability.
It is evident that a company's future position with respect to earnings and growth will be influenced more favourably, if the profit potential of a new project is higher.

There is, therefore, a need to measure profitability. In other words, a profitability yardstick is required with which to assess the attractiveness of new investments.
Such a yardstick should serve two purposes :

(a) It should enable projects to be selected which look sufficiently profitable for the company to be rejected which do not appear to offer sufficient attractive to carry out. It should, therefore, lead to a correct <u>screening</u> of proposals for investment, so that projects which do not meet a minimum requirement of profitability can be dropped.

(b) It should provide a reliable indication as to which of various alternative proposals for investment is the more attractive, keeping in mind that funds available for investment are limited. In other words, a correct <u>ranking</u> of investment proposals, competing for the company's funds, should be achieved.

Two conclusions immediately follow from the above :

(i) It is important that within a company whose management has to decide on many possibilities for investment, the assessment of project profitability should always follow the same lines of approach, i e a standardised method should be used.

(ii) It is a vital and primary task for a business enterprise to decide what the minimum acceptable profitability level for its new projects should be.

without having to go into detail often regard to the latter problem, since this would fall outside the scope of this paper, a few brief remarks on the subject are felt to be of interest.

Management may wish to see their company grow rapidly. However, too many new projects will tend to depress the future earnings of the company, as it will always take a number of years before such new projects will start to contribute adequately to the company's profit. Finance may then become a problem, since it will prove difficult to attract new finance into a company with a relatively poor profit record in relation to its capital employed.
The other extreme would be a very slow growth rate, leading to the obvious disadvantages, since a small part only of the profits would be ploughed back for reinvestment. Such a policy may be dangerous indeed, since the company's competitors would certainly be very active and after a period the company would find its position seriously weakened. In this case profits will diminish in the long run as no new products have added or modernisation effected.
Between these two extremes a balanced position should be sought. In practice the best way of tackling the problem might be to make a financial forecast of the existing business and to superimpose on this a varying volume of investment with a view to the maximisation of profitability, taking into account such other considerations of finance, dividend policy, etc. From such models the management can get to the profitability of new projects which must be derived.

II. BASIC ELEMENTS OF PROFITABILITY CALCULATION

The Vikings, in their adventures, when fitting out ships for raiding, used to do this in a very simple way. Although a large number of vessels never returned, it took the odds, as in each of these cases the profit was very substantial. At that time each ship was a single project, it was either going to bring back a rich booty or the opportunity of the enterprise was lost. No elements safeguarded, nor apparently - was it necessary - any calculation of the investment.

It is clear that a businessman of today, being far more concerned about the future position of his company, will approach his investment problem in a more sophisticated way. From his study of expected cash flow he requires an assessment, as well as can be done, of the uncertainties which are inherent in estimating future cash flow, i.e. what sort of profit that is likely to be made with the capital cost of the project, the cost of manufacture (i.e. raw materials, the process to be used), from selling the product, etc. To judge the merits of a new project, the basic elements involved are to a large extent the same as in principle

always the same. However, they will have to be worked out in more or less detail depending on the yardstick to be applied. These elements are the following.

1 The available market for the product

An assessment will have to be made of the size and growth potential of the market for the product(s) in question and an estimate must be made of the market share that can be achieved by the company. Furthermore, also the prices at which the product(s) can be sold will have to be considered carefully, both for the home and export market. This is, no doubt one of the most difficult jobs in predicting the future. Use will be made of the price history of the product (or of a substitute product for similar use in case the product is a completely new one) but it is difficult to estimate what the reaction of competitors might be, whether they as well plan for extension and consequently whether the danger of a substantial overcapacity developing may exist. In addition to the price also the costs of marketing the products should be determined, including the cost of the sales department, cost of delivery, packing, storage and handling, and cost of packages.
A continuous analysis of the market and an extrapolation into the future by people who are well aware of its peculiarities looks the best way to obtain a balanced forecast, which takes account of all upward and downward pressures. It should be realised, however, that even so the actual price development may be substantially different, e.g. the development of a new process or a competitive product not foreseen at the time may cause a price drop which makes the forecast invalid. Nevertheless, in most cases developments will not be so dramatic and it is part and parcel of business life to accept this type of risk.

2 Capital cost of the new plant

Having determined the volume of product that can be sold, the capacity of the plant to be considered can now be set and its capital cost estimated. Care should be taken that the capital cost so determined should, indeed, embrace all the facilities which will have to be constructed to realise the project. Apart from the processing units proper, it should also include the cost of such items as site preparation, social amenities, access roads, sewer system, storage and handling facilities, flare system, supply of utilities, measures to abate water and air pollution and so on.
In an early stage of development approximate figures can be given for the several parts of the project, by scaling from previously built plants and by applying overall percentages for off-plot items. However, the accuracy will be rather low and a technical study in detail will be required in furtner developing the project to firm-up the capital costs

[illegible] will have to [illegible] in [illegible] sufficient [illegible] to prepare [illegible] experience [illegible] made [illegible] in this field by people who [illegible] and who keep [illegible] analysis of the actual cost [illegible] for the the estimate [illegible] investment [illegible] will also be very useful for expenditure [illegible] conservation.

Cost of production

From the design data or from the records of actual operation of plants of similar type, yield and consumption figures will be available which can be converted into cost per unit of product. If the cost of the basic input materials are known. With regard to the latter there may be a good reason to approach at an early stage potential suppliers of those materials which have an important bearing on the total cost of the product. Fixed costs, covering the cost of operating labour, cost of maintenance and overheads, can often be estimated with reasonable accuracy by using the cost records of plants of similar nature and by seeking the advice from staff who have a good experience in the operation and maintenance of chemical plants. Overheads are usually estimated on a statistical basis [illegible] in case [illegible] by making a detailed analysis of the many items which will form the total overhead required.

With the above data available, it is possible to apply a simple profitability yardstick which admittedly is not much used for final decisions but seems worth mentioning as a short-cut for a quick initial appraisal.
By deducting the out-of-pocket expenses of production and of marketing from the proceeds, the annual cash surplus at full load and before tax can be calculated. This cash surplus can then be divided by the fixed capital involved in the project to obtain a "rate of pay-out".

Example :	Capital	100
	Proceeds	80 (at full load)
	Manufacturing Expenses	45
	Marketing Expenses	10

Rate of Pay-out = $\frac{80 - 45 - 10}{100}$ = 25% per year

The profitability, theoretically, should be estimated for the full lifetime of the project. However, this [illegible] is rarely known exactly. In most cases it is only possible to set an arbitrary [illegible] lifetime or, e.g., [illegible], because [illegible] before its [illegible] in the market, [illegible] improved [illegible], rendering [illegible].

It is, therefore, usually necessary to relate the profitability [illegible] to a (more or less) arbitrary short period. In this case the project [illegible] is [illegible].

[illegible] are used in different periods in the future, the following [illegible]:

When [illegible] the various years [illegible] to keep the [illegible]:

(a) [illegible]

(b) [illegible]

[illegible]

[illegible]

Full details of these two projects A and B are tabulated in Appendices II and III respectively
From these tables it will be seen that project A requires an outlay of £ 230,300 on fixed assets, whereas modifications of the existing development plant in project B are estimated at £ 125,250 only. For the sake of the calculation equal construction periods have been assumed
The larger plant, despite the low incremental capital cost to realise the extra sale, will be more efficient when operating at full capacity, which can be seen from the following :

Project A 15,000 t/a			Project B 5,000 t/a	
	in £/t			in £/t
Netback		40.0		52.8
Variable cost	6.0		10.0	
Fixed cost	13.0		15.0	
Depreciation	7.7	26.7	5.0	30.0
Gross profit		14.0		22.8

However, the higher manufacturing costs of case B are more than compensated by the higher netback obtainable, so that on balance profit before tax in case B is some £ 9/t higher

Let us now consider how the profitability yardsticks selected for further investigation shape up with regard to the screening and ranking criteria, whether they are both projects A and B profitable investment [illegible], which investment is to be preferred.

1 The pay-back time method

The [illegible] often referred to as the "pay-back criterion", indicates the time lapse between the start of the project and the point in time where the cumulative cash inflow breaks even with the cumulative expenditure. A graphical presentation of the cumulative cashflows of projects A and B is shown in Appendix IV

It appears [illegible] times are almost equal, [illegible] proportions, of 5 years when [illegible]
The [illegible] is to be preferred on [illegible] to answer. The higher [illegible], represented in [illegible] the earlier expenditure [illegible] great [illegible] the project, or [illegible] investors, might favour [illegible] risk

It is especially under conditions of great uncertainty that the pay-out criterion can serve as an indication for ranking purposes, in so far that the shorter pay-out time will then be preferred in case capital outlays will be more or less the same. This policy will tend to minimize the risks of the company. Equally, under such conditions the ... pay-out time, the less ... profit ...

One may conclude, therefore, that under specific conditions, the pay-out time method ... may be ... order of preference ... reliable results ... make and if no ... can be ... is to give an indication ...

This leads ... the most serious shortcoming of the method in that the pay-out time ... limited only ... whole project ... figure ... cash income, realized after the pay-out point ... is, in particular, at the point ... the cumulative ... total cash income ... project ... profitability ... the ... project ... how ... this is what ... to ... It may be ... the ... is not ... different ... which ...

... the ...

This method ... to ... method. Company ... reports in ... are shown ... method ... particular project ... project ... the ... results ... and ... when ... the ... project ... Furthermore, the ... project ... will ...

... which takes ... is applied ... both ... for projects ... these assets

decreases from year to year because of depreciation, whilst usually the book profit increases after the early years when the plant gets more fully loaded, the series of return figures obtained shows a tendency to increase. The method certainly has its merits. It takes into account the whole lifetime of the plant and, by superimposing the project on a forecast of the existing business of the company, a picture can be obtained of the company's book profit and balance sheets with and without the project. This may be of interest particularly in cases where the project is of large size as compared to the existing business of the company concerned. Although the project in itself may be sufficiently attractive to improve the overall company during a number of years in such a way that it nevertheless may be felt to be objectionable.

As an indication of the profitability of the employed capital and, therefore, as a tool for screening, this method certainly can be very useful. However, the usefulness of the method as a tool for ranking has to be considered. To this end a graphical presentation of the annual book returns and the average cumulative book returns is given in Appendix VII.

It can be seen that both the series of annual returns and those of the average cumulative returns show an identical picture. Initially, B appears the better of the two alternatives as less capital has to be spent. However, during a number of interim years the order of preference seems to be reversed, whereas over the entire period, B again appears to be a better proposition. The choice between the alternatives A and B is difficult to make. The reason is that it depends on the time period we consider which alternative we would prefer. If one regards initial earnings to be of more importance than later ones, one would certainly make the choice in favour of A. In case would like to stress the earnings at full capacity reached at a later stage, one would prefer to take the whole life of the plant into consideration, alternative B would be the most attractive. However, this aspect of timing is not adequately taken into account by the method. This can easily be seen from the following example. Projects X and Y have identical average net employed capital over the period considered. Net income, however, although in total the same, differs as to the periods in which it is earned.

Years	1	2	3	4	5
Project X					
Average net capital employed	450	350	250	150	50
Net income	-	50	100	150	200
Book Return per annum	-	14 3/7%	40%	100%	400%
Average cumulative book return	-	6.5%	14 3/7%	25%	40%
Project Y					
Average net capital employed	450	350	250	150	50
Net income	200	150	100	50	-
Book Return per annum	44 4/9%	42 5/7%	40%	33 1/3%	-
Average cumulative	44 4/9%	43 3/7%	42 1/7%	41 2/3%	40%

The average cumulative rate of return measured over the whole lifetime of both projects is equal to 40%, indicating that, although individual annual results differ considerably, both proposals in the long run are equally attractive. Nevertheless, a company would prefer project X because of its faster earnings potential.

This financial statements method fails to take into consideration the so-called 'time value of money'. The entrepreneur is not indifferent to the fact whether he receives £ 10 a year earlier or later. He will always show a preference for the earlier when it relates to a receipt of cash and for the latter when an outlay of money is under discussion. The reason for this is the opportunity to re-invest money and to realise extra income which otherwise would be foregone.

If we introduce the 'time value of money'-concept it will be clear that the financial statements method has another weak point. It is not only net earnings which are generated by a project but depreciation was well. In other words, the cash flow which comprises net income plus depreciation is the real basis to be considered if one introduces the opportunity to re-invest money

It may be concluded, therefore, that a method in order to be a sound device for both screening and ranking, should meet two requirements :

- it should take account of the cash flows during the full economic life of a project,
- it should take account of the 'time value of money"

It will be seen in the following that the discounted cash flow method meets both these requirements

The discounted cash flow method

This method is chosen as the very concept of the time value of money a few simple examples will assist in demonstrating, how this concept can be applied in profitability studies

Assume that for a given company each additional pound (£) tied-up in the business should yield a profitability of 10% per year One may then conclude that £ 1 received or spent today will be equivalent to £ 1.10 one year from now or to £ 1.21 two years from now etc Similarly, the £ 1 received or spent today would have been equivalent to £ 0.9 1 one year before or to £ 0.83 two years earlier etc

It will be clear that the application of this principle makes it possible to express in monetary terms the distance in time, which separates any element in the cash flow, associated with a project, from any other cash flow element In the case of a number of cash flow figures this is conveniently done by reducing all cash flows to a chosen key date by multiplying with the appropriate discount factor The summation of these reduced cash flow elements is usually termed the present value or present day value of the cash flow per that date

Two examples may elucidate this way of approach :

a) A company has to solve a transport problem It can either buy its own road tanker or it can contract out to a transportation firm In the first alternative, it will have to invest in a road tanker, which is assumed to have a three year life It is also known that the company can achieve an 8% minimum return on its investments An analysis of the two alternatives shows the following annual cost comparison:

	Operating cash inflows	Connection cash outflows	Discount factor for 8 per annum
1970	£ 10,000	-	1.000
1971	7,000	£ 7,000	.926
1972	9,000	7,000	.857
1973	9,000	7,000	.794

The annual cash-flows are now discounted at 1st January, 1970, using the discount factors listed above, and the following present values are obtained :

£ 17,150	£ 16,542

The company might decide to accept the contractor's bid. It will be seen that the problem solved here is a ranking problem.

c) The same company has a plant on a different site on one of its plants, which still works as a viable component after recovery this could be installed on the present site on an additional column would have to be added, costing £ 10,000. The lifetime will be 4 years and annual maintenance costs and the effect of inflation the following would be £ 1,500 each year The cash flow picture, when including the column, would be as follows:

1970	investment	£ (10,000)
1971/74	annual saving	£ 1,500

Present value of future cash flows:

PV at 8% per annum equals £ (3,737) and PV equals zero per annum at a discount rate of 3%

The company decided to reject the proposal and not to recover the material from the waste stream. The problem tackled in this case was a screening problem.
Conversely, for a given set of cash flows, associated with a new project, a discount rate could be found for which the present value of the project would amount to zero. In other words, the present value of the cash outflows - in the early years - will be equal to the present value of the cash inflows - usually in the later years - after discounting at that rate.
The discount rate under these circumstances is called the internal rate of return of the project.

Quite generally, therefore, the essence of the discounted cash flow method can be expressed as follows :

$$\sum_{n} \frac{(\text{cash in-flow}) \text{ year } n}{(1+i)^n} - \sum_{n} \frac{(\text{cash out-flow}) \text{ year } n}{(1+i)^n}$$

When equated to zero and solved for i, the earning power of a project will result, which provides a yardstick for screening purposes

The numerical value obtained for the polynomial for a given value of i, represents the present value of the cash flow in question for a discount rate of i The present values are useful for ranking purposes

The above considerations will now be applied to the projects A and B, already cited in the foregoing. It will be assumed that the cut-off point for profitability has been set for the company at an earning power of 8%

The following table recapitulates the cash flows for both projects (see Annexes II and III) :

Year	1	2	3	4	5	6	7
Cash flow, project A	(200)	(215)	25	155	195	205	205
Cash flow, project B	(50)	(75)	5	25	40	60	82

Upon calculating the earning powers, it is found that :

earning power, project A equals 11.5%
project B equals 13.0%

The conclusion to be drawn from these results is simply that both projects A and B meet the minimum standard of an earning power of 8%. It follows that both projects are worthy to be carried out, although B appears to be better than A. Since, however, as was assumed from the beginning, the proposals are mutually exclusive the choice becomes more complicated

Calculation of the present values for a discount rate of 8% reveals the following :

8% present Value for Project A $ 35,000
8% present Value for project B 25,000

It is evident, that a positive present value means that the earning power of the proposal is higher than the cut-off rate The present values obtained confirm, therefore, that both projects A and B meet the minimum requirements However, the ranking order has been reversed On the basis of present values project A appears to be preferred over B, whereas according to the earning power outcomes project B looked to be the most attractive proposition The optimum choice is still not clear

It will be understandable, however, that the ranking choice should not be based on the individual earning power outcomes, because the capitals involved are different If one faces the choice between earning 15 % on a small investment of £ 125,000 or 11 % on a higher capital of £ 515,000 it may very well be that the last proposition is the more attractive This will be true, if the incremental investment of £ 390,000 will generate enough incremental cash to justify the extra expenditure Therefore, an incremental cash flow should be calculated and the earning power for this cash flow determined

Incremental cash flow of project A over project B

Year	1	2	3	4	5	6	7
Cashflow A - B	(150)	(240)	16	150	155	145	123

The earning power associated with this cash flow is calculated to be 10.5% The conclusion to be drawn is that indeed, proposal A, although having a somewhat lower EP than B, is the most attractive proposal since the additional capital to be spent still shows a profitability which is above the minimum required level It will be noted that this result is in line with the present value results which already indicated project A to be the most attractive in spite of its higher expenditure

This method can be universally applied to any type of cash flow, associated with an investment proposal in industry In particular, the DCF method can deal with ease and elegance with the common problem of successive investments in a business, whether in the case of step-wise expansion or for instance, by integrating backwards into base material production at a certain stage The DCF method may rightly be termed a powerful tool in the solution of economic problems encountered in industry

4. A worked out case study

To show the DCF method in its practical application, a fully worked out example for the profitability assessment of an imaginary building project is shown in Appendices VIII-1 to VIII-5. It should be noted that the levels of costs and prices, used in this example, are not necessarily applicable under present conditions. This is however, irrelevant for the present purpose. The appendices show in some detail the data which have to be considered, the type of calculations to be performed to arrive at the cash flow figures associated with the project. The following elements are worked out in the appendices :

sales forecasts and production programming, having regard to the build-up of sales in the initial years of production,

selling prices, marketing costs and payments to plant,

the estimated capital cost of the production plant,

the manufacturing costs payable,

the overall capital requirements of the project,

the calculation of the tax, payable by the company and

finally, the resulting cash flow.

The parameters characterising the project can now be calculated and are found to be as follows:

DCF internal rate of return	10.6%
Discounted present value	£ 1,275,000
Capital employed present value	£ 900,000
Pay-back time	8.6 years

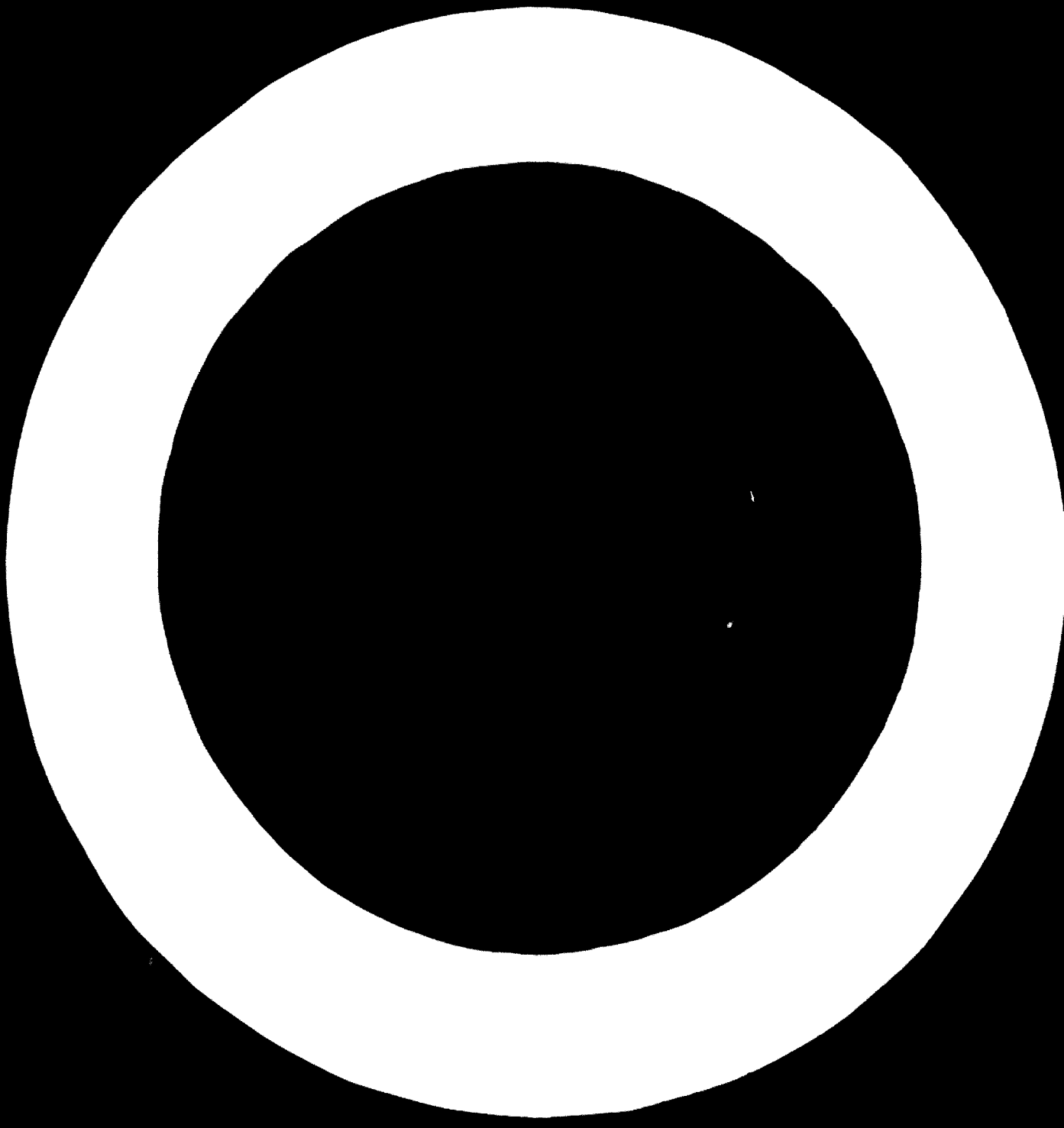
In the table appended as No. IX, the cash flows generated by the project, both annually and on a cumulative basis, are shown graphically.

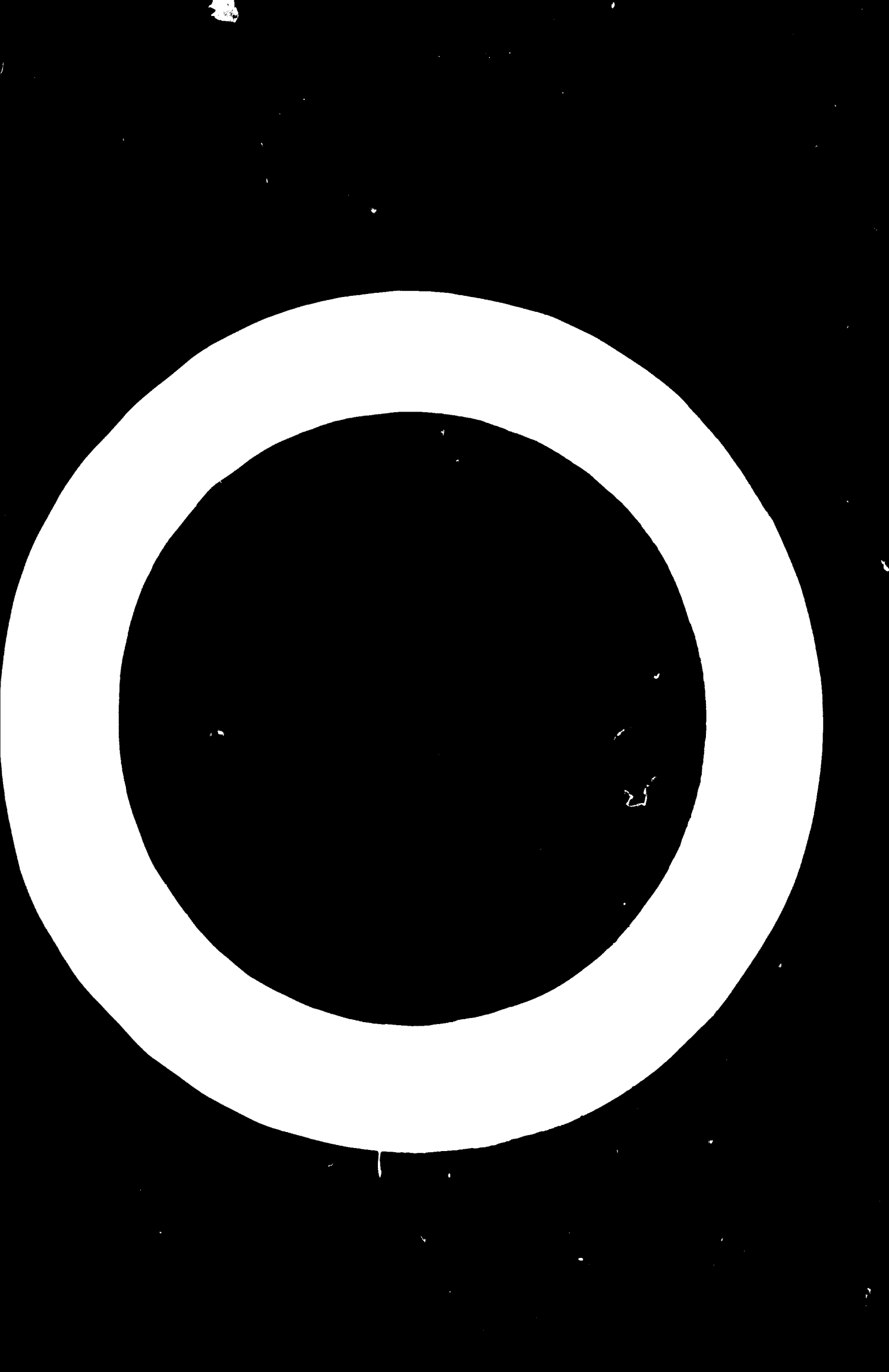
Graphs of this nature enable an appraisal to be made of the finance required for a project before it reaches the productive stage, when it starts to contribute to the company's finances.

IV UNCERTAINTY AND RISK

Especially for new products or processes the uncertainties and, consequently, risks will be considerable. Market research, process development departments will have given their best opinions, pilot plants may have performed well and [illegible] marketing may have proved a good [illegible] concept.

Nevertheless, a great many uncertainties and risks will still exist. Difficulties may be encountered during the construction of the plant, leading to higher capital expenditure or a delay in completion of the construction work itself. The operating efficiency, particularly in initial operation, may be disappointing and lower yields on basic materials may be achieved, leading to higher than estimated manufacturing costs. A competitive product may appear on the scene, resulting in slower than anticipated market build-up or lower ceiling prices for the product from the new plant. Therefore, as corollaries to the main financial calculation, the sensitivity of the project to a number of adverse factors, which may or may not occur, should be determined. An analysis of these risks and sensitivities, showing their impact on the project's attractiveness, should complete the evaluation of new projects. This sensitivity analysis adds more dimensions to the evaluation and will assist towards a balanced appraisal of new investment proposals.





Project b

Calculation of the Book-Return

Year	1	2	3	4	5	6	7
Fixed assets	50	125	125	125	125	125	125
Depreciation	-	-	25	50	75	100	125
Book value	50	125	100	75	50	25	0
Average book value	25	87	112	87	62	37	12
Working capital	-	-	25	30	30	30	30
Average working capital	-	-	15	28	30	30	30
Average capital employed	25	87	127	115	92	67	42
Net income	-	-	5	5	15	35	57
Net return per annum	-	-	4.0%	4.3%	16.1%	51.5%	132.1%
Average cumulative net return			2.4%	3.5%	5.6%	11.6%	20.9%

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Appendix V

Project A — Calculation of the Book-return

Year	1	2	3	4	5	6	7
Fixed assets	200	500	500	500	500	500	500
Depreciation	-	-	100	200	300	400	500
Book value	200	500	400	300	200	100	0
Average book value	100	350	450	350	250	150	50
Debtors	-	-	67	90	100	100	100
Stock	-	-	60	66	66	66	66
Creditors	-	-	(11.5)	(14)	(14)	(14)	(14)
Working capital	-	-	115.5	142	152	152	152
Average working capital	-	-	58	129	147	152	152
Average capital employed	100	350	508	479	397	302	202
Net income	-	(15)	38.5	81.5	105	105	105
Book return per annum	-	(4.3%)	7.6%	17.0%	26.5%	34.8%	52.0%
Average cumulative		(4.3%)	1.5%	7.3%	11.5%	14.8%	18.0%

Polyster resin project

Production Programme (metric tons)

Year	Sales Forecast		Production for Stock		Total Production
	Home	Export	Home Market	Export Liftings	
3	1,500	4,000	200	600	6,300
4	2,000	4,800	60	140	7,000
5	2,500	5,000	60	140	8,300
6	2,800	6,500	120	140	9,560
7	3,000	7,000			10,000
8	3,200	6,800			10,000
9	3,400	6,600			10,000
10	3,500	6,500			10,000
11	3,500	6,500			10,000
12	3,500	6,500			10,000
			440	1,100	

all figures in Fl/m.t.

Polystyrene Project

Polystyrene Unit

Capacity: 10,000 t/a (tower process)

Estimated Capital Cost

	N.Fl.
Heat transfer equipment (6 exchangers)	25,000
13 vessels	130,000
4 reactors	300,000
1 furnace	15,000
1 conveyor	5,000
1 extruder and related equipment	200,000
25 pumps, blowers and drives	100,000
Plant and equipment for blending, colouring, etc.	1,000,000
Total plant and equipment	1,775,000 (a)
Instrumentation	250,000
Piping, electrical and miscellaneous materials:	700,000
Total materials	2,725,000 (b)
Freight, duty, purchasing and related charges	300,000
Erection	1,000,000 (c)
Design	500,000 (d)
Process building	525,000
Contingency	400,000
Total estimated erected cost	6,400,000 (e)

Notes:

1. Total erected cost (e) is 3.6 times the estimated value of plant and equipment (a).
2. Total materials (b) is some 1.5 times total (a).
3. Erection (c) is approximately 35% of the total of materials (b).
4. Design (d) is some 18% of the total value of materials (b).

[illegible]

[illegible] Ethylene, crystal [illegible]

[illegible] 30,000 t/a

	Unit	dfl./t	fl./unit	fl./year	fl./ton
Raw material					
[illegible] ethylene	t	1.00	820.0	8,200,000	820.0
Auxiliaries					
Chemicals and catalysts					
[illegible]	kg	4.0	2.40		
[illegible]	kg	0.01	5.0		
[illegible]	kg	1.04	6.0	60,000	8.0
[illegible]					
Utilities					
Steam 4 b.	t	1.0	7.17		
Electricity	10^3 kWh	0.50	50.81		
Cooling water	10^3 t	0.045	11.56		
Air	t	0.065	9.42		
Fuel gas	t	0.08	45.0		
Nitrogen	m^3	1.0	0.15	410,000	41.0
Total variable				8,670,000	869.0
Operating [illegible] men at fl. 15,000/yr.				210,000	
Maintenance - 4% of process capital				480,000	
Overhead (incl. [illegible] charge) 110%				514,000	
Total fixed				900,000	90.0
Total undepreciated manufacturing costs				10,560,000	1,056.0

Polystyrene [illegible]

Capital requirements

1. Process [illegible]		fl. 6,400,000
2. Plant & [illegible]		
Steel [illegible] 200 tons x fl. 3500/t	fl.	525,000
Chem. [illegible] - 2 months		13,000
[illegible] 2.5% of process cost		160,000
Cash - 4% of annual [illegible]		2[illegible]
	fl.	[illegible]
3. [illegible]		
Cost of [illegible] - [illegible] x fl. 3,500/man	fl	51,000
Other [illegible] costs, 1st year - 1% of process capital		64,000
Loss of [illegible] - 5% of first year		256,000
Consumption of [illegible] - 10% of first [illegible]		2[illegible]
	fl.	413,000
4. Royalties		
An [illegible] amount will have to be made of fl 200,000 - 100% of which will be creditable against [illegible] royalty of 1.0 % to. Total amount to be paid fl 500,000.		
5. Working Capital		
Stocks : About 2 months stock [illegible] at depreciated cost	fl.	1,700,000
Debtors : 6 weeks	fl.	1,570,000
6. Total	fl.	10,[illegible]

Polystyrene Project

Tax Calculation

(Million Guilders)

	1	2	3	4	5	6	7	8	9	10	11
Cash before tax	-	(0,04)	(0,04)	1,22	1,57	2,40	2,10	1,90	1,87	2,07	2,07
Book value tearable						0,22	0,22				
Depreciable base											
Taxable profit		(0,04)	(0,04)								
Tax payable 50%		-	(0,02)	(0,02)	(0,79)	(1,07)	(1,24)	(1,11)	(0,93)	(1,03)	(1,03)
Cash after tax		(0,05)	(0,05)	(0,04)	0,44	1,11	1,09	1,00	1,75	1,72	1,72

Polystyrene [illegible]

Cashflow [illegible]

Sales tonnage			[illegible]	[illegible]	[illegible]
Volume [illegible]			[illegible]	[illegible]	[illegible]
Volume of production			[illegible]	[illegible]	[illegible]
Net sales			[illegible]	[illegible]	[illegible]
Pre-commencement expenses		(6.65)	(1.34)		
Running revenue				(0.3)	(0.[illegible])
Variable costs			(5.[illegible])	(1.[illegible])	(1.[illegible])
Fixed costs			(0.[illegible])	(0.[illegible])	(0.[illegible])
Cash before tax		(6.65)	(1.00)	1.21	1.[illegible]
Stock value increase			[illegible]	[illegible]	[illegible]
Depreciation 10%			(0.[illegible])	(0.[illegible])	(0.[illegible])
Taxable income		(6.65)	[illegible]	[illegible]	1.[illegible]
Tax 50%		-	(0.13)	(0.[illegible])	(0.[illegible])
Cash after tax		(6.65)	(0.13)	[illegible]	[illegible]
Fixed investment	(1.92)	(3.[illegible])	(0.[illegible])		
Plant working capital			(1.[illegible])		
Royalty down payment			(0.2)		
Debtors			(0.01)	(0.23)	(1.21)
Cash flow	(1.92)	(3.89)	(2.[illegible])	[illegible]	[illegible]
Cash flow cumulative	(1.92)	(5.81)	(7.[illegible])	(7.19)	([illegible])

Pay-out time [illegible] years (including [illegible] building time)

Earning power [illegible]%

Present value £ 1,135,00[illegible]

10% present value £ 300,000

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	—						
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]							
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[illegible]							[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	2.32	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
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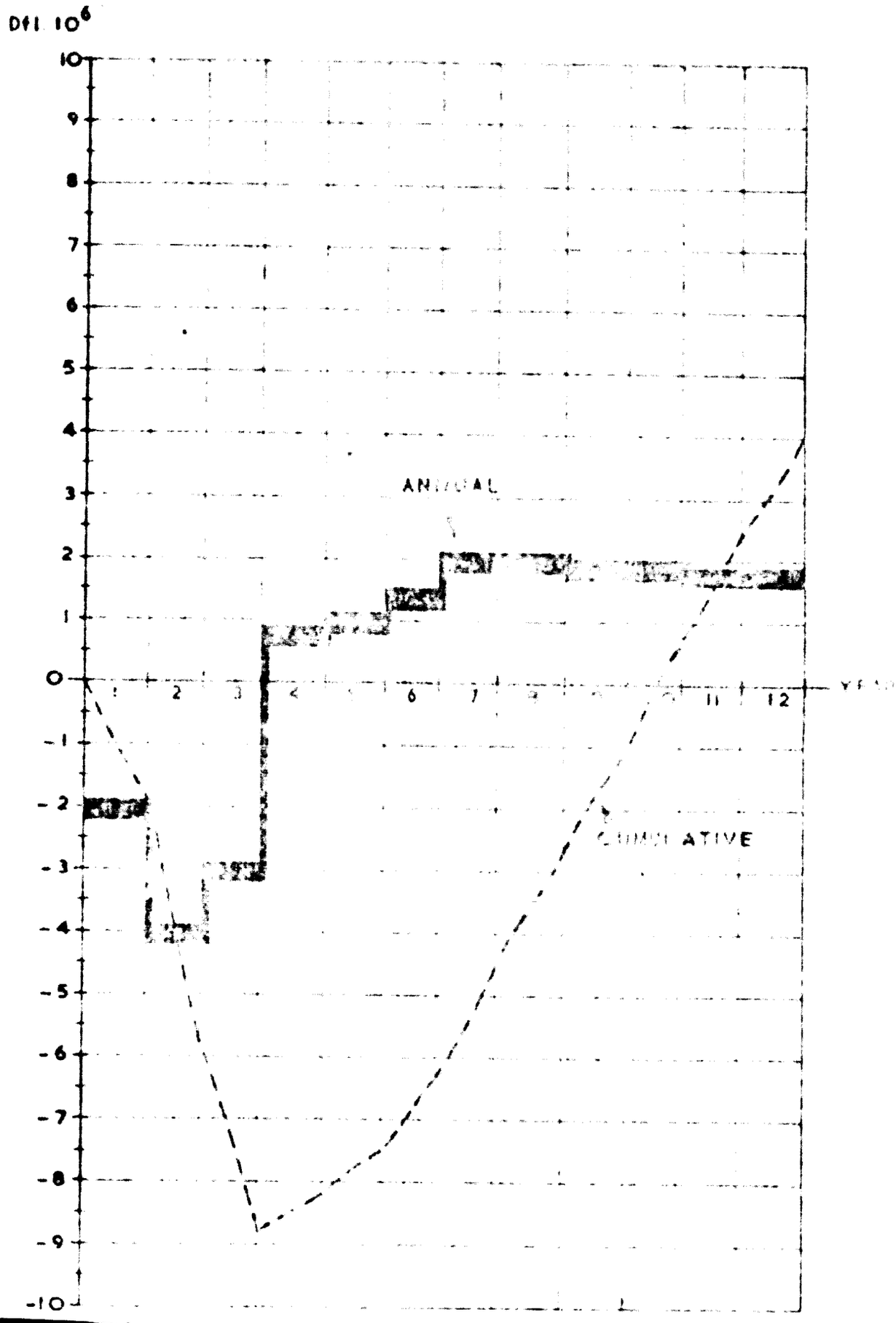
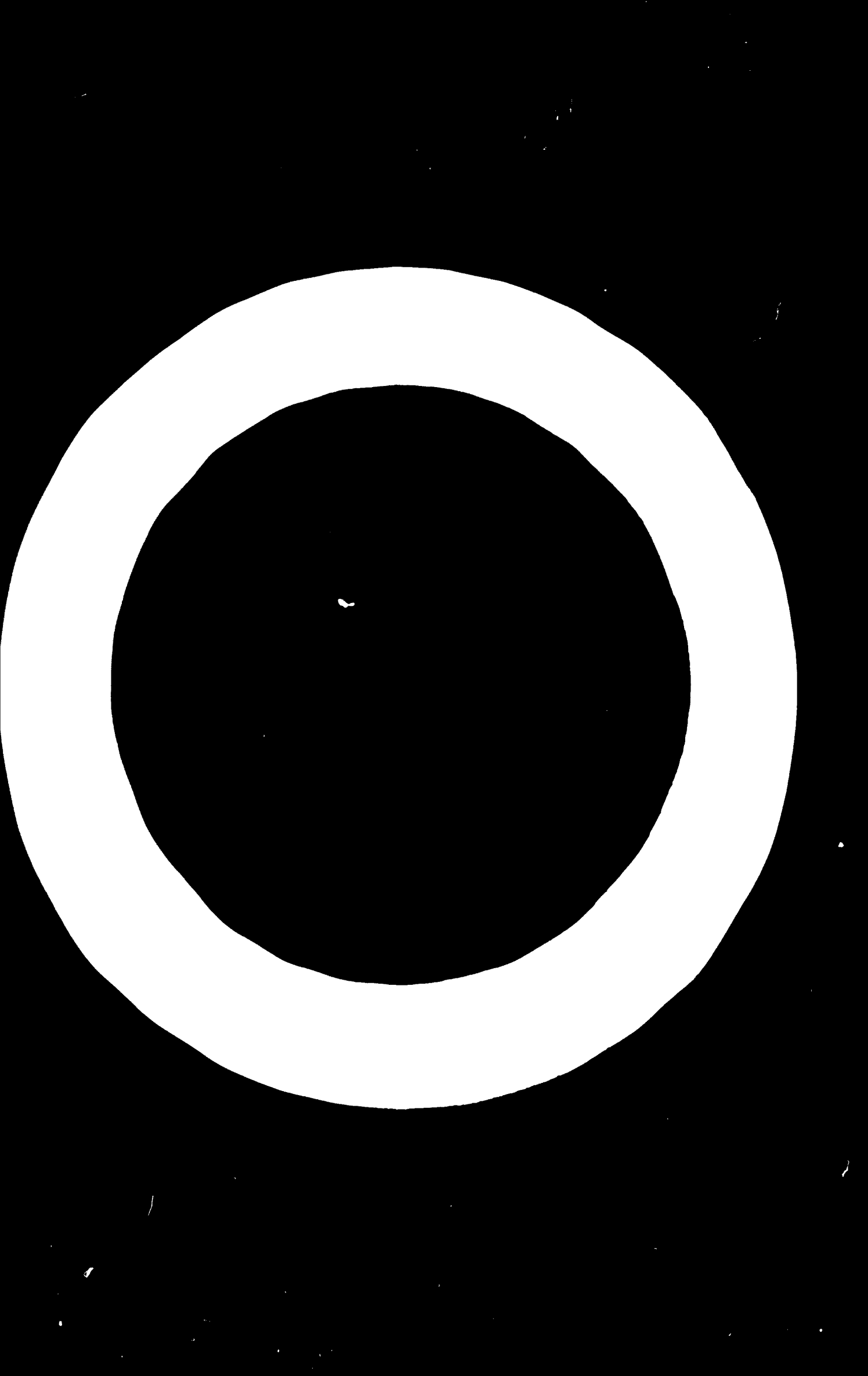
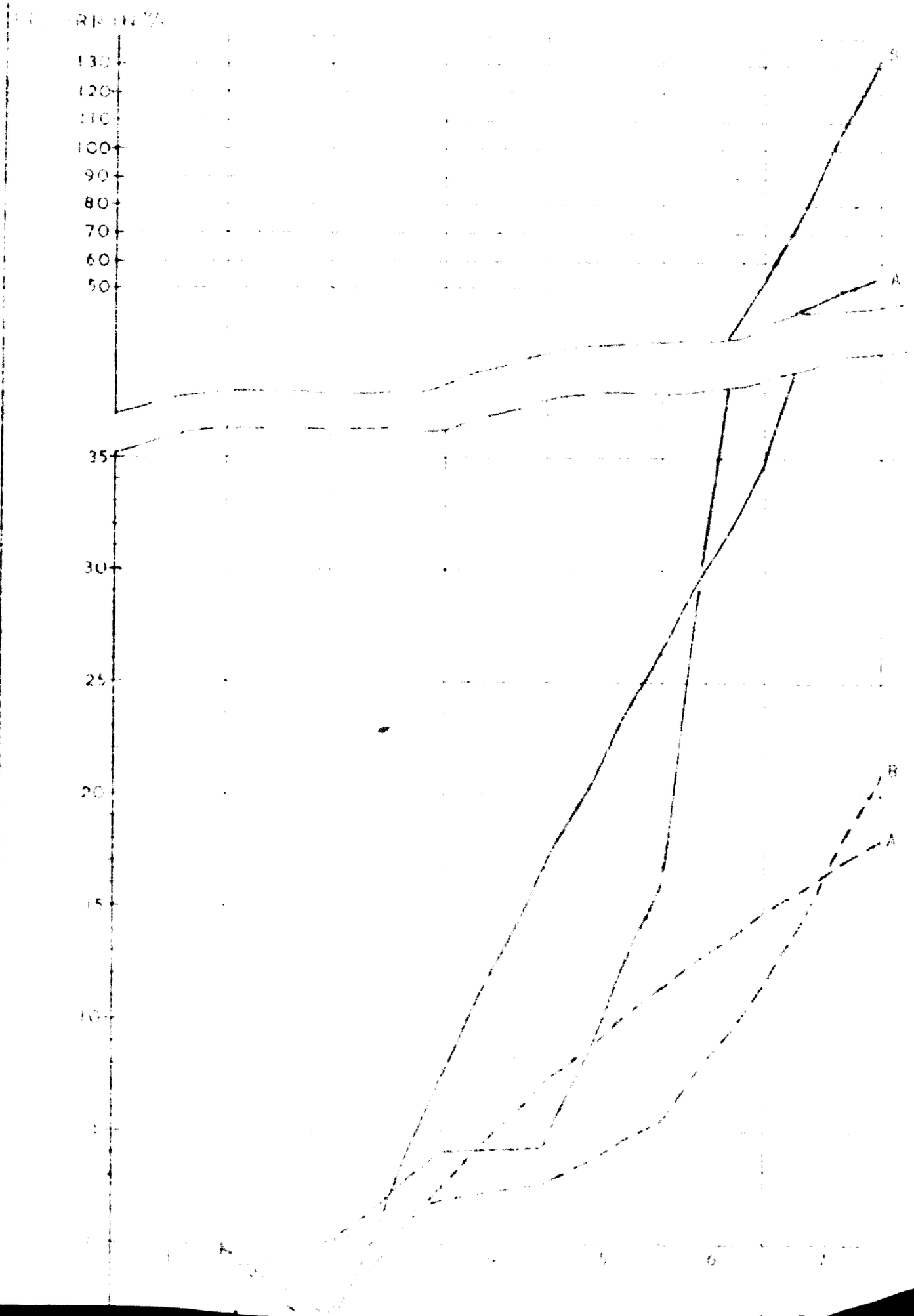
							[illegible]
							[illegible]
[illegible]	(0.11)	[illegible]	[illegible]	—	[illegible]	—	[illegible]
1.21	1.79	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

POLYSTYRENE PROJECT, ANNUAL AND CUMULATIVE CASHFLOW

PV surplus at 8 % fl. [illegible] pay-back time 8 years
PV surplus at 10 % fl. [illegible] earning power 10.6 year



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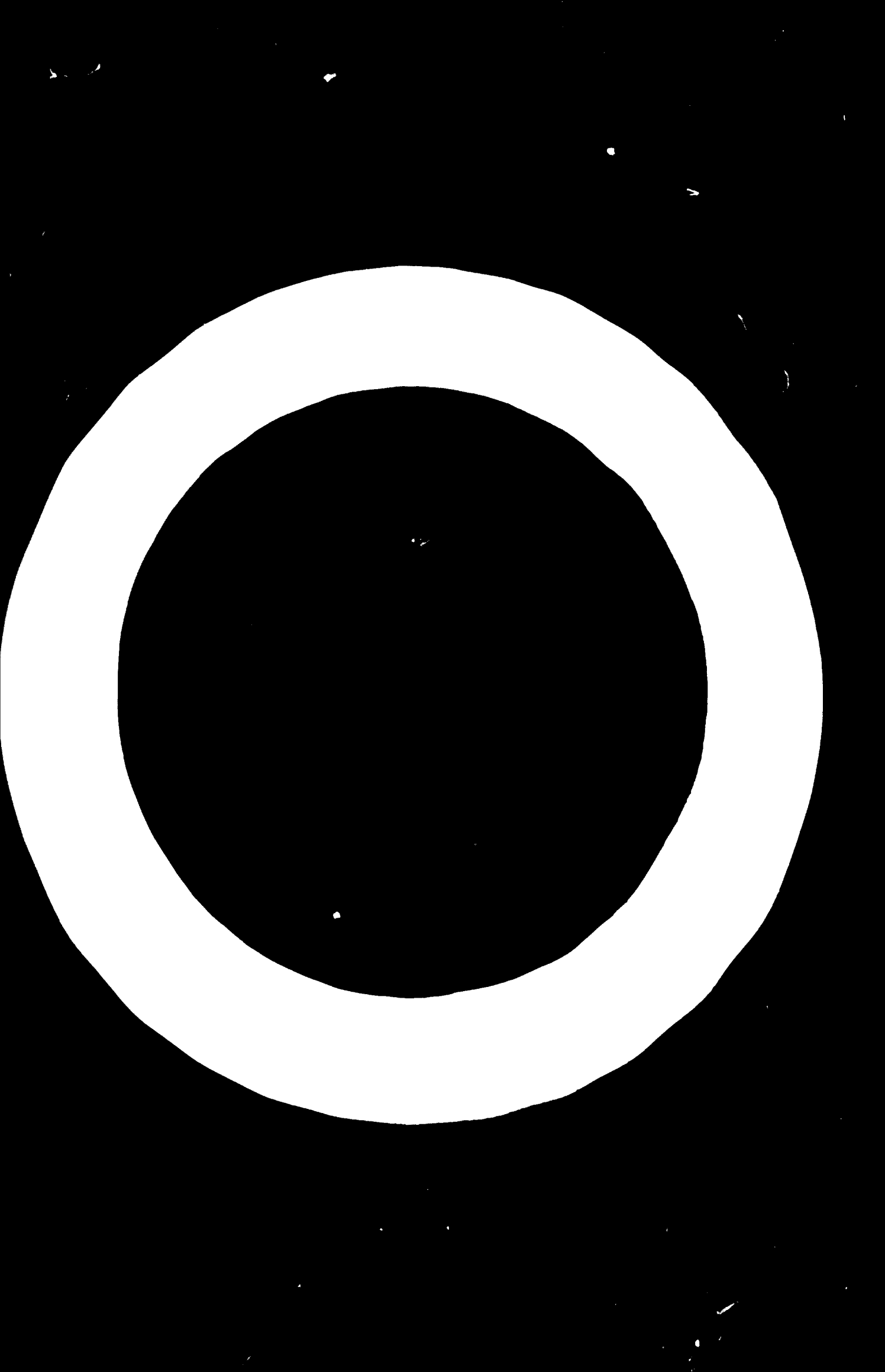
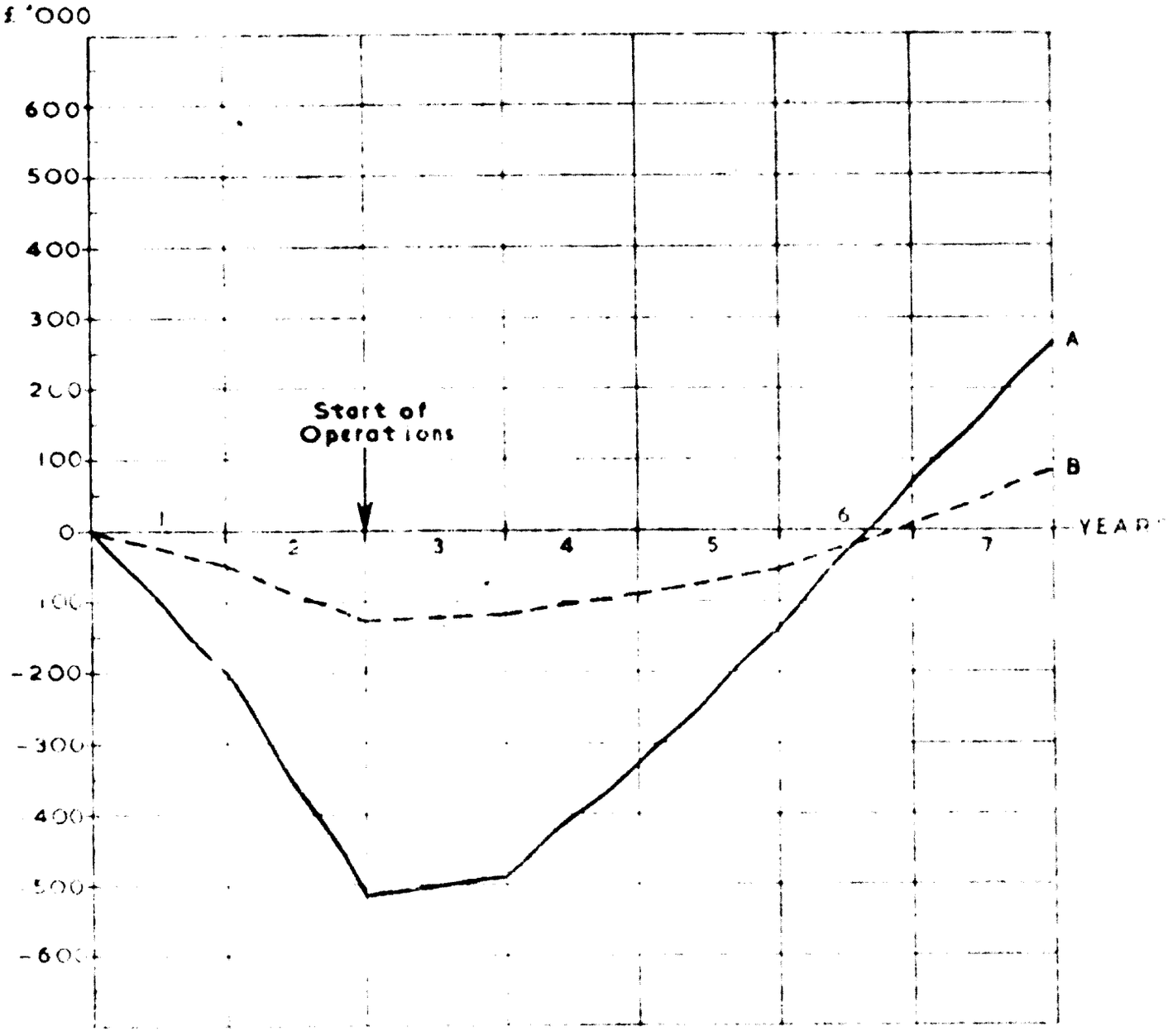
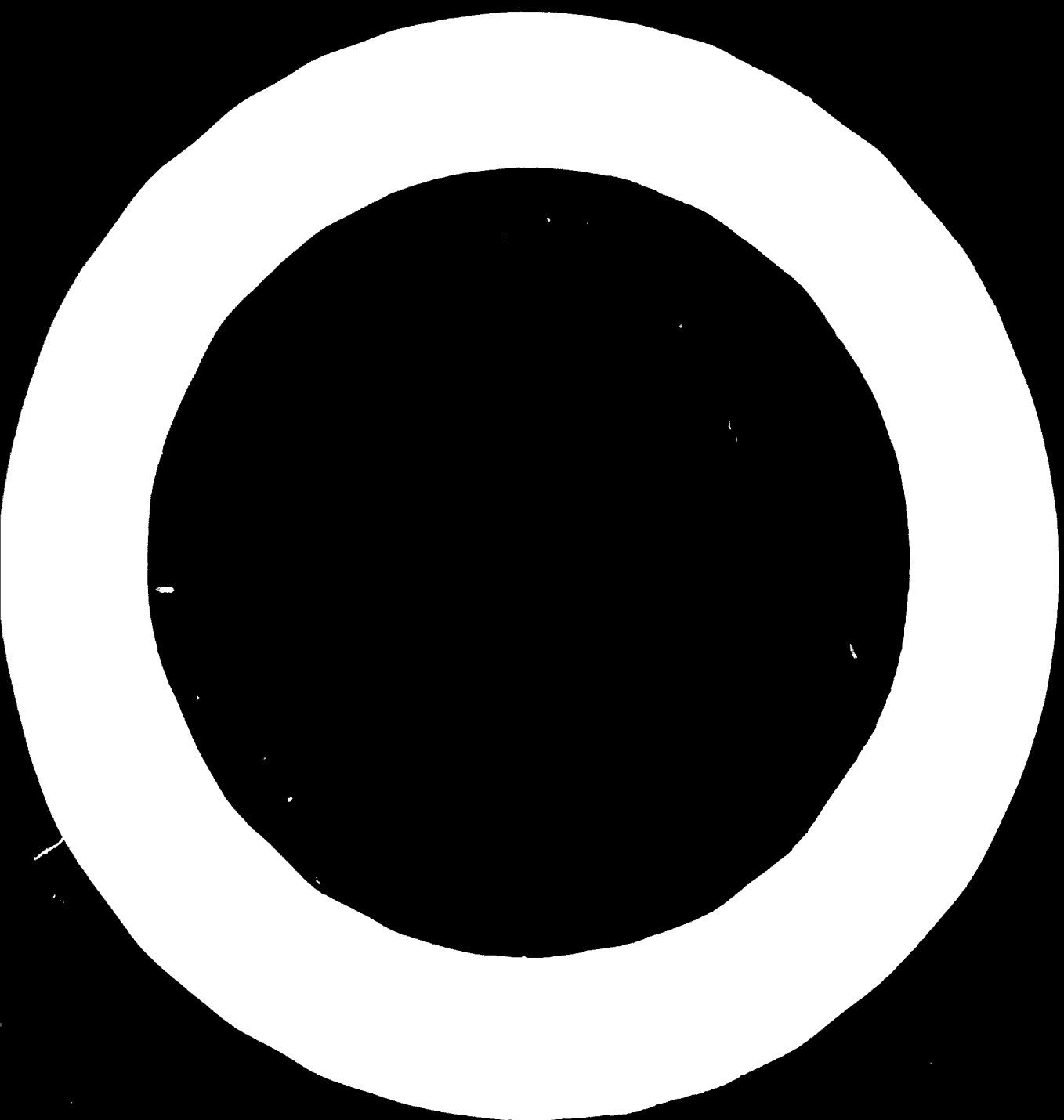


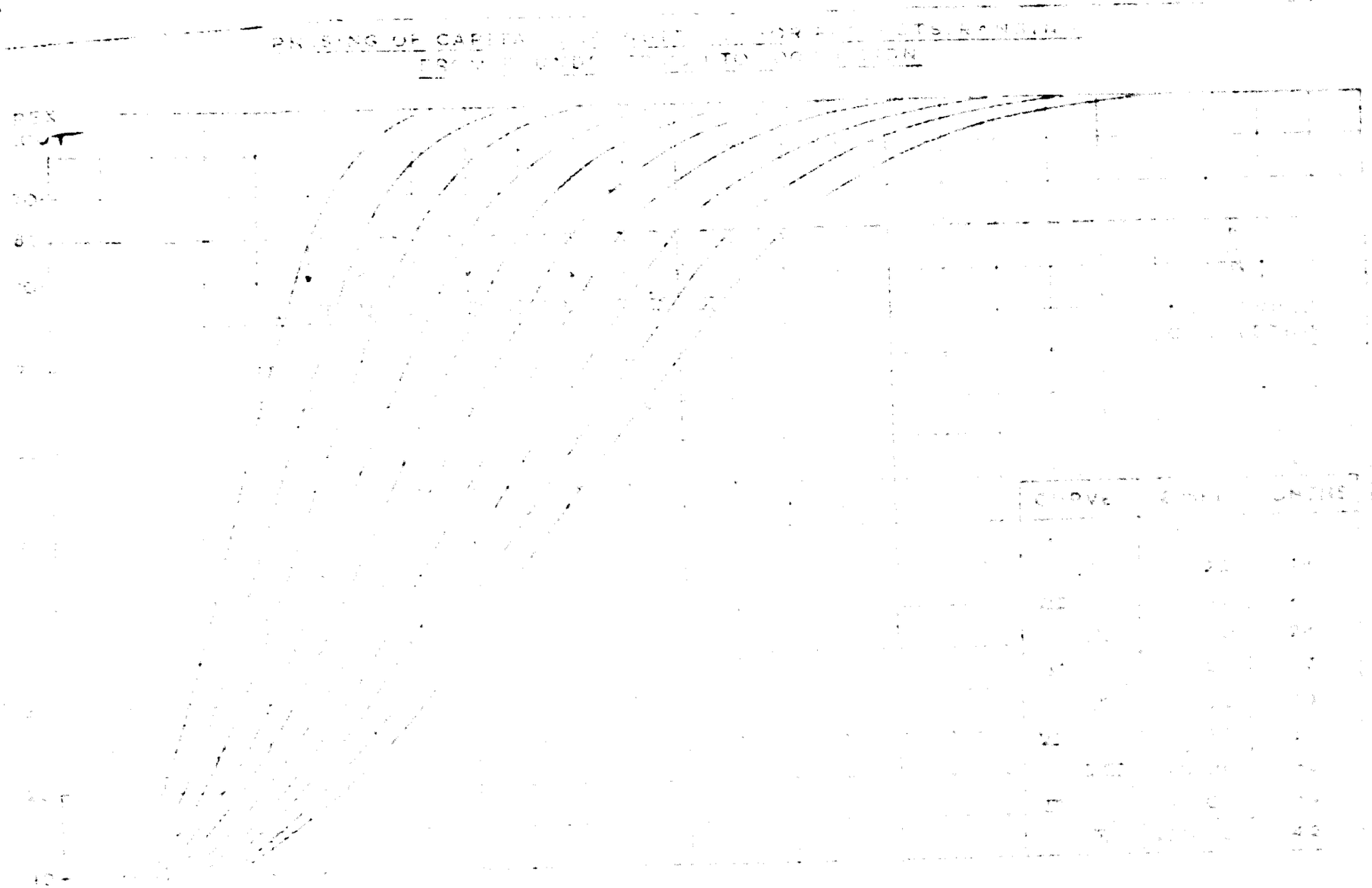
PAY-OUT TIMES OF PROJECTS A AND B

——— Cumulative cashflow of project A

— — — Cumulative cashflow of project B







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