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United Nations Industrial Development Organization

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ORIGINAL: ENGLISH

[illegible] EVALUATION OF FEASIBILITY STUDIES[1]

by

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India

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S U M M A R Y

1. The crucial importance of feasibility studies in the process of decision making on projects is now widely recognized in the developing countries. The selection of industrial projects is a long and sequential search process and the feasibility studies form a vital link in the chain of investigations leading to the final decision.

2. A possible sequence for the choice of a steel project could be as follows. First, a preliminary project formulation is carried out listing a number of alternative areas where the steel industry could be located. The second step consists of a detailed consideration of the selected alternatives. The next step is to carry out economic and financial analyses to the alternatives for which the cost estimates have been prepared. The decision whether investment in the project should be undertaken or not is made at this step.

3. Developing countries are not always equipped or experienced to evaluate the thoroughness or relevance of feasibility studies. The paper indicates some of the criteria that must be taken into account while evaluating a feasibility study and is based on the experience of the developing countries.

4. The use of social cost-benefit analysis involves an extension of the concept of profitability to national objectives and values. There are three basic steps in arriving at the social profitability of the project. First, a statement of the set of different objectives. Secondly, social measures of the

values of the inputs and outputs of the project or the social and shadow prices. Thirdly, a decision criterion to reduce the stream of social cost and benefit flows to an index, the value of which may be used to select or reject the project or rank it relatively to some other project.

5. In the conditions obtaining in a developing country, a closer look at the feasibility study might well help in reducing much more serious delays as well as infructuous expenditure at later stages. This has a number of implications with regard to design considerations, demand analyses, and management. It would be desirable while evaluating projects to carry out risk analysis and managerial factors.

6. In the evaluation of feasibility studies, normally a number of hidden inputs and outputs arising out of externalities is left outside the periphery of financial analysis. Although many of the externalities are difficult to quantify, qualitative appraisal of skill formation, direct and indirect employment generation, inter-industrial linkages, effects of import substitution etc. has to be carried out.

7. The case study cited in the paper is based on a feasibility report prepared in 1970 for the installation of a medium-sized integrated iron and steel project in a developing country. Though the commercial profitability analysis indicated that the project was viable, it was considered desirable to carry out a social cost-benefit analysis, in view of the magnitude of the investment involved and the importance of the project to the national economy. The discounted social cost-benefits yielded a ratio of 1:2.6. The rate of return calculated on the basis of net social costs and benefits worked out to about 15 per cent as compared to the commercial rate of return of about 7 per cent.

8. To sum up, in the evaluation of feasibility studies, the conventional techno-economic analysis should be duly weighed with other evaluation criteria such as social profitability, regional and national considerations, and aggregate beneficial impact of the project on the overall economy.

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1. [illegible] in the [illegible] maximum alloca- [illegible] responsibility for the [illegible] capital resources, [illegible] technical and [illegible] provided by [illegible] as the [illegible] projects, [illegible] steel. In [illegible] facilitated by the [illegible] Nations Industrial [illegible] agencies and [illegible]

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3. [illegible] of a steel project [illegible] First, a preli- [illegible] listing a number of [illegible] manufacturing a particular [illegible] of location [illegible] study of the cost [illegible] alternative sites and delivering [illegible] cost and availability

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4. The second step [illegible] [illegible] detailed consideration of number of [illegible] [illegible] alternatives. Thus, for a particular location, [illegible] [illegible] [illegible] differences in the scale of production, the [illegible], the design of plant and equipment, the [illegible] [illegible] [illegible], the raw materials [illegible] [illegible] [illegible] [illegible] are considered. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] worked out [illegible] [illegible] capital and operating [illegible] [illegible] [illegible] on the basis of [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] carry out [illegible] [illegible] [illegible] [illegible] of the [illegible] alternatives [illegible] [illegible] [illegible] [illegible] the preparation of project [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] rate of return [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], the most viable [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] on the project is [illegible] [illegible] [illegible] [illegible]

5. Even after the project [illegible] [illegible] operation, [illegible] studies are [illegible] [illegible] through [illegible] in the design and plant [illegible], in the [illegible] [illegible] [illegible] or in the [illegible] [illegible] [illegible] [illegible] to be [illegible] with a view to improve the overall [illegible] of the project.

[illegible]

6\. [illegible] from the viewpoint [illegible] experience [illegible] countries. [illegible] financial analysis be tested further by the technique of social cost-benefit analysis.

7\. Developing countries may not always be equipped or experienced [illegible] of feasibility studies. This annex indicates some of the criteria that must be taken into account while evaluating a feasibility study and is based on the experience of the planning and development of iron and steel industry as well as the designing and construction of steel plants in India and other developing countries.

II. SOCIAL COST-BENEFIT ANALYSIS

Why social cost-benefit analysis

8\. The rationale of social cost-benefit analysis can be described as follows. Commercial profitability reflects only the financial costs and benefits of the project, which need not, in general, coincide with social costs and benefits. The latter (social costs and benefits) needs to be evaluated with respect to the set of national objectives. This argument involves a rejection of the principle that private and social interests in a market economy necessarily coincide.

[illegible] the 'real' [illegible]. This gap has to be plugged in two ways [illegible]:

i) By [illegible] and [illegible] from it. These are the indirect costs and benefits known as external economies and diseconomies, and

ii) by [illegible] which will give a true measure of social profitability.

Social profitability

10. Social profitability in any given period may be defined as the difference between social benefits and social costs in that period. A typical project involves using certain resources (inputs) to produce various goods and services (outputs). The inputs give rise to the direct costs, and the outputs yield the direct benefits. There may be also indirect costs and benefits. The costs and benefits will be typically distributed over a certain length of time. To the extent that units of benefit received or costs incurred at different points of time are viewed differently from one another on the basis of the chosen set of national objectives, the time pattern of the flow of costs and benefits is important. Further, the flows of costs and benefits over the life-time of the project must be reduced to an index or measure which may then be used to evaluate different projects.

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11. [illegible]
project planning [illegible]
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The [illegible]

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16. Again, calculations of commercial profitability are based on the market rate of interest on capital. However, the market rate is not equal to the marginal product of capital due to market imperfections, and therefore is inappropriate for computing the present value of projects. Instead, a social rate of discount would have to be used.

17. Another reason for market and social prices to diverge lies in indirect taxes as well as subsidies. For instance, if there is customs duty on imported equipment, this is a cost item to its purchaser. However, from the point of the society as a whole, it does not represent a genuine cost since it involves only transfer payments. Hence such duties should be deducted in computing social costs.

18. In many cases, input prices in developing countries are administered or regulated by the Government. However, the administered price itself has frequently little relation to social opportunity cost due to the distortion of the operation of law of supply and demand; railway rates and electricity prices offer familiar examples. For these also, shadow prices may have to be computed.

19. In most cases, the shadow prices would have to be set at the national or perhaps the regional level. However, very often no such national parameters will be readily available to the project evaluating agency. In such cases, the national government or the planning authority will have to indicate the range of values of the national parameters. The evaluation will then be made by working out different values for the index of social return, corresponding to different shadow prices, that is, by carrying out a sensitivity analysis.

Decision criteria

20. The type of choice facing the decision maker can be classified as follows.

i) **Accept-reject:** The decision maker may have to take yes or no decisions on projects considered singly. The decision rule should enable him to accept or reject each individual project.

ii) **Ranking:** If some input, such as capital, is limited in supply, it may well be that not all 'acceptable' projects can be undertaken. In this case, projects must be ranked or ordered in terms of the objective function. The decision rule for accept-reject situations cannot always be applied without modification to cover these situations.

iii) **Choosing between exclusive projects:** Projects may not be independent of each other. One form of inter-dependence exists when one project can only be undertaken to the exclusion of another project, e.g. two different ways of achieving the same objective. The projects are then 'mutually exclusive' and the decision rule must enable the decision maker to choose between the alternatives.

21. A special case of mutual exclusion exists when any given project can be undertaken now or in a later period. There is then the problem of choosing the optimal point in time to start the project. This is the problem of 'time-phasing' and, once again, the decision rule should offer guidance on this issue.

22. The decision criteria favoured in economic theory is the Net Present Value (NPV) rule. This states that the flow of social benefits and costs over the lifetime of the project should all be discounted to the present at the social rate of discount

and the project should be accepted or rejected, according to whether its NPV is positive or negative. This rule incorporates directly the principle that benefits and costs are of different value, depending on the time at which they occur. It also reflects the volume rather than simply the rate of social profit associated with a project. Its calculation depends on the given rate of discount.

23. In the presence of constraints on the resources available for investment, the problem becomes one of ranking projects in the order of preference and to select the optimal combination of projects such that the total combined cost exhausts the budget. Ranking of projects simply on the basis of NPVs does not necessarily achieve this objective.

24. Projects should then be ranked by their benefit-cost ratio, i.e. by NPV/K where K indicates investment cost at 'social' prices, at the predetermined discount rate. The decision maker starts with the project with the highest benefit cost ratio, then the next, and so on, going down the list till the budget is exhausted.

25. The present value rule can also be applied to the time-phasing problem, which is often important. The net present value of a project can sometimes be increased by delaying its start and even projects which are judged not worthwhile now can be worthwhile later on. The optimal year for starting the project will be that in which the net benefits of the project are maximised.

26. Of course, in practice the procedure is complicated by various factors. Capital costs are likely to vary with postponement and will not be known with certainty; interest rates may well vary with time; economies of scale may well be present, so that projects with large amounts of in-built capacity may well be justified if the cost of installing in-built capacity is less than the benefits that would be derived from economies

of scale when the plant works to capacity; and, most frequently, there will be political and other reasons in favour of 'early start' and so on.

Social rate of return

27. The present value rule requires the use of some predetermined social discount rate to discount future benefits and costs. An alternative rule is to calculate the discount rate which would give the project a NPV of zero and then to compare this 'solution rate' with the predetermined social discount rate. The rule for accept-reject and for ranking is to adopt any project which has an internal rate of return in excess of the predetermined social discount rate. As with the NPV rule, then, it remains essential to choose some acceptable discount rate.

28. The social rate of return approach suffers from a number of limitations. In the first place, it may not exist, or if it does, it may be non-unique; only if the net flow of benefits changes sign not more than once, is the social rate of return unique. It is tedious to calculate. It says nothing about the size of the project; one may prefer a bigger project with greater absolute benefits than a smaller one with a higher social rate of return, but lower absolute benefits. In comparing exclusive projects, it cannot be applied without further adjustment. On the other hand, it has some advantages also; for example, it is more easily acceptable to the administrators.

29. A number of other criteria are also used; for example the pay-back period. This is defined as the number of years it takes for the (undiscounted) sum of net benefits (benefits — costs) to pay back the initial outlay on the project. The smaller this period, the better is the project supposed to be, because the initial investment is recovered sooner. This criterion ignores costs and benefits beyond the recoupment period. It also fails to discount the benefit flows within the period to the present time. The rule is particularly irrelevant to projects with long gestation periods, such as steel.

30. The decision criteria mentioned may have to be modified in order to take account of risk and uncertainty. Many of the variables used to compute cost estimates or net present values are uncertain. This may be dealt with by introducing a conservative bias in the evaluation. Alternatively, the figures which appear to be most likely can be chosen. A more scientific approach would be to apply a probability analysis to obtain the probable rates of return. In practice, however, adequate data for computing such an index may not be available and approximations may have to be used instead.

Technical alternatives

31. An important problem for project evaluation is the extent to which technical alternatives can be reconsidered in evaluating projects. Much of a feasibility study consists of technical/engineering details. How far, in evaluating such a study, should these details be questioned? One view is that they should not be questioned at all. The concern of the evaluator should be to work out a cost-benefit analysis based on exactly the same technical assumptions as were made in the feasibility study itself.

32. The logic of this view is fairly clear. The feasibility study is made by people with technical expertise who are presumed to have examined the alternatives in depth. Going over the same ground once again would be both unnecessary and undesirable. However, the procedure to be adopted would depend on the circumstances of each case: the expertise with which the feasibility study was carried out, the nature of the data used, the resources of the evaluating organization, the time at its disposal etc. It is also customary to submit a draft report and discuss it with the project authorities, before it is finalised. In general, in the conditions prevailing in a developing country, it would be advisable to treat the feasibility report seriously. Even if a second look means some delay, it might well help in reducing more serious delays as well as infructuous expenditure later. This closer look at the project has, in turn, a number of implications.

(i) Design considerations

33. Firstly, there is, of course, no question of re-opening every single issue of technical and engineering design at this stage. However, some checki g up of major points of interest would be quite in order. These could include design standards for plant such as the coke ovens, blast furnace complex, steel-making units, and the rolling mills; the validity of the supporting utility schemes such as water, transportation, and power; the effective capacity of major production units; the basic production processes for the various stages of iron and steel production, and the quality, specification, and availability of raw materials, especially coal, iron ore etc.

34. Secondly, if these investigations suggest any modifications to the alternatives considered in the feasibility report, these should be seriously explored. Often, the range of alternatives is greater than is admitted in the feasibility study. Take a conventional blast furnace, for instance. In addition to the choice of an appropriate size and number of furnace, other considerations regarding the auxiliaries such as number of stoves, cast-house arrangement, type of handling facilities and burden preparation, degree of automation and technological innovations such as high top pressure, high blast temperatures etc. are involved. In steelmaking again, the choice of process (oxygen blowing from top or bottom), unit size which includes the converter capacity for oxygen processes and transformer rating for electric arc furnaces, type of refractory, method of hot-metal handling (through torpedo ladles or mixers), and casting technique (conventional ingot casting or continuous casting) need to be evaluated. On all such issues, it is important to know what the alternatives were and precisely on what basis they were rejected or even if they were considered at all.

35. The frequent neglect of such alternatives at the feasibility study level may be due to preoccupation with the basic choice of product-mix and process to the neglect of

different [illegible] facilities. This may in large be [illegible] in part to the adoption of a technical-commercial [illegible] cost-benefit approach in [illegible] the alternatives. Even if the basic design and process choices are given, slight modifications could often make large differences to the estimates of social benefit, since some inputs may be [illegible] much more valuable and others much less so than their [illegible] prices indicate.

16. Thirdly, the conscious and systematic search for alternatives is an essential part of the project planning process. The earlier this starts the better. One of the major limitations of existing procedures for project choice in developing countries is their failure to look for a large enough number of alternatives at a fairly early stage. A particular alternative is selected by the feasibility study and is identified both by planners and by the public at large, with the project as such. The choice of location, product-mix, and process tends to become frozen from this stage onwards. Social cost-benefit analysis, if it is applied at all, is applied at a much later stage when negotiations for finance have started. By that time it may be too late to reconsider alternatives seriously. The only decision is whether to go on with the project as it has been formulated or to reject it altogether. In such a procedure the real purpose of project evaluation is lost.

(ii) Demand analysis

17. The proper evaluation of a feasibility report for a steel project requires that the question of the demand for steel must be thoroughly analysed. This is so for several reasons. In the first place, steel is not a simple, homogeneous product. It comes in a wide variety of categories, shapes, and sizes. Between the categories, relatively little substitution is possible in production; for instance, the rolling and finishing facilities to be provided will vary according to the different

categories of [illegible] materials [illegible] [illegible] to India. [illegible] being produced in [illegible]. These [illegible] unbalance, [illegible] analysis of demand [illegible] rational basis for [illegible] planned.
Secondly, [illegible] demand also on other [illegible] be examined in the light of the [illegible] steel [illegible] economy as a whole. [illegible] itself any [illegible] on the price changes. It is argued that the demand for steel is [illegible], [illegible] the quantity of steel demanded does not vary [illegible] with [illegible]. The experience of developing countries [illegible] for this view, at least so far as the [illegible] consumption of steel is concerned. [illegible] transport [illegible] consumption, the total demand for steel [illegible] to changes in the relative price [illegible] in the case of certain categories of steel used in construction, prices [illegible] a significant effect on consumption. [illegible] the demand for [illegible], utiliza-tion of blast furnace slag [illegible] from steel production could also be useful.

30. The question of export demand requires separate analysis. This may [illegible] for a developing country which typically imports steel. [illegible], it is virtually certain that certain [illegible] have a long-run comparative advantage in the production of certain types of steel or steel products [illegible], [illegible] internal market is too small to sustain [illegible] steel plant, these countries

have to export. Even if a country [illegible] to import certain types of steels [illegible] period, it might well start exporting other [illegible] of steel in the near future. Special attention should be [illegible] to such possibilities in planning the [illegible] projects. This should ideally be an essential part of the [illegible] demand analysis.

39. Finally, it should be borne in mind that the construction period for a steel plant and time before it can be expected to reach the rated capacity are fairly long. Hence it is future demand that is relevant and a fairly long-run demand analysis is called for. Various methods of demand analysis, such as the time trend, simple and multiple regression and steel intensity, are being adopted for projecting future steel demand. However, in view of the detailed analysis of steel categories and products required, the end-use method may be more appropriate for developing countries.

(iii) Management

40. So far our discussion of how to evaluate a feasibility study has made no reference to management. This is because a feasibility study often contains little information about project organization and management. This state of affairs is not accidental. It reflects the prevailing misconception that industrial development is simply a matter of installing new plant and equipment in the 'right' areas. But the development of an efficient and dynamic organization to operate and manage a new plant is also important, and nowhere is it more important than in steel.

41. Steelmaking is a complex business. Managerial difficulties often lead to the actual performance of a steel plant being significantly lower than had been indicated in the feasibility report.

42. Among the ills that have beset steel mills in developing countries are the following: delays in construction; low rates of capacity utilization; inadequacy of spare parts and poor

inventory control [illegible], poor quality control, and poor maintenance of [illegible], [illegible] various degrees, [illegible] dimension, [illegible] plant [illegible] steel control. The output [illegible] above those estimated in the [illegible] study [illegible] the actual rate of return often [illegible] short [illegible].

<u>Risk analysis and managerial factors</u>

43. The rate of return on a project is not necessarily given beforehand. For a given type of plant, the performance, and hence the rate of return, may vary quite widely within a certain range. The actual rate of return is likely to depend on various factors - the most important being the nature of management. Since, in principle, it is the 'mathematical expectation' of the return from a project which gives the appropriate index of project performance under uncertainty, knowledge of managerial factors can be extremely important in evaluating feasibility studies for complex industrial plants.

44. In practice, because of the non-availability of data, risk analysis of steel projects in developing countries will not often be possible. Hence the question of analysing managerial factors in such a framework will not arise. However, such factors should not be neglected, simply because they are difficult to measure. It would be desirable, in evaluating projects, to collect and assess information on the management and organisational structure envisaged for it. Is a suitable General Manager likely to be appointed quickly? Are programmes for executive development and training being arranged? Is the proposed management structure top heavy? Is there any scheme for the devolution of authority to the middle level management? How far will the authority rest with the plant? Will the individual steel plant be given any responsibility for developing and operating its own mines and quarries? Even rough answers to such questions can help in reducing gross errors of estimation for the returns to be expected from new steelworks.

Externalities

45. [illegible] number [illegible] [illegible] economies [illegible] its [illegible] in [illegible] economies [illegible] effect [illegible] attitudes [illegible] the other hand, external [illegible] environmental pollution [illegible] steel project [illegible] which should be taken into consideration [illegible] point of view. It is [illegible] possible [illegible] many of the externalities [illegible] from the development [illegible] quantify. However, [illegible] aspects and take into [illegible] effects on the [illegible] qualitative [illegible] externalities [illegible] in the final [illegible] paragraphs [illegible] important externalities, [illegible] ii) employment generation, [illegible] import substitution and export promotion, are briefly discussed.

46. Skill formation. [illegible] viewed as an important by-product of the steel industry as it provides greater opportunity than many other industries for the formation of technical skills in a wide range of trades and disciplines. The value [illegible] the steel [illegible] does not reflect this particular contribution of the project [illegible] profitability. It is [illegible] contribution of the project to [illegible] logical development and [illegible] and technical talent. [illegible] instance, [illegible] gained and skills developed in the [illegible]

[illegible]
be [illegible] the [illegible]
services.

[illegible] [illegible] interest [illegible]
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exchange [illegible]
influences the [illegible]

decisions [illegible]. The rationale behind this is the chronic balance of payment difficulties of most developing countries, which demand vigorous import substitution and export promotion measures. As developing countries account for about three-fifths of the world's iron ore resources, they can capitalise on their resource endowment to build local steel industry as well as steel transforming industries. It has been observed that the foreign exchange expended on the building of new steel capacity is recouped in a few years, after which the net savings in foreign exchange may be very substantial. Also in view of the instability of iron ore prices it would be more advantageous to develop the domestic production of iron and steel and export them in greater quantities, instead of concentrating on exports of the raw material only.

Shadow prices

80. In computing the social return on steel projects, there are a number of items for which the use of shadow prices rather than prevailing (i.e. market or administered) prices clearly appears more appropriate. Of these, the most important are items involving foreign exchange. Consider first, the [illegible] of the output. The actual price at which steel is sold to consumers in most developing countries, is a highly artificial administered price with little [illegible] returns. On the other hand, not only is steel a major import substitute but assists other user industries in effecting import substitution. Given the decision to industrialise, the alternative to domestic production of steel is to import from abroad. Hence the landed price of imported steel (in domestic currency) gives a measure of its opportunity cost or true value. However, this may need further adjustments.

1) First, this procedure assumes that the unit price of steel imports is independent of the amount imported. This may not be entirely accurate. However, the import of steel by a given developing country would

form a tiny fraction of world imports. Hence the error in assuming the import price to be the same at all levels of output is likely to be negligible.

ii) Secondly, there has been a glut in the world steel market in recent years and prices have been comparatively low. Evidence of some amount of 'dumping' by steel exporters may also have occurred. However, the world price may rise in future. If so, the use of current world price of steel would underestimate the 'true benefits' of domestic production.

iii) Thirdly and most important, the landed price will reflect the prevailing exchange rate between the domestic currency and the currency of the country from which the steel would have been imported. Hence this price will have to be adjusted upwards to allow for a premium on foreign exchange i.e. by converting the foreign exchange cost of the potential import into the domestic currency concerned at a shadow rate.

51. On the cost side, a substantial part of the equipment and engineering services for a new steel mill in a developing country will probably be imported from abroad. Again, a number of foreign managerial and technical staff are likely to be employed at least for the running in period, probably longer. Hence the investment and operating costs for this period will have a foreign exchange component which must also be revalued.

52. In carrying out these adjustments, two types of estimation problems are involved. First, what is the appropriate shadow rate of foreign exchange? This is not a matter that can be settled by the project evaluation agency. If any shadow rates have been suggested at the national level, for example, in carrying out aggregative planning exercise, these should be used. Otherwise, a sensitivity analysis should be carried out, using different but fairly high shadow rates. Secondly, a detailed

breakdown of costs between domestic and foreign components is required for all major items. If such information is not given in the feasibility report, further investigations need to be carried out. In principle, items requiring foreign exchange 'indirectly', e.g., domestic equipment produced with foreign machinery, should also be revalued. However, such information may not easily be available and perhaps no great harm be done by omitting them.

53. Among other items of cost that may need adjustment are costs of raw materials, especially coal. These invariably account for a large part of the unit costs of steel production. However, the price of coal in many developing countries is significantly lower than the marginal cost of production. Hence a higher 'shadow price' of coal should be used to reflect social opportunity cost of resources used up. Further, if the steel plants are situated at a long distance from the coal mines, the costs of haulage can also be a significant consideration. On the other hand, railway rates charged for long distance on bulk materials have little relation with marginal costs of transportation; equalisation of delivered prices irrespective of distance travelled and other similar devices distort the picture. Appropriate adjustments are needed to correct such distortions.

54. Since steel is a capital intensive industry with a long gestation period, the returns, if the present value measure is used, will depend significantly on the rate of discount. Again, the appropriate rate of discount must be decided on a national level. The shadow wage rate is likely to be relatively less important for the steel industry. In the first place, more labour will probably be employed in any case than is justified by the market wage. Secondly, a steel project will, nevertheless, not be a very important employer of unskilled labour.

55. How large the effect of these adjustments on the rate of return on steel projects will be, will vary between countries and types of project. However, their general trend is quite clear. The valuation of steel output at import prices, corrected by the shadow rate of foreign exchange will by and large tend to increase the rate of return on domestic production. The valuation of the foreign exchange components of investment and operating costs in the same way will encourage the use of indigenous skills and equipment (for example in design and construction), wherever these are available and penalise excessive dependence on foreign resources. Shadow prices of transport will help remove the subsidy to plants located far from the coal mines which is implied by the prevailing structure of railway rates and hence will favour steel plants near the sources of raw material.

III. CASE STUDY

Social profitability of the installation of a medium-sized integrated steel plant in a developing country

56. This case study is based on a feasibility report prepared by Dasturco in 1970 for the installation of a medium-sized integrated iron and steel project in a developing country. The gross value added in manufacturing and mining as a percentage of value added in commodity production in the country was 20 in 1966 which is considered a low bench-mark for industrialization.

57. The country depends entirely on imports for its steel requirements and the imports have been rising at an average rate of 11 per cent since 1964 costing the exchequer over $ 30 million annually. This is likely to double within a decade, as the steel demand projections have indicated. At the same time, the country has some iron ore reserves, though of poor grade, petroleum coke to smelt the ore and the bulk power from a hydel project which should enable the country to produce iron by adopting a proven electro-metallurgical process for conversion to steel.

58.   This case study reviews briefly the various factors taken into consideration in the evaluation of the project - its commercial and financial aspects and social profitability. The values of the national parameters (for example shadow wage rate, social discount rate, shadow foreign exchange rate etc) adopted for the purpose of the study [illegible] indicated by the project authority.

<u>Analysis of the project</u>

59.   The steel demand study based on the end-use method, cross-checked by other statistical methods of projection, indicated that the overall steel requirements would be about 400,000 tons in 1975, and 680,000 tons in 1980. Accordingly, it was proposed that a plant capacity of about 300,000 tons/year initially and 625,000 tons/year in the next stage would be a viable size in the context of the recent technological developments. The product-mix for stage I would be 140,000 tons of billets to meet the requirements of an existing rod mill and about 150,000 tons of light structurals, bars and rods. In stage II, the product-mix would include, in addition to the 140,000 tons of billets, about 200,000 tons of structurals, bars and rods, and 235,000 tons of hot rolled strip.

<u>Use of local raw materials</u>

60.   A major objective of planning the first integrated steel plant in the country under study was to utilise to the maximum extent possible local iron ore and other raw materials. As the exploration data on local iron ore, limestone, dolomite and manganese ore were inadequate, the consultants recommended further geological prospecting on a 'crash-programme' basis to develop the deposits. However, as the preliminary tests on local iron ores indicated that they were not economically amenable to beneficiation, the consultants proposed the use of an appropriate blend with imported iron ore for initial plant operation.

61. As geological investigations did not reveal the presence of coal in the country, the possibility of utilizing petroleum coke - a by-product of the country's expanding oil industry - as reductant was considered. But desulphurisation would be necessary to reduce the high sulphur content of the petroleum coke. Accordingly, the use of imported small coke along with desulphurised petroleum coke as reductant was recommended.

Process and site selection

62. Based upon the study of raw materials, the scale of operations, the availability of hydel power and other techno-economic factors, the processes proposed were direct electric smelting for ironmaking, LD converters for steelmaking, with continuous casting and rolling mills, and various auxiliary and ancillary facilities. During stage II, by which time the local iron ore deposits would have been developed and their suitability for sponge ironmaking established, the use of pre-reduced material was envisaged.

63. Six alternative sites were investigated and a site which had the advantage of lowest freight cost of raw material assembly and product distribution was recommended. The plant layout was so developed as to ensure the rational and economic movement of materials and to provide for rapid expansion in future, taking into consideration the plant's operational requirements and other techno-economic factors.

Commercial evaluation

64. The profit and loss estimates prepared for a 30-year period of operation (which was taken as the economic life of the plant) indicated that after making full provision for depreciation and amortisation, the cumulative net profits over a period of 30 years would be about $ 408 million representing an annual average net profit of $ 13.60 million, equivalent to about 6.5 per cent yield on the total fixed capital of about $ 215 million.

65. The estimated cash flow statement showed that the total cash surplus generated during the 30 year period would be about $ [illegible] million as against the total fixed investment of about $ 215 million. The plant could be expected to break-even when operating at about [illegible] per cent of the rated capacity. The internal rate of return estimated on the basis of discounted cash flow works out to about [illegible] per cent. The total present value of net inflows discounted at 7 per cent amounted to about $ [illegible] million compared to a corresponding total outflow of $ [illegible] million. The excess present value index was 1.02 at the same discount rate. The pay back period was estimated at [illegible] years on the traditional basis and 24 years on discounted basis. The average annual foreign exchange saving was estimated at $ [illegible] million.

Social evaluation

66. Even though the commercial profitability analysis indicated that the project is viable, it was considered desirable to carry out a social benefit-cost analysis in view of the magnitude of the investment involved and the importance of the project for the national economy. The basic criterion in deciding whether the project should be approved was the extent to which the proposed project will benefit the nation as a whole. The crux of the problem was to ascertain the balance of social cost and benefits to the economy from the installation of the plant, through a social profitability analysis.

67. For this purpose, all costs of materials during the construction and operation periods were converted to international prices in order to arrive at their real cost. The benefits from the project would be reflected in the social value of the output, which was obtained by converting the output to monetary terms on the basis of international prices for importing the same level of output. Foreign exchange cost was taken as direct social cost. For all items of local plant and machinery, equipment, transportation, materials and other inputs, the

social costs were taken [illegible] international prices. In the absence of adequate data [illegible] applied to a group of [illegible] items [illegible] value [illegible].

68. The [illegible] cost [illegible] component of [illegible] and [illegible]. If the project absorbs a large portion of [illegible] labour resources, the opportunity cost of labour would be zero. On the other hand, if the project involves [illegible] of highly skilled labour from other industries to the project, the social cost would perhaps [illegible]. In this study, therefore, for skilled labour [illegible]. In the case of semi-skilled labour a [illegible] rate of 60 per cent and for unskilled labour (assumed to be [illegible] from agriculture) 60 per cent of the [illegible] wage [illegible] were adopted in consultation with the project authority.

69. In computing social costs and benefits, items such as import duties, taxes and [illegible] like profits of contractors were ignored. Most of these are only transfer payments and therefore, do not involve any loss or gain to the nation.

70. The resulting difference between the social benefits and costs represents the social profit. Once the social profit is ascertained, the procedure for discounting is the same as followed for financial analysis. The social rate of discounting is again a subjective matter involving the judgement of the policy makers. In developing countries, a rate ranging from 6 to 8 per cent may be appropriate in most cases.

A. Social costs

71. The study was based on the assumption that the plant would be located at the recommended site. The opportunity cost of the land required was considered negligible as it was mostly barren and could not be put to more economical use. For the

purpose of this study, no attempt was made to assess the social cost of the land and development expenditure, since the cost of land and site development estimated at ∯ 0.45 million constituted only a small fraction of the total cost of the project.

72. The total expenditure on planning and promotion of the project was estimated at ∯ 0.95 million, of which ∯ 0.40 million was assumed to be payable in foreign exchange and treated as tradable. The balance of ∯ 0.55 million expendable in local currency was allocated between expenses on supervisory and skilled personnel and residual expenses in the ratio of 60:40.

Building and structures

73. For the main factory buildings and structures, the total cost in stage I would amount to ∯ 28.63 million and in stage II to ∯ 20.00 million. The foreign exchange component on the basis of c.i.f. value of imported materials would be ∯ 14.31 million and ∯ 9.50 million respectively in two stages. The local currency cost for materials for the buildings and structures was estimated at ∯ 3.24 million in stage I and ∯ 2.13 million in stage II. The labour charges during stage I were estimated to be ∯ 8.54 million and during stage II ∯ 6.57. Of these amounts, the expenditure in foreign currency in the two stages would be ∯ 1.98 million and ∯ 1.80 million respectively. For local currency cost on the country's personnel, it was assumed that 15 per cent would be for supervisory staff, 35 per cent for skilled labour, 20 per cent for semi-skilled labour and the balance 30 per cent for unskilled labour. The residual costs for stage I and stage II were estimated at ∯ 2.54 million and ∯ 1.80 million respectively to be incurred in local currency.

Plant and machinery

74. The total financial expenditure on plant and machinery as erected was estimated at ∯ 85.62 million during stage I and ∯ 63.00 million during stage II. Out of this ∯ 148.62 million, about ∯ 79.74 million would be direct spending in foreign exchange (including interest charges on long term credits for imported equipment) in stage I and ∯ 57.07 million in stage II and these amounts were treated as direct social costs.

75.	The expenditure on local machinery in the two stages was estimated at $ [illegible].79 million and $ 4.50 million respectively. This entire expenditure was classified as tradables. It was assumed that the prices of local machinery would be 20 per cent higher than international prices and therefore the local currency prices of tradable components were divided by 1.2 to arrive at their accounting or 'shadow' prices. The local costs of machinery erection during stage I and II were estimated at $ 2.[illegible] million and $ 1.43 million respectively. An estimated 40 per cent of the expenditure would be on tradable items, 40 per cent on labour and the balance 20 per cent on residuals. Labour charges for skilled labour, semi-skilled labour and unskilled labour were allocated on the basis of 40 per cent, 40 per cent and 20 per cent respectively. Internal transportation costs were ignored, as they were not significant and also as they had good potential for social benefits resulting from infra-structure development.

Design, engineering, supervision etc

76.	Design, engineering, supervision and administrative expenses during construction for stages I and II were estimated at $ 8.60 million and $ 7.0 million respectively. Out of $ 8.60 million for stage I, $ 5.0 million was estimated to be direct foreign exchange spending and the balance $ 3.60 million in local currency (70 per cent for skilled labour and 30 per cent for residuals). For stage II, the foreign exchange requirement would be $ 4.20 million and the remaining expenditure of $ 2.80 million in local currency was allocated on the same basis as for stage I.

77.	The total expenses on technical assistance for stages I and II were estimated at $ 12.60 million and $ 0.80 million respectively (75 per cent of which would be payable in foreign exchange and the balance 25 per cent was treated as residuals). However, the training costs were not included in social costs since these would simultaneously result in social benefits which would outweigh social costs. Start-up expenses were also ignored.

[illegible]

[illegible] materials [illegible] The [illegible] materials [illegible] on hand [illegible] the value [illegible] production [illegible] the other, [illegible] economic value [illegible] indigenous raw materials. [illegible] domestic raw materials [illegible] expenditure on raw materials was estimated at £ [illegible] million per annum for full operation of [illegible] and £ [illegible] million per annum for stage II.

__Labour and [illegible]__

79. The expenditure on [illegible] period are estimated at £ 1.[illegible] per annum [illegible] and [illegible] million per annum during stage II. The [illegible] expenditure was broken down as 10 per cent for [illegible] labour, 30 per cent for semi-skilled labour, and [illegible] per cent for unskilled labour. The [illegible] skilled labour was valued at the market rate of 90 per cent and unskilled labour at 60 per cent [illegible]

80. The total [illegible] expenses [illegible] operation of stage I and II were [illegible] and £ [illegible] million per annum respectively. [illegible] would be in local currency [illegible] and service staff (10 per cent [illegible] labour, 20 per cent for [illegible] and the balance [illegible] per cent [illegible]

[illegible]

[illegible] $ 1.56 million and $ [illegible] respectively would be [illegible]. The local [illegible] were converted by a factor 1.15 as the local prices are [illegible] higher by 15 per cent in comparison to international prices of these materials and services.

[illegible]. The capital cost of power generation during the operational period was computed on the basis of the marginal cost of generating equipment [illegible] per annum required for stages I and II respectively. The average cost per kW of the full generating capacity of the power station was estimated at $ [illegible]. Thereafter, the marginal cost of generating additional power supply [illegible] was estimated to be 10 per cent lower than the average cost. The marginal cost per kW, therefore, was estimated at $ [illegible] which was applied in this study. On this basis, the total annual cost of power generation was estimated at $ [illegible] million during stage I and $ [illegible] million during stage II.

[illegible]. The total annual cost of power supply was allocated on the basis of [illegible] per cent expenditure on [illegible] (since this is a highly capital intensive project), [illegible] per cent on labour and [illegible] per cent on [illegible]. The entire labour requirement was assumed to be in the supervisory and skilled category.

b. Social Benefits

[illegible]. The total value of benefits from the project was measured as the total tradable value of the finished products. The total value of finished products at current international prices was estimated at $ [illegible] million per annum for full operation of stage I and $ [illegible] million per annum for operation of stage II.

Social profitability

85. The social profitability analysis revealed that the total social costs amounted to $ 91 million as against social benefits of $ 722 million, giving a cost benefit ratio of 1:8. After allowing for risk and/or uncertainties, the social discount rate was fixed at 7 per cent, which is considered reasonable for developing economies. The discounted value of social costs at 7 per cent amounted to $ 57 million against the discounted value of social benefits amounting to $ 150 million, thus yielding a cost-benefit ratio of 1:2.6. It was observed that even at this fairly high social rate of discount, the project was socially viable.

86. The rate of return calculated on the basis of net social costs and benefits worked out to about 15 per cent as compared to the commercial rate of return of about 7 per cent. The social rate of return, therefore, seemed to justify the desirability of the project from the social benefit viewpoint.

IV. CONCLUDING REMARKS

87. In this second development decade and after, the countries of the 'third world' which have embarked on a programme of rapid industrial development will require large inputs of steel of different categories. Since steel is the pace setter of economic growth, the establishment of new steel capacity is vital for most developing countries to carry them forward on the path of economic independence and self-reliance. The possibility of indigenous production should be explored continuously as a matter of long-term planning whenever this proves feasible.

88. In evaluating feasibility studies, the conventional techno-economic analysis should be duly weighed with other evaluation criteria such as social profitability, regional and national considerations and the aggregate beneficial impact of the project

on the overall economy. The streams of benefits and costs computed at the market rate of interest should be systematically corrected by bringing in the factors which markets do not reflect. External economies in the form of skill formation, employment generation, linkage effects etc have also an important bearing on the benefits accruing to the society by the installation of a plant. The social rate of discount should reflect a desirable growth rate which is capable of being achieved by the country. With all the necessary adjustments for social costs and benefits, the evaluation of feasibility studies based on the index of the cost-benefit ratio, will indicate the extent of social desirability of the project.

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