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PROGRAMMING DATA AND CRITERIA FOR THE PULP
AND PAPER INDUSTRY



Santiago, Chile



Explanatory note

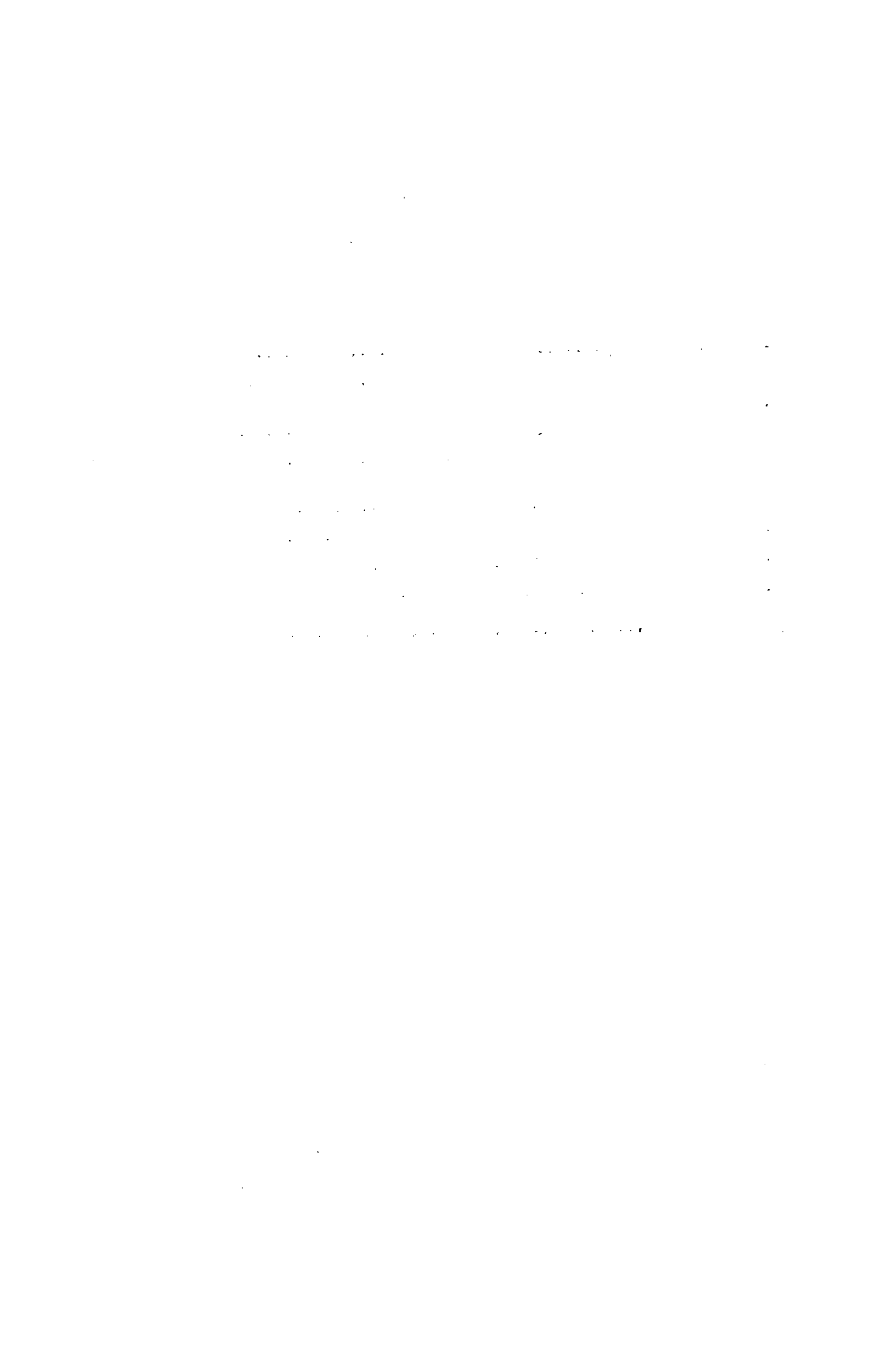
Because it is difficult to find a common denominator which could reflect the average production conditions of the pulp and paper industry in Latin America, the North-American figures and practices have been adapted in this document. The main differences between these and the Latin American practices are higher productivity and salaries of the labour force, and lower capital charges. Because of these factors, the economies of scale in direct manufacturing in Latin America are not so markedly greater than those in investment.

In spite of these differences, this document fulfills that purpose for which it was prepared: to show the effects of economies of scale in some branches of the pulp and paper industry.

The data presented herein cannot be applied to individual projects without changing them substantially according to the local conditions in each case.

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1. Introduction

The purpose of this study is to provide industrial programming data and criteria and to demonstrate the economies of scale in the pulp and paper industry at levels suited to the growing Latin American industry. The pulp and paper industry may be considered as "capital intensive" of the same order of magnitude as the basic steel and oil refining industries.

The Food and Agriculture Organization (FAO) and other organizations of the United Nations have explored this field from several points of view, principally in papers presented at the FAO/ECLA/BTAO Latin American meeting of experts on the pulp and paper industry in Buenos Aires in 1954 and at the FAO/ECAFE/BTAO conference on pulp and paper development in Asia and the Far East in Tokyo in 1960. The pertinent United Nations publications relating to industrial programming data in the pulp and paper industry are tabulated in Annex 1.

This report has been prepared for presentation to the United Nations Seminar on Industrial Programming planned for Sao Paulo, Brazil in March 1963. Nonetheless, it is believed that the programming data presented herein will be found to be useful in the preliminary planning for pulp and paper development throughout the industrially developing areas of the world.

The definitions of the symbols used throughout this study are presented in Annex 2.

The data presented herein should be applied to specific situations only with a full understanding of the many variables that may be involved. The data should be considered as being of greater accuracy in a relative sense within this study than in an absolute sense. For a specific project, therefore, there is no substitute for a careful study of that particular situation.

Examination of the economics of plants utilizing combinations of processes to produce more than one type of product have been avoided herein in order not to unnecessarily complicate the presentation.

/As a

As a practical matter, however, many a pulp and paper mill, in order to properly serve its natural market and to attract enough demand to make the plant economic, will offer several types of products, often including products made of paper and paperboard. Such combinations, of course, tend to increase the unit cost of the individual product above what the unit cost would be if the plant were to produce only one product or a very closely related group of products.

2. Product Selection

The seven products studied were selected to provide a representative cross-section of the major products of the pulp and paper industry.

They are:

1. Unbleached kraft pulp
2. Bleached kraft pulp
3. Unbleached kraft pulp and paper
4. Bleached kraft pulp and paper
5. Newsprint (partially integrated)
6. Unbleached semichemical pulp and paper
7. Bleached semichemical pulp and paper

The first two cases represent intermediate products enjoying a wide world market, are normally made from coniferous wood, and are usually sold in baled air-dry sheets to non-integrated paper mills. The cases studied are so based.

The third and fourth cases are the integrated extensions of the first two cases. These cases are based upon the manufacture of bag, sack, and wrapping papers in rolls. No paperboards are included in these cases.

The fifth case, newsprint in rolls, utilizes low-density broad-leaved wood for the groundwood portion of the furnish, and purchased semi-bleached kraft pulp for the chemical pulp portion. Although the use of broad-leaved wood is uncommon in the manufacture of newsprint, the technology is believed to be well-established. Because of the preponderance of broad-leaved woods in Latin America, the foregoing basis was selected as being

/particularly applicable

particularly applicable to this region. The partially-integrated arrangement was selected because the necessary small chemical pulp mill required for full integration can seldom be justified in the small to medium-sized newsprint mill. If an attractive market can be found for excess chemical pulp, the economics of the fully-integrated newsprint mill can usually be improved by making the chemical pulp mill several times as large as would be required for newsprint alone. Such a project, then, becomes in effect a combination chemical pulp and newsprint mill, which is a fairly common arrangement.

The last two cases are based upon the exclusive use of low-density broad-leaved wood in order to simplify the estimates and presentation. In commercial practice these products are sometimes made from a blend of fibers containing a preponderance of the neutral sulphite semichemical hardwood pulp projected herein, but never exclusively from such pulp. The sixth case is based upon the manufacture of corrugating board in rolls, and the seventh of bleached uncoated unsuper-calendered groundwood-free book and writing papers in rolls.

As noted individually above, all the cases in which paper is produced are based upon production in the form of rolls, although most of the products are also sold in sheets. This basis was selected in order to simplify the estimates and presentation, and should have no effect upon the principles demonstrated herein. Likewise, the other simplifications described are not expected to have any effect upon the principles involved.

3. Process characteristics and investigation method
of equipment inputs and of fixed investment

This industry is now evolving from a part batch, part continuous process industry to one which is truly continuous process, much like oil refining. The processes utilized herein are all based upon the use of single-line continuous equipment.

/Most of

Most of the steps in the processes are characterized by considerable flexibility in capacity. Production can be generally increased above normal capacity at the expense of materials, energy, or degradation of product. For those steps in the process in which only losses of materials or energy are involved, this characteristic does allow for step-wise growth in capacity.

The determination of equipment inputs is relatively simple in that in all major items of equipment single pieces have been provided for each step in the process, and likewise in nearly all cases of minor equipment. Single pieces of equipment are available for nearly all steps in the processes in capacities much greater than those studied herein. Major equipment is custom-built to the needs of the buyer, so that in a well-designed plant there is no significant idle time when producing the product for which the plant was designed.

Three plant capacities have been selected for study in the small to medium size range. One or more of these capacities are appropriate to the national markets in most Latin American countries, but are small in relation to the market in the projected Latin American "common market". The daily capacities, operating 24 hours per day, seven days per week, are 50, 100, and 200 metric tons.

Existing pulp mills in Latin America range from many small ones producing only a few tons per day up to several chemical woodpulp mills in the 100 to 200 metric tons per day range. One sulphate woodpulp mill at Laja in Chile produces some 225 tons daily. According to present plans, this mill will soon be increased to a capacity of 625 tons daily. The chemical and semichemical pulp mills of less than 100 tons of daily capacity generally have no chemical recovery systems, whereas those sulphate pulp mills of 100 tons and larger generally recover their chemicals.

Newsprint mills in Latin America generally range in capacity from 100 to 175 tons daily, although not all newsprint machines are devoted

/exclusively to

exclusively to that product. The largest newsprint mill is located at Monte Alegre, Paraná, Brazil. This mill is expected to shortly complete construction of a new addition that will increase newsprint capacity to some 425 tons daily.

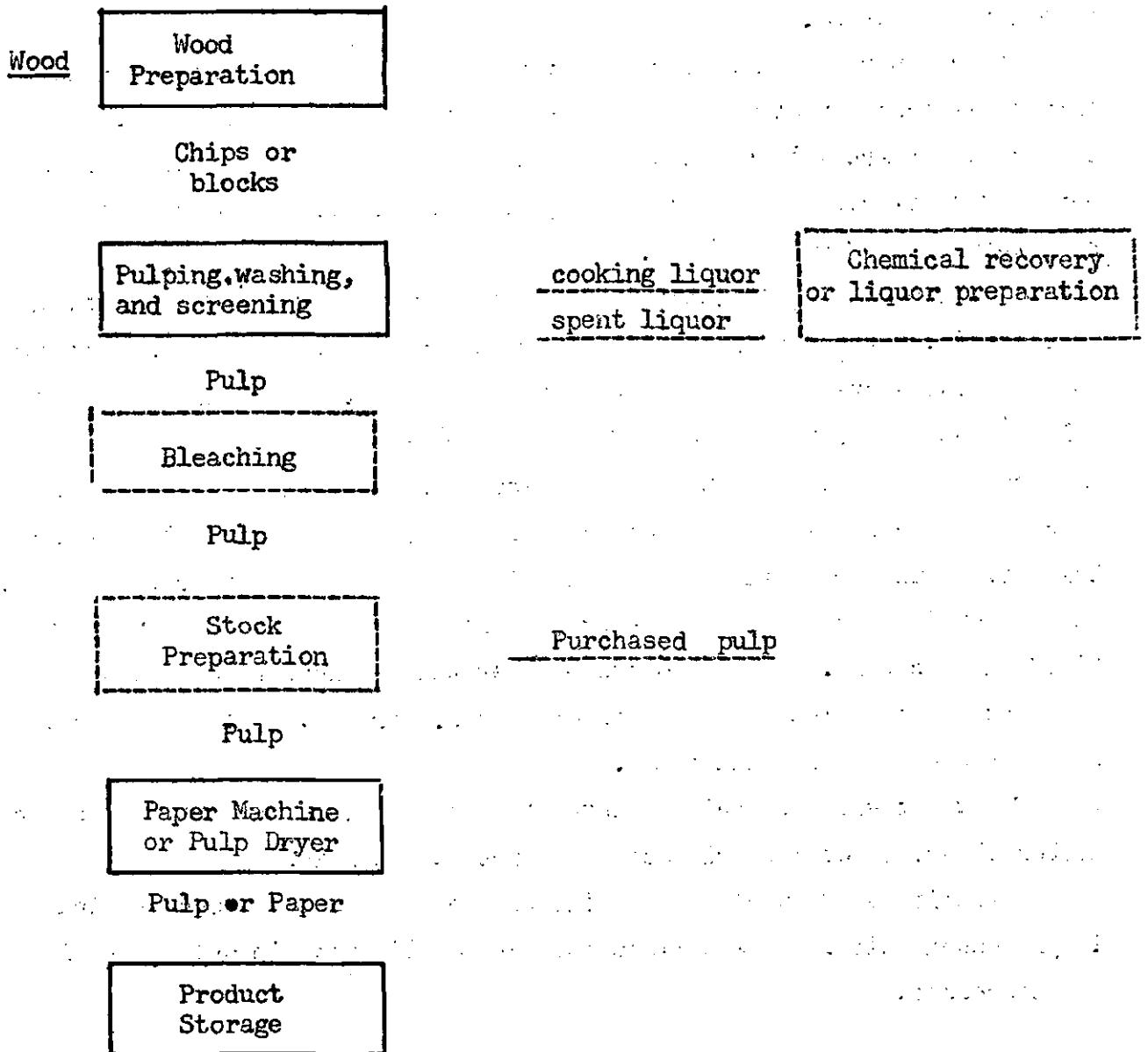
Other paper and paperboard mills range from many small ones producing only a few tons per day up to several in the 100 to 150 ton range. Most of the latter are multiple paper machine mills, whose economics would not normally be expected to be as favourable as those mills producing the same tonnage on fewer machines.

Annual operating periods in the Latin American pulp and paper industry vary widely, but 330 operating days per year may be considered representative, and have therefore been used throughout this study. This allows for numerous holidays and separate shutdowns for major maintenance. General North American practice is to shutdown only for 3 or 4 holidays per year, at which time major maintenance work is begun and at times completed within a holiday, so that operating periods of 350 to 360 days per year are common. On an annual basis, then, the capacities studied are 16 500, 33 000, and 66 000 metric tons. In the foregoing operating periods no provision is made for possible time lost due to lack of orders, strikes, or circumstances beyond the control of management.

Because these 3 capacities have been applied to each of the 7 products listed above, a total of 21 cases are presented herein.

A simplified flow diagram applicable to all the processes studied is presented below. Broken lines indicate application in only part of the processes.

Wood



/The method

The method used in determining fixed investment for each of the 21 cases was tailored to the availability of data. Current prices of most items of major equipment were obtained from the manufacturers of such equipment. Extensive use was made of capital cost estimates contained in a dozen appropriate economic studies loaned by a consulting engineering firm. Lastly, the experience of a member of the FAO/BTAO/ECLA Pulp and Paper Advisory Group in preparing similar economic studies of proposed pulp and paper ventures was drawn upon.

No determination of floor areas required has been made, partly because such data would have little significance because unit building construction costs vary widely according to the type of equipment supported or housed, so that each building is generally useful only for its particular purpose, and partly because extensive engineering effort would have been involved in preparing 21 such estimates. Building costs have therefore been estimated from world-wide experience on previous projects, as have the costs of equipment installation.

4. Determination of labour inputs

Manning tables have been prepared by job title and department, as well as estimates of annual man-hour requirements, for each of the 21 cases. These estimates are based upon good North American practice for modern single-line pulp and paper mills similar to those studied herein. Four men are required to man each round-the-clock post, so that each works an average of 42 hours per week, there being 168 hours in each week. Many variations of shift rotation are practiced, but most involve three shifts of 8 hours each per day, with the fourth man being off duty that day. These estimates are presented in Annex 3.

It has not been possible within the scope of this study to determine manning practices in the Latin American pulp and paper industry. It appears, however, that in general more workers are required for a given task than in North America. It has been found, throughout the world pulp and paper industry, that there is little variation in unit labour cost for a given product at a given capacity. It is apparently axiomatic that the lower the

/wage rate,

wage rate, the more people are required to perform a given task. It has been demonstrated that there is little difference in innate intelligence between the various peoples of the world, so that the lower productivity of the worker outside North America must be due to one or more of the following factors:

1. Lack of adequate training
2. Lack of adequate supervision and management
3. Lack of labour-saving equipment
4. Small-scale operations
5. Restrictive labour practices and laws

The foregoing estimates may also be expressed as man-hours per ton of product, as follows:

Unit labor requirements in man-hours per ton of product

<u>Product</u>	<u>Daily capacity in metric tons</u>		
	<u>50</u>	<u>100</u>	<u>200</u>
Unbleached kraft pulp	14.8	8.4	4.8
Bleached kraft pulp	16.7	9.3	5.3
Unbleached kraft pulp and paper	18.7	10.3	5.8
Bleached kraft pulp and paper	21.1	11.5	6.4
Newsprint (partially integrated)	13.9	8.2	4.9
Unbleached NSSC pulp and paper	13.6	7.8	4.5
Bleached NSSC pulp and paper	17.2	9.6	5.4

5. Determination of inputs of raw material, power, fuel, and maintenance

The principal raw material in all cases is, of course, wood. The four kraft cases are based upon the use of coniferous wood, as typified by Chilean plantation insignis pine, which is reported to have an average density of 370 kilograms of bone-dry wood per solid cubic meter of green wood. The other three cases are based upon the use of low-density broad-leaved wood, as exemplified by the salicaceous species of the Paraná delta in Argentina, which are said to have an average density of 450.

/Estimated wood

Estimated wood requirements are also based upon pulp yields of 46 per cent of the weight of the wood in the unbleached kraft cases, 42 per cent in the bleached kraft cases, 90 per cent in the case of groundwood for newsprint, 75 per cent in the unbleached neutral sulphite semi-chemical (NSSC) case, and 52 per cent in the bleached NSSC case.

The principal chemical requirements are based upon typical consumption rates for plants of the types under study.

The newsprint case is based upon a furnish containing 80 per cent ground-wood produced on site and 20 per cent purchased semi-bleached kraft pulp.

The estimated unit requirements of wood, woodpulp, and principal chemicals for each of the seven products under study may be summarized as follows:

Unit raw material requirements per ton of product

	Wood m3s	Woodpulp ADMT	Na ₂ SO ₄ Kg	CaCO ₃ Kg	Na ₂ CO ₃ Kg	S Kg	Cl ₂ Kg	NaOH dry Kg
Unbleached kraft pulp	5.3	-	60	30	-	-	-	-
Bleached kraft pulp	5.8	-	66	70	-	-	90	40
Unbleached kraft pulp and paper	5.5	-	60	30	-	-	-	-
Bleached kraft pulp and paper	6.0	-	66	70	-	-	90	40
Newsprint (partially integrated)	1.8	0.21	-	-	-	-	-	-
Unbleached NSSC pulp and paper	2.7	-	-	-	135	40	-	-
Bleached NSSC pulp and paper	3.9	-	-	-	325	125	155	70

/The minor

The minor variations noted above in the wood requirements in the kraft cases are the result of different moisture contents of the products, and allowance for fibre losses in papermaking and for shrinkage in bleaching. Pulp is normally sold on the basis of 10 per cent moisture content, whereas the moisture content of paper varies from 5 to 8 per cent according to type.

Minor raw materials, operating supplies, and maintenance materials have been consolidated under "other materials", for the simple reason that the available data provides no breakdown.

Inputs of electric power and fuel have been determined from estimates of the power and net heat (after heat recovery) requirements of each department in each plant. It has been assumed for purposes of this study that all electric power would be purchased, and that all fuel consumed would be industrial fuel oil.

The estimated unit requirements of electric power and fuel oil for each of the seven products under study may be summarized as follows:

Unit electric power and fuel oil requirements per ton of product

<u>Product</u>	<u>Electric Power</u> kWh	<u>Fuel Oil</u> Kg
Unbleached kraft pulp	560	155
Bleached kraft pulp	800	300
Unbleached kraft pulp and paper	1 050	290
Bleached kraft pulp and paper	1 200	420
Newsprint (partially integrated)	1.750	280
Unbleached NSSC pulp and paper	900	420
Bleached NSSC pulp and paper	1 200	570

As noted earlier, maintenance inputs are not available separately, but are of course accounted for in the manufacturing cost estimates.

6. Components of financial investment

Capital requirements for each of the 21 cases have been estimated by groups of closely related plant functions as follows. The direct erected cost of the structures in each group and the direct erected cost of equipment in each group have been separately estimated. To the sum of these two components has been added a 15 per cent allowance for construction overhead and a 15 per cent allowance for engineering and contingencies to arrive at the plant capital estimates. To these have been added 3 per cent of the plant capital to allow for interest during construction and 30 per cent of the annual direct manufacturing cost to allow for working capital to arrive at the estimated total investment required in each case.

These hypothetical plants have been sited, for purposes of this study in a hypothetical area that is readily accesible to world markets and which contains a reasonable amount of economic infrastructure. No provision has been made in the estimates for import duties and taxes because most countries waive such charges in the case of a new industry approved by the government. Similarly, no provision has been made for price escalation, because such increases are difficult to predict and because prices of pulp and paper normally keep pace with inflation. Also, in recent years it has been possible to negotiate fixed-price (in US\$) contracts for most equipment. It would be prudent, however, to make appropriate provision for possible price escalation in the financing of an actual project. Also, no provision has been made for any financing fees, because such fees are not paid in the majority of pulp and paper projects. Lastly, start-up expenses have not been capitalized, because in most pulp and paper projects such costs are charged directly to operations. However, short-term funds must be provided for this purpose.

The construction overhead allowance is intended to provide for such items as construction management and supervision; accounting, purchasing, and expediting; temporary shops and services; rental and maintenance of construction equipment; miscellaneous labour costs such as job clean-up,

/unloading, handling

unloading, handling and storing of materials and equipment; employer-paid labour benefits, and contractor's profit. If a construction camp is required, the cost of construction and operation of such a camp is usually included under construction overhead.

Construction overhead costs generally range between 10 and 30 per cent of the direct costs of structures and equipment, depending largely upon the remoteness of the location. The 15 per cent allowance used herein may be considered appropriate for the hypothetical location of the hypothetical plants, although the allowance would not be adequate for more than a nominal construction camp to house only a small part of the construction force.

The allowance for engineering and contingencies is intended to provide for a complete engineering service and for the cost of items not included in the preliminary estimates, the need for which may only be revealed during the detailed design and construction of the project. This allowance is not intended to provide for rising costs during the construction period.

All other things being equal, engineering expense and certain elements of construction overhead can be expected to occur at a higher rate on a small project than on a large one. It is apparent that engineering costs are more closely related to the number of steps in the process than to the size of the plant. However, no data is available to measure these factors, so that the allowances noted above have been applied equally to all cases.

Interest during construction^{1/} will vary according to interest rates, proportion of borrowed capital, and the construction period. The allowance of 3 per cent used herein would provide for half the plant capital required to be borrowed at 6 per cent interest for the last year of construction, and therefore may be considered to be a reasonable allowance.

Working capital requirements vary with inventory levels and terms of purchase and sale, and are therefore most closely related to manufacturing costs. The allowance of 30 per cent of annual manufacturing cost used herein is believed to be ample for most circumstances.

The capital cost estimates do not provide for the following:

1/ No provision is made for any return on equity capital during construction.

^{1/}1. The costs

1. The costs involved in the development of pulpwood supplies or other raw materials. It is believed that the material prices used herein are adequate inducement for others to provide the capital involved.

2. Capital for housing. It is expected that there is either adequate housing available in the community or that government-supported loans would be available for housing and community facilities.

3. Facilities external to the plant site, such as roads, railways, power transmission lines, etc. It is expected that such facilities would be provided by others.

The estimates of total investment and unit investment per daily ton in each of the 21 cases may be summarized as follows:

Total and unit investment^{2/} required in millions of US\$

<u>Product</u>	<u>Daily capacity, metric tons</u>					
	<u>50</u>		<u>100</u>		<u>200</u>	
	<u>Total</u>	<u>Unit</u>	<u>Total</u>	<u>Unit</u>	<u>Total</u>	<u>Unit</u>
Unbleached kraft pulp	6.0	0.12	8.5	0.085	13.0	0.065
Bleached kraft pulp	8.5	0.17	12.0	0.12	18.0	0.09
Unbleached kraft pulp and paper	9.0	0.18	12.0	0.12	18.5	0.0925
Bleached kraft pulp and paper	11.0	0.22	15.0	0.15	23.0	0.115
Newsprint (partially integrated)	7.5	0.15	10.0	0.10	15.0	0.075
Unbleached NSSC pulp and paper	7.0	0.14	9.0	0.09	12.5	0.0625
Bleached NSSC pulp and paper	9.5	0.19	13.0	0.13	20.0	0.10

It should be noted that the foregoing estimates do not include provision for electric power generation, bleaching chemical manufacture, nor for chemical recovery plants except in the first four cases. For each product, the basic process design is the same for each size of plant; only the size has been varied.

More detailed capital cost estimates are presented in Annex 4.

^{2/} For preliminary planning of specific projects, perhaps 25 per cent should be added to these amounts for possible investment in supporting facilities such as those specifically excluded in the text. Only in unusually favourable circumstances could a project carry a higher burden and still be economic; conversely, many proposed ventures might be uneconomic at the basic investments in the above table.

/The effect

The effect of external economics on a pulp and paper project can be quite marked, and can spell the difference between a profitable and an unprofitable enterprise. In well-developed areas, outsiders often provide, as a means of marketing goods and services, and in the case of governments, to provide employment, the necessary capital for all the external requirements, such as those listed before the preceding table, of a new pulp and paper mill. Of course, there are circumstances under which an enterprise finds it necessary from a defensive viewpoint to own or control all or part of these externals, particularly the vital pulpwood supply. Normally, the external capital required in such developed areas is low in relation to plant investment, although under certain circumstances investment in timberlands can become significant.

On the other hand, if a pulp and paper project is to be located in a remote area whose main attraction is a supply of pulpwood, the investment required external to the proposed plant can well exceed that within the plant, and unfortunately there are no local governments and no established enterprises in such areas to help carry the burden. In such cases, then, the total investment required rises to the point that an otherwise profitable venture becomes unprofitable.

Between the two foregoing extremes there are of course many possibilities that can be made economically feasible, and such is most often the case in Latin America. Companies often provide such plant externals as pulpwood plantations for part of the requirements, part of the housing and community building requirements, electric power generation facilities, chemical production facilities, and less often many others; but which, in all cases, require a total external investment that is small in relation to plant investment because there exists a reasonable amount of economic infrastructure in the area.

It may also be of interest to relate the investment required to the number of workers employed in each of the 21 cases. This relationship is presented in the following table.

/Investment required

Investment required (in US\$) per worker

<u>Product</u>	<u>Daily capacity, metric tons</u>		
	<u>50</u>	<u>100</u>	<u>200</u>
Unbleached kraft pulp	\$ 49 000	\$ 62 000	\$ 82 000
Bleached kraft pulp	62 000	78 000	103 000
Unbleached kraft pulp and paper	58 000	71 000	97 000
Bleached kraft pulp and paper	63 000	79 000	110 000
Newsprint (partially integrated)	65 000	74 000	92 000
Unbleached NSSC pulp and paper	63 000	70 000	84 000
Bleached NSSC pulp and paper	67 000	82 000	112 000

The above data emphasize the high investment requirements of the industry; not many industries have higher ratios for new plant. Long-established North American companies will generally report lower ratios because of the inclusion of employees in activities with low investment-employee ratios (such as woodcutting, paper product manufacture, and distribution) and because of the inclusion of obsolescent plant.

7. Determination of costs

Direct manufacturing costs have been estimated for each of the 21 cases studied herein. Such costs fall into two categories: those that are directly proportional to production, and those that are not.

For a given process design, consumption rates of all materials, electric power, and fuel are generally uniform. These cost components have been extended at consumption rates shown previously herein and at approximate average free market world prices^{3/} to arrive at annual and unit manufacturing costs.

Labour and administration and overhead costs, however, are disproportionate to production, and vary only moderately with plant size. Labour requirements have been estimated as described earlier herein, and extended at approximate average hourly labour costs in the North American pulp and paper industry because the manning tables have been established on a North American basis.

^{3/} Prices within certain Latin American countries may be considerably higher than world prices.

Administration and overhead allowances have been based upon experience. Actual costs vary greatly from plant to plant, and the allowances used herein make no provision for any unusual charges. The allowances are intended to provide for the cost of supervisory, management, administrative, engineering, and technical personnel, and for insurance, property taxes, and sundry overhead. No provision is made for selling expenses, which are accounted for later in mill-net price estimates.

The direct unit manufacturing cost estimates may be summarized as follows:

Direct unit manufacturing costs^{4/} in US\$ per metric ton

<u>Product</u>	<u>Plant capacity in metric tons per day</u>		
	<u>50</u>	<u>100</u>	<u>200</u>
Unbleached kraft pulp	138	102	83
Bleached kraft pulp	167	127	105
Unbleached kraft pulp and paper	169	124	100
Bleached kraft pulp and paper	200	150	123
Newsprint (partially integrated)	150	119	101
Unbleached NSSC pulp and paper	124	93	75
Bleached NSSC pulp and paper	191	152	130

The detailed manufacturing cost estimates are presented in Annex 5.

Similar estimates including certain capital charges to arrive at total production cost are presented in Annex 7 and discussed later herein.

It may also be of interest to examine the proportions of the major groups of manufacturing cost elements. This relationship is shown in the following table.

^{4/} These costs have been computed on the basis of 330 operating days per annum and a 100 per cent operating ratio. Most new mills reach rated capacity several months after startup and often produce at 10 to 20 per cent above rated capacity within a few years. Further, modern mills tend to experience higher operating ratios than the average.

PERCENTAGES OF MANUFACTURING COST ELEMENTS

Product	Wood and woodpulp	Chemicals and other materials	Energy	Labour	Adminis- tration and Overhead
<u>Plant capacity: 50 metric tons per day</u>					
Unbleached kraft pulp	26	7	5	32	30
Bleached kraft pulp	24	12	7	30	27
Unbleached kraft pulp and paper	23	9	8	33	27
Bleached kraft pulp and paper	21	14	9	32	24
Newsprint (partially integrated)	29	7	13	28	23
Unbleached NSSC pulp and paper	15	12	12	32	29
Bleached NSSC pulp and paper	14	26	11	27	22
<u>Plant capacity: 100 metric tons per day</u>					
Unbleached kraft pulp	37	9	7	24	23
Bleached kraft pulp	32	16	10	22	20
Unbleached kraft pulp and paper	31	12	11	25	21
Bleached kraft pulp and paper	28	18	12	23	19
Newsprint (partially integrated)	38	8	17	21	16
Unbleached NSSC pulp and paper	20	16	17	25	22
Bleached NSSC pulp and paper	18	34	14	19	15
<u>Plant capacity: 200 metric tons per day</u>					
Unbleached kraft pulp	44	12	9	17	18
Bleached kraft pulp	39	20	12	15	14
Unbleached kraft pulp and paper	39	15	14	17	15
Bleached kraft pulp and paper	34	22	15	16	13
Newsprint (partially integrated)	44	10	19	15	12
Unbleached NSSC pulp and paper	25	19	21	18	17
Bleached NSSC pulp and paper	21	40	16	12	11

/In the

In the foregoing classifications, fuel oil and electric power have been included under energy, and contingencies have been included under administration and overhead.

In the above table, it will be noted that as productive capacity rises, the proportions of the two cost elements only slightly related to capacity, namely labour and administration and overhead, decrease markedly. In larger capacities than those shown, these elements continue to decline, but less markedly.

It will also be noted that the category "chemicals and other materials" is unusually high in the last product, bleached neutral sulphite semi-chemical pulp and paper. This is the result of the high cooking and bleaching chemical and paper additive requirements. The cooking chemicals, about one-third of this category, can best be recovered in conjunction with a kraft pulp mill recovery plant.

In newsprint, the category "wood and woodpulp" is unusually high because of the inclusion of purchased chemical woodpulp. In a fully-integrated newsprint mill, this category would be the lowest of the seven products. The reasons for selecting the "partially integrated" approach were explained earlier herein.

In plants 100 tons daily and larger, pulpwood is the largest cost element, except in the case of the last product for reasons explained above, and of the next to the last product because of the high pulp yield. This emphasizes the importance of pulpwood costs.

Graphical representations of the total investment, direct manufacturing and total production cost estimates are presented in Annex 8.

It will be noted from the graph of unit investment required versus plant capacity that unit investment can be expected to decline beyond 200 tons of daily capacity. Experience in other studies indicates that the curves becomes nearly flat at around 500 tons in most cases. Similarly, unit manufacturing costs are nearly level at around 500 tons.

It is, however, impossible to generalize upon the minimum economic size for entry into a particular market. This will vary in accordance with the following influences:

/1. Product or

1. Product or combination of products
2. Local prices of materials, energy, transportation and labour
3. Degree of tariff protection
4. Degree of natural protection (primarily transport)
5. Design of plant
6. Ability of management

It can be said, however, in view of the plans of the Latin American Free Trade Area to gradually eliminate tariffs between its members, that any new pulp and paper project to produce large-volume products in any of the member countries of less than 200 tons daily capacity should enjoy an unusually favourable situation in order to be economic. The large-volume products include chemical woodpulp, newsprint, kraft bag, sack and wrapping papers, kraft linerboard, corrugating board, and folding boxboard.

Expansion of existing plants carries with it economies of scale that are less than those of single-line plants of the same capacity, but are nonetheless significant. In general, it is more profitable to expand an existing plant than to build a new one for the added capacity. For example, an existing 100 ton plant expanded to 200 tons capacity is more profitable than two 100 ton plants, but not as profitable as a plant built with an initial capacity of 200 tons.

As noted earlier, total production cost estimates reflecting certain capital charges are presented in Annex 7. Depreciation is provided for at a rate of 6.67 per cent per annum on depreciable assets, equivalent to an average useful life of 15 years. An allowance of ten percent per annum of total capital is intended to provide for interest and profit on investment without regard to the proportion of equity and loan capital. However, no provision has been made for income taxes because of their widely varying application in Latin America, which in general are lower than those of North America and Europe.

The total production cost estimates presented in Annex 7 are summarized in the following table. The mill net prices shown in the table are approximations based upon world prices. Their derivation is explained later herein.

/UNIT COSTS

UNIT COSTS AND PRICES IN US\$ PER METRIC TON

Product	Capacity (MTPD)	Capital charges	Direct cost	Total cost	Mill net price
Unbleached kraft pulp	50	58	138	196	110
	100	41	102	143	110
	200	32	83	115	110
Bleached kraft pulp	50	82	167	249	130
	100	58	127	185	130
	200	44	105	149	130
Unbleached kraft pulp and paper	50	87	169	256	160
	100	58	124	182	160
	200	45	100	145	160
Bleached kraft pulp and paper	50	108	200	308	190
	100	73	150	223	190
	200	56	123	179	190
Newsprint	50	72	150	222	125
	100	48	119	167	125
	200	36	101	137	125
Unbleached semi-chemical pulp and paper	50	67	124	191	120
	100	44	93	137	120
	200	30	75	105	120
Bleached semi-chemical pulp and paper	50	92	191	283	190
	100	62	152	214	190
	200	48	130	178	190

/It will

It will be noted that the economies of scale in direct manufacturing costs are significantly greater than those of investment, ranging roughly from 50 to 100 per cent greater. This of course reflects the importance of the cost elements that vary only slightly with plant size, namely labour and administration and overhead. Also, in only four of the twenty-one cases, all at 200 tons of daily capacity, does the mill net price exceed the total production cost. This would seem to indicate that even 200 ton mills making the mass-produced products may be marginal when meeting world market competition.

In order to evaluate the ability of the 21 hypothetical plants to compete in world markets, gross earnings estimates have been prepared for each case. Approximate mill-net prices for each product have been derived from approximate world prices by deducting appropriate allowance for shipping and selling expenses. Annual net sales have then been derived for each case from the mill-net prices. By deducting therefrom annual manufacturing costs, annual gross earnings have been derived. Gross earnings are earnings before depreciation, interest, and income taxes. Gross earnings as a percentage of total investment have also been calculated for each case. A gross earnings rate of 20 per cent is generally considered in North America as the minimum in order to be attractive to investors, although this minimum rate will of course vary considerably according to circumstances, and may be on the order of 30 per cent in Latin America.

The estimated gross earnings as a percentage of total investment, when competing on the world market, are as follows:

/Gross earnings

Gross earnings as a percentage of total investment

<u>Product</u>	<u>Capacity of plant in metric tons per day</u>		
	<u>50</u>	<u>100</u>	<u>200</u>
Unbleached kraft pulp	Loss	3	14
Bleached kraft pulp	Loss	1	9
Unbleached kraft pulp and paper	Loss	10	21
Bleached kraft pulp and paper	Loss	8	19
Newsprint (partially integrated)	Loss	2	10
Unbleached NSSC pulp and paper	Loss	10	23
Bleached NSSC pulp and paper	Loss	10	20

The detailed mill-net price and gross earnings estimates are presented in Annex 6.

The earnings in the above cases could be measurably improved if the plants were to operate 350 days annually instead of the assumed 330 days.

In general, if the hypothetical plants were to compete in world markets, the 50 ton plants would operate at a loss, the 100 ton plants would have unsatisfactory earnings, and the 200 ton plants would be at best marginally attractive. No great importance should be attached to the earnings differences shown above within the 100 ton plants and within the 200 ton plants.

On the other hand, it is not expected that the Latin American pulp and paper industry will face world competition in the foreseeable future, except in the case of newsprint in Argentina and Brazil, and part of the Chilean exports of newsprint and woodpulp. Argentina produces only token amounts of newsprint, and Brazil's newsprint plant is to reach a capacity of 425 tons daily in 1962, a level adequate to meet world competition. Chile is able to export newsprint and sulphate woodpulp at production levels on the order of 200 tons per day partly because of unusually low wood costs, and partly because of tariff concessions granted by most of the members of the Latin American Free Trade Area.

8. Conclusions

It is concluded that there are indeed important economies of scale in the pulp and paper industry, particularly at capacities suited to new development in most Latin American countries.

The source of the economies of scale lies in the continuous process nature of the industry. With increasing size of a specific design of plant, labour requirements and administration and overhead costs increase only slightly, so that unit manufacturing costs decline markedly. Labour requirements vary little with size of plant for a given design because most workers are overseers of one or more steps in the process, and because a man can operate a large piece of process equipment as readily as a small one. Only in the handling of raw materials and finished product are more workers required in the larger plant. Similarly, it takes about as many managerial, supervisory, and other administrative employees to administer a large plant as a small one of the same design. Only in the case of insurance and property taxes do overhead costs rise with increasing plant.

Similarly, plant investment requirements do not rise as rapidly as plant size, so that unit investment requirements decrease with increasing plant size of a specific design of plant. This is the case because a piece of process equipment of twice the capacity costs less than twice as much as the smaller one; the same applies to the building to house the equipment, and to the cost of installation. Also, the cost of supporting facilities, such as plant railways and roads, and shops, laboratories and offices, do not rise as rapidly as plant capacity.

In planning for the future development of any pulp and paper industry, whenever and wherever the objective is production at the lowest possible cost, it appears that every effort should be made to build the largest single-line plants possible consistent with anticipated demand during the ensuing few years within a natural market area.

List of Annexes

1. UN publications relating to industrial programming data in the pulp and paper industry
2. Definition of symbols
3. Manning tables for pulp and paper manufacturing cost estimates
4. Summary of capital investment
5. Pulp and paper manufacturing cost estimates
6. Mill-net price and gross earnings estimates
7. Total production cost estimates - including capital charges except income taxes
8. Graphs of total investment, direct manufacturing and total production costs.

Annex 1

UNITED NATIONS PUBLICATIONS RELATING TO INDUSTRIAL PROGRAMMING DATA
IN THE PULP AND PAPER INDUSTRY

1. FAO/ECLA/BTAO Latin American meeting of experts on the pulp and paper industry: Buenos Aires (1954)
 - (a) 3.02 Secretariat paper: Amapá - Yucatán. A study of hypothetical pulp and paper mills based on tropical mixed woods
 - (b) 3.03 Secretariat paper: Mill size, integration, location. A study of investment and production costs in hypothetical pulp and paper mills
 - (c) 3.1 Influence of mill size and integration on investment and cost, by A.B. Karlstads Mekaniska Werkstad (Sweden)
 - (d) 3.12 Economics of newsprint production, by P.R. Sandwell, President, Sandwell & Co.,Ltd. (Canada)
2. Chile: Potential pulp and paper exporter, by the FAO/ECLA/ BTAO Pulp and Paper Advisory Group for Latin America: Santiago (1957)
3. FAO/ECAFE/BTAO Conference on pulp and paper development in Asia and the Far East: Tokyo (1960)
 - (a) Secretariat paper V: Technical and economic aspects of industrial pulp and paper production in the region
 - (b) Secretariat paper VII. c: Small-scale industrial pulp and paper production
 - (c) Background paper VII.c.1: Small-scale pulp and paper production by P.R. Sandwell, President, Sandwell & Co. Ltd. (Canada)
 - (d) Secretariat paper VII (a): Comparative investment data for different types and sizes of mills
 - (e) Chapter VIII Appendix A: Comparative investment data for different types and sizes of mills
4. Raw materials for more paper: FAO, Rome (1953).

Annex 2

DEFINITION OF SYMBOLS

ADMT	-	air-dry metric ton (10 per cent moisture)
ADMTPA	-	air-dry metric tons per annum
FMT	-	finished metric ton
Kg	-	Kilogram
kWh	-	kilowatt hour
M ³	-	cubic meter
M ³ s	-	solid cubic meter (of wood without bark)
M ³ s/A	-	solid cubic meters per annum
MH	-	man-hour
MT	-	metric ton
MTPA	-	metric tons per annum
MTPD	-	metric tons per day
MWH	-	megawatt hour (one million watt-hours)
NSSC	-	neutral sulphite semi-chemical
US\$	-	United States dollar
US\$/A	-	United States dollars per annum
US\$/MT	-	United States dollars per metric ton

Chemical formulas and common names

CaCO ₃	-	calcium carbonate: limestone
Cl ₂	-	Chlorine:the elemental molecule contains two atoms
Na ₂ CO ₃	-	sodium carbonate: soda ash
NaOH	-	sodium hydroxide: caustic soda
Na ₂ SO ₄	-	sodium sulphate (anhydrous): salt cake
S	-	sulphur

MANNING TABLES FOR PULP AND PAPER MANUFACTURING COST ESTIMATES

Item	Unbleached kraft pulp			Bleached kraft pulp			Unbleached kraft pulp and paper			Bleached kraft pulp and paper			Newsprint (partially integrated)			Unbleached semi-chemical pulp and paper			Bleached semi-chemical pulp and paper		
	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD
Wood Preparation Plant																					
(2 shifts per day)																					
Foreman	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Scaler	2	2	2	2	2	2	2	2	2	2	2	2	-	2	2	2	2	2	2	2	2
Wood Handling Equipment Operator	2	4	4	2	4	4	2	4	4	2	4	4	2	2	2	2	2	4	2	2	4
Wood Handling Equipment Helper	2	2	4	2	2	4	2	2	4	2	2	4	-	-	2	-	2	2	-	2	2
Barkerman	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Chipperman	2	2	2	2	2	2	2	2	2	2	2	2	-	-	-	2	2	2	2	2	2
Subtotal	12	14	16	12	14	16	12	14	16	12	14	16	6	8	10	10	12	14	10	12	14
Relief Men (for 7 day operation)	5	6	7	5	6	7	5	6	7	5	6	7	2	3	4	4	5	6	4	5	6
Total	17	20	23	17	20	23	17	20	23	17	20	23	8	11	14	14	17	20	14	17	20
Groundwood Pulp Mill																					
Block Reclaimer													4	4	4						
Grinderman													4	8	16						
Screen Tender													4	4	4						
Total													12	16	24						
Chemical or Semi-chemical Pulp Mill																					
Chip Reclaimer	4	4	4	4	4	4	4	4	4	4	4	4				4	4	4	4	4	4
Semi-chemical Liquor Maker	4	4	4	4	4	4	4	4	4	4	4	4				4	4	4	4	4	4
Pulping Operator	4	4	4	4	4	4	4	4	4	4	4	4				4	4	4	4	4	4
Washerman and Screen Tender	4	4	4	4	4	4	4	4	4	4	4	4				4	4	4	4	4	4
Bleacherman	4	4	4	4	4	4	4	4	4	4	4	4				4	4	4	4	4	4
Total	12	12	12	16	16	16	12	12	12	16	16	16				12	12	12	16	16	16
Chemical Recovery and Steam Plant																					
Recovery Boiler Operator	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Recovery Boiler Helper	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Steam Boiler Fireman	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Lime Kiln Operator	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Liquor Maker	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Total	20	20	20	20	20	20	20	20	20	20	20	20	4	4	4	4	4	4	4	4	4
Paper Mill or Pulp Dryer																					
Tour Foreman	-	-	-	-	-	-	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Stock Preparation Man	-	-	-	-	-	-	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Additives Preparation Man	-	-	-	-	-	-	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Machine Tender	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Back Tender	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Winderman	-	-	-	-	-	-	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Fourth Hand	-	-	-	-	-	-	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Fifth Hand	-	-	-	-	-	-	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Sixth Hand	-	-	-	-	-	-	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Pulp Balerman	4	4	8	4	4	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Broke Pulper Man	-	-	-	-	-	-	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Weighter and Lift Truck Driver	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Car Loading Lift Truck Driver	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4
Purchased Pulp Slusherman	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4	4	4	4	4	4	4
Total	18	19	24	16	19	24	38	39	44	42	43	48	38	39	41	30	31	36	42	43	48

Annex 3 (concluded)

Item	Unbleached kraft pulp			Bleached kraft pulp			Unbleached kraft pulp and paper			Bleached kraft pulp and paper			Newsprint (partially integrated)			Unbleached semi-chemical pulp and paper			Bleached semi-chemical pulp and paper		
	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD
Technical Control																					
Control Chemist	2	2	2	2	2	2	2	2	2	3	3	3	1	1	1	1	1	1	2	2	2
Laboratory Technician	2	2	2	3	3	3	3	3	3	3	3	3	2	2	2	1	1	1	2	2	2
Shift Tester	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Instrument Mechanic	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	2	2	2
Instrument Helper	1	1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1
Total	11	11	11	12	12	12	12	12	12	14	14	14	9	9	9	8	8	8	11	11	11
Shops and Stores																					
Millwright Foreman	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Millwright	4	5	6	5	6	7	5	6	7	6	7	8	4	5	6	4	5	6	5	6	7
Shift Millwright	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Millwright Helper	4	5	6	4	5	6	4	5	6	4	5	6	4	5	6	4	5	6	4	5	6
Oiler	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pipefitter Foreman	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pipefitter	3	4	5	4	5	6	4	5	6	5	6	7	3	4	5	3	4	5	4	5	6
Pipefitter Helper	3	4	5	4	5	6	4	5	6	5	6	7	3	4	5	3	4	5	4	5	6
Machinist	2	3	4	3	4	5	3	4	5	4	5	6	2	3	4	2	3	4	3	4	5
Welder	1	1	2	1	2	2	1	2	2	2	2	3	1	1	2	1	1	2	1	2	2
Sheet Metal Worker	-	1	1	1	1	2	1	1	2	1	2	2	-	1	1	-	1	1	1	1	2
Automotive Mechanic	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Painter	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Electrician Foreman	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Electrician	2	2	2	3	3	3	3	3	3	4	4	4	2	2	2	2	2	2	3	3	3
Shift Electrician	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Electrician Helper	2	2	2	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	3	3	3
Storekeeper	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Store Clerk	-	1	2	1	2	3	1	2	3	1	2	3	-	1	2	-	1	2	1	2	3
Total	36	45	54	44	53	62	44	53	62	52	61	70	36	45	54	36	45	54	44	53	62
Materials Handling and Yard																					
Foreman	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Truck Driver	1	2	3	2	3	4	2	3	4	3	4	5	1	2	3	1	2	3	2	3	4
Laborer	2	4	6	4	6	8	4	6	8	5	7	9	2	4	6	2	4	6	4	6	8
Watchman	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Total	8	11	14	11	14	17	11	14	17	13	16	19	8	11	14	8	11	14	11	14	17
Summary of Labor																					
Wood Preparation Plant	17	20	23	17	20	23	17	20	23	17	20	23	8	11	14	14	17	20	14	17	20
Groundwood Pulp Mill	-	-	-	-	-	-	-	-	-	-	-	-	12	16	24	-	-	-	-	-	-
Chemical or Semi-chemical Pulp Mill	12	12	12	16	16	16	12	12	12	16	16	16	-	-	-	12	12	12	16	16	16
Chemical Recovery and Steam Plant	20	20	20	20	20	20	20	20	20	20	20	20	4	4	4	4	4	4	4	4	4
Paper Mill or Pulp Dryer	18	19	24	18	19	24	38	39	44	42	43	48	38	39	44	30	31	36	42	43	48
Technical Control	11	11	11	12	12	12	12	12	12	14	14	14	9	9	9	8	8	8	11	11	11
Shops and Stores	36	45	54	44	53	62	44	53	62	52	61	70	36	45	54	36	45	54	44	53	62
Materials Handling and Yard	8	11	14	11	14	17	11	14	17	13	16	19	8	11	14	8	11	14	11	14	17
Total	122	138	158	138	154	174	154	170	190	174	190	210	115	135	163	112	128	148	142	158	178

Man-hours per annum (at 2 000 FH/man/A)

244,000 276,000 336,000 276,000 308,000 348,000 308,000 340,000 380,000 348,000 380,000 420,000 230,000 270,000 326,000 224,000 256,000 296,000 284,000 316,000 356,000

Annex 4
SUMMARY OF CAPITAL INVESTMENT

Description	Unbleached kraft pulp (air-dry in bales)			Bleached kraft pulp (air dry in bales)			Unbleached kraft pulp and paper (bag, sack, and wrapping papers)			Bleached kraft pulp and paper (bag, sack, and wrapping papers)		
	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD
Part A - Structures												
Site, plant rail and roads, sewers, and fire protection	US\$ 200 000	230 000	300 000	240 000	280 000	360 000	240 000	280 000	360 000	260 000	310 000	400 000
Offices, laboratories, shops and stores	80 000	90 000	100 000	100 000	110 000	120 000	100 000	110 000	120 000	110 000	120 000	130 000
Water supply and distribution	30 000	40 000	50 000	180 000	280 000	400 000	30 000	40 000	60 000	190 000	300 000	430 000
Steam supply and distribution (incl. fuel storage)	20 000	20 000	30 000	20 000	30 000	50 000	20 000	30 000	50 000	30 000	40 000	60 000
Electric power distribution (purchased power)	10 000	20 000	30 000	10 000	20 000	30 000	10 000	20 000	30 000	10 000	20 000	30 000
Wood supply and chip production and storage	80 000	120 000	180 000	80 000	120 000	190 000	80 000	120 000	180 000	80 000	120 000	200 000
Pulp mill (cooking, washing, and screening or grinding and screening-newsprint)	100 000	170 000	300 000	110 000	190 000	340 000	100 000	170 000	300 000	110 000	190 000	340 000
Bleach plant (incl. bleach liquer making)	-	-	-	110 000	160 000	230 000	-	-	-	110 000	160 000	230 000
Chemical recovery plant	150 000	250 000	440 000	160 000	270 000	480 000	150 000	250 000	440 000	160 000	270 000	480 000
Cooking liquer preparation plant (NSSC)	-	-	-	-	-	-	-	-	-	-	-	-
Paper mill (incl. roll finishing and shipping)	-	-	-	-	-	-	370 000	480 000	760 000	340 000	470 000	800 000
Pulp drying plant (incl. shipping)	230 000	260 000	370 000	190 000	340 000	400 000	-	-	-	-	-	-
Total structures	US\$ 900 000	1 200 000	1 800 000	1 200 000	1 800 000	2 600 000	1 100 000	1 500 000	2 300 000	1 400 000	2 000 000	3 100 000
Part B - Equipment												
Site, plant rail and roads, sewers, and fire protection	40 000	70 000	120 000	50 000	80 000	130 000	50 000	80 000	130 000	60 000	100 000	160 000
Offices, laboratories, shops and stores	70 000	100 000	150 000	90 000	130 000	180 000	90 000	130 000	180 000	100 000	150 000	200 000
Water supply and distribution	60 000	100 000	160 000	200 000	300 000	400 000	60 000	100 000	160 000	220 000	330 000	440 000
Steam supply and distribution (incl. fuel storage)	70 000	110 000	200 000	150 000	240 000	410 000	150 000	250 000	430 000	220 000	380 000	630 000
Electric power distribution (purchased power)	50 000	90 000	140 000	70 000	110 000	180 000	90 000	130 000	230 000	100 000	150 000	250 000
Wood supply, chip production and storage	250 000	400 000	630 000	270 000	430 000	690 000	250 000	400 000	650 000	280 000	440 000	700 000
Pulp mill (cooking, washing, and screening or grinding and screening-newsprint)	450 000	700 000	1 200 000	500 000	800 000	1 400 000	450 000	700 000	1 200 000	500 000	800 000	1 400 000
Bleach plant (incl. bleach liquer making)	-	-	-	870 000	960 000	1 600 000	-	-	-	870 000	960 000	1 600 000
Chemical recovery plant	1 100 000	1 500 000	2 400 000	1 200 000	1 650 000	2 600 000	1 100 000	1 500 000	2 400 000	1 200 000	1 650 000	2 600 000
Cooking liquer preparation plant (NSSC)	-	-	-	-	-	-	-	-	-	-	-	-
Paper mill (incl. roll finishing and shipping)	-	-	-	-	-	-	2 560 000	3 110 000	4 520 000	2 650 000	3 140 000	4 520 000
Pulp drying plant (incl. shipping)	1 010 000	1 530 000	2 000 000	1 000 000	1 500 000	2 010 000	-	-	-	-	-	-
Total equipment	US\$ 3 100 000	4 600 000	7 000 000	4 400 000	6 200 000	9 600 000	4 800 000	6 400 000	10 000 000	6 200 000	8 100 000	12 500 000
Part C - Construction expenses												
Construction Overhead	600 000	850 000	1 300 000	850 000	1 200 000	1 800 000	900 000	1 200 000	1 650 000	1 150 000	1 500 000	2 350 000
Engineering and contingencies	600 000	850 000	1 300 000	850 000	1 200 000	1 800 000	900 000	1 200 000	1 650 000	1 150 000	1 500 000	2 350 000
Total construction expense	US\$ 1 200 000	1 700 000	2 600 000	1 700 000	2 400 000	3 600 000	1 800 000	2 400 000	3 300 000	2 300 000	3 000 000	4 700 000
Total Plant Capital	US\$ 5 200 000	7 500 000	11 400 000	7 300 000	10 400 000	15 800 000	7 700 000	10 300 000	16 000 000	9 900 000	13 100 000	20 300 000
Interest during construction	US\$ 150 000	200 000	300 000	200 000	300 000	500 000	250 000	300 000	500 000	300 000	400 000	600 000
Working capital	650 000	800 000	1 300 000	1 000 000	1 300 000	1 700 000	1 050 000	1 400 000	2 000 000	800 000	1 500 000	2 100 000
Total investment	US\$ 6 000 000	8 500 000	13 000 000	8 500 000	12 000 000	18 000 000	9 000 000	12 000 000	18 500 000	11 000 000	15 000 000	23 000 000

Annex 4 (Contd.)

Annex 4 (concluded)

Description	Newsprint (partially integrated) (hardwood groundwood, purchased chemical pulp)			Unbl. semichemical pulp and paper (hardwood NSSC corrugating board)			Bleached semichemical pulp and paper (hardwood NSSC book and writing papers)		
	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD
Part A - Structures									
Site, plant rail and roads, sewers, and fire protection	US\$ 200 000	230 000	300 000	200 000	230 000	300 000	240 000	280 000	360 000
Offices, laboratories, shops and stores	80 000	90 000	100 000	80 000	90 000	100 000	100 000	110 000	120 000
Water supply and distribution	20 000	30 000	40 000	20 000	30 000	40 000	140 000	230 000	340 000
Steam supply and distribution (incl. fuel storage)	30 000	40 000	60 000	30 000	50 000	70 000	40 000	60 000	100 000
Electric power distribution (purchased power)	20 000	30 000	40 000	10 000	20 000	30 000	10 000	20 000	30 000
Wood supply and chip production and storage	40 000	70 000	100 000	50 000	80 000	120 000	70 000	100 000	140 000
Pulp mill (cooking, washing, and screening or grinding and screening-newsprint)	150 000	250 000	400 000	70 000	110 000	180 000	130 000	190 000	260 000
Bleach plant (incl. bleach liquor making)	-	-	-	-	-	-	80 000	120 000	170 000
Chemical recovery plant	-	-	-	-	-	-	-	-	-
Cooking liquor preparation plant (NSSC)	-	-	-	40 000	50 000	70 000	60 000	80 000	120 000
Paper mill (incl. roll finishing and shipping)	360 000	560 000	760 000	300 000	440 000	690 000	330 000	510 000	760 000
Pulp drying plant (incl. shipping)	-	-	-	-	-	-	-	-	-
Total structures	US\$ 900 000	1 300 000	1 800 000	800 000	1 100 000	1 600 000	1 200 000	1 700 000	2 400 000
Part B - Equipment									
Site, plant rail and roads, sewers, and fire protection	40 000	70 000	120 000	40 000	70 000	120 000	50 000	80 000	130 000
Offices, laboratories, shops and stores	70 000	100 000	150 000	70 000	100 000	150 000	90 000	130 000	180 000
Water supply and distribution	50 000	80 000	130 000	50 000	80 000	130 000	150 000	230 000	330 000
Steam supply and distribution (incl. fuel storage)	190 000	330 000	550 000	250 000	430 000	730 000	330 000	550 000	930 000
Electric power distribution (purchased power)	120 000	200 000	360 000	70 000	120 000	200 000	100 000	150 000	250 000
Wood supply, chip production and storage	150 000	220 000	300 000	160 000	250 000	400 000	240 000	320 000	500 000
Pulp mill (cooking, washing, and screening or grinding and screening-newsprint)	800 000	1 300 000	2 200 000	450 000	730 000	1 300 000	740 000	1 300 000	2 100 000
Bleach plant (incl. bleach liquor making)	-	-	-	-	-	-	650 000	720 000	1 200 000
Chemical recovery plant	-	-	-	-	-	-	-	-	-
Cooking liquor preparation plant (NSSC)	-	-	-	110 000	120 000	170 000	150 000	220 000	280 000
Paper mill (incl. roll finishing and shipping)	2 580 000	3 100 000	4 490 000	2 600 000	3 000 000	3 500 000	2 600 000	3 100 000	4 500 000
Pulp drying plant (incl. shipping)	-	-	-	-	-	-	-	-	-
Total equipment	US\$ 4 000 000	5 400 000	8 300 000	3 800 000	4 900 000	6 700 000	5 100 000	6 800 000	10 400 000
Part C - Construction expense									
Construction Overhead	750 000	1 000 000	1 500 000	700 000	900 000	1 250 000	950 000	1 300 000	1 900 000
Engineering and contingencies	750 000	1 000 000	1 500 000	700 000	900 000	1 250 000	950 000	1 300 000	1 900 000
Total construction expense	US\$ 1 500 000	2 000 000	3 000 000	1 400 000	1 800 000	2 500 000	1 900 000	2 600 000	3 800 000
Total Plant Capital	US\$ 6 400 000	8 700 000	13 100 000	6 000 000	7 800 000	10 800 000	8 200 000	11 100 000	16 600 000
Interest during construction	US\$ 200 000	250 000	400 000	200 000	250 000	300 000	250 000	300 000	500 000
Working capital	900 000	1 050 000	1 500 000	800 000	950 000	1 400 000	1 050 000	1 600 000	2 900 000
Total investment	US\$ 7 500 000	10 000 000	15 000 000	7 000 000	9 000 000	12 500 000	9 500 000	13 000 000	20 000 000

Annex 5
PULP AND PAPER MANUFACTURING COST ESTIMATES

Item	Units	Price	Unbleached kraft pulp (air-dry in bales: 10% moisture)			Rate	Bleached kraft pulp (air-dry in bales: 10% moisture)			Rate	Unbleached kraft pulp and paper (bag, sack and wrapping papers)		
			Rate	50 MTPD	100 MTPD		200 MTPD	Rate	50 MTPD		100 MTPD	200 MTPD	Rate
Statistics													
Production (pulp: air-dry; paper: finished weight)	MTPA	-	-	-	-	-	-	-	-	-	-	-	-
Pulpwood - solid wood	m ³ s/A	5.3m ³ s/ADMT	16 500	33 000	66 000	-	16 500	33 000	66 000	-	16 500	33 000	66 000
Chemical woodpulp (semi-bleached kraft)	ADMTPA	-	-	-	-	-	-	-	-	-	-	-	-
Saltsake (Na ₂ SO ₄)	MTPA	60kg/ADMT	990	1 980	3 960	66kg/ADMT	1 090	2 180	4 360	60kg/FMT	990	1 980	3 960
Limestone (CaCO ₃)	MTPA	30kg/ADMT	495	990	1 980	70kg/ADMT	1 155	2 310	4 620	30kg/FMT	495	990	1 980
Soda ash (Na ₂ CO ₃)	MTPA	-	-	-	-	-	-	-	-	-	-	-	-
Sulphur	MTPA	-	-	-	-	-	-	-	-	-	-	-	-
Chlorine	MTPA	-	-	-	-	90kg/ADMT	1 485	2 970	5 940	-	-	-	-
Caustic soda (NaOH) (dry basis)	MTPA	-	-	-	-	40kg/ADMT	660	1 320	2 640	-	-	-	-
Fuel oil	MTPA	155kg/ADMT	2 560	5 120	10 240	300kg/ADMT	4 950	9 900	19 800	290kg/FMT	4 790	9 580	19 160
Electric Power Purchased	MWh/A	560 kWh/ADMT	9 240	18 480	36 960	800 kWh/ADMT	13 200	26 400	52 800	1650kWh/FMT	17 330	34 660	69 320
Water	10 ³ m ³ /A	80m ³ /ADMT	1 220	2 440	4 880	25m ³ /ADMT	4 125	8 250	16 500	100m ³ /FMT	1 650	3 300	6 600
Labor	MH/A	-	244 000	276 000	316 000	-	276 000	308 000	348 000	-	308 000	340 000	380 000
Labor Force (excluding administration)	Men	-	122	138	158	-	138	154	174	-	154	170	190
Annual Operating Period	Days	-	330	330	330	-	330	330	330	-	330	330	330
Annual Manufacturing Cost (US\$/A)													
Pulpwood - unbarked		US\$ 7.00/m ³	609 000	1 218 000	2 436 000		672 000	1 344 000	2 688 000		637 000	1 274 000	2 548 000
Chemical wood-pulp		150.00/ADMT	-	-	-		-	-	-		-	-	-
Saltsake		40.00/MT	40 000	80 000	160 000		44 000	88 000	176 000		40 000	80 000	160 000
Limestone		10.00/MT	5 000	10 000	20 000		12 000	24 000	48 000		5 000	10 000	20 000
Soda ash		40.00/MT	-	-	-		-	-	-		-	-	-
Sulphur		30.00/MT	-	-	-		-	-	-		-	-	-
Chlorine		75.00/MT	-	-	-		111 000	222 000	444 000		-	-	-
Caustic soda		70.00/MT	-	-	-		46 000	92 000	184 000		-	-	-
Fuel oil		20.00/MT	51 000	102 000	204 000		99 000	198 000	396 000		96 000	192 000	384 000
Electric power		8.00/MWh	74 000	148 000	296 000		166 000	332 000	664 000		139 000	278 000	556 000
Other materials		-	115 000	231 000	462 000		132 000	264 000	528 000		138 000	276 000	552 000
Labor		3.00/MH	732 000	828 000	948 000		828 000	924 000	1 044 000		924 000	1 020 000	1 140 000
Administration and overhead		-	600 000	650 000	700 000		650 000	700 000	750 000		700 000	750 000	800 000
Contingencies		-	74 000	143 000	274 000		100 000	192 000	378 000		61 000	120 000	200 000
Total			2 300 000	3 400 000	5 500 000		2 800 000	4 200 000	6 900 000		2 800 000	4 100 000	6 600 000
Unit Manufacturing Cost (US\$/MT)													
Pulpwood - unbarked			36.90	36.90	36.90		40.70	40.70	40.70		38.60	38.60	38.60
Chemical woodpulp			-	-	-		-	-	-		-	-	-
Saltsake			2.40	2.40	2.40		2.70	2.70	2.70		2.40	2.40	2.40
Limestone			0.30	0.30	0.30		0.70	0.70	0.70		0.30	0.30	0.30
Soda ash			-	-	-		-	-	-		-	-	-
Sulphur			-	-	-		-	-	-		-	-	-
Chlorine			-	-	-		6.70	6.70	6.70		-	-	-
Caustic soda			-	-	-		2.80	2.80	2.80		-	-	-
Fuel oil			3.10	3.10	3.10		6.00	6.00	6.00		5.80	5.80	5.80
Electric power			4.50	4.50	4.50		6.40	6.40	6.40		6.40	6.40	6.40
Other materials			7.00	7.00	7.00		8.00	8.00	8.00		12.00	12.00	12.00
Labor			44.40	25.10	14.40		50.20	28.00	15.80		56.00	30.90	17.30
Administration and overhead			36.40	19.70	10.60		39.40	21.20	11.40		42.40	22.60	12.10
Contingencies			3.00	3.00	3.80		3.40	3.80	3.80		3.10	3.00	3.10
Total			138.00	102.00	83.00		167.00	127.00	105.00		169.00	124.00	100.00

Annex 5 (cont.)

Annex 5 (continued)

Item	Units	Price	Bleached kraft pulp and paper (bag, sack and wrapping papers)			Newsprint (Partially integrated) (hardwood groundwood, purchased chemical pulp)				
			Rate	50 MTPD	100 MTPD	200 MTPD	Rate	50 MTPD	100 MTPD	200 MTPD
Statistics										
Production (pulp: air-dry; paper: finished weight)	MTPA	-	-	16 500	33 000	66 000	-	16 500	33 000	66 000
Pulpwood - solid wood	m ³ /A	6.0m ³ /FMT	-	99 000	198 000	396 000	1.8m ³ /FMT	30 000	60 000	120 000
Chemical woodpulp (semi-bleached kraft)	ADMTPA	-	-	-	-	-	0.21ADMTPA/FMT	3 500	7 000	14 000
Saltcake (Na ₂ SO ₄)	MTPA	66kg/FMT	-	1 096	2 180	4 368	-	-	-	-
Limestone (Ca CO ₃)	MTPA	70kg/FMT	-	1 155	2 310	4 620	-	-	-	-
Soda ash (Na ₂ CO ₃)	MTPA	-	-	-	-	-	-	-	-	-
Sulphur	MTPA	-	-	-	-	-	-	-	-	-
Chlorine	MTPA	90kg/FMT	-	1 485	2 970	5 940	-	-	-	-
Caustic soda (Na OH) (dry basis)	MTPA	40kg/FMT	-	660	1 320	2 640	-	-	-	-
Fuel oil	MTPA	420kg/FMT	-	6 950	13 900	27 800	280kg/FMT	4 620	9 240	18 480
Electric Power Purchased	MWH/A	1 200kWh/FMT	-	19 800	39 600	79 200	1 750kWh/FMT	28 880	57 760	115 520
Water	10 ³ m ³ /A	270m ³ /FMT	-	4 455	8 910	17 820	50m ³ /FMT	825	1 650	3 300
Labor	MH/A	-	-	348 000	380 000	420 000	-	230 000	270 000	326 000
Labor force (excluding administration)	Men	-	-	174	190	210	-	115	135	153
Annual Operating Period	Days	-	-	330	330	330	-	330	330	330
Annual Manufacturing Cost (US\$/A)										
Pulpwood - unbarked	US\$	7.00/m ³ _B	-	693 000	1 386 000	2 772 000	-	210 000	420 000	840 000
Chemical woodpulp		150.00/ADMTP	-	-	-	-	-	525 000	1 050 000	2 100 000
Saltcake		40.00/MT	-	44 000	88 000	176 000	-	-	-	-
Limestone		10.00/MT	-	12 000	24 000	48 000	-	-	-	-
Soda ash		40.00/MT	-	-	-	-	-	-	-	-
Sulphur		30.00/MT	-	-	-	-	-	-	-	-
Chlorine		75.00/MT	-	111 000	222 000	444 000	-	-	-	-
Caustic soda		70.00/MT	-	46 000	92 000	184 000	-	-	-	-
Fuel oil		20.00/MT	-	139 000	278 000	556 000	92 000	184 000	368 000	
Electric power		8.00/MWH	-	158 000	316 000	632 000	231 000	462 000	924 000	
Other materials		-	-	247 000	495 000	990 000	170 000	330 000	660 000	
Labor		3.00/MH	-	1 044 000	1 140 000	1 260 000	690 000	810 000	978 000	
Administration and overhead		-	-	750 000	800 000	850 000	500 000	550 000	600 000	
Contingencies		-	-	56 000	159 000	188 000	82 000	94 000	230 000	
Total				3 300 000	5 000 000	8 100 000		2 500 000	3 900 000	6 700 000
Unit Manufacturing Cost (US\$/MT)										
Pulpwood - unbarked				42.00	42.00	42.00		12.70	12.70	12.70
Chemical woodpulp				-	-	-		31.80	31.80	31.80
Saltcake				2.70	2.70	2.70		-	-	-
Limestone				0.70	0.70	0.70		-	-	-
Soda ash				-	-	-		-	-	-
Sulphur				-	-	-		-	-	-
Chlorine				6.70	6.70	6.70		-	-	-
Caustic soda				2.80	2.80	2.80		-	-	-
Fuel oil				8.40	8.40	8.40		5.60	5.60	5.60
Electric power				9.60	9.60	9.60		14.00	14.00	14.00
Other materials				15.00	15.00	15.00		10.00	10.00	10.00
Labor				63.30	34.50	19.10		41.80	24.50	14.80
Administration and overhead				45.50	24.20	12.90		30.30	16.70	9.10
Contingencies				3.30	3.40	3.10		3.80	3.70	3.00
Total				200.00	150.00	123.00		150.00	119.00	101.00

Annex 5 (cont.)

Annex 5 (concluded)

Item	Units	Price	Unbleached semichemical pulp and paper (hardwood NSSC corrugating board)			Bleached semichemical pulp and paper (hardwood NSSC book and writing papers)				
			Rate	50 MTPD	100 MTPD	200 MTPD	Rate	50 MTPD	100 MTPD	200 MTPD
Statistics										
Production (pulp: air-dry; paper: finished weight)	MTPA	-	-	16 500	33 000	66 000	-	16 500	33 000	66 000
Pulpwood - solid wood	m ³ /A	2.7m ³ /FMT	-	45 000	90 000	180 000	3.9m ³ /FMT	65 000	130 000	260 000
Chemical woodpulp (semi-bleached kraft)	ADMTPA	-	-	-	-	-	-	-	-	-
Saltcake (Na ₂ SO ₄)	MTPA	-	-	-	-	-	-	-	-	-
Limestone (Ca CO ₃)	MTPA	-	-	-	-	-	-	-	-	-
Soda ash (Na ₂ CO ₃)	MTPA	135kg/FMT	-	2 250	4 500	9 000	325kg/FMT	5 400	10 800	21 600
Sulphur	MTPA	40kg/FMT	-	700	1 400	2 800	125kg/FMT	2 035	4 070	8 140
Chlorine	MTPA	-	-	-	-	-	155 kg/FMT	2 530	5 060	10 120
Caustic soda (Na OH) (dry basis)	MTPA	-	-	-	-	-	70kg/FMT	1 180	2 360	4 720
Fuel oil	MTPA	420kg/FMT	-	6 950	13 900	27 800	570kg/FMT	9 400	18 800	37 600
Electric Power Purchased	MWH/A	900kWh/FMT	-	14 850	29 700	59 400	1 200 kWh/FMT	19 800	39 600	79 200
Water	10 ³ m ³ /A	50m ³ /FMT	-	825	1 650	3 300	200m ³ /FMT	3 300	6 600	13 200
Labor	MH/A	-	-	224 000	256 000	296 000	-	284 000	316 000	356 000
Labor Force (excluding administration)	Men	-	-	112	128	148	-	142	158	178
Annual Operating Period	Days	-	-	330	330	330	-	330	330	330
Annual Manufacturing Cost (US\$/A)										
Pulpwood - unbarked		US\$ 7.00/m ³ a	-	315 000	630 000	1 260 000	-	455 000	910 000	1 820 000
Chemical woodpulp		150.00/ADMT	-	-	-	-	-	-	-	-
Saltcake		40.00/MT	-	-	-	-	-	-	-	-
Limestone		10.00/MT	-	-	-	-	-	-	-	-
Soda ash		40.00/MT	-	90 000	180 000	360 000	-	216 000	432 000	864 000
Sulphur		30.00/MT	-	21 000	42 000	84 000	-	61 000	122 000	244 000
Chlorine		75.00/MT	-	-	-	-	-	198 000	380 000	760 000
Caustic soda		70.00/MT	-	-	-	-	-	83 000	166 000	332 000
Fuel oil		20.00/MT	-	139 000	278 000	556 000	-	188 000	376 000	752 000
Electric power		8.00/MWH	-	119 000	238 000	476 000	-	158 000	316 000	632 000
Other materials		-	-	132 000	264 000	528 000	-	297 000	594 000	1 188 000
Labor		3.00/MH	-	672 000	768 000	838 000	-	852 000	948 000	1 070 000
Administration and overhead		-	-	500 000	550 000	600 000	-	600 000	650 000	700 000
Contingencies		-	-	112 000	150 000	248 000	-	100 000	106 000	238 000
Total				2 100 000	3 100 000	5 000 000		3 200 000	5 000 000	8 600 000
Unit Manufacturing Cost (US\$/MT)										
Pulpwood - unbarked				19.19	19.10	19.10		27.60	27.60	27.60
Chemical woodpulp				-	-	-		-	-	-
Saltcake				-	-	-		-	-	-
Limestone				-	-	-		-	-	-
Soda ash				5.40	5.40	5.40		13.10	13.10	13.10
Sulphur				1.30	1.30	1.30		3.70	3.70	3.70
Chlorine				-	-	-		11.50	11.50	11.50
Caustic soda				-	-	-		5.00	5.00	5.00
Fuel oil				8.40	8.40	8.40		11.40	11.40	11.40
Electric power				7.20	7.20	7.20		9.60	9.60	9.60
Other materials				8.00	8.00	8.00		18.00	18.00	18.00
Labor				40.70	23.20	13.50		51.60	28.70	16.20
Administration and overhead				30.30	16.70	9.10		36.40	19.70	10.60
Contingencies				3.60	3.70	3.00		3.10	3.70	3.30
Total				124.09	93.00	75.00		191.00	152.00	130.00

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Annex 6

MILL - NET PRICE AND GROSS EARNINGS ESTIMATES

Item	Units	Unbleached kraft pulp			Bleached kraft pulp			Unbleached kraft pulp and paper			Bleached kraft pulp and paper			
		50	100	200	50	100	200	50	100	200	50	100	200	
Approximate World Price	US\$/MT		135			155			190			220		
Less Allowances for: - Selling Expense	US\$/MT		5			5			10			10		
Freight Expense	US\$/MT		<u>20</u>			<u>20</u>			<u>20</u>			<u>20</u>		
Total deductions	US\$/MT		25			25			30			30		
Estimated Mill-Net Price	US\$/MT		110			130			160			190		
Plant Capacity	MTPD		50	100	200	50	100	200	50	100	200	50	100	200
Annual Net Sales	US\$/A	1 815 000	3 630 000	7 260 000	2 145 000	4 290 000	8 580 000	2 640 000	5 280 000	10 560 000	3 135 000	6 270 000	12 540 000	
Annual Manufacturing Cost	US\$/A	2 300 000	3 400 000	5 500 000	2 800 000	4 200 000	6 900 000	2 800 000	4 100 000	6 600 000	3 300 000	5 000 000	8 100 000	
Annual Gross Profit	US\$/A	(Loss)	230 000	1 760 000	(Loss)	90 000	1 680 000	(Loss)	1 180 000	3 960 000	(Loss)	1 270 000	4 440 000	
Gross Earnings on Investment (before depreciation, interest and income taxes)	Percent	(Loss)	3	14	(Loss)	1	9	(Loss)	10	21	(Loss)	8	19	

Annex 6 (concluded)

Item	Units	Newsprint (Partially integrated)			Unbleached semichemical pulp and paper			Bleached semichemical pulp and paper		
		50	100	200	50	100	200	50	100	200
Approximate World Price	US\$/MT		150			145			220	
Less Allowances For: Selling Expense	US\$/MT		5			5			10	
Freight Expense	US\$/MT		20			20			20	
Total deductions	US\$/MT		25			25			30	
Estimated Mill-Net Price	US\$/MT		125			120			190	
Plant Capacity	MTPD	50	100	200	50	100	200	50	100	200
Annual Net Sales	US\$/A	2 063 000	4 125 000	8 250 000	1 980 000	3 960 000	7 920 000	3 135 000	6 270 000	12 540 000
Annual Manufacturing Cost	US\$/A	2 500 000	3 900 000	6 700 000	2 100 000	3 100 000	5 000 000	3 200 000	5 000 000	8 600 000
Annual Gross Profit	US\$/A	(Loss)	225 000	1 550 000	(Loss)	860 000	2 920 000	(Loss)	1 270 000	3 940 000
Gross Earnings on Investment (Before depreciation, interest and income taxes)	Percent	(Loss)	2	10	(Loss)	10	23	(Loss)	10	20

Annex 7

TOTAL PRODUCTION COST ESTIMATES INCLUDING CAPITAL CHARGES EXCEPT INCOME TAXES

(Dollars)

	Unbleached kraft pulp			Bleached kraft pulp			Unbleached kraft pulp and paper			Bleached kraft pulp and paper		
	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD
1 Structures	900 000	1 200 000	1 800 000	1 200 000	1 800 000	2 600 000	1 100 000	1 500 000	2 300 000	1 400 000	2 000 000	3 100 000
2 Equipment	3 100 000	4 600 000	7 000 000	4 400 000	6 200 000	9 600 000	4 800 000	6 400 000	10 000 000	6 200 000	8 100 000	12 500 000
3 Construction expenses	1 200 000	1 700 000	2 600 000	1 700 000	2 400 000	3 600 000	1 800 000	2 400 000	3 700 000	2 300 000	3 000 000	4 700 000
4 Total plant capital	5 200 000	7 500 000	11 400 000	7 300 000	10 400 000	15 800 000	7 700 000	10 300 000	16 000 000	9 900 000	13 100 000	20 300 000
plus,												
5 Interest during construction	150 000	200 000	300 000	200 000	300 000	500 000	250 000	300 000	500 000	300 000	400 000	600 000
6 Total capital subject to depreciation	5 350 000	7 700 000	11 700 000	7 500 000	10 700 000	16 300 000	7 950 000	10 600 000	16 500 000	10 200 000	13 500 000	20 900 000
plus,												
7 Working capital	650 000	800 000	1 300 000	1 000 000	1 300 000	1 700 000	1 050 000	1 400 000	2 000 000	800 000	1 500 000	2 100 000
8 Total investment	6 000 000	8 500 000	13 000 000	8 500 000	12 000 000	18 000 000	9 000 000	12 000 000	18 500 000	11 000 000	15 000 000	23 000 000
9 Total annual depreciation (6.66% of "6")	356 700	513 400	780 000	500 000	713 400	1 086 700	530 000	706 700	1 100 000	680 000	900 000	1 393 400
10 Allowance to cover profit and interest (10% of "8")	600 000	850 000	1 300 000	850 000	1 200 000	1 800 000	900 000	1 200 000	1 850 000	1 100 000	1 500 000	2 300 000
11 Total capital charges except income taxes (9+10)	956 700	1 363 400	2 080 000	1 350 000	1 913 400	2 886 700	1 430 000	1 906 700	2 950 000	1 780 000	2 400 000	3 693 400
12 Total production (in tons)	16 500	33 000	66 000	16 500	33 000	66 000	16 500	33 000	66 000	16 500	33 000	66 000
13 Capital charges per unit (11% 12)	58	41	32	82	58	44	87	58	45	108	73	56
14 Direct unit manufacturing cost	138	102	83	167	127	105	169	124	100	200	150	123
15 Total unit production cost except income taxes	196	143	115	249	185	149	256	182	145	308	223	179
16 Estimated mill net price-world basis	110	110	110	130	130	130	160	160	160	190	190	190

Annex 7 (concluded)

	Newsprint			Unbleached semichemical pulp and paper			Bleached semichemical pulp and paper		
	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD	50 MTPD	100 MTPD	200 MTPD
1 Structures	900 000	1 300 000	1 800 000	800 000	1 100 000	1 600 000	1 200 000	1 700 000	2 400 000
2 Equipment	4 000 000	5 400 000	8 300 000	3 800 000	4 900 000	6 700 000	5 100 000	6 800 000	10 400 000
3 Construction expenses	1 500 000	2 000 000	3 000 000	1 400 000	1 800 000	2 500 000	1 900 000	2 600 000	3 800 000
Total plant capital	6 400 000	8 700 000	13 100 000	6 000 000	7 800 000	10 800 000	8 200 000	11 100 000	16 600 000
plus,									
5 Interest during construction	200 000	250 000	400 000	200 000	250 000	300 000	250 000	300 000	500 000
6 Total capital subject to depreciation	6 600 000	8 950 000	13 500 000	6 200 000	8 050 000	11 100 000	8 450 000	11 400 000	17 100 000
plus,									
7 Working capital	900 000	1 050 000	1 500 000	800 000	950 000	1 400 000	1 050 000	1 600 000	2 900 000
8 Total investment	7 500 000	10 000 000	15 000 000	7 000 000	9 000 000	12 500 000	9 500 000	13 000 000	20 000 000
9 Total annual depreciation (6.66% of "6")	440 000	596 700	900 000	413 400	536 700	740 000	563 400	760 000	1 140 000
10 Allowance to cover profit and interest (10% of "8")	750 000	1 000 000	1 500 000	700 000	900 000	1 250 000	950 000	1 300 000	2 000 000
11 Total capital charges except income taxes (9 + 10)	1 190 000	1 596 700	2 400 000	1 113 400	1 436 700	1 990 000	1 513 400	2 060 000	3 140 000
12 Total production (in tons)	16 500	33 000	66 000	16 500	33 000	66 000	16 500	33 000	66 000
13 Capital charges per unit (11% 12)	72	48	36	67	44	30	92	62	48
14 Direct unit manufacturing cost	150	119	101	124	93	75	191	152	130
15 Total unit production cost except income taxes	222	167	137	191	137	105	283	214	178
16 Estimated mill net price-world basis	125	125	125	120	120	120	190	190	190

Figure I

UNIT INVESTMENT REQUIRED

Natural scale

Unit total plant investment
(Millions of dollars per daily ton of capacity)

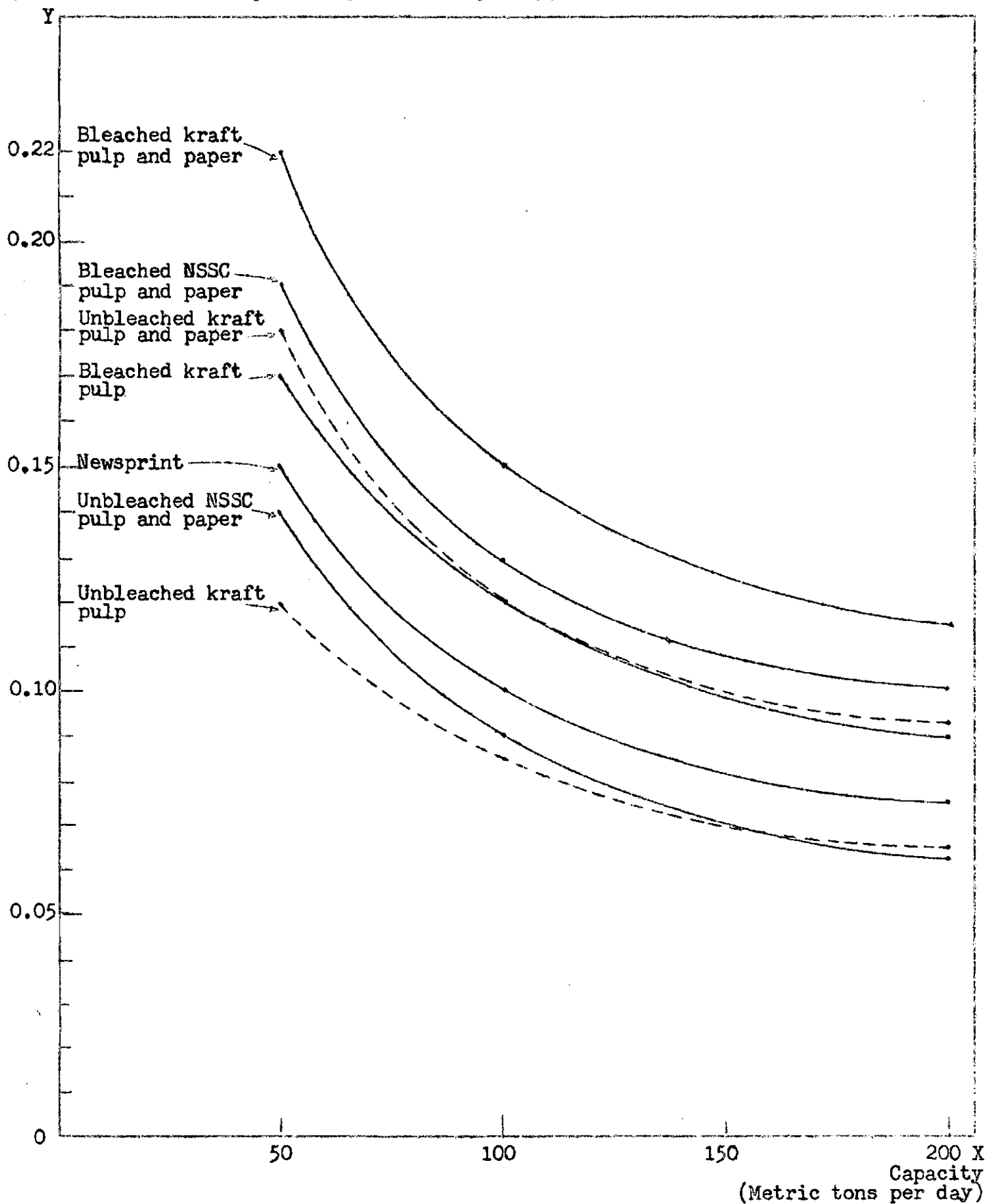


Figure II

DIRECT UNIT MANUFACTURING COSTS

Natural scale

Direct unit manufacturing costs
(Dollars per metric ton)

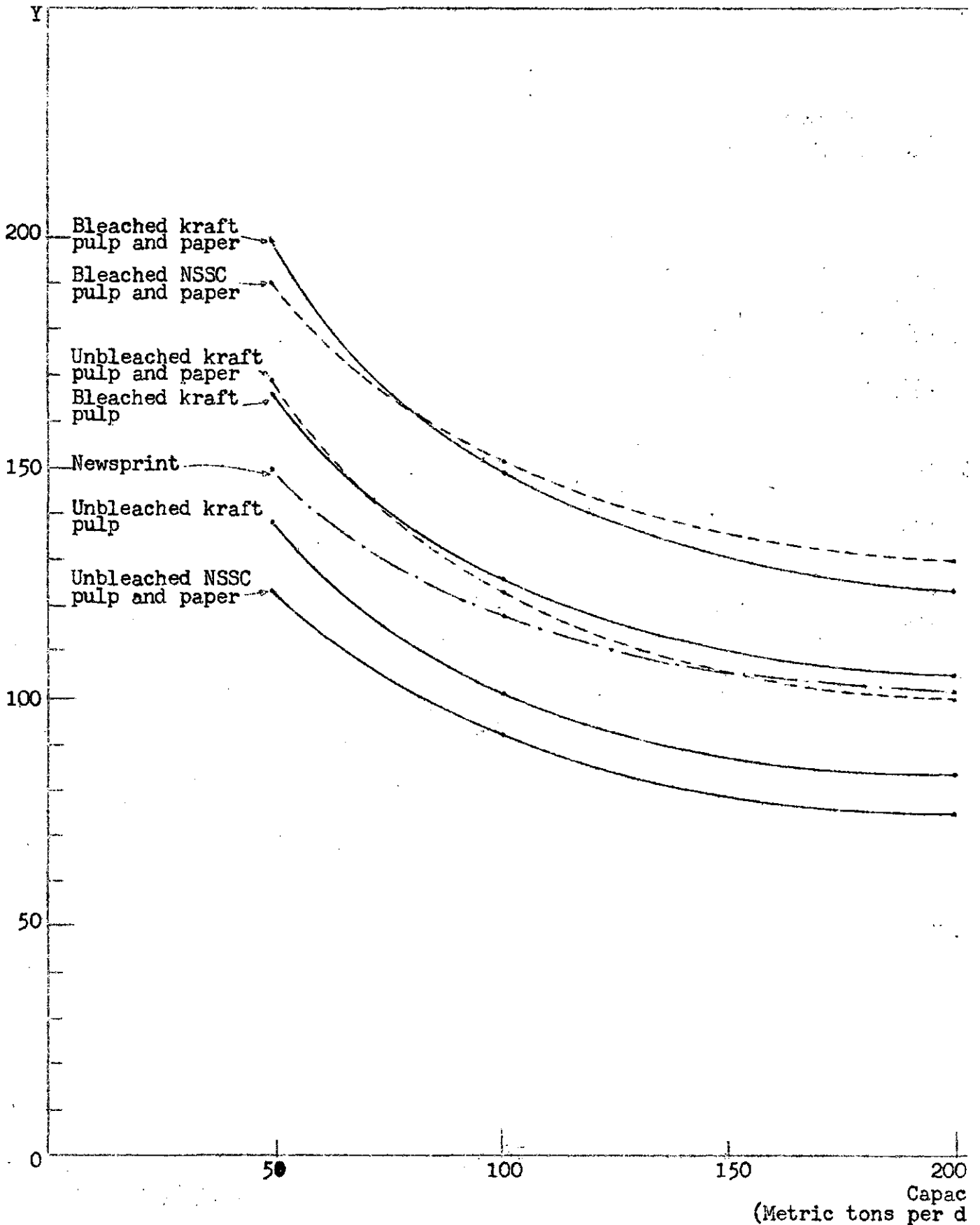


Figure III

TOTAL UNIT PRODUCTION COSTS

Natural scale

Total production costs
(Dollars per metric ton)

