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Symposium on the Development of the Plastics
Fabrication Industry in Latin America

Bogotà, Colombia, 20 November - 1 December 1972

COSTING METHODS FOR INVESTMENT REQUIREMENTS AND ESTIMATES IN FABRICATION OF PLASTICS [1/]

by

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SUMMARY

COSTING METHODS FOR INVESTMENT REQUIREMENTS AND ESTIMATES IN FABRICATION OF PLASTICS[1/]

by

John F. Lontz
Consultant
Wilmington, Delaware, U.S.A.

As in any industry committed to capital investment for initial outlay and for sustained economic return on investment costing methods and systems in plastics fabrication are indispensible adjuncts for (a) maintaining effective productivity of the committed investment in machinery and facilities and (b) developing expanded outlets or markets whereby costing methods plastics can demonstrate economic advantages over competitive, conventional materials. Regardless of the accounting approach, the application of a costing method into the production system should be a continuing exercise and surveillance for sound management and for short term and long range planning objectives.

Costing methods are as varied as the preferences and bias of circumstances under which the accounting methods are employed, and as a result "cost" can mean different

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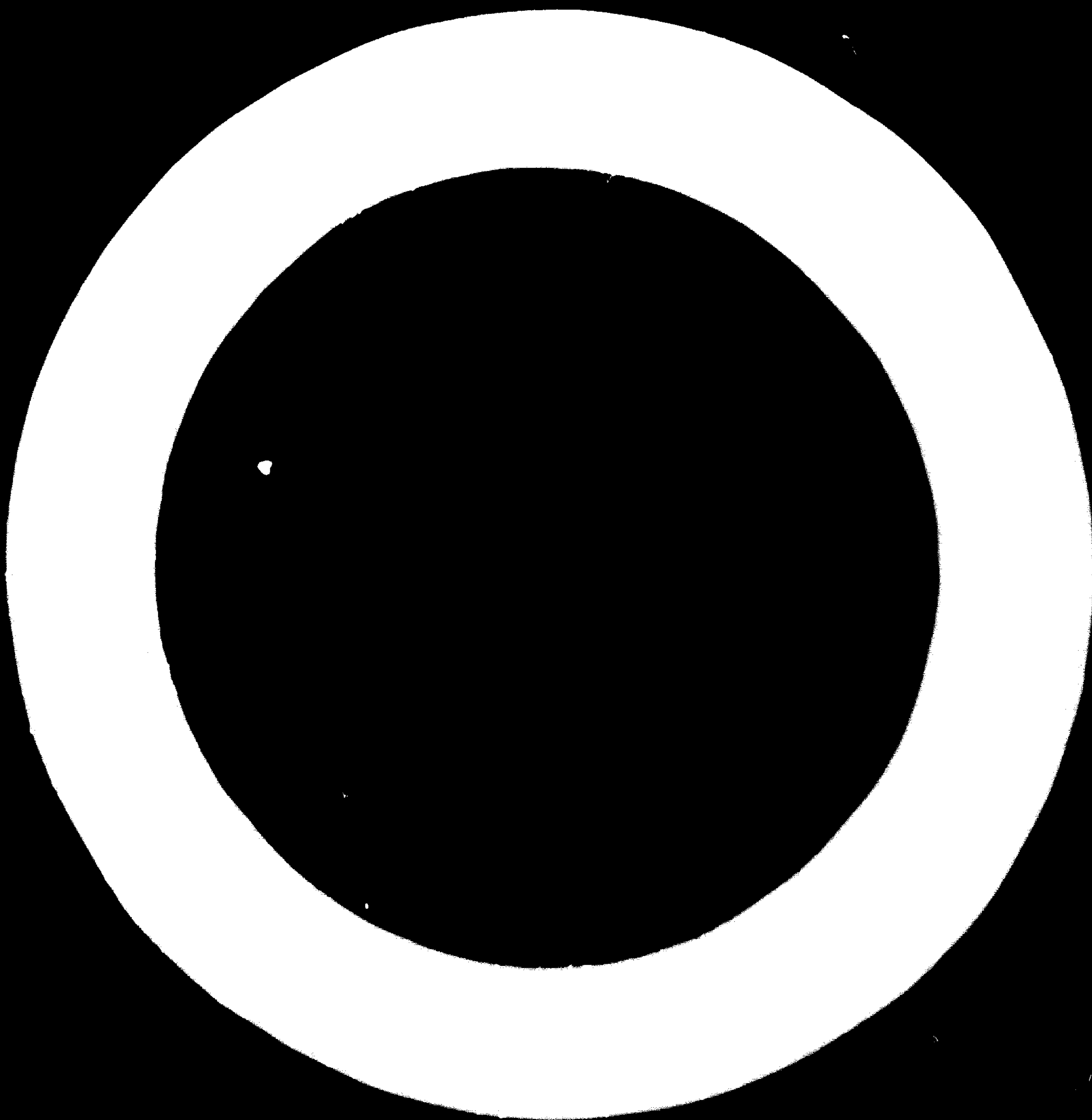
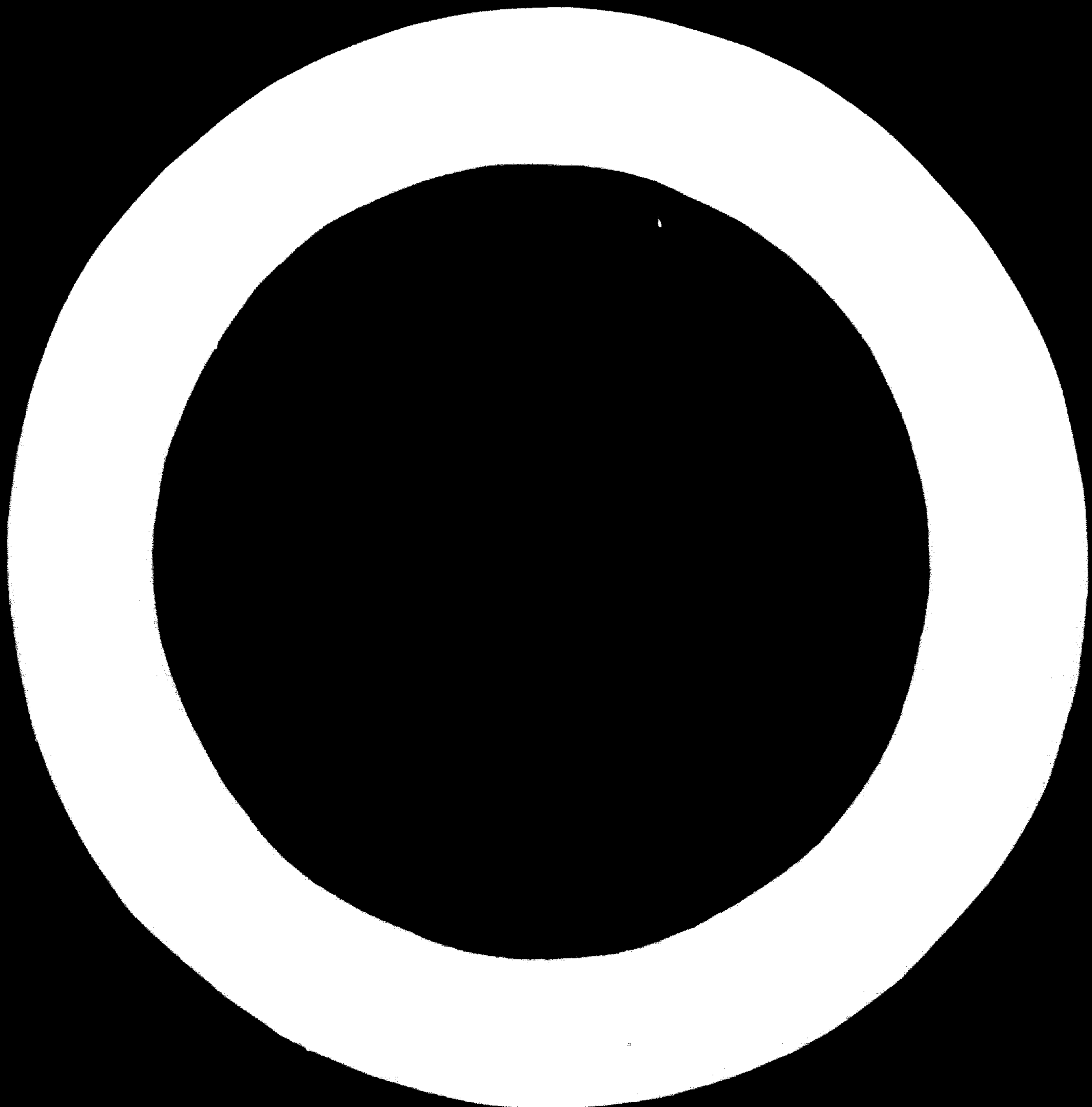


things to different people. Nevertheless, continued development and application of a costing system despite divergent terms of reference can serve as an important feature of decision analysis in two respects, namely, (a) determining capital investment, new and supplemental, for initiating, modernizing, or expanding plastics fabrication technology, and (b) maintaining high return on investment, earnings, or profitability.

In fulfilling these two features, two costing methods are appropriate. The first of these, Investment Costing System (ICS), relates to estimating earnings and return on investment on an annualized basis for a given capital committment. This system is particularly suited, and even madatory, for fabrication projects involving large scale constructions usually of a standardized design and specifications such as piping, conduits, containers, sheeting, and the like for markets or planned requirements in agriculture, transportation, and construction of housing. A specific, hypothetical exercise is presented for the case of manufacturing glass fibre reinforced piping and conduits of large diameters with such advantages over iron pipe as lowered unit weight and corrosion resistance in fresh and disposed water. In the ICS system there is provided an integrated estimate starting from market estimates with built-in flexibility for adjusting cost items all the way from initial investment, through materials costs and operations costs, to final transfer or sales.

A second and common method is the Unit Cost System (UCS), of equal importance as the ICS, in which the production of a specific article, hence a unit, is subjected to a preliminary cost estimate to ensure that the final cost along with a statutory return in investment is carefully scrutinized and firmed. In this case, a hypothetical example is provided for an injection moulded article, whose design may change from time to time, as an exercise for determining the economic choice between two acceptable plastics but with some possible differences in resin cost and unit output.

In the final analysis, the two costing methods and derived systems of productivity, in whatever format is chosen by management, one should be readily converted [illegible] form of system analysis and the subsequent decision analysis [illegible] simplified costing methods [illegible] requirements and on-going estimates in plastics fabrication.



C O N T E N T S

PURPOSE OF THIS REPORT

This presentation is an exercise in developing investment costs and Return on Investment in relation to specific fabrication of plastics articles. As an exercise of a purely hypothetical nature, it is intended to convey some acquaintance with costing methods which can be expected to vary with needs and opportunities for fabrication of plastics in developing countries. In some instances costs may be of lesser importance temporarily than the need for developing indigenous fabrication technology, which in itself may have long-term reward or return by the very cogent aspect of developing a self-sufficient industry.

The author desires to express the caution that this presentation is simply an exercise, gleaned from years of experience in surveying and assessing various plastics fabrication technologies some of which were unique to a specific plastic endowed with unique property merits. Some have proved to be short-lived largely from lack of appreciation of the costs that in time deprived the plastics article of its market opportunity because of excessive investment and hence loss of profits. Still others failed by inadequate planning to exploit market potential. It is therefore hoped that some costing system will be utilized diligently as an integral part of plastics technology in seeking and fulfilling needs and applications in agriculture, housing, sanitation, transportation, and innumerable consumer items.

I. INTRODUCTION

As in any industry committed to capital investment for initial outlay and for sustained economic return on investment costing methods and systems in plastics fabrication are indispensible adjuncts for (a) maintaining effective productivity of the committed investment in machinery and facilities and (b) developing expanded outlets or markets where by costing methods plastics can demonstrate economic advantages over competitive, conventional materials. Regardless of the accounting approach, the application of a costing method into the production system should be a continuing exercise and surveillance for sound management and for short term and long range planning objectives.

Costing methods are as varied as the preferences and bias of circumstances under which the accounting methods are employed, and as a result "cost" can mean different things to different people (1). Nevertheless, continued development and application of a costing system despite divergent terms of reference can serve as an important feature of decision analysis in two respects; namely, (a) determining capital investment, new and supplemental, for initiating, modernizing, or expanding plastics fabrication technology, and (b) maintaining high return on investment, earnings, or profitability.

In fulfilling these two features, two costing methods are appropriate. The first of these, Investment Costing System (ICS), relates to estimating earnings and return on investment on an annualized basis for a given capital committment. This system is particularly suited, and even mandatory, for fabrication projects involving large scale constructs usually of a standardized design and specifications such as piping, conduits, containers, sheeting, and the like for markets or planned requirements in agriculture, transportation, and construction of housing. A specific, hypothetical exercise is presented for the case of manufacturing glass fiber reinforced piping and conduits of large diameters with such advantages over iron pipe as lowered unit weight and corrosion resistance in fresh and disposed water. In the ICS system there is provided an integrated estimate starting from market estimates with built-in flexibility for adjusting cost items all the way from initial investment, through materials costs and operations costs, to final transfer or sales.

A second and common method is the Unit Cost System (UCS), of equal importance as the ICS, in which the production of a specific article, hence a unit, is subjected to a preliminary cost estimate to ensure that the final cost along with a statutory return in investment is carefully scrutinized and firmed. In this case, a hypothetical example is provided for an injection molded article, whose design may change from time to time, as an exercise for determining the economic choice between two acceptable plastics but with some possible differences in resin cost and unit output.

II. Estimating the Market or Planned Needs

In any costing system, the determination of the market potential along with more definable market opportunities is of paramount importance before any committment to capital investment is undertaken. Acquiring new plastics fabrication facilities involves considerable risk in two respects. First of these is either (a) over-capacity which imposes an unnecessary drain on capital resources or source of capital funding or (b) under-capacity with loss of sales opportunity as the plastics items becomes economically competitive. Secondly, there is the risk of early obsolescence of the committed equipment and this would be tantamount to loss of capital through its dis-use. Consequently, the preparation of market estimates or estimates of specific needs of items for essential productivity in a given country or region is an indispensible activity and exercise. It is not done just once as for preliminary or initial planning. Rather, it should be revised continually and constructed from several points of views, economic, and even esthetic, and of course in relation to national or regional needs.

Constant Preparation of Market Estimates and Forecasts. The estimation of market potential and wherever possible realistic market opportunities is an activity and exercise that must be carried out with regular periods of forecasts, such as one, three and more years in advance, or some appropriate combination of short term and long term intervals. The long term forecasts would be applicable to such plastics construction items as conduits and pipe for the conveyance of water and waste disposal with a recurring need for nationally planned programs that could extend for decades. In contrast, there would be short-term needs that would fulfill ever-changing designs, either by virtue of engineering durability or by virtue of esthetic appeal. In the latter case one could present the example of standardized crates for containers of milk, fruit juices or beverages on the one hand, and protective helmets or headgear which undergo styled changes from year to year. In these instances, the market estimates dictate the specific capital equipment and ancillary components that would be selected for the articles to be manufactured at costs reasonably acceptable on competitive basis with articles fabricated or designed with non-plastics materials, notably metals, or would be competitive with potential imports.

Market Potential and Opportunities versus Unit Costs. In view of what has just been stated, the revisions or adjustments in the market estimates can provide the means for ascertaining how to expand the production volume and at the same time gain a significant return in terms of earnings or profit. Market potential represents the sales volume for a given plastics fabricated article that would completely fulfill the needs without consideration of the unit cost. An example in this case would be the market potential exclusive of unit cost, for instance, for shipping shipping crates made either out of wood, iron screen, aluminum flat stock, or injection-molded plastics resin. Let us assume that each materials type is produced for the numerous design variations of the crates and that the sales price is accorded to each type, in which the plastics crate has only a fractional potential or what can be termed market opportunity, cost considered. In effect there is a gap between the market potential and the market opportunity for the given plastics crate. If we now recall that the plastics crate has the advantage of longer endurance over the wood by virtue of being rot-proof, over iron screen by virtue of non-rusting, and over aluminum by virtue of salt water resistance, then we can locate in the gap between the market potential and market opportunity, some incremental for the plastics crate for increased sales volume. Hence, market potential and market opportunities represent the boundary limits, so to speak, within which unit costs estimates available for modifications in design and selection of the appropriate favor plastics resin to make the given plastics crate competitive. Finally, when the market opportunity is annualized, it is then a matter of determining long range, sustained productivity of the committed investment.

III. Investment Costing System

From a purely economic standpoint, the investment costs exists in order to determine such features as income over costs, or return on investment in meeting the market needs or national planned programs. Costing systems are primarily components of accounting of costs for specified categories stemming from investments, which in the case of the plastics fabrication industries, relate to the machinery and equipment procured for producing plastics articles. The systems may vary as the management elects to categorize the costs. The ideal system would therefore be the one that accounts for all costs, including those that may be allocated from other fabrications or supplementing processes, or where plant and facilities are shared by some allocation. One such system of investment costing is depicted in Chart 1 where direct investment costs are (A) progressively supplemented by allocated costs (B) as in the case where new investment is added on to an existing plastics fabrication operation. These costing investment costs are further defined as follows.

Direct Plant Investment. This category is usually the permanent investment feature that is ascribed to a specific plastics fabrication for which a total engineering preparation and installation has been made from starting plastics materials to the finished article, sold or transferred to the consumer or using agency. However, as in any manufacturing line, numerous supporting engineering facilities that remain permanently with the major fabrication item are added for the integrated manufacturing operations, including the building in which the fabrication is located and all service lines.

Allocated Investment. When a new plastics fabrication line is added, it usually acquires a share of the central facilities of the original or predecessor plant, including the building site, utilities and general facilities. These may increase or improve with passing years and hence must be, as shown in the chart, added to the direct plant investment.

Inclusive Direct Plant Investment. This is the combined subtotal of the Direct Plant Investment and the Allocated Investment. It is useful as a guide for determining the proportionate share of the preceding investment costs. It may serve to determine whether or not existing plant utilities and facilities to which a new investment is to be added may be excessive and hence suggest new line of utilities, or facilities or even a new site for reasons of obsolescence of the pre-existing building and facilities. In other words, a scrutinization of the prior investment in buildings, utilities, and facilities, that may be expensive, inefficient, or obsolete, may well justify additional investment in the Direct Plant Investment. It must be borne in mind that often obsolete allocated investment may impose prohibitive costs for expanded or new fabrication lines.

Supplemental Investment. Referred to as subsidiary investment, and often ignored in costing systems are costs in special equipment and facilities that are pooled with other manufacturing lines. This would be in the form of special gauges or testing equipment utilized off the plant, transportation to distant warehousing, technological centre support, and so on. This category of costs could be included in the Allocated Investment, but is suggested as a separate component for reasons that it may not be recurring as the latter and subject to changes in less than a year or two. It would also be particularly useful in some minor investment to support some equipment that is procured on a lease basis such as dies for injection-molding and extrusion.

Permanent Investment. While the term permanent may not be altogether proper, it is the additive cost involving the combined sub-totals of the Inclusive Direct Plant Investment and the Supplemental Investment. Again as in the case of the Inclusive Direct Plant Investment it can serve for intermediate surveillance of the now gradually increasing investment costs and be useful for management to determine the need for the supplemental investment as well as possible over-capitalization.

Working Capital. This category of the investment costing provides for the required cash to maintain the necessary payments of operations and purchases, and also for listing the receivable accounts of deferred charges, and inventories to cite the conventional items. In effect these items impose a permanent bearing on the overall investment. Working capital serves as a component for monitoring accumulating costs as well as the ultimate effect on the total investment and must be monitored to make sure that it does not overburden the investment. It usually varies in many fabrication operations in the range of from 15 to 25 percent as determined by the writer's analysis of various plastics fabrication operations.

Total Investment. This investment now provides the aggregate total from which a measure of earnings and profit for the fabrication of a plastics article is determined from gross sales. When the latter is placed on an annual basis, or annualized as is often termed, it provides a useful measure of the fabrication operation efficiency in terms of a ratio of Return on Investment (ROI). The Return on Investment while merely a quotient, nonetheless can serve several purposes, chief among which is to provide an answer to a common question of how effectively the committed capital, hence the investment, is utilized. Just as lending facilities rate the use of money or funds in terms of interest rates, so the return on investment can be used as a percentage figure in the same manner. Most importantly, the Return on Investment provides an opportunity for management to evaluate profitable production, to set up priorities for listed articles of fabrication and to determine where efficient utilization can be made of the various component investments, to mention just a few monitoring features. By itself the total investment has little utility unless it is equated in relation to unit operating costs so that the Return on Investment can be determined on an annualized basis, such as will be described with a hypothetical, model case for the production of special type of plastics pipe for waste disposal.

IV. Illustrative Case of Investment Costing System

Estimated Annual Requirements. To provide a working example of the Investment Costing System, we shall start from a market estimate that has been developed after detailed study of a presumed urgent, high priority item, namely, the indigenous need for plastic pipe to be installed as a part of a much-needed waste-disposal system for chemical processing plants such as the discharge of corrosive effluents from phosphate production or corrosive brine for which metal pipes are prohibitive from the standpoint of corrosive attack and deterioration. Such a hypothetical model market estimate or governmental planning estimate is shown in Table 1 for which a glass-reinforced conduit is proposed and presented as an exercise with no implication for the presumed imports price or by competitive pipe meeting the engineering standards of static and impact strength. In this example, a trial estimate of the Return on Investment is the object of the costing system, that is, to determine on economical basis how sound or acceptable is the specific pipe making equipment and resin type to provide the strong, corrosion resistant pipe of the given dimensions. The price in this case of US $1.25 dollars per meter in a standards 12 meter, fabricated length of pipe is strictly hypothetical and readers should regard this only as an arithmetic exercise.

Material Composition - Ingredients and Costs. The next operation, as shown in Table 2, is to lay out the Materials Ingredient Cost as would be derived, shown in the lower section of Table 2, from the formulation of the resin and glass fiber to be used in producing the pipe. At this point, some prior development of resin-glass fiber test plaques with a range of ingredient proportions should have been made and checked out against typical corrosive effluents, under accelerating or exaggerating test conditions with elevated temperatures for deterioration translated into some terms of expected longevity. This is necessary in order to fix and specify the resin-glass fiber formulation, which may not necessarily be that indicated in Table 2. Once having established the formulation with reasonable assurance that it will fulfill the service with only minor adjustments, one is then to proceed with the costing operation.

Equipment Requirements. The hypothetical case is continued based on an ester resin composited with chopped and woven glass fibers which can be set up into a manufacturing line. In this phase of estimation the total number of manufacturing lines is determined as shown in Table 3 with unit equipment costs for various components of the complete line. The format set up in this Table 3 is one that can be revised to suit the preferences or opinions of the estimater. For the hypothetical case, the net equipment cost of US $195,000 now provides an important starting point for the serial costing sequence outlined in Chart 1. For the particular case of 576,000 meters for the second year of the estimate as shown in previously in Table 1, four (4) manufacturing lines are needed, based on the rather intensive around-the-clock 3-shift operations.

Investment Cost Estimate. Starting with the site preparation, presuming a new plant operation, the investment costs shown in Table 4 are now entered into the various components of the Direct and Allocated costs prescribed in Chart 1. In this hypothetical case the Total Investment amounts to US $676,100. This is also termed Total Project Cost as is often done with unit costing, that is, for developing costs of the plastic pipe on a per meter basis. Various accounting systems differ in this area, such as not including contingencies, which for the case of developing countries taking on new equipment and or processes the training of specialists, is applied in the direct plant costs just as the engineering and design services of the architect. This may be further supplemented or expanded by other cost categories. Regardless of the preference for supplementation, the important feature is to include the contingencies of these two specific cases in once-costed categories as a necessary price tag for the equipment or least related inseparably to it just as freight is applied to equipment cost.

Manufacturing or Operative Costs. Having determined the market opportunity and the ingredient costs, one then proceeds to develop the operative costs, such as described in Table 5, often referred to as the unit cost which provides two categories of costs, namely (a) the annualized operative costs needed for determining the Return on Investment in one case and (b) unit cost for a 12 meter length of the specific waste disposal pipe as a matter relating to the ultimate transfer price or sales price but also to value in use. For the particular case of the waste disposal pipe considered here, namely 48,000 12-meter lengths, Table 5 discloses a cost of manufacture on an annualized basis amounting to US $514,420 (Item 4) which with added overhead for sales, research and development, and administration provides a cost sales or transfer amounting to US $542,920. The latter figure now places the costing in a position for determining the next, important costing item.

In developing the manufacturing or operative costs, as shown in Table 5, the corresponding unit manufacturing cost for one single pipe-length, the form in which it would be sold or transferred to another project, is detailed for each of the costing items parallel to the costs on the annualized basis. Thus, one attains a cost of manufacture of US $10.72 for a single 12-meter length, which with added overhead increases this unit length cost to US $11.31.

The validity of the formats applied here to either the annualized cost or its coresponding unit cost is secondary to costing program. We are concerned here with the system of detailing all of the conceivable costs, pursued in some progressive order such as shown in Table 5. While other descriptive categories can be applied and perhaps even preferred by those embarking on the system, it is nevertheless significan to observe that both the annualized and the unit bases are completely interchangeable. It is evident also that such factors as costs of ingredients and their formulating level, the process lay-up and curing schedules, along with the dimensional requirements of the pipe will have a significant effect in modifying the figures given here several times that indicates as US $542,920 and US $11.31, respectively.

Return on Investment Analysis. It is axiomatic that investment in the form of committed capital should be expected to provide a return at least in the same order as investment that is in the form of negotiable deposits or cash drawing some rate of interest. Therefore, it is proper that once the latter moves into investment of capitalized equipment the same rate of interest now termed Return on Investment, should be realized from sales and transfer of the pipe produced or manufactured by the manufacturing line for which negotiable capital was expended. Table 6 provides a procedural summary of a hypothetical case for a waste-disposal pipe. With an approximated working capital such as shown in Table 6, applied to determine the total, net investment, the return on investment for this particular case as indicated in Table 7 amounts to 11.11 percent.

The Return on Investment can be used, as suggested in Table 5 to evaluate the performance of management over the production of the pipe in which at least 6 percent is attained along with an allowable overage of 3 percent. Thus the overall project and its management should attain at least 9 percent return on investment, or some other figure prescribed by the ownership or directorate over the fabrication operation. Any percentage points above this statutory figure gives a positive gain, while that below this statutory figure depicts a deficit which would then be scrutinized for the source and for corrective action. The latter may require re-pricing if all the technical efficiencies have been reasonably exhausted, so as to attain the positive excess over the statutory return on investment. It is not unusual to expect as high as 25 to 50 percent statutory return once the manufacturing operations had all the defects corrected, usually at about the third year of operation sustained for a period of 5 to 10 years. The latter is assured by continuing research and development including devising cost-saving operations and formulations.

V. Unit Costing System

Already included in the above Investment Costing System, in which the Unit Costing System has been applied to each corresponding costing item, this system is particularly applicable when (a) a new article is to be produced more often than not in competition with some established article and (b) when a new investment is considered to produce on larger or increased scale some plastics article often not efficiently produced from other competitive materials or construction. It is conceivable that some investment has already been committed and the experience of the manufacture is now ready for expanded production. In any case, the same system of costing is applied, commencing with a Market Estimate that establishes the level of required annualized production even though the specific article may involve a seasonal or fractional production schedule.

Market Characteristics or Features. It should be borne in mind that a plastics article must justify its cost merits against all possible competitive materials which a discriminating consumer would prefer thus negating the plastics venture. While the case of waste disposal pipe fulfills the technical requirement of corrosion resistance which cannot be provided by metals, the case for a consumer article, such as a protective headgear for construction workers or for motorcyclists is often a matter of which material is cheaper or less expensive granting that the minimum protective standards are equivalent. Another feature of this type of plastics article compared to the pipe case is that market saturation can be attained with head gear in a matter of one or several years, whereas the pipe needs may indeed prevail for considerably longer periods of sustained production.

Market Estimates. Following a through market analysis on the immediate needs of 25-liter pails manufactured with injection-molding existing facilities, a market estimate of 5 million units is presumed to be firmed as an annual requirement for a given regional development program. The pails would be suited for commerce of processed oils, syrups, etc., with the unique merit of resistance to salt-water corrosion and requiring no painting or protective finishing. It is assumed that the market would tolerate a price of US $1.00, or an annual sale of US $5,000,000.

The obvious next step is to determine the number of injection molding machines that would be required for this level of production, such as shown in Table 8 taken verbatim almost from a published costing exercise (2) to which the author wishes to accord special recognition.

Investment Cost Estimate. As was the case for the pipe discussed previously, a similar investment cost procedure is developed as shown in Table 9, in which a total project cost of US $4,278,816 is devised with the now obvious reservations that this attains only as an exercise.

Manufacturing or Operative Costs. Shown in Table 10 are the costs based on the two basis of (a) annualized costs and (b) cost unit costs as per pail. In the one case the cost of sales totals US $3,670,600 on annualized basis and in the other case US $0.734 per pail. It is at this point that the estimations can utilize the same costing procedure but applied to other categories of plastic than polypropylene and then recomputed back from the injection molding schedule in order to attain the adjusted direct costs. In this manner it is possible to establish some cost figure for the article unit that might reflect lower costs in cases where the end-use requirements would be less stringent such as once-used containers. At this juncture, it may be of interest to consider an alternate to the injection molding process, such as vacuum forming or rotational molding, at the same time assuming the role of a potential competitor likely to use other plastics resins such as ABS or ABS reinforced with glass fibers, and so on. This would involve an entirely new line of equipment with its own investment requirements geared to the production of same production level of 5,000,000 pails. What has been said thus far emphasizes the importance of establishing the economic merits of likely competitive plastics types before new equipment investment is committed. The discipline of costing even with hypothetical competitive constructs should therefore be quite evident and convincing.

Return on Investment Analysis. As was the treatment of the costs for the pipe case, the Return on Investment is now computed according to the procedure shown in Table 9 which indicates a return of 12.95 percent. The same appraisal of the merits of this Return on Investment is now a matter for management consideration. With this information, coupled with the comparison of the return on investment for other competitive cases, such as vacuum forming or rotational casting including other dimensions and constructions of larger pails, the proper decision on what investment should be accorded the priority becomes self-evident. Thus, management could more cogently decide whether the new project and its investment is justifiable or not. If a higher return on investment is required by some governing or regulating authority, the costs increments totalling up the costs would be studied and sharpened so to speak to determine where reasonable adjustments could be made, often in such a simple case as a lowered contract purchase price of the basic plastics resin. Furthermore, additional market and end-use values could be re-examined in trial market studies to determine whether a selling or transfer price of more than one dollar would be acceptable. In the final analysis, then, the concept of applying some estimate of the Return on Investment represents a firm guide for many technical and managerial decisions and analyses.

VI. Concluding Comments

From what has been profferred in the foregoing discussions, it should be clear that the economic well-being of the plastics fabrication technology, in order to sustain a firm position, should be integrated in a constant surveillance and analysis such as depicted in Chart 2. This integration places in balance the two costing systems guided by the market estimates as the leading requirement on the one hand and, on the other, the best technical specifications or description based on article design, plastics resin selected and the fabrication method. In effect it is the Market Estimate or some planned requirement that should lead off the costing exercise utilizing the expected endurance properties, the article design, and the processing technology as component parts of the exercise. In this regard, it is conceivable that each component of the exercise can be incorporated into a computerized program into which controlling variables such as plastics resin costs, fabrication cycles, and so on can be introduced in order to derive appropriate figures on earnings or profitability and Return on Investment.

There are numerous aspects of costs and how they are derived and interpreted that may be subject to challenge. This situation in itself develops a healthy scrutiny of the justification for undertaking any fabrication venture. In such challenges it is evident that management should weigh the costs in considering and deciding on alternative fabrication courses. Next, there is the aspect of setting selling prices to assure that some statutory return on investment is attained or set up as the performance goal, as depicted in Table 1. Ultimately, the format for the costing systems provides a display of cost components that may require some special attention or corrective action, such as excessive and unused inventory or over-production that consumes the plastics resin that would be more economically utilized in some other project.

In the final analysis, the two costing methods and derived systems of determining earnings, profitability, or Return on Investment, in whatever format is chosen by management, can and should be convertable from one to another. Ultimately some form of systems analysis (3) and the subsequent costing decision analysis (4) can be set up as a permanent and simplified costing methodology for ever changing and increasing investment requirements and on-going estimates in plastics fabrication.

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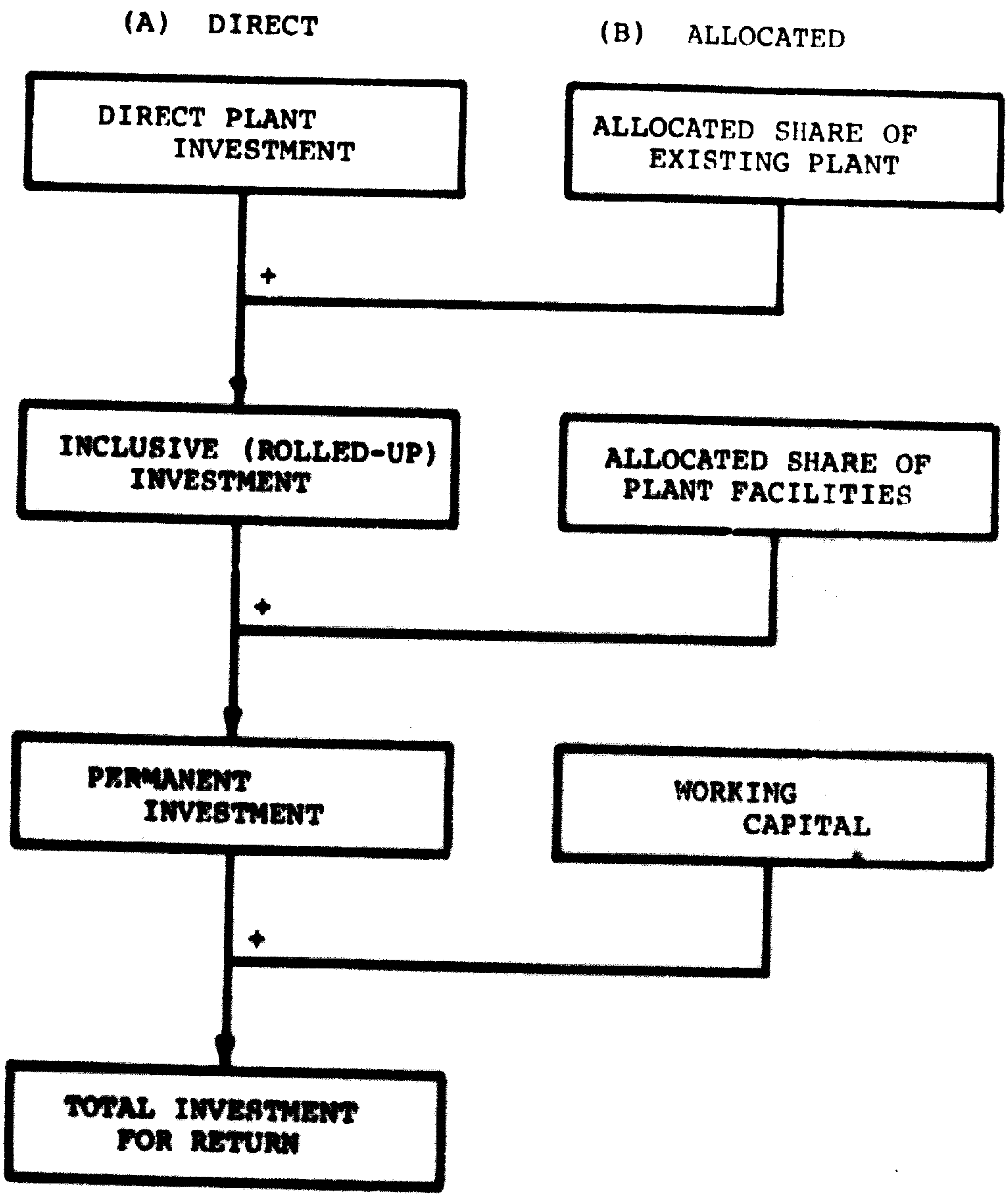

CHART 1. DERIVATION OF INVESTMENT COSTS FOR PLASTICIS FABRICATION

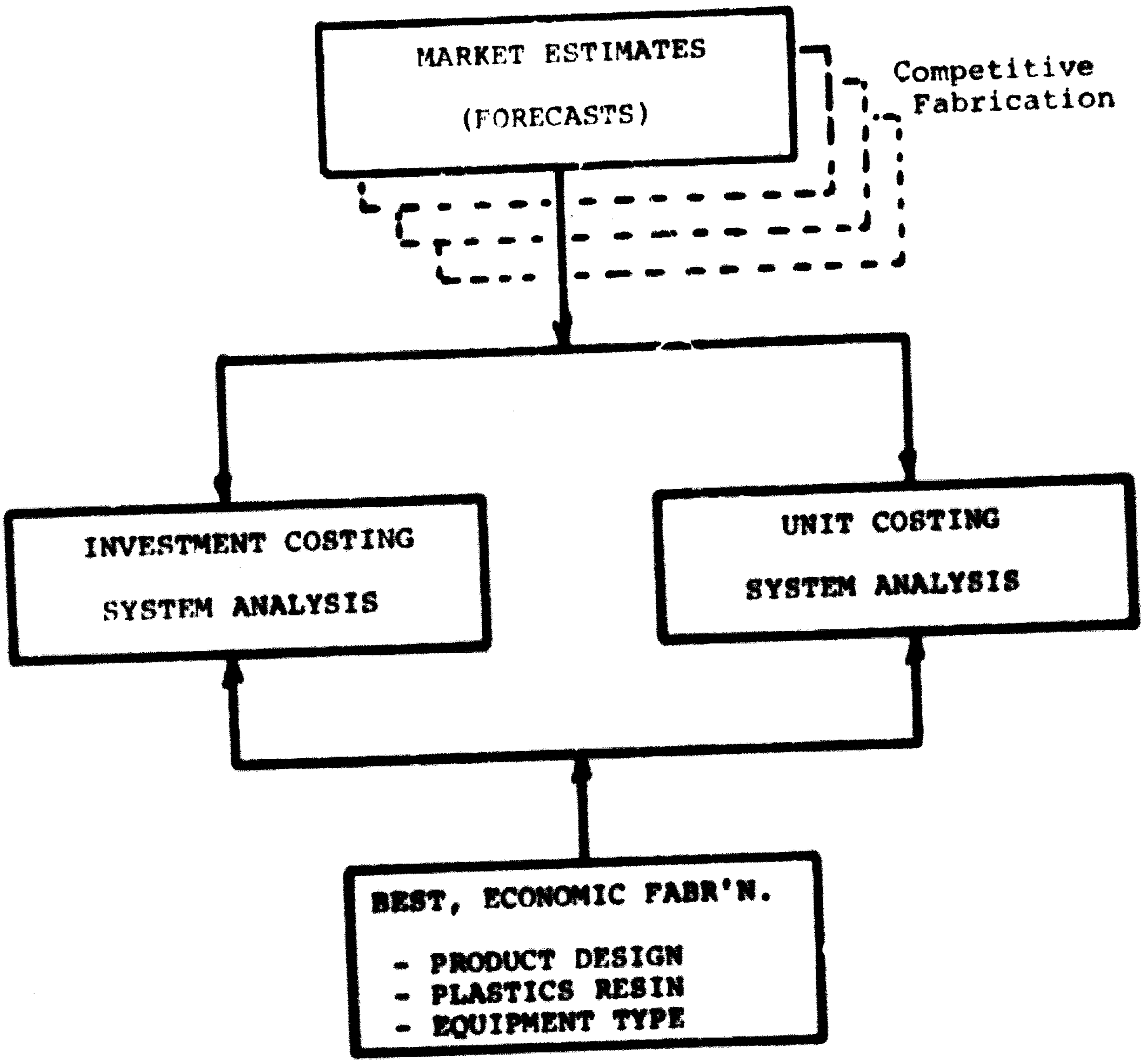

CHART 2. INTEGRATED SYSTEMS ANALYSES FROM MARKET ESTIMATE TO BEST TECHNOLOGY

TABLE 1. HYPOTHETICAL MARKET ESTIMATE OR ANNUAL REQUIREMENT

ITEM: PLASTIC PIPE, GRP, SCHEDULE LOW PRESSURE

SPECIFICATION (REFFRENCE) ______

DIMENSIONS I.D. 100 MM O.D. 106.35 MM

WALL 3.18 MM UNIT LENGTH 12 METERS

APPLICATION WASTE DISPOSAL

ANNUAL REQUIREMENTS - PROJECTED (ASSUMPTIONS)

YEAR	UNITS 12 M LENGTHS	SALES PRICE US $	NET SALES US $	COMPARATIVE PRICE/M		
				GRP	PE	IRON
19__	36,000	--	--	--	--	--
19__	48,000	15.00	480,000	*	*	*
19__	--	--	--	--	--	--
19__	--	--	--	--	--	--

***Comparative price to be used for determining value-in-use, a separate exercise comprising such features as:**

(a) initial standard or equivalent unit price

(b) Installation and maintenance during the expected service life

(c) total years of expected service or endurance.

GRP means Glass Reinforced Plastic M means meter

ML means 12-meter length PE means polyethylene

PART A

TABLE 2. MATERIAL COMPOSITION - INGREDIENTS COST ANALYSIS

ITEM	DENSITY GM/CC	PRICE US $ / KILO. IMPORTED	LOCAL
MONOMER	1.12	*	0.48
RESIN			
CATALYST			
GLASS FIBER, CHOPPED	2.15	*	0.12
FILAMENT			
ADDITIVES	--	*	*

PART B. INGREDIENT COST FOR PIPE SPECIFIED IN TABLE 1

INGREDIENT	DENSITY	VOLUME BASIS		WT. BASIS		COST	
	GM/CC	%	CC	%	KG.	US$/KG.	US$/ML
RESIN	1.12	60	5695	43.9	6.38	0.48	3.06
GLASS FIBERS	2.15	40	3797	56.1	8.16	0.12	0.98
COMPOSITE	1.53	100	9492	100.0	14.54	0.28	4.04

COMPARE WITH:	POLYETHYLENE	*
	CAST IRON (SPUN CAST	*

* Prices and costs to be determined in concurrent market estimates and value-in-use

TABLE 3. EQUIPMENT REQUIREMENT (HYPOTHETICAL)

A. ARTICLE ITEM: GRP PLASTIC PIPE (100 mm I.D.)

SCHEDULE (TO BE SPECIFIED) 12 METER-LENGTH

B. MARKET ESTIMATE/REQUIREMENT 576,000 METERS

*(48,000 12-METER LENGTHS)

C. EQUIPMENT LIST

MANUFACTURING LINES:	4	UNIT PRICE US $	TOTAL COST US $
1. MANDRELS (12-METER)*	4	10,200	40,800
2. CURING CHAMBERS	2	8,400	16,800
3. SPRAY NOZZLES	4	.1,200	2,400
4. SPRAY REVERVOIR	4	750	3,000
5. ROVING FEEDER	1	60,000	60,000
6. SOLVENT RECOVERY	1	50,000	50,000
7. LIFTS, ETC.	4	8,000	32,000
NET EQUIPMENT COST			195,000

D. OUTPUT PER UNIT MANUFACTURING LINE BASED ON:

1. PER HOUR 2 *(12-METER LENGTHS)
2. PER SHIFT (8 hour) 16
3. PER DAY (3 shifts) 48
4. PER YEAR (250 days) 12,000

E. MANUFACTURING LINES REQUIRED: 4 (48,000/12,000

TABLE 1. INVESTMENT COST ESTIMATE - SUMMARY

		US $	US $
1.	LAND ACQUISITION FOR SITE	8,000	
2.	SITE PREPARATION	40,000	
3.	FOUNDATION AND BUILDING	125,000	
4.	WIRING AND ELECTRICAL	62,500	
5.	HEATING AND/OR VENTILATION	30,000	
6.	PROCESS PIPING	18,000	
	SUB-TOTAL		283,500
7.	EQUIPMENT COSTS (TABLE 3)	195,000	
8.	ENGINEERING AND CONSTRUCTION	90,000	
9.	TRAINING OPERATING PERSONNEL	12,500	
10.	CONTINGENCY (CA 10% of 2 - 9)	57,300	
	SUB-TOTAL		354,800
11.	CAPITAL COST, TOTAL		638,300
12.	COMPENSATION FOR INVESTMENT, 6.0 %		37,800
13.	TOTAL INVESTMENT COST		676,100

N.B. As in the case of the previous hypothetical exercises the cost figures indicated here are assumptions.

TABLE 5. UNIT COST ESTIMATE - 48,000 ML OF GRP PIPE

		ANNUAL US $	PER LENGTH US $
1.	DIRECT COSTS		
	A. RAW MATERIAL, RESIN	146,000	3.06
	B. GLASS FIBERS	47,000	0.98
	C. WRAPS	9,600	0.02
	D. MISC.	4,800	0.10
	E. TOTAL, RAW MATERIALS	208,360	4.34
	F. DIRECT LABOR (3 OPERATORS/LINE)	51,000	1.06
	G. OPERATING SUPPLIES	1,500	0.03
	H. MAINTENANCE	43,000	0.90
	I. FINISHING MATERIALS	26,000	0.54
	J. POWER	50,000	1.05
	K. UTILITIES	2,500	0.05
	L. TOTAL, DIRECT COSTS	**382,360**	7.97
2.	**PLANT BURDEN**		
	A. SALARIES - ADMINISTRATION	**76,000**	1.58
	B. PAYROLL	**8,000**	0.17
	C. MISCELLANEOUS	**4,000**	0.09
	TOTAL, PLANT BURDEN	**88,000**	1.84
3.	**GENERAL BURDEN**		
	A. DEPRECIATION	33,060	0.69
	B. INSURANCE, TAXES	11,000	0.22
	TOTAL GENERAL BURDEN	**44,060**	0.91
4.	**TOTAL MANUFACTURING COSTS**	**514,420**	
	A. MANUFACTURING COST PER PIPE LENGTH		10.72
5.	**OVERHEAD (ALLOCATED)**		
	A. SALARIES	**7,800**	0.16
	B. RESEARCH AND DEVELOPMENT	12,900	0.27
	C. ADMINISTRATION	**7,800**	0.16
	D. TOTAL OVERHEAD	**28,500**	0.59
6.	**COST OF SALES OR TRANSFER**	542,920	11.31

TABLE 6. RETURN ON INVESTMENT ANALYSIS

		US $	
1.	EARNINGS (PROFIT) AFTER TAXES		
	A. SALES/TRANSFERS @________/12 ML	720,000	
	B. COST OF SALES/TRANSFER (TABLE 5)	542,920	
	C. ANNUAL EARNINGS BEFORE TAXES	175,080	
	D. TAXES. RATE 50 %	87,540	
	E. ANNUAL EARNINGS (PROFIT) AFTER TAXES	87,540	
2.	TOTAL NET INVESTMENT		
	A. TOTAL PROJECT COST (TABLE 4)*	676,100	
	B. WORKING CAPITAL REQUIRED (Table 7)	110,890	
	C. TOTAL NET INVESTMENT	786,990	
3.	RETURN ON INVESTMENT (ROI)		PERCENT
	(1e) / (2c) x 100		11.11
4.	STATUTORY ROI PERCENTAGE		
	A. COMPENSATORY INTEREST ON 2c 6.0 %		
	B. MINIMUM OVERAGE EXPECTED 3.0 %		
	C. NET EXPECTED MINIMUM		9.00
5.	EVALUATION OF PROJECT ON ROI BASIS (3) - (4e)		
	A. POSITIVE (GAIN) OVER EXPECTED PERFORMANCE		2.11
	B. NEGATIVE (DEFICIT) OVER EXPECTED PERFORMANCE		--

TABLE 7. HYPOTHETICAL WORKING CAPITAL REQUIREMENT

		REFERENCE	BASIS RATE *	US $
1.	DIRECT COSTS, MATERIAL	TABLE 5 (1e)	1/4 ANNUAL	52,090
2.	DIRECT LABOR	TABLE 5 (1f)	1/6 ANNUAL	8,500
3.	TOTAL PLANT BURDEN	TABLE 5 (7d)	1/12 ANNUAL	7,500
4.	TOTAL GENERAL BURDEN	TABLE 5 (8c)	1/12 ANNUAL	42,800
5.	CONTINGENCIES	--	--	--
6.	TOTAL WORKING CAPITAL			110,890

*The basis rate is a matter of management judgment or decision to ensure adequate discount cash for operating charges and expenses. The fractional annual rates given here are indicated as a guide. The usual range of working capital for plastics fabrication varies between 15 and 25 percent.

TABLE 8. FABRICATION OF PLASTIC PAILS - INJECTION MOULDING MACHINE REQUIREMENT

PLASTICS RESINS: POLYETHYLENE, POLYPROPYLENE

CAPACITY : 25-LITER

MARKET ESTIMATE: 5,000,000

	UNITS	
	LB	KG
AVERAGE WEIGHT	1.90	
OUTPUT WITH 5,000,000 PAILS/YEAR	1500 LB/HR	680 KG/HR
MOULD CAPACITY - 2-CAVITY/48 SEC. CYCLE	4.75	2.15 KG
SCRAP	(2% TOTAL PRODUCTION)	
OPERATING BASIS - 24-HOUR DAY AND 250-DAY YEAR		
MOULDING MACHINE CATEGORY	100 TON	

CALCULATION	
(1500 / 0.98) X 60 MIN X 4.75	5.4
INJECTION MOULDING MACHINES REQUIRED	6

TABLE 9. INVESTMENT (PROJECT) COST ESTIMATE

	US $	US $
1. LAND ACQUISITION (A) }	151,000	
2. SITE PREPARATION }		
3. FOUNDATION AND BUILDING	453,400	
4. WIRING AND ELECTRICAL	113,440	
5. HEATING AND VENTILATION	57,300	
6. PROCESS PIPING	22,500	
SUB-TOTAL		798,540
7. EQUIPMENT COSTS	2,520,000	
8. ENGINEERING AND CONSTRUCTION	386,225	
9. TRAINING OPERATING PERSONNEL	(b)	
10. CONTINGENCY (10% APPROX.)	331,854	
SUB-TOTAL		3,238,079
11. CAPITAL COST, TOTAL		4,036,619
COMPENSATION FOR INVESTMENT		242,197
13. TOTAL INVESTMENT (PROJECT) COST		4,278,816

(A) combined costs, subject to site of installation and also possible extension to existing plant, hence allocated cost.

(B) Combined costs, subject to pro-rating the project

TABLE 10. UNIT COST ESTIMATE - INJECTION MOLDED PAILS

		ANNUAL US $	PER PAIL US $
1.	DIRECT COSTS		
	A. RAW MATERIALS, PE (US $ 0.308/KILO)		
	B. PP (US $ 0.353/KILO)		
	C. HANDLES		
	D. MISC.		
	SUB-TOTAL RAW MATERIALS	1,864,000	0.373
	F. DIRECT LABOR	154,000	0.031
	G. OPERATING SUPPLIES	1,500	0.0003
	H. MAINTENANCE (LABOR AND MATERIALS)	129,300	0.026
	I. FINISHING MATERIALS	295,000	0.059
	J. POWER	152,400	0.031
	K. UTILITIES (HEATING)	4,000	0.001
	TOTAL DIRECT COSTS	2,600,000	0.521
2.	PLANT BURDEN		
	A. SALARIES - ADMINISTRATION	231,000	0.046
	B. PAYROLL	92,000	0.018
	C. MISCELLANEOUS	50,000	0.010
	D.		
	TOTAL PLANT BURDEN	373,200	0.074
3.	GENERAL BURDEN		
	A. DEPRECIATION		
	B. INSURANCE, TAXES	493,000	0.098
	TOTAL GENERAL BURDEN	493,000	0.098
4.	TOTAL MANUFACTURING COSTS	3,466,600	
	A. MANUFACTURING COST PER PAIL	--	0.693
5.	OVERHEAD (ALLOCATED)		
	A. SALARIES	154,000	0.031
	B. RESEARCH AND DEVELOPMENT	--	--
	C. ADMINISTRATION	50,000	0.010
	TOTAL OVERHEAD	204,000	0.041
6.	COST OF SALES OR TRANSFER	3,670,600	0.734

TABLE 11. RETURN ON INVESTMENT ANALYSIS

	US $	PERCENT
1. EARNINGS (PROFIT) AFTER TAXES		
A. SALES/TRANSFER	5,000,000	
B. COST OF SALES/TRANSFER (TABLE 10)	3,670,600	
C. ANNUAL EARNINGS BEFORE TAXES	1,329,400	
D. TAXES, COMPOSITE RATE 50.0 %	664,700	
E. ANNUAL EARNINGS	664,700	
2. TOTAL NET INVESTMENT		
A. TOTAL PROJECT COST (TABLE 9)	4,278,816	
B. WORKING CAPITAL REQUIRED	853,460	
C. TOTAL NET INVESTMENT	5,132,276	
3. RETURN ON INVESTMENT		PERCENT
(1e) / (2c) x 100		12.95
4. STATUTORY ROI PERCENTAGE		
A. COMPENSATORY INTEREST ON 2c 6.0 %		
B. MINIMUM OVERAGE EXPECTED 3.0 %		
C. NET EXPECTED MINIMUM		9.0
5. EVALUATION OF PROJECT ON ROI BASIS (#) - (4e)		
A. POSITIVE (GAIN) ON EXPECTED PERFORMANCE		3.95
B. NEGATIVE (DEFICIT) OVER EXPECTED PERFORMANCE		

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