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PRE-PROJECT PLANNING FOR INDUSTRIAL ESTATES

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PRE-PROJECT PLANNING FOR INDUSTRIAL ESTATES

INTRODUCTION

This paper sets out the main tasks to be performed in the pre-project planning of an industrial estate and some of the main considerations which must guide the performance of these tasks. It therefore describes the work involved in producing a "project proposal".

A project proposal is a statement which enables those who must supply the finance and the authority required to implement an industrial estate project to judge its merits. Its preparation is a complex job. There are so many variables in industrial estate planning that there are numerous possible solutions. In a given set of circumstances, the essential thing in working out the most appropriate solution is to ask the right questions about each important element of the problem. In any given problem, it should be fairly easy to determine which elements are important and which are not.

In this paper, an attempt is made to set out all elements of possible importance in planning and scheduling an industrial estate project, with a view to providing a frame of reference for the authority initiating the estate, by setting the planner's terms of reference; the planner, by providing him with a check-list which may be refined or corrected by his own knowledge and experience; and the Seminar, to facilitate its discussion of the corresponding agenda item.

In preparing the paper the author has relied heavily on published works. A list of those found most useful and to which indebtedness is acknowledged is appended.

This paper has been prepared by Mr. Paul Quigley, General Manager, Shannon Free Airport Development Co., Ltd, Clare, Ireland.

I. THE PROJECT PROPOSAL

The terms of reference of the person charged with preparing a project proposal for an industrial estate will vary with the purpose and type of the estate, the existence of a site or the need to select one, and other considerations. The taks may range from provision of a few partially-developed acres as a site for industry to construction of a fully-developed estate with prebuilt factories and a complex range of services. All or any number of the following elements may be included in the terms of reference, the common essential factor being the economic substantiation of the proposal.

1. Contents of the project proposal

A project proposal may include any or all of the following elements:

- Statement of terms of reference and, if these do not make it clear, of the purpose of the industrial estate and the area required for it.
- Description of the general area (town or region) chosen for the industrial estate location; its advantages and disadvantages; and why it was preferred over other possible areas.
- Description of the site proposed, in words and drawings; and of the alternative sites over which it was preferred.
- Reasons for selecting the proposed site.
- List of types and sizes of industries suitable for location on the estate based on assessments of feasibility and desirability.
- Tentative layout plan for total development.
- Tentative layout plan for the first stage of development, if the project is to proceed in stages. It is likely that there will be fewer unknowns in relation to the first stage, which will normally be a more precise plan.

- Description of necessary utilities to be provided - roads, water, power, drainage, sewers, and so on.
- Reasons for providing or not providing ready-built factories.
- Description of common service facilities recommended, justification of the proposals and recommendations as to how the facilities should be provided.
- Estimate of the time required for each stage of work from inception to first occupation and to completion.
- Recommendations in regard to the selling or leasing of sites or buildings, and charges for services.
- Proposals for promoting the estate. If this cannot be done successfully within the framework of existing laws and agencies for the promotion of industry, a statement of what wider provisions might be needed.
- Recommendations with regard to the organization required for the construction, operation and management of the estate.
- Proposals for controls, including restrictive clauses in lease agreements or covenants.
- Estimate of the capital cost of works for the first stage and for total development.
- Estimate of operational ,administrative and promotional costs.
- Overall estimate of income and expenditure; and of the return on investment (short-term and long-term) which can be expected.
- Recommendations with regard to financing.
- Statement of the benefits to be expected other than direct financial return, such as employment created, and contribution to local taxation.

2. Purpose of the industrial estate

The objective, or group of objectives, to be achieved by a particular estate should be stated in clear and precise terms from the beginning. If the objective is incorrectly identified, the plan will probably be wrong; if the objective is unclear, the planning will be confused.

A clear statement of the objective should precede pre-project planning and, indeed, should determine the qualifications needed in the planners. Can one man do the job, or is a team required ? Should the planner provide overall economic substantiation, or is this available from an earlier regional study ? What are the skills required - economics, architecture, engineering, town-planning, sociology, traffic-planning, or others ? Specialized skills may of course be needed to follow on the pre-project plan, but the statement of the objective will determine those most important from the beginning. If the planner is not given such a statement he must obtain it.

A discussion of industrial estates policies does not belong to this paper, but the following list of objectives - some of which may be combined - indicates the variety of programmes in which industrial estates may play a role:

- Implementation of a policy of population distribution at the regional or national level.
- Encouragement of industrial growth in particular areas to provide employment where it is most needed.
- Promotion of industrial entrepreneurship, especially in the indigenous group of the population.
- Encouragement of growth in the industrial sector of the economy, especially in small-scale and medium-sized industries.
- Achievement of economies of concentration in industrial development in relation to services, communications and all other facilities.

- Exploitation of natural resources such as timber, minerals, oil, by a concentration of user-industries.
- Provision of conditions which will attract foreign investment and entrepreneurship.
- Positive zoning of industry in relation to town planning, urban renewal and slum clearance schemes.
- Decentralization of industry as a counter to urban concentration.
- Diversification of industry in a given location towards greater stability of employment and trade.
- Exploitation of advantages of locations such as river, sea or air ports.
- Improvement of working conditions in industry.
- Increase of tax income to municipal and other authorities by encouraging new industries and facilitating the expansion of existing ones.
- Strategic distribution (in a military sense) of industry and/or of population.
- Achievement of commercial profits in privately-sponsored industrial estate projects.

3. Relationship to over-all plans

Any industrial estate is part of an economic and social environment extending initially over the area from which its labour is drawn, then over areas from which it takes its raw materials, power and industrial services, and over the area in which its products are sold. It is necessarily a part of the many economic and social activities of its environment. The former may include other industry, agriculture, distribution, services and tourism. The latter include housing, education, health services, recreation.

Ideally, planning should be for the region first and only subsequently for the estate - or, sometimes, system of estates - which will form part of and help bring about the total physical plan for the region.

A regional development plan has been defined in two specific ways:

"(a) A plan is a model of an intended future situation with respect to economic and social activities, their locations and land area required and the structures, installations and landscape which are to provide the physical environment for these activities; and

"(b) A plan is a programme of action and pre-determined co-ordination of legislative, physical and administrative measures designed to promote the change from the present to the proposed situation." 1/

It is clearly more logical and ultimately more efficient to design the whole in outline before designing the part. In commenting on an earlier draft of this paper the United Nations Centre for Housing, Building and Planning set out the principles which would govern the approach to industrial estates with particular reference to regional planning. These merit quotation in full:

"In terms of over-all physical planning industrial estates can be an important tool for the expression of a policy of population distribution for a metropolitan or resource base region.

"In this connexion, therefore, it is important to think in terms of planning a system of industrial estates for a given region (or country) rather than a series of individual industrial estates to be planned successively 'as the need may arise'. The technique of planning a system in this fashion would not only ensure a better land use pattern for the region but would also facilitate the staging of development including the provision of the infra-structure and services.

"In regions which are partially industrialized it is extremely useful to undertake first of all a survey of existing firms to collect data on industrial types, site size, expansion needs and traffic generating capacity.

1/ See Report on United Nations Mission on Urban Policies and Regional Planning in Japan, 1964 - TAO/JAP/1.

"An analysis of the data provided by such a survey will make it possible to construct much more realistic plans for future industrial estates. In addition, by combining such data with the industrial, employment and production targets established in the economic plan, economic goals and objectives can be translated into space requirements.

"The physical planning agency in co-operation with the industrial development agency can then select general locations for the industrial estates which will be required to provide for the estimated employment and production. In this phase the physical planning agency will take into account such factors as land capability for agricultural use and other competing claims. It will also consider such factors as topography and drainage, land ownership, ease of servicing, relationship to existing or proposed uses of adjoining areas, and accessibility to labour supply, port and airport facilities.

"Ideally, the final stage in this process is not to create merely industrial estates or industrial estates plus housing areas, but rather comprehensively planned centres, areas or districts which would include along with industrial estates, residential areas and centre core areas of shops, schools, churches, administrative offices and other required community facilities. The industrial estates would therefore be component parts of a comprehensive town plan on a conveniently small scale (micro-region) which would depend for its scale and character on its relation to the over-all urban pattern of the broader region within which it is located."

Clearly, regional planning and the above principles would provide the best basis for determining industrial location and for selecting the location and size of the estate. It would enable the industrial estate planner to take account of the total environment and of changes to be expected in that environment. Such planning should be backed by legislative measures to prevent undesirable development (for example, of industrial slums around the estate) and to secure desirable development (for example, of new housing made necessary by increased employment and standards of living).

This paper must also, however, take account of situations where the planner may have to produce a proposal in the absence of, or without the opportunity, time or resources to prepare a regional plan; and of situations where the location and/or size of the estate may be pre-determined. The following sections are therefore set out to cover all possible situations in a general way but should, wherever suitable, be applied in the light of the principles and methodology quoted above.

As a minimum, in the absence of an over-all plan, the planner will have to take account of the immediate environment on housing, transport facilities and amenities. Unless he engages in this wider study, what would otherwise be an ideal estate could be choked by uncontrolled growth or starved by inadequate growth in its surroundings.

An illustration of the desirability of over-all planning is given by the relationship between manufacturing industry and tourism, both of which may be important economic activities in the same region or country. It is obvious that they conflict in claims for land use, but it could be short-sighted to say that because we want the one in a particular area we may not have the other. For example, Puerto Rico promotes industrial location, tourism, and rum in one advertisement. The amenities which attract tourists may serve also to attract industrialists. A first-class hotel may be important in opening up an area to outside industrial development. Growth in tourist traffic will improve services by air, sea, road and rail and incidentally provide better services for industry. The solution to the problem of conflicting claims for land use may lie, therefore, not in abandoning one but in careful planning and zoning to provide the best possible conditions for both.

II. PRE-PLANNING SURVEYS

1. Size of industrial estates

In some cases, the size of an industrial estate may already have been determined for a particular location. For example, the planner may be told: "We have 80 acres at this port on which we want to build an industrial estate" or "We want a 100-acre industrial estate here as part of the plan for this region".

In such cases, the planner must verify that an estate of that size is economically feasible and can be supported by the existing infra-structure (including population) in terms of criteria for site selection such as those set out in part III below. If any part of the infra-structure is inadequate, he must state what is needed - for example, better roads or greater power supply - and balance the cost of such provisions against the alternative of reducing the size of the estate. Whether he determines the balance of advantage in economic or social terms will depend on the purpose of the estate, but even where the purpose is a social one he must set out the cost of achieving it.

In a few cases the size may be stated without reference to location. For example, it may be national policy to establish a 20-acre (8 hectares)[2/] industrial estate as a pilot project in the promotion of small industrial enterprises, the location to be that which offers the best prospect of success. In this instance the planner's task is to select among competing locations the one which will offer the best prospects for rapid occupancy of the estate by efficient and productive small-scale industries.

Again, the size may not be stated but may be determined by finance available, or by limiting factors in a particular location, or derived from a study of the types of industry likely to be available to the location.

It may be that there are no such precise limitations to size. The infra-structure may be adequate for a very large, or several smaller, estates. In these circumstances, are there any guides to the ideal size ?

2/ One acre = 0,404687 hectare.

Generally speaking, the bigger the estate the greater the economies that can be expected in developing the area and in providing buildings, services and facilities. Also, the bigger it is the more attractive it will be as a market for commercial suppliers of materials and equipment and services to industry. And the better will factories on the estate be able to avail of each other's productive resources as suppliers and subcontractors, thus tending to improve the profitability and productivity of all factories. Risks are spread better on a large estate; the failure of an individual firm will have less effect on the economy of the estate and on the community, and workers will get other jobs more easily. In these terms, therefore, the bigger the estate is the better.

But size also has disadvantages. Too great a concentration of workers in one area will impose strains on housing, commuting, and traffic movement generally. These strains may not be removable, or their removal may add new costs to the project that may defeat its economic or social purpose.

The correct balance between these opposing considerations can only be determined in terms of the precise location of the estate. For example, very large estates are made possible, in the United States - among other reasons - because the majority of people own cars and are willing and able to commute.

One British expert, Lord Holford, has given as his personal view that the optimum size of an estate for light industry is between 50 and 150 acres. (20 and 60 hectares). "It can be assumed", he says, "that 100 acres of light industrial development in full production will contain between 50 and 70 factories and employ between 4,000 and 6,000 workers. This is not an unwieldy size for correlation with housing estate or small-scale satellite development." The Clyde Valley Report recommends that estates should be larger than 50 acres wherever possible.

Another way of looking at size is from the viewpoint of administration of the completed estate, particularly where it contains rented factories and provides various central services and facilities. It has been suggested that about 30 acres is a minimum, and 100 an optimum, from this point of view. But much larger estates could be justified in relation to special location advantages.

2. Small-scale and rural industrial estates

Much smaller estates than indicated in the preceding section may be called for in the realization of regional plans. In that section and indeed throughout this paper, the industrial estate is primarily considered as a location for general manufacturing industry, where a wider range of utilities and services are provided, including in many cases some pre-built standard factories. Such estates call for the greatest detailed attention to their planning. But their existence does not, and should not, exclude the need for smaller industrial locations throughout a region.

The latter may simply be small developed sites located in relation to regional development proposals. Estates in this category will be tied in to the existing or proposed infra-structure of roads, power, water supply and sewerage. Labour will be available from existing nearby villages or proposed housing developments. The estates will not call for special infra-structure development and the question of economy of scale discussed in the last section will not arise or will be of little importance. Nor will there normally be a complexity of services calling for resident estate administration, so that questions of economy of administration will not be of serious weight. Such small estates fulfill a necessary purpose in providing logical industrial locations related to over-all land use plans and population distribution.

In agricultural areas they accommodate local industries such as food-processing plants, food-packing plants, primary processing of agricultural raw materials, creameries, and repair workshops for agricultural machinery. They may be combined with supply depots for agricultural requirements such as fertilizers, fuel and equipment. Their purpose will be as much the development of agriculture as the development of rural industry.

Another category of industrial estate is that which, while much more completely developed and serviced than the latter, is still planned on a small scale. In this case the diseconomies of scale may be offset by social or economic benefits. This will often be so in a developing country where the purpose of the estate is to promote small industry by providing it with incentives and services. Shortage of entrepraneurs, of skilled labour and of markets for products may place limits on size. The "demonstration effect" may be important, especially for the first few estates, and the achievement of

economies of scale may then not be a paramount consideration. But whether or not the economic size is achieved, careful feasibility studies must be undertaken at theplanning stage.

3. Workers per acre and balance of employment

Related to the size of the estate is the question of the number of workers per gross acre. This will of course depend on the type of industry and on the density of development. Accurate forecasts are impossible but rough forecasts are usually necessary. As a rule, industrial estates are devised for light industries. Heavy industry tends to prefer less restricted sites, in terms both of expansion possibilities and of use restrictions, and in any case is generally excluded by regulation from the estates. For an average development, primarily of light industry, a figure of 50 workers per acre (124 workers per hectare) would be normal within a range of from 30 to 70 per acre.

Where existing industry in the region is representative of the type and size of industry likely to be located on the estate, a study of its size, employment, products, etc. will give more precise data for planning.

The estimates should show the numbers of men and women likely to be employed, since in any given social environment there should be a correct balance of employment of both sexes. These data are important for determining the types of industry which can be set up. There is also a social aspect: if there are many jobs for women and too few for men, the men will be unable to support families or will migrate to places with better prospects, with consequent social ills. Employment estimates are also necessary to determine requirements for housing and social amenities.

4. Types of industry

It is a necessary part of pre-project planning to determine with some precision the types of industry which may be established on the estate. The less developed the economy the greater is the need for this. An estate cannot be planned on the mere expectation that industry will settle in it; it must be known that there is scope for specific industries and that the needs of these industries will be met in the chosen location. Evidence in this regard will provide the main part of the economic justification of the project.

Where common services are to be provided, many of them, for instance, training centres, supply depots, foundries should be planned in relation to the prospective industries. Economic surveys are also useful for promoting trading between firms, subcontracting or co-operative purchasing. And promotion of entrepreneurship will be most efficient when it is directed in accordance with a list of industries most suited to the estate.

The surveys may range from the preparation of a list of "likely" industries based on national import statistics to detailed feasibility studies for each possible industry. The latter would call for specific examination of markets, materials, labour availability and suitability, supplies and services, production and distribution costs and many other factors. The site selection criteria listedbelow should be assessed not merely for industry in general but with particular industries in mind.

5. Survey method

In the absence of a regional plan which should ideally precede site selection and would indicate at least the general location of the estate, the search for the best site will normally be carried out in at least two stages: first, the selection of the most favourable general area (region or town) and then the choice of the best site there. These stages roughly coincide with two types of work: first, the desk research at the centre, followed by on-the-spot inspection of possible sites and their surroundings. Between these two stages, the data relative to the site selection criteria will be collected. How the work will break down in practice as between the stages will depend on the relative importance of various criteria (which in turn will depend on the purpose of the estate) and on the availability of information - including population and labour statistics, market data and maps - from central sources.

A most important part of the second stage will be a study of existing factories and workshops in the area. It may ideally form part of the regional planning approach suggested earlier and in this connexion should provide data on industrial type, site size, present employment, expansion needs and traffic

generating capacity. It will in any case be needed to determine the types of industry likely to be located on the estate. In this regard the planner will be particularly interested in possibilities for developing local handicraft undertakings into modern manufacturing units.

It should also, at least in the more immediate vicinity of the proposed location, determine the services and supplies available to new industry and give valuable information in regard to markets. And it should indicate the skills available in the area as part of the examination of labour suitability.

There can be no hard-and-fast rule about the extent of the area to be covered in the industrial survey or about the depth of the study. Whether all industries are examined, or all above a certain size, or a sample only, will depend on many factors including the availability of statistical information, the importance of various factors related to the purpose of the estate, the level of the existing economy, and whether an urban or rural site is proposed.

III. CRITERIA FOR SITE SELECTION

The criteria listed below, while set out in relation to site selection, are also relevant to the case where the site is already determined.

Where the site sought is for a pilot project, special criteria may be needed. As a rule, the best location for a pilot project will be in or near a large town. The success of a project near the largest city will not prove anything about the possibilities of estates as a means of correcting regional imbalance. But if a "demonstration effect" is the main objective, it may be best to locate the estate wherever success is most likely even though this may not be typical of future locations.

It may be desirable to attach the estate to another growth nucleus such as a large basic industry - a steel-works, for example, or a major electrical generating station. Big projects like these will require transport, communications and other elements of social infra-structure which might also serve for the estate. In this case the criteria below should be checked for the development of the whole industrial complex.

1. Labour availability

The planner should estimate the population available for employment now and in future years - or at least establish that it will be adequate. To do this he needs information on population trends relating to the rate of natural increase or decrease and of emigration or immigration; figures of unemployed and under-employed in the various possible areas; and information on existing employment and on any new demands on labour supply likely to arise. He should check on the proportion of the listed unemployed that is in fact suitable for industrial employment.

Changes in the pattern of employment are important. An area where employment is declining because of the passing of traditional industry, for instance, through depletion of mineral resources) or because of technical change (for instance, the increasing mechanization of a major industry), may not only have available labour, but labour accustomed to industrial life and having industrial skills.

In estimating labour availability account must be taken of new service employment arising from new industrial employment. One United Kingdom estimate is that three people are employed in services for every two employed in manufacturing industry. Similarly, it is estimated that in the British New Towns, industrial workers will form from 17 to 20 per cent of the total population. A United States estimate gives eight service workers to every three industrial workers.

A drift of population from agricultural areas to urban centres also creates employment needs. Stimulation of industrial growth at smaller towns within the area from which people are moving is often resorted to in an attempt to check such migration.

Skills available in the area will be indicated by the study of existing factories and workshops. Examination of existing technical schools, of their output and ability to increase output, will also be needed. Information on where students go at present on completion of courses, both from technical and primary schools, will be valuable in the assessment of labour supply.

The balance of existing employment should be checked.

The labour supply should be within reasonable commuting distance, unless housing and community development are an integral part of the industrial project or unless they are promised (and this is a less sure base) in terms of an over-all development plan. There must be good roads to facilitate commuting; and a rail link would be a bonus. The limit to commuting distance depends on the means of travel - cars, public transport, bicycles and walking, in descending order. The fact that very long distances are covered by commuters in some places should not distort the picture - this may well arise from lack of planning in the past and should not influence planning for the future. It should be remembered also that the modern industrial estate, with rare exceptions, consists of low buildings using electric power in pleasant landscaped surroundings. It is therefore nnncessary to plan it at a distance from housing. It is unlikely that any estate will be well located if it is more than fifteen miles from a population centre. This demands cars and public transport and preferably the distance should be very much less: the shorter the better.

If the site is separated from existing housing, it will almost certainly be necessary to provide for houses beside it at least for those people who must be on quick call to factories and it should be established that a suitable housing site exists. Where there is insufficient housing within a convenient distance for the general work-force, the alternatives of either providing new housing near the estate or improving methods of commuting should be examined. The solution may depend on the adequacy of existing housing for the new labour force. There are very few areas with surplus housing, and in many the infra-structure is already so burdened that it may be no more expensive to provide new houses at the estate than to add them to the nearest town, particularly when costs of commuting are taken into account. These costs may fall in part on the industries, in part on the workers, and in part on the community at large and represent in total an economic burden which can be capitalized to relate directly to housing costs. If new housing is provided at the estate, the planner must be mindful of the need to have a sufficient population in the new area to support necessary facilities and amenities - schools, shops, churches and recreational amenities.

2. Markets and communications

Markets and communications go together because the industrialist is concerned with accessibility to markets rather than proximity, though the latter will be important for small local industry. In many small firms frequent contact between the proprietor and his customers is vital. Actual distance will also be important where transport forms a large element of cost or where products are perishable. The general trend is for the work-content of industrial products to grow and for the relative importance of transport costs to decline.

Population figures and per capita incomes are not the only indicators of a market. Large industries in otherwise sparsely populated regions for instance, oil installations, or military establishments may constitute useful markets for many types of industry. Import-export statistics - if available for the area - are valuable; and inspection of goods on sale in local shops can provide guidance. The survey of local industry will also give information.

Highways are the essential means of communication for most estate-type industry, and the estate should be linked to the national system or to a large urban centre. Railways are a bonus rather than a necessity, except in areas where the highway system is inadequate.

Traffic forecasts may indicate a need for highway improvements to cater for the growing industrial and commuter traffic. The highway authority should undertake to carry these out in a timely fashion. Where both highway and estate are paid for out of central funds, the anticipated cost of such improvements will be a factor in comparing alternative sites.

The site should desirably have a long highway frontage, not to provide additional points of access (which could be traffic hazards) but to aid in the promotion of the estate. Factories supplying local markets will be particularly interested in the advertising value of sites on the frontage.

Airports are growing in importance for industrial development, not only because they permit quick transport to market of high-value-for-weight products but because of the readiness of supply of spares and urgently-needed materials. Also, they facilitate supervision of industries set up by foreign capital, which can be important where the purpose of the estate is to attract outside investment and skills. Two examples from the Shannon Free Airport Industrial Estate illustrate the growing importance of air transport: pianos are exported by air by one factory which gains savings in speed to market, reduced crateage, and reduced breakage; and a data-processing firm punches and verifies cards for American clients, competing successfully over three thousand miles in speed and price.

Accessibility to sea ports is important, and is essential for export-oriented industries or industries using raw materials from overseas. Such industries will pay particular attention, in choosing a location, to distances from ports and frequencies of sailings from these ports to various destinations.

Good postal and telephone facilities are necessary to most industries, and good telex facilities to many - particularly those with overseas connexions. Actual delivery times of letters to and from key centres should be checked; also, the loading on existing telephone exchanges and whether these can be extended in good time to take the new industrial load.

3. Supplies and services

This factor is less likely to relate to raw materials (unless in relation to a specific industry or to, say, an estate aimed at using agricultural products) than to the availability of industrial hardware and the many services on which industry calls - from stationery to engineering maintenance. The study of existing factories and workshops will show the supplies and services which are available locally and those which need to be provided in the estate. Typical industrial requirements include foundry-work, plating, joinery, electrical services, plumbing, and general engineering maintenance.

Most such services need not be located right beside the estate but their value diminishes with distance.

4. Local enterprise

As has been often stressed in United Nations publications, a fundamental condition of the success of industrial estate projects is that they should be integrated in programmes of broader scope, for instance, programmes of promotion of small-scale industries or regional planning. Another condition is that regional and local authorities should realize the role and importance of industrial estates and work to help them succeed. It is conceivable that disinterest in industrial development - possibly because of other major pre-occupations, for instance, tourism - would militate strongly against success even in an area favourable in every respect to industrial development. As a rule, interest in industrialization will be evidenced by the existence of plans and projects in this field.

The best and most helpful indicator of suitability is the existence of a local master-plan relating industrial to over-all development. On the site, one can quickly get an impression of how well or badly the local authority manages its affairs. Housing, traffic planning, roads, health services, schools, churches and public amenities are part of the necessary infra-structure of industry and their quality will influence its success.

Other indicators are: service industries - electric power, gas, railways, air and sea ports - keen to increase their market; voluntary bodies - for instance, chambers of commerce - prepared to help; and prominent citizens enthusiastic for the project.

It is when he is selecting the site that the developer is in the most powerful position to get bids for support. These can be in many forms and should be taken into the assessment. They can include cheap or free land; supply of main utilities to site; development of connecting roads or needed housing; fixing of special rates of local taxation for new industry; provision of special educational facilities; supply of power, gas or water at low rates; direct investment in the project; and support in the promotion of the project. The final stages of selection may thus be combined with negotiation .

5. Utilities

Power: An adequate and dependable supply of electric power is essential. This would favour sites near power stations or main high-tension lines. For average small-scale to medium-sized industrial enterprises, the available capacity requirement would be of the order of 1 KW per 100 to 200 square feet (9 to 18 square metres) of factory space, assuming full use of modern powered equipment.

Water: The general water supply pattern of possible areas should first be examined in terms of rivers, reservoirs and main pipe-lines. The nearer the site is to a main supply, the better. In the absence of an existing supply the feasibility and costs of the required water will call for a specialized engineering study. The requirement for drinking and sanitary needs only would be about 10 gallons (45 litres)[3/] per worker per day. Water will also be required for industrial purposes, fire-fighting, landscape maintenance and possibly factory cooling. These demands will vary greatly according to industry types, the estate plan, and the estate location. While there is therefore a danger that any figure might be misleading, it is necessary to have some preliminary planning guide in order to estimate likely total demand.

3/ One imperial gallon = 0.045460 hectolitre.

An industrial development with mixed light-to-medium industry, with no very special water requirements (as would be the case for paper-making) and ignoring factory cooling, would have a total requirement of from 30 to 80 gallons (136 to 364 litres) per worker per day: a figure of 60 gallons (273 litres) could be used in preliminary estimates.

Sewerage: Sewer capacities (apart from storm water which may be treated separately) can be taken as equivalent to the water supply. If there is no existing system adequate for the new development, proximity to suitable disposal points (sea, or large rivers, or land areas for treatment) will be important It is assumed that all industrial effluents will be treated, if necessary, to conform with standards of acceptability for the general system.

Gas: Gas can be a useful bonus, necessary to a minority of firms, but the increasing use and availability of bottled gas reduces the importance of a town supply or of piped gas on the estate. The attraction of natural gas must be related to the probable duration of the supply.

In estimating utility requirements, allow for the housing - if any - to be built in association with the estate.

6. Climate

In general the climate will be suitable for industrial development if people are already working there successfully. It may be necessary to remember this, particularly if the site location is being determined by somebody from a more temperate area. Industry has developed most rapidly in climates which were not only harsh, but which added to the cost of production the need for heating factories. Hotter climates, particularly with architectural advances in the insulation and cooling of buildings, should be as suitable for industry.

Records of wind velocities and of earthquakes may be important not only in relation to site selection but in relation to building design.

7. Educational facilities

These are referred to in part in connexion with section 1 "Labour Availability" and section 4 "Local Enterprise". Educational facilities at all levels, and particularly basic and technical levels, are important.

The existence of a university or a higher technological college is an attraction to many types of industry. Qualified men can be recruited readily. Top level technological advice can be obtained from staff, and research and testing facilities are normally available. Special courses can usually be provided to meet specific industrial requirements.

8. Land availability and costs

In determining the size of the land, consideration should be given to the requirements for expansion and to the question whether reserve land should be bought at the same time. Usually it should, because the industrial project will increase land values around it, and because zoning or planning controls may not be strong enough to protect the land from other development. In the absence of such controls it will probably be necessary also to acquire a "buffer zone" around the estate, particularly along highway approaches, to prevent undesirable growth in the surroundings.

The cost of land, relative to the total cost of the project, is unlikely to be a major determinant of location unless the site adjoins a large city. If it is associated with a large urban development, slum clearance or redevelopment schemes may indicate possible sites.

Land ownership is likely to be more important and a site which would involve several different owners, possibly with unclear or complicated titles, could mean long and serious delays in starting the project. The fewer the owners the better; and best of all if the state or the local authority owns the land.

9. Site suitability

The ideal site will be level but well drained, with soil of good bearing quality and an arable top-soil to facilitate landscaping.

It has been recommended that slopes should not exceed 1 in 10. A slope as steep as this would cause serious difficulty where large floor areas are required and particularly where factories will be expanding. Slopes of more than 1 in 15 or 1 in 20 will call for expensive "cut and fill" and will seriously interfere with access to factories from various points. The site

should not be subject to flooding or subsidence. Test bores will be required to determine soil bearing conditions. A bearing capacity of about one ton per square foot would normally be ample. Piling should not be required for two-storey buildings or for normal industrial floor loadings. Taller buildings are the exception on most modern estates and the extra cost of piling for these is not likely to be significant in the total.

10. Availability of building materials and labour

The size of building jobs already carried out, and their cost, will be the best indicators for estate construction. In the absence of such data a careful examination of local materials, of the feasibility and cost of transporting non-local materials, and of available building skills will be required. This survey may determine the design of buildings: a good architect can design adequate factories which can be erected largely by unskilled labour if necessary.

IV. PLANNING THE ESTATE

1. The Standard Factory

Whether or not the estate is to contain pre-built standard factories should be decided before planning begins. This will depend upon the purpose of the estate. An estate for the development of small-scale industries in a developing country will usually feature standard factories, the extra cost being considered as a necessary promotional expenditure.

In favour of standard factories

The arguments in favour of pre-built standard factories are several and weighty:

It has been demonstrated widely that a great variety of industrial operations can be carried out efficiently in non-specialized specialized buildings.

Standard factories can readily be leased, saving the industrialist capital expenditure at a developmental stage which makes great demands on his capital. (Non-standard factories can also be leased but only to a specific type of tenant and re-leasing, if necessary, will be more difficult.)

They enable production to start quickly - often a requirement for new industrial projects.

They avoid problems and effort for the industrialist in a field in which he is unlikely to be experienced - that of construction and arranging for services.

They can be so planned as to facilitate expansion, even where this is not forecast by the industrialist.

They will improve standards of working conditions and hence of productivity in industry. (But with restraint - lavishness would be uneconomic for the developer and the industrialist).

They give the developer better control of the appearance, facilities and amenities of the whole estate.

Rentals can be adjusted according to the purpose of the estate, whether it is to encourage a particular industrial development or to produce a profit.

They can reduce the cost and increase the speed of building by making possible the use of standard components and building methods.

Sizes of standard factories

If standard factories are to be used, they are the basic building block of the estate, or of the part of the estate which they occupy; and their sizes should be determined as a first step in planning. These can vary enormously with the purpose of the estate and one estate will normally contain several sizes.

It is generally desirable to limit the number of sizes of basic units on a given estate. A single, well-planned basic unit can be used in multiples to provide a wide variety of factory sizes. Keeping to this unit will give economies in standardization of components and in construction and will facilitate maintenance and repair. A well-designed unit can also give a pleasing harmony to the estate as a whole and will simplify the layout of blocks and buildings.

It is very unusual for a prospective industrial tenant to have such a precise picture of his requirements as will enable him to say: "A working area of 4,000 square feet would be too small, but I do not and will not want 6,000 square feet". If the area is big enough for him, he will usually welcome some undefined amount of extra space even when he is paying rent for it. In a general-purpose estate, therefore, the steps upwards in size of buildings can be fairly large.

Typical sizes of buildings would be:

400 to 1,500 square feet (37 to 139 square metres)[4/] for rural crafts, for small nursery factories in which new industry could develop to a stage of needing larger premises, and for service workshops.

1,500 to 6,000 square feet (139 to 557 square metres) for larger nursery factories, service workshops, and small developed industries.

4/ One square foot = 0.092903 square metre; one foot = 0.304801 metre.

6,000 to 25,000 square feet (557 to 2,322 square metres) for general industrial development.

25,000 square feet and upwards - usually in multiples of a basic unit of around 10,000 or 20,000 square feet - for larger industries.

Most general industrial estates use mainly basic units of sizes within the two middle ranges above. Mr. Edward D. Mills has illustrated the use of a basic building unit of 450 square feet (30 x 15 feet) (418 square metres) as a rural terrace craft unit, doubled to 900 square feet as a terrace workshop unit, doubled again to 1,800 square feet as a terrace nursery factory unit, or multiplied to give a standard factory unit of 9,450 square feet expandable to 27,000 square feet.[5/] In practice a larger basic unit would probably be used for the larger sizes to give fewer columns.

A similar approach is to use a few basic sizes in common terraces, with non-load-bearing side walls so that they can be removed to allow a firm to occupy more than one unit. Thus a terrace of twelve units each of 6,000 square feet (557 square metres) might be occupied by five factories each of 6,000 square feet, two factories of 12,000 square feet each, and one factory of 18,000 square feet. Further, the terrace can be so planned that the end units can be further sub-divided, say into four units of 1,500 square feet each at each end.

An alternative to terrace planning is to build the standard units in lots which allow for expansion. Typically (as in Puerto Rico) the lot allows for expansion of the factory to double its initial size. These are discussed more fully in section 4 below.

Which of these alternatives is better will depend on development costs of the lots versus terrace sites, and will be related to the speed of development. A terrace provides for economical site use and gives a good finished appearance but a terrace with empty gaps in it does not look well. While the completion of a terrace prevents expansion of factories within it, most industrial-estate-type firms can transfer to larger premises elsewhere on the estate without incurring inhibiting costs or inconvenience.

5/ "Planning, Design and Construction of Industrial Estates with Particular Reference to Africa", by Edward D. Mills, in United Nations, Industrial Estates in Africa (Sales No.: 66.II.B.2).

When the sizes of basic units have been decided, the shape can be determined by trial layouts on the site plan. Sides in a 2 : 1 ratio, commonly used or approximated, can be used for most sizes.

Building design

Detailed building design is proper to final planning rather than to the project proposal; but broad specifications are necessary for preliminary layouts and cost estimates. Some factors to be considered are listed here:

Factories will have three main sections: work floor, offices and toilets. It is also very desirable that each factory should have an enclosed open yard. In smaller factories the office area will usually be under the common roof; in larger factories it is desirable to roof offices separately because of the lower and hence less expensive roof required and so that, if desired, they can be built strong enough to support a second floor for expansion.

Roof-supporting columns hinder work layout and work-flow, but long spans are expensive; roof spans selected (which determine the basic unit) will be a compromise between these two considerations. Any column sterilizes about 30 square feet (nearly 3 square metres) of factory floor around it and therefore involves a cost (which should be taken into account in reaching the compromise solution) of 30 times the building cost per square feet. The economic span for larger buildings is likely to be between 50 to 100 feet. The bay spacing will be governed by the type of roof and glazing used. Where building widths exceed 30 or 40 feet, or where factories are built in terraces, roof glazing rather than wall glazing will be necessary. For smaller buildings, Mr. Mills' suggestion for "portal frame structures with a bay spacing of 15 feet (4.57 metres) and a span of 30 feet (9.14 metres)" should be effective.

Other important recommendations which he makes include:

> "Buildings [in hot climates] must be designed so that walls and windows have the minimum exposure to the sun by placing the long axis on the average path of the sun and providing wide overhanging eaves to create shade."

> "Buildings in any hot climate should be designed with cross-ventilation... In arid regions, where winds are hot and dry in summer and cold in winter, ventilation openings, windows, and the like can be reduced for comfort."

> "Generally, temporary buildings are not cheap and they usually last too long, finally becoming inefficient and expensive eyesores."6/

Roof heights will affect costs. Light and medium industry, where forklift trucks are commonly used for the movement and stacking of goods, will expect heights to trusses of not less than 12' 6" (3.81 metres)

The costs of existing buildings, and the experience of builders in the area, will usually permit sufficiently accurate estimates to be made for the project proposal on the basis of specifications in very broad outline. Where these are not available, more complete design will be required for costing.

Floor design will depend on soil conditions. With reasonable sub-soil, a 6-inch layer of dry-fill, and a 6-inch to 8-inch (15 to 20 centimetres) layer of concrete, smooth finish and dust-proofed, should meet most industrial requirements.

The use of air-conditioners or air water-coolers may need to be considered.

Multi-storey "flatted" factories are not considered, as being proper to urban re-development schemes rather than to industrial estates; as such they must form a secondary part of a total city plan.

Building standards, which will affect costs, have to be fixed in relation to the purpose and location of the estate. For example, if an estate is aimed at attracting foreign industry, both standards and rents should be competitive with locations in other countries. If it is aimed at promoting local small industry, standards should provide some improvement on existing buildings but within cost limits which will give acceptable rents. If it is close to housing, the appearance and standard of finish of factories will have an additional importance. Also, costs of maintenance must be borne in mind at the design stage. A building cheap to build but expensive to maintain could be bad economy.

6/ Ibid., pages 24, 25 and 30.

2. Roadways

Roadways must be designed in outline at the preliminary stages since their widths will determine the site layout and, together with their carrying quality, the costs involved. The main considerations in their planning are:

They should be adequate for estimated traffic flow and provide against congestion between the main highway and any point on the estate where goods or personnel will be loaded or unloaded.

At the same time, they should give economy in development and not occupy an undue proportion of the estate area. (Say, not more than 25 per cent - a reasonable figure would be 15 per cent).

They should not contain traffic hazards such as acute-angled junctions, multiple junctions, concealed junctions, mixtures of pedestrian, bicycle and vehicular traffic, or steep hills. Traffic should ideally be one-way. Vehicles should be able to park safely without relying on their brakes.

Road design should provide for the installation and easy maintenance of utilities including water, power and sewerage mains on verges.

They should not be congested by vehicle loading or unloading, or by car-parking. These should be either completely separated from the roadway or in clearly-defined docks with limited access to the traffic-carrying road.

During the first phase of development some roadways may be paved only on part of their ultimate widths; but it is necessary to allow sufficient right-of-way from the beginning, with utilities so sited that they will not be covered by road-widening.

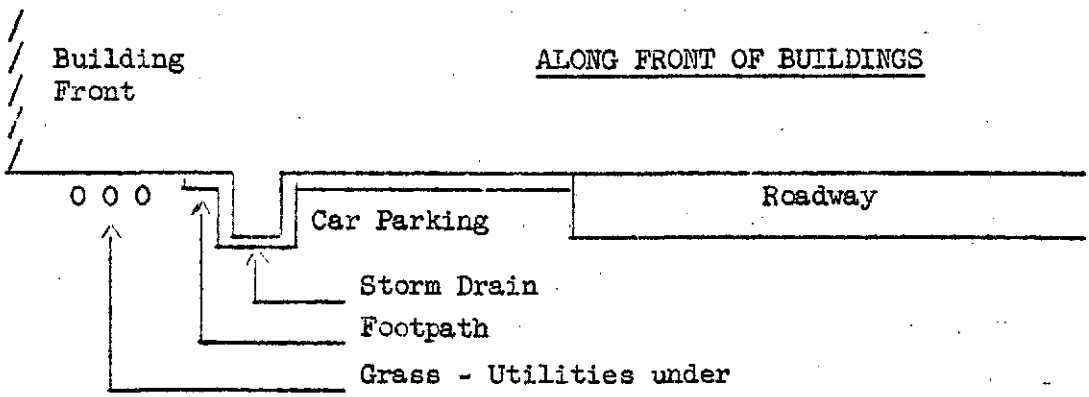
These considerations generally indicate a rectangular road pattern insofar as the shape of the site (including the desirability of using natural drainage runs) allows. Cul-de-sacs restrict movement and are undesirable where inter-communication between factories and access to central services are important, but may be necessary to open up isolated sites and have advantages in eliminating through traffic and in reducing road and utility costs.

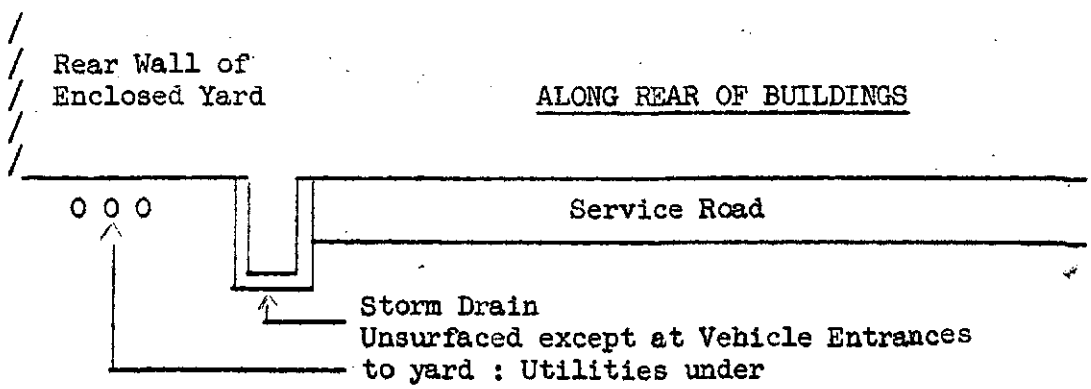
Roadway design is clearly subject to many variables and can hardly be discussed in a general way. One such variable is whether individual factory lots, containing their own car-parking and vehicle-loading areas (section 4 below), or terraced standard factories are to be used.

In the case of individual lots, roadways serve only for traffic flow and the main question to be decided is whether factory lots should be connected directly to the roadway, or whether interference with main road traffic should be limited by providing a subsidiary service road. Which of these solutions is best will depend largely on the size of individual lots. It is desirable not to have intersections with the main road at more frequent intervals than about 600 feet (183 metres); but the desirable will have to be related to the possible in terms of cost.

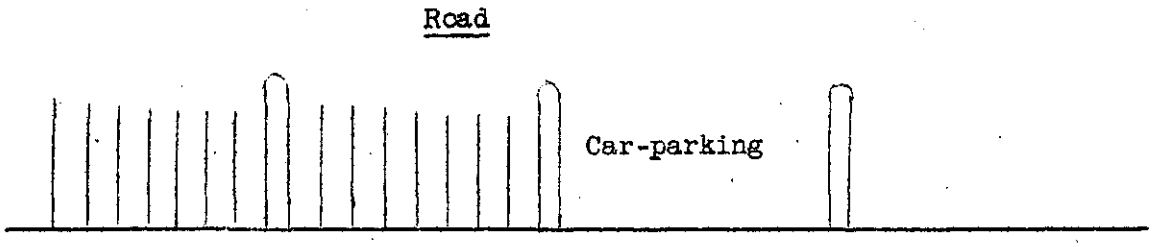
Terraced standard factories are used in so many estates (entirely or for part of the estate) that it is worth looking at the road pattern involved in some more detail. These call for two types of roadway: a roadway for traffic movement and for access to fronts of factories, with some car-parking provision along the fronts, and a service roadway for access to backs of factories where loading and unloading of goods will normally take place.

Typical cross-sections of such roads are:





Normally building fronts (and rears) will face each other across such roadways, and the section on the left of the road will be duplicated on the right. Car parking areas will be divided up by "fingers" in plan to separate them clearly from the road, thus:



Depth of such car-parking areas would be at least 15 feet (4.57 metres); 18 feet would be better where it can be afforded. Utilities are kept under grass or unpaved areas for easy maintenance. Storm drains may or may not be covered throughout, and may or may not feed into general sewers. Curbs are normally provided to roads. Useful dimensions are: width of truck, 8 feet; lane for parking parallel to curb, 10 feet; minimum lane for moving traffic, 12 feet; minimum curb radius for trucks, 25 feet; for tractor-trailer vehicles, 40 feet.

It is desirable to choose a paved road width in use in general road systems in the area. Drivers will be accustomed to it. Building, maintenance and repair methods and costs will be well known. Also, roads may later be taken over by the local authority. The width will depend on anticipated traffic densities and little guidance can be given. Existing estates have main roads from 24 to 50 feet wide; secondary roads from 16 to 38 feet wide; and service roads from 10 to 22 fet wide. (Larger dimensions in the United States).

Where many workers will be cycling or walking within the estate it will be necessary to provide paths separated from vehicle-carrying roads.

While the street-lighting system will not need to be designed at this stage, provision for it must be made in cost estimates. Increasing machine values mean increasing shift-work, and the modern estate will need good lighting.

3. Railways

In practice, where an estate is served by a railway, the railway authority will normally be responsible for designing and constructing the stations, sidings, and connexions to factories. It is usual to run rails along the rear of factory lots, and it is desirable to sink spur tracks so that waggon floors will be level with factory floors. 7/ Level crossings should be eliminated or at least kept to an absolute minimum so as to reduce accidents.

4. Blocks and lots

Sizes of blocks, that is, the areas to be subdivided into factory lots to each of which all utilities will be connected, will determine the road plan. Their long dimension - along the road - will be set in terms of economy of road and utility lengths and ease of access to lots. Their depth (unless determined by the size of terraced standard factories) will be chosen both in terms of economy and in terms of giving flexibility within the range of factory sizes to be provided for in that part of the estate. Generally, depths which will give a 2 : 1 rectangle to individual lots, with the short side along the frontage are favoured.

Lot depths in large industrial estates in the United States vary from about 125 feet to about 600 feet. Depths in the recently-planned Teeside Industrial Estate (United Kingdom) for small and medium industries average 300 feet for most sites. The shorter the depth, the greater the proportion of roadways to total area. An approach to size for a particular estate would be to take the likely size of factory: add for trucking and parking areas; add for outside storage space (where this is useful); add for expansion space to be provided; add for clear areas to be left around factories: and establish the 2 : 1 rectangle which would give this area. The longer side of the rectangle would then be the lot depth which will be the same as the block depth

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7/ "Industrial Estates - Tool for Industrialization" by William Bredo. Published by the International Industrial Development Centre of the Stanford Research Institute, The Free Press of Glencoe, Illinois, 1960.

where factories have front and rear access; or half the block depth where there is front access only.

What proportion of the total area should be covered with buildings ? The "industrial park" concept of large landscaped areas around factories may be attractive, but too much open space would be a departure from principles of concentration, convenience and economy. Where these benefits are important, the less open the space the better. When we allow for open areas within lots, landscaping, car-parks, roads and loading docks, the built-up area should not exceed 50 per cent of the total area; and United Kingdom research indicates that the figure should be one-third. Many estates permit building on no more than half the lot; some allow it on two-thirds. Open space for landscaping can usefully be combined with employee recreation areas.

It is usual to lay down a minimum distance between buildings and roads - for example, 75 feet on major roads and 10 feet on side roads. One purpose is to preserve access for fire-fighting.

Expansion can be provided for in terraced factories by using non-load-bearing side walls, so that the industrialist may reserve the plot beside his factory and, when it is built upon, remove the intervening wall. In the case of factories on individual lots, it is common practice to allow 100 per cent expansion space. If this is not used, it may be valuable for the expansion of the adjoining factory to more than 100 per cent. If this expansion allowance is inadequate for a particular industrialist, it will still be possible to make a special arrangement with him.

5. Car-parking

Trends everywhere in car ownership are upwards. Unless ample provision is made now, factories may be severely inconvenienced in the future - even to the stage of re-location - or very expensive solutions, such as multi-storey parking, may have to be found. It is not necessary to make hard-stands for more than current needs but areas must be reserved, possibly as grassed areas which can be paved as required. If in the future they are not required for parking they could still be used for factory buildings or other estate purposes.

As guides: in Puerto Rico one parking space has been provided for each 12 employees; in the United States many estate covenants call for one space per 500 or 1,000 square feet of factory space, or for every 1 1/2 or 3 employees. Each vehicle parked will require about 300 square feet, allowing for manoeuvering space.

There are two general types of car-park: employee parks, which may be detached from, but should be convenient to, factories; and visitors' and executives' parks, in front of or besides factories. It is usually desirable to provide also for bicycle parking - the small areas involved can be beside factories, preferably inside yards.

Bus lay-bys for taking on or letting off passengers, and possibly a central bus parking area and shed, will also be required. The lay-bys should be spaced to be not more than five minutes' walk from any factory.

If a high level of car ownership is likely, a Radburn layout as adopted in the Teeside plan should be considered. This involves road approaches to the backs of factories and car-free areas for pedestrians at the office ends. These car-free areas are finished as pleasantly landscaped courts, and road-noise interference with office operations is removed. Canteens can also be suitably located facing on the courts.

6. Utilities

In the ideal situation, where the estate is planned in relation to total community development, utilities such as water mains and sewerage will most economically be provided as part of, or as an extension of, the community system. Only where this is not feasible will an independent system be provided.

Water and sewerage mains (and power mains, where these are underground) together with gas pipes and steam supply pipes, where they are provided, should run alongside roads, preferably under grass or unmade ground for easy maintenance access. Estates where buildings have deep set-backs from roadways (say 100 feet) may be an exception. In large estates with several utility mains, underground walk-ways may be considered, but these are extremely costly.

Water

Where expensive treatment is needed for available water, separate systems for potable and non-potable water may be desirable. Supply needs of blocks and of factories can be estimated as indicated in part III section 5 to determine the sizes of mains. There may also be insurance requirements which would fix minimum sizes for mains.

Where economically feasible, "ring" systems of mains should be used to reduce the danger of supply interruptions caused by pipe breaks, to enable sections of mains to be shut off for maintenance, and to prevent pressure drops when users at different positions on the line are drawing water at the same time.

Sewerage

Pump houses and treatment plants should be planned to minimize pipe runs while avoiding nuisance from smells. Capacities required from any area can be taken as equivalent to the water supply to that area.

Usually the system will be designed to accept normal domestic sewerage, and trade effluents which do not conform to acceptable standards should be treated by the factory concerned before entering the system.

Where large quantities of trade effluent are anticipated, a separate disposal system for these may be worthwhile but is expensive.

Whether or not storm-water drains are connected into the sewerage system will depend on total run-off and rate of run-off of storm water. Most often, the storm-water system is best kept separate.

Power

It costs much more to bury electric cables than to run them on overhead poles, but the extra cost may be justified by greatly-improved appearance and greater safety. This is particularly so in densely-built estates - for example, where terraced factories are used.

Distribution sub-stations, at which high voltages are reduced to user voltages, will be located on the estate in accordance with the anticipated load pattern. Main line capacities can be estimated as indicated in part III section 5. Close co-ordination with the electricity authority in planning and in providing for growing loads will be essential. As with water, ring systems of distribution are very desirable.

Steam

Consideration may need to be given to the supply of steam for industrial processes and factory heating from a central boiler house. This may be an economic proposition for a densely-built development, where pipe runs and

consequent losses will be small, and where it is possible to estimate closely in advance what total requirements will be. Otherwise it will be necessary to install or provide boiler capacities for the maximum possible load, which may never be reached. Unless steam is produced in conjunction with the generation of electric power, it is unlikely that a central station will be able to compete with individual oil-fired boilers in factories.

7. Zoning

The planned separation of different types of industry will:

- Minimize nuisances caused by smoke, dust, noise and odours (clean air is required by many modern industries and can only be provided by eliminating or separating out sources of air pollution at a sufficient distance);
- Minimize risks from fire or explosion;
- Reduce traffic hazards (for instance, by separating road and rail);
- Enable needs to be met most economically (for instance, by grouping heavy steam-users around a central boiler plant, grouping rail users together, grouping nursery factories near common service facilities);
- Provide the most attractive over-all appearance for the estate (for instance, by zoning standard factories according to size and separate from individually-built factories which are likely to be of miscellaneous styles).

Zoning of factories together merely because they have like products is not recommended. Industrialists probably prefer to be at a distance from other factories using the same skills because of possible unsettling effects on workers.

Zoning is therefore partly a matter of prior planning and partly a matter of selection of industries and their allocation to suitable sites.

8. Estate services

The extent to which services should be supplied by the estate developer will depend on the purpose of the estate and on the availability and quality of services from commercial firms, the local authority and the state. Services can also be provided by co-operative arrangements between factories. To the extent that these sources can supply the needs, they can be rented premises, or licenced to operate on the estate. This will minimize the developer's commitment and at the same time enable him to secure a return from profitable services. Industrial services such as foundry-work, forging and woodworking may be provided by commercial entrepreneurs, if there are sufficient opportunities, or by the sponsoring authorities if the estate is aimed at promoting small industry development.

The following list covers the most important services provided on existing estates:

- Removal and disposal of industrial waste, combined with salvage.
- Fire and police protection.
- Canteens.
- Bus terminal for commuter traffic.
- Rentable warehouse space.
- Health service, ranging from first aid station as a minimum to fully equipped medical and dental facilities.
- Post office and telephone/telex exchange.
- Bank, shipping and insurance agencies.
- Communal repair and maintenance workshop.
- Central garage for vehicle maintenance and repair.
- Training centre.
- Building and maintenance service.
- Customs and excise office.
- Showrooms for industrial estate products.
- Supply depots for industrial hardware, machines and general equipment.
- Recreational centres and playgrounds.
- Children's crèche.
- Central office services (ranging from translating, typing, duplicating, and printing, to data processing with the possibility of a computer service).

- Meeting rooms, club rooms.
- Advisory services and assistance in recruitment and selection, wage determination, industrial relations, welfare services, selection and installation of machinery, methods improvement, supervisory training, business finance, production management, and marketing.
- Foundry to supply ferrous and non-ferrous castings.
- Common leasing shop to lease out portable tools and other machinery, with skilled operators to guide in use.
- Woodworking shop.
- Forging and heat treatment shop.
- Toolroom to supply dies, jigs, etc.
- Research and testing centre; technical library.
- Weighbridge.

One of the advantages of an industrial estate is that firms there can use spare production capacity in sub-contracting for, or supplying parts to, other firms on the estate. For example, a firm with a plating plant or injection-moulding machinery may not have full use for it, but can offer a service to other firms. Thus, the total productive capacity of the estate is better used. Over-supply of central manufacturing services would bring the opposite result - under-utilization of resources - and therefore must be guarded against.

The siting of central services requires careful thought. A "central" canteen must be sited in relation to walking distances and the length of the lunch-break; on a large estate this will call for more than one canteen.

9. Phasing estate development

The cost of developing land (providing drainage, roads and utilities) is high and therefore development is normally carried out in stages related to the rate of growth. No general rules can be laid down, but certain points might be borne in mind:

The best attraction to industry is to have successful enterprises already on an estate, in a pleasant environment and supplied with all necessary utilities and services. Therefore the first phase should be achieved quickly and

should be reasonably complete in itself. Development work on the first phase area should be completed as quickly as possible, so that buildings can be erected in an area free of heavy builders' plant and excavations and the dirt and inconvenience that go with them. Grassing, tree-planting and any other landscaping should be commenced as soon as possible, if necessary fencing the areas involved against disturbance by building operations. It should be possible to route constructional traffic for further areas around rather than through the first area. To achieve better promotion of the estate, the first phase area will probably be located near the main highway.

These considerations serve as a guide to the size of the first phase area. This area should not exceed what can be completely developed within two or three years. The size of successive phases to completion need not be determined in advance - experience will permit more accurate determination - but the over-all plan should permit development in logical steps, building work being separated from area development as far as is possible.

Some works may need to be carried out full-scale at the beginning - for instance, embankments to prevent flooding of the area, or main drainage. Other works, such as watermains or main sewers, may most economically be carried out in full scale at the beginning as the pipe size normally will not greatly affect the cost of pipe laying. Roads may be widened in accordance with growing traffic demands.

It is essential that utilities be phased so as to be ready in good time to meet requirements. If early industries encounter grave difficulties from, for example, lack of water, the estate will acquire a bad reputation which will be difficult to overcome.

Similarly, the need to phase housing and community development to industrial development calls for, at the very least, close co-ordination between the estate agency and the housing agency; and may indicate that one agency should accept responsiblity for both.

V. OPERATIONAL CONSIDERATIONS

1. Restrictions

Restrictions on the activities of estate industries are necessary in their own interest, and a good code of restrictions will enhance the attractiveness of the estate to industry. These can be in the form of covenants between the industries and the estate agency; restrictions built into leases; or licencing arrangements. They will also call for screening of prospective occupants. Whatever the mechanisms used, the restrictions should secure the:

Avoidance of nuisance - smoke, dust, smells - which would affect the operation of other industries.

Avoidance of hazards - fire, explosion - which could endanger neighbouring premises.

Maintenance of appearance of the estate by preventing unauthorized building (including fences and walls); by controlling sign-boards and advertisements; by preventing the dumping of waste; by limiting the uncovered area which may be used for storage; by providing for the preservation of landscaped areas; by specifying building set-backs; and by limiting building to a stated proportion of the lot.

Maintenance of utilities by preventing the disposal of harmful effluents into sewerage systems, and by enabling control to be exercised where necessary in the use of water - for example, by forbidding carwashing.

Maintenance of leased properties by preventing unauthorized interference with building structures; by restricting use of buildings to the purpose statedin the lease; by preventing unauthorized subleasing; and by requiring tenants to keep buildings in good condition.

Maintenance of any necessary degree of compatibility between factories; for example, by ruling out very large firms which might dominate the estate or too many firms producing the same goods.

2. Rental versus selling

Whether it is best to rent buildings, to sell buildings, or to lease sites on which the industrialist will erect his own building, depends on the purpose of the estate. Frequently it is desirable to offer all possibilities.

Renting of standard buildings has advantages for the developer and the industrialist. Standard buildings may, of course, also be sold. It is argued that the ownership of buildings ties the industrialist more effectively to the estate and to the community, and that he can more readily locate elsewhere when he is the tenant of a rented building. This is not necessarily so. Ownership of a building gives the industrialist an asset which he can sell, and by doing so he may move more readily.

Where the estate agency retains ownership it can participate in rising property values, adjusting rents upwards on termination of lease agreements or on changes of tenancy.

The major argument in favour of selling (and circumstances may make it an over-riding argument) is that the estate agency recovers its capital investment more quickly and can re-invest it, if desired, in further development.

Leases can be drawn to cover any period of years - a lengthy period, to tie the industrialist to the estate, or a short period to encourage entrepreneurs in risk ventures and to enable rent adjustments to be made more frequently. All leases should be terminable on consent of the lessor, for example to enable a tenant to move to larger premises on the estate or to take account of a tenant's inability to continue through causes outside his control.

Where standard buildings are leased, it is usual to complete them to a "shell" stage with final partitioning, electrical work, finishes, and the like to be decided in agreement with the tenant, or to be provided by the tenant. Special finishes, or alterations to the building, may involve increased costs which might not be of value to any subsequent tenant. It is good policy to separate payment for these "extras" from "standard" rental and to collect it over a short period.

Options to buy may usefully be incorporated in lease agreements, to give the attraction of greater flexibility in arrangements and to enable the industrialist to defer capital commitments until his expensive establishment phase is past. They are usually exercisable only within a limited period, say five years. The selling price at each year is fixed in advance and the extent to which this is made attractive (for instance, by allowing for rental payments already received) will depend on the rental or sale policy of the estate agency.

Rental charges need not be uniform over the years, and may be scaled upwards so that the industrialist's burden will be eased in the establishment period. The level of rents may be subsidized, initially or throughout, as part of a policy of encouraging industrialization.

Nor need rental charges be uniform over the estate - they may be scaled according to location, for example, with higher rents for buildings on the frontage of the estate or near central facilities.

It is frequently desirable to grant industrialists options on land adjoining their buildings, to facilitate expansion. The charge for options should take full account of the development costs of land, unless a subsidization policy applies. If it does, the option period should be strictly limited to encourage rapid full development of the estate and to prevent unsightly gaps in development. The option can be extended in individual cases if desired, possibly at a higher charge.

3. Administration

The skills required and the demands on management in developing an estate are different from those needed for operating the estate. Unless the estate is a very large one, involving new construction and heavy promotion over a long period of years, it is desirable to think of these requirements separately, even though they may be supplied by one administration.

Administration at the stage of construction and initial promotion - the need for which ends with full development of the estate - can often best be supplied by a national or regional agency responsible for the development of several estates. However, this carries the disadvantage that those responsible for shaping the estate are not directly responsible for its successful administration - there is much to be said for having the long-term administrator closely involved in planning and construction.

The change in management requirements as the project progresses through planning, construction, promotion and growth to completion indicates the desirability of having a flexible administrative and technical force. This can be provided by using consultants and contractors wherever feasible rather than building up a large "permanent" amdinistration. Even for continuing tasks, such as building maintenance and landscaping, the trend is to have these done by contract in accordance with carefully-written specifications.

Whether or not the estate is being established by a central agency, there will be need for a strong local estate management with wide powers, subject to any necessary over-all policy, to promote the estate, to negotiate contracts, sales and lease agreements and to ensure the effective running of the estate as a whole. Depending on the purpose of the estate and on the need to co-ordinate industrial development with outside community development, it may be desirable to set up a local board of management which could include representatives of the local administrative authority, utility and transport authorities and local commercial interests as well as of the estate authority.

The tasks which may devolve on the permanent estate management will include:

Construction of new buildings and utility in successive phases of development.

Maintenance of buildings, utilities, and landscaping.

Supply and administration of services.

Promotion of the estate.

Negotiations of sale and lease agreements.

Co-ordination of outside services, such as transport for workers.

Examination and approval of proposals for alterations to buildings, siting of advertisements, sign-boards, and so on.

Application of controls to ensure that all conditions of tenancy and restrictive covenants are kept.

Collection of rentals and service charges and preparation of control accounts.

It is not possible to generalize in regard to the size and organization of the management structure, which will vary according to the size of the estate, whether lease or sale policies are followed, and the extent of the services supplied directly by the estate agency. In developing the management structure it will probably be better to work back from the "developed estate" situation rather than forward from initial needs.

VI. SPECIALIZED ESTATES

Specialization can be in terms of purpose (for instance, an industrial nursery); products (for example, in order to use certain resources such as petroleum by-products); skills (for example, to make more effective use of handcraft skills such as carpet-making or woodcarving); or location (for instance, a port location). Some considerations relative to this last type of specialization will be reviewed here, noting only that the other types, while having possible advantages in particular circumstances, may have the serious disadvantage of lack of diversification and hence lack of stability in times of recession in an industry.

1. Port estates

Seaports are specially attractive to industries handling heavy or bulky loads, such as heavy engineering, milling and many chemical industries. They are also attractive to export-oriented industries and, of course, to industries supplying shipping needs. The attraction is greatest when the port has a high frequency of services and is capable of handling large vessels.

The problems of industrial estate development near such sea ports are unlikely to be those of attracting industry (provided the labour supply is there) but rather of estate planning in relation to high land costs, existing development, restricted space, public amenities, and integration with port facilities such as docks and warehouses. In most such places, therefore, estate development will definitely follow port development and the authority concerned will be the port authority. Where port facilities are non-existant or undeveloped, but where they could be provided and possibilities for industry are good, industrial development may be a primary concern, as was the case in the Italian port of Marghera. The success of Marghera is based on offering bulk industries (chemical, metallurgical, petroleum, etc.) their own waterside frontage and enabling them to provide directly all loading and unloading facilities. 8/

8/ See "The Port and Industrial Zone of Marghera", by G. Giavi, in United Nations, Industrial Estates in Asia and the Far East (Sales No.: 62.II.B.5).

2. Airport estates

Rather different considerations generally apply to airports, which are becoming increasingly attractive as estate locations. Airports are newer and will normally have less existing development on their perimeters - indeed, they are often deliberately separated from existing communities. As well as the location advantages already mentioned, they are usually served by good highways which can also serve for the initial development of industry. (But road planning will call for special attention to ensure no interruption of the necessary ease of movement between the airport's terminal buildings and the city it serves.) The flat terrain in which airports are sited is ideally suited to modern one-storey factory buildings with large level floor areas, and it permits maximum flexibility in estate layout. (The flat terrain also increases the need for attention to landscaping - trees should be planted at the earliest possible stage in the project.)

Where a new airport is to be built, the possibility of associating an industrial estate with it should be examined and, if decided upon, the estate's location, land requirements and general layout should be taken into account in planning the airport.

Industrial location at airports, if planned in relation to runways and flight-paths, will not lead to any operational hazards or nuisance. Aircraft noise is usually of little or no concern. A relevant factor in relation to building location is the diminishing need of modern aircraft for a variety of runway directions to suit wind direction. In existing airports a study of the recent history of runway use may indicate the possibility of taking one or more runways out of commission in order to give wider scope in building location.

To quote a recent study: "A location which often is a good choice for the industrial park is on the side of the runway opposite the terminal. This is particularly true of airports used by air carriers, where diversion of industrial traffic from the terminal traffic boulevard is advisable. Also, in this area, airport supporting services are not competing for land to use for activities such as terminal auto parking and commercial concessions. A location in the vicinity of the general aviation area has the advantage of being close to the area where the aircraft will be stored and maintained. This location keeps ground taxi time at a minimum." 9/

9/ See "Planning the Airport Industrial Park", AC No. 150/5070-3, dated 30 September 1965. Published by the Federal Aviation Agency, Distribution Section, H-Q - 438, Washington, D.C. 20553.

The same study states: "An airport industrial park should be at least 50 acres to justify the management effort required for planning, promotion, and continuing operation". This comment can be taken as relating to industrial estates in general and therefore would be subject to the qualifications set out in part II, section 1.

Housing, which will often be required at airport locations because of their separation from existing locations, will be more subject to noise nuisance than will factories. Noise must be planned for either by keeping housing a sufficient distance from flight paths or by insulation.

Special clauses will be necessary in restrictive convenants or leases. Smoke-emission will generally be completely banned, or possible only within approved hours to permit blowing-out of burners. Radio-emissions will likewise be forbidden. Special attention will be paid to external lighting and illuminated signs will be forbidden or restricted in nature or location so that there will be no danger of confusion with airport operational lighting. Similarly, specially shaded street lighting will probably be necessary.

Where the purpose of the estate is the modernizing of industry, an airport location can have an important psychological advantage in that the industrialist is in daily contact with the still new and rapidly advancing technology of aviation through proximity to aircraft activity and the facilities, architecture, services and personnel associated with it.

An airport may provide a good location for an industrial estate whether or not the industries there will use air cargo services. But the close availability of these services remains the most important industrial characteristic of the airport. The type of industry which will be attracted and aided by them is, as already mentioned, that which produces goods having a high value-for-weight ratio, because the extra cost of air over surface transport will have a proportionately small effect on the selling price. What extra cost can be carried with advantage depends on other factors. Fragile goods are likely to travel better by air, with consequently lower breakage loss or insurance cost, or both. Perishable goods (dressed meat, fish products, and so on) may require air transport. Products subject to rapid fashion change - the colour of garments, for example, may gain in competitive advantage by greater speed

to market. 10/ Goods travelling in small lots to widely scattered markets, particularly where quick delivery is called for - machine replacement parts, for example - may call for air transportation.

As pointed out in a recently published handbook, a "full and direct comparison of air and surface shipment and distribution goes far beyond a simple comparison of transport rates, to cover direct shipping costs, indirect costs, and intangible factors". 11/

The authors describe a "total cost approach" in which the main cost elements can be summarized as follows:

(a) Transport charges.

(b) Packing and crating costs. Packing and crating costs can be greatly reduced for air freight, and the weight saving will also be reflected in transport charges.

(c) Pick-up, transfer and delivery charges. Pick-up and delivery charges are usually less than for surface freight, and there are no additional charges for transfers between connecting airlines.

(d) Insurance premiums. These are much lower for air freight than for most surface transport.

(e) Interest charges - capital turnover. "The faster goods are delivered the sooner capital goes back to work."

(f) Warehousing and inventory costs. "The most immediate and tangible savings result from the complete elimination of transit warehousing and related handling and wharfage charges, in the actual process of moving goods from one place to another. The second, and usually larger, group of savings are connected with storage warehousing, tied up with the holding of inventories, particularly in market areas."

10/ "Half of France's textile exports to the United States now cross the Atlantic by air". TIME, 24 December 1965.

11/ "Air Freight, Key to Greater Profit", by Groenewege and Heitmeyer, printed in the United Kingdom by Aerad Printers and Publishers, Hayes Road, Southall, Middlesex, England; 1964.

(g) Charges for documentation. Much less elaborate documentation is needed for air than for surface transportation.

(h) Customs clearance costs. "At most airports customs clearance takes far less time, provided the necessary papers are available and in order."

Industries considering location on an airport estate may not be experienced in air transportation and it will be highly desirable to have available expert advice to help in assessing the transport economics related to their product. This can be supplied by airline cargo representatives; by qualified commercial shipping agencies; or by the employment of a specialist on the estate staff.

A final point is that the trend is towards a reducing gap between air and surface transport charges for most commodities. The applicability of air transport will extend to a growing number of products and many items are now shipped by surface will certainly move by air in the future.

The ideal situation is where the estate can be located close to both a sea port and an airport. As well as the communication advantage, the one tends to attract heavier, the other lighter industry so that there will be a good diversity of industrial development and a good balance between male and female employment. Close organizational co-ordination between the port authorities and the estate authority will be vital and the project is likely to have greatest over-all success where there is one authority responsible for all elements.

The possibility of giving the port estate duty-free status may be considered. This isolates the estate, in customs terms, from the remainder of the country and permits import of raw or partly-manufactured materials without payment of duty. Duty only becomes payable when the products leave the estate for the rest of the country. Dutiable goods coming into the estate from other ports can be brought in under bond.

Where the industries are primarily concerned with the home market it is doubtful if duty-free status gives a worthwhile advantage. The benefit of the delay in duty-payment on imported raw materials will be offset by the work associated with customs clearance of goods to and from the home market. On the other hand, where the industries are mainly exporting and are likely to

require substantial imports, duty-free status can give definite advantages. If these are to be fully realized it is essential to have a high-level customs officer on the estate, charged with advising and assisting the firms there, and to have minimum formalities associated with import and export clearances - only those formalities necessary for the collection of needed statistical information.

VII. COMPLETION OF PROJECT PROPOSAL

Time and cost figures have to be applied to each element planned. Figures should be obtained from experience in the region relative to each aspect of the work, and applied to the quantities or personnel involved in the proposal. Circumstances will dictate the limits of accuracy required: the closer these are, the greater will be the time and cost involved in preparing the proposal.

Following on acceptance of the proposal, the next stage will be to prepare an over-all master plan related to each phase of construction, charted time schedules for each contract (at least simple bar-charts, though the complexity and cost of the project will probably justify more sophisticated critical path analysis techniques), and detailed contract drawings for the first phase. At the same time, the organization will be set up, any necessary legislation obtained, and land acquisition completed. One of the first tasks of the new estate authority will be to design its promotional campaign and to commence it in a timely fashion.

SELECTED PUBLICATIONS

1. "INDUSTRIAL ESTATES - TOOL FOR INDUSTRIALISATION" by William Bredo. Published by the International Industrial Development Centre of the Stanford Research Institute, The Free Press of Glencoe, Illinois, 1960. Price: $6.00.

2. "INDUSTRIAL ESTATES IN ASIA AND THE FAR EAST" - particularly the chapter by T.S. Vedagiri on "PHYSICAL PLANNING OF INDUSTRIAL ESTATES", and the chapter on "THE PORT AND INDUSTRIAL ZONE OF MARGHERA" by G. Giavi. United Nations publication, 1962. Price: $4.50 (Sales No.: 62.II.B.5).

3. "THE PHYSICAL PLANNING OF INDUSTRIAL ESTATES". United Nations publication, 1962. Price: $0.75 (Sales No.: 62.II.B.4).

4. "ESTABLISHMENT OF INDUSTRIAL ESTATES IN UNDERDEVELOPED COUNTRIES". United Nations publication, 1961. Price: $1.00 (Sales No.: 60.II.B.4).

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6. "INDUSTRIAL ESTATES: POLICIES, PLANS AND PROGRESS - A COMPARATIVE ANALYSIS OF INTERNATIONAL EXPERIENCE". United Nations publication, 1966. Price: $1.00 (Sales No.: 66.II.B.16).

7. "CLYDE VALLEY REGIONAL PLAN - 1946". Sir Patrick Abercrombie and Robert H. Matthew. Published by the Clyde Valley Planning Advisory Committee, Scotland.

8. "REPORT OF COMMITTEE OF DEVELOPMENT CENTRES AND INDUSTRIAL ESTATES". Published by the Stationery Office, Dublin, Ireland, at 2/6-d. Also COMMENTS on the Report by the Irish National Industrial Economic Council, at 8d.

9. "TEESIDE INDUSTRIAL ESTATE, 1964". A report prepared for the Board of Trade and the Industrial Estates Management Corporation for England by Napper Errington Lee Collerton Barnett Allott, Chartered Architects and Planning Consultants. This beautifully prepared report is not for sale, but copies may be sought from the Industrial Estates Management Corporation for England, Team Valley, Gateshead-on-Tyne 11, England.

10. "PLANNING THE AIRPORT INDUSTRIAL PARK" - AC No. 150/5070-3, dated 30 September 1965. Published by the Federal Aviation Agency, Distribution Section, H-Q - 438, Washington, D.C. 20553. This 30-page circular deals with the planning, organization control and operation of this type of industrial development and contains valuable layouts of existing estates.

11. "AIR FREIGHT, KEY TO GREATER PROFIT", by Groenewege and Heitmeyer. Printed in the United Kingdom by Aerad Printers and Publishers, Hayes Road, Southall, Middlesex, England, 1964. Price 15/-d.