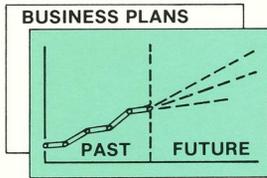
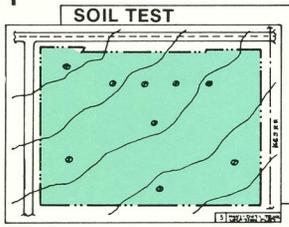


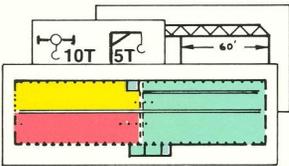
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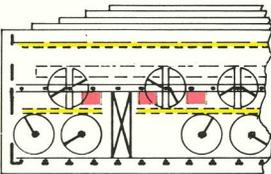
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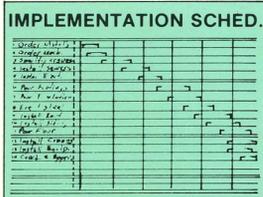
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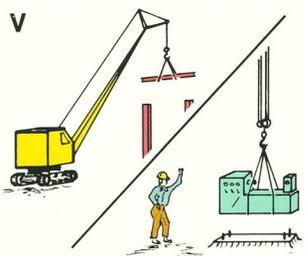
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SYSTEMATIC PLANNING OF INDUSTRIAL FACILITIES – S.P.I.F.

VOLUME I

by **Richard Muther**
and **Lee Hales**

Management & Industrial Research Publications

SYSTEMATIC **P**LANNING OF **I**NDUSTRIAL **F**ACILITIES — **S.P.I.F.**

VOLUME I

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PREFACE

It would take many volumes—indeed more than any one person could write or even know about thoroughly—to cover the full topic of facilities planning. It is not our intent to write such a compendium. Rather, we are offering to practical facilities planners a way of planning better via a structured approach.

Systematic Planning of Industrial Facilities (SPIF) was conceived and designed as directly aiding the planner of industrial facilities, his superiors, and his subordinates. Its development has been targeted at both a general and a specific guide to industrial facilities planners. It puts together an organized approach that is generally adaptable to any project of industrial facilities planning, be it large or small, short or long term, hurried or deliberate, a new facility or modification of an existing one.

A book with these criteria or aims is an ambitious undertaking; perhaps even to tackle it is a bit presumptive. So, it is with recognition for incompleteness that we submit this structured approach for general distribution in book form. At the same time, our consulting associates have followed the methodology in these pages on many successful projects. And, we have been told by clients—some numbered among the leading industrial firms of the world—that SPIF is both directly helpful and soundly dependable.

Actually, SPIF is presented in two volumes. Volume I describes the background, basic concepts, and the methodology of SPIF; and it provides supplementary explanations of the planning for each component individually plus a section of examples. Volume II explains the application of SPIF in practice and provides a series of decision aids, useful appendices, and working forms.

Our efforts in these volumes are not in any way meant to imply that past projects are poor or even to point out they might have been done better. Rather, we suggest that there is always a better method, and since our experience tells us that the methodology we have developed over hundreds of projects can be helpful to planners, we'd like to share it with others.

This book will present many specific techniques that are individually helpful. Any book on realistic planning should do so. But, planners should appreciate that it is the total planning system, its underlying logic, and its organized-refinement sequence that we feel is of greatest merit. Thus, SPIF is a whole approach in which other planning systems like Systematic Layout Planning (SLP) and Systematic Handling Analysis (SHA) become supportive subsystems.

SPIF is not a book of knowledge, encyclopedia, or handbook, although it has many of their features. Rather, as a combination of procedures, SPIF is a structured system of planning; as a book, it is primarily an instruction manual, aid, guide, and reference.

The reader should not expect to get from SPIF:

- The resolution of all his facilities problems.
- Tables of data, rules of thumb, or quick-answer solutions.

- Detailed designs or even a series of overall designs from which the planner can select the one he likes best.

Rather, SPIF is an approach to help knowledgeable planners organize to plan better and faster--through systematic structuring of their planning effort. Like every discipline, it has boundaries beyond which it cannot be expected to apply. Consequently, each reader will have to adapt SPIF to his own particular situation. In doing so, he should note that it is assumed the user of this book already has some familiarity with industrial facilities and has had some experience in planning them. It further presupposes that he is ready and willing to improve his performance and that of the people who work for him. To such persons, SPIF can be an important step forward.

Your authors wish to thank all of our clients and friends who have contributed to the development of SPIF. We are especially indebted to the staff of Richard Muther & Associates, Inc. and the affiliate members of Muther International who have struggled with us to present SPIF in a clear meaningful manner.

Richard Muther
Lee Hales

PREFACE TO THE THIRD EDITION

The third edition of Volume I is basically the same as the first edition so far as the methodology is concerned. What has changed is the structure of the planning pattern for each of the five components: layout, handling, communications, utilities and building.

When originally developed, for example, Systematic Layout Planning (SLP) had a nine-step planning pattern. Similarly, each of the four other components followed a nine-step pattern. This pattern has been restructured into five sections. This is more convenient. It is more directly compatible with SPIF. And it allows more flexibility when the pattern repeats itself in Phase III - Detailed Planning.

We should point out also, that the pattern varies, as you would expect, depending on the size of the detail planning's subproject. That is, the Phase III Detail Planning may repeat the Phase II planning pattern, or it may follow the Simplified or short-form pattern, or or it may adopt the facilities plan of some similar industry or sister company. We may have been remiss, in earlier writing, in pointing out these logical options.

Richard Muther
Lee Hales

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INTRODUCTION TO VOLUME I . . . WHAT TO DO WHEN PLANNING

This book is for planners of industrial facilities. It is organized to be of maximum aid to them. As a result, it is divided into several parts. By reference to the Table of Contents, you will see that Volume I is chiefly description. Volume II is chiefly application.

Volume I includes four parts:

- *Part One, the ingredients of planning, sets forth the definitions involved in facilities planning, the reasons for planning, the responsibility of management for facilities planning, and the opportunities for better short- and long-term operations through well-planned facilities. It sets forth twelve basic concepts that underlie the planning of industrial facilities.*
- *Part Two, the process of planning, introduces the SPIF planning system and explains its logic and its features.*
- *Part Three, the components of planning, includes an explanation of the planning procedure for each of the components or constituent disciplines. Each planning subsystem directly supports SPIF—as well as serving as a stand-alone procedure where the planning is limited or less comprehensive.*
- *Part Four, examples of planning, is a reference section which presents a number of graphic examples that support the text descriptions both conceptually and specifically.*

Part One, which follows, includes two chapters, one on definition, background and perspective, and the other on basic concepts that underlie the planning of industrial facilities.

CHAPTER 1 . . . UNDERSTANDING FACILITIES PLANNING

Planning industrial facilities involves devising or determining how you intend your plant should be physically organized to perform or produce. The job of the facilities planner is to provide the plant space, structures, machinery, and equipment needed by an industrial company to execute with efficiency its program of designing, producing or converting, and distributing its products.

DEFINITIONS

Planning is the act of developing or deriving a method for doing, or a way of accomplishing something. Planning is directed toward the future so that subsequent decisions can be made quickly, effectively, and with a minimum of disruption. Simply stated, planning is determining ahead of time what you should or intend to do.

Industrial means related to or connected with any branch of trade, production, manufacture, or of all these collectively. Industries typically involve processes that may be described as: extractive (mine, fishery), convertive (flour mill, cotton gin), analytic (oil refinery, machine shop), synthetic (garment making, appliance assembly), or a combination of these.

Facilities are the tangible fixed assets required for an enterprise to function. The term includes the land or real estate, buildings, or structures, process machinery, and the support equipment both stationary and mobile—especially if the equipment is built into the land or buildings as are bridge cranes and most utilities. Thus, in addition to those things related to the processing of materials or the producing of products, “facilities” also involve storage warehouses, offices and laboratories, service areas like a maintenance shop and boiler room, and auxiliaries like car parking, cooling pond, water tower, scrap collection depot, waste water disposal, or gas storage tanks. More frequently, facilities are the total of all these—land, buildings, machinery and equipment—integrated into a profitably operating works or entity. Indeed, for a company with operations at multiple locations, the several plants may jointly be considered as their facilities. See [Figure 1-1](#). Usually, we include as “facilities” those fixed assets of a company that are capitalized and depreciated over a period of years, as compared to items like expendable tooling, pallets or shop boxes, and supplies, that are normally considered as expense items.

A facility is a combination of physical things. It relates to other things with products or materials, markets, sources of supply, people, and money. When working together with these related things, the term “facilities” forms the heart of what may generally be termed industry’s *physical resources*. See [Figure 1-2](#).

The term plant is almost synonymous with facility, but has a connotation of machinery, equipment, and buildings for only the processing, producing or generating portion. *Factory* is similar, but often on a smaller scale and usually only one building. *Mill* is like factory, but is most often used when related to grinding, crushing, rolling and heavy or rough forming operation. *Works* is similar to plant, mill, or factory. All these terms are sometimes limited to mean the operating or production areas of a facility; in other cases, they include as well the offices, warehouses, laboratories and related support structures or equipment.

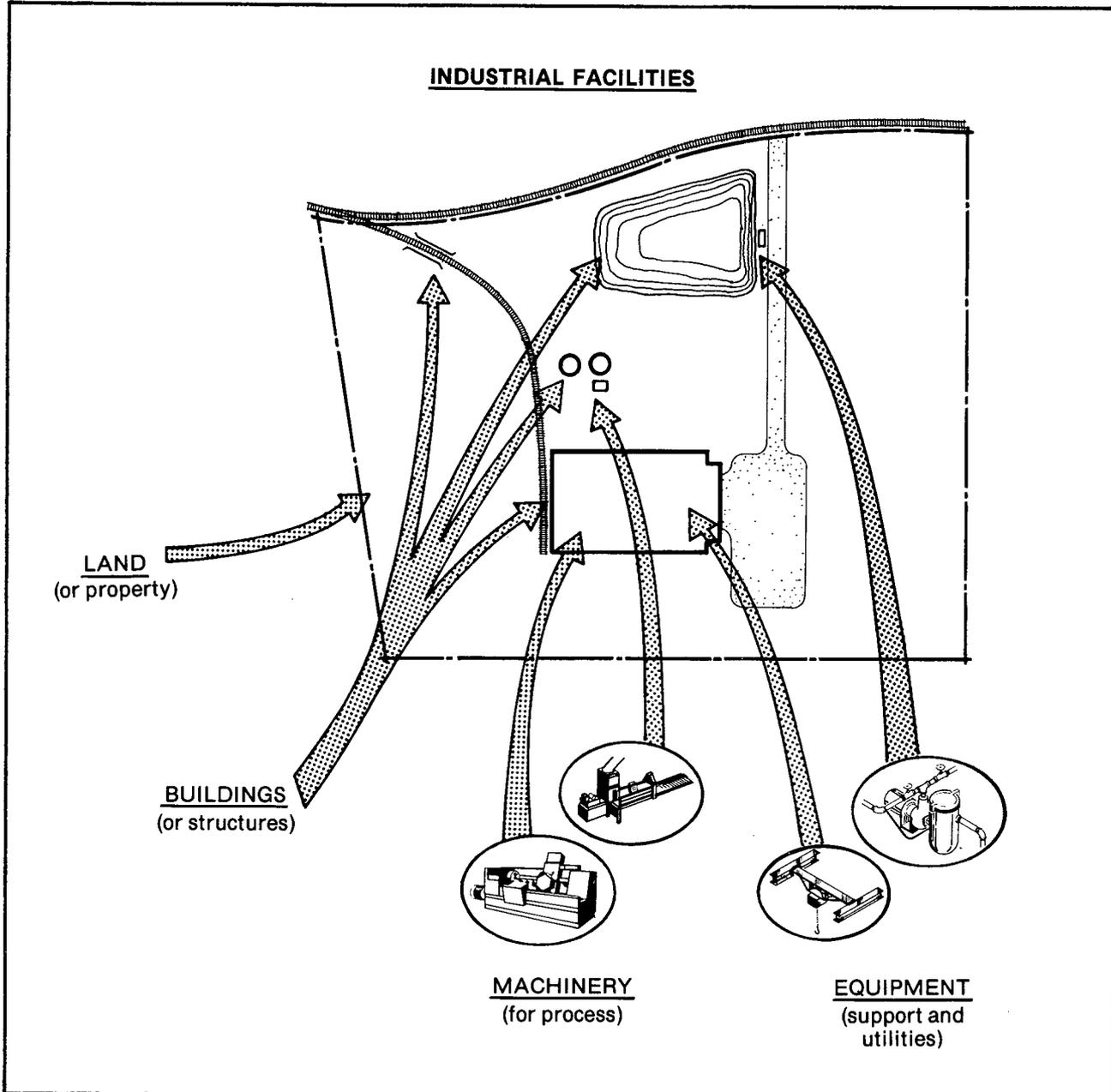


Figure 1-1. Industrial facilities are the fixed or capital assets of a company in any branch of trade, production, or manufacture.

Note that the *physical resources* in Figure 1-2 include people and money. Both of these are essential for an industrial facility to operate. This means people (workers and managers) and money (capital investment money and working capital) must be obtainable in the right quantities when needed to permit the facilities to perform.

People, with their individual strengths and shortcomings, are a key consideration in the operating of any industrial facility and, therefore, a vital part of its planning. Money, with its limited availability and its normal requirement of providing a satisfactory return, becomes a key factor in justifying investment in new or used facilities and, therefore, a major consideration in their planning.

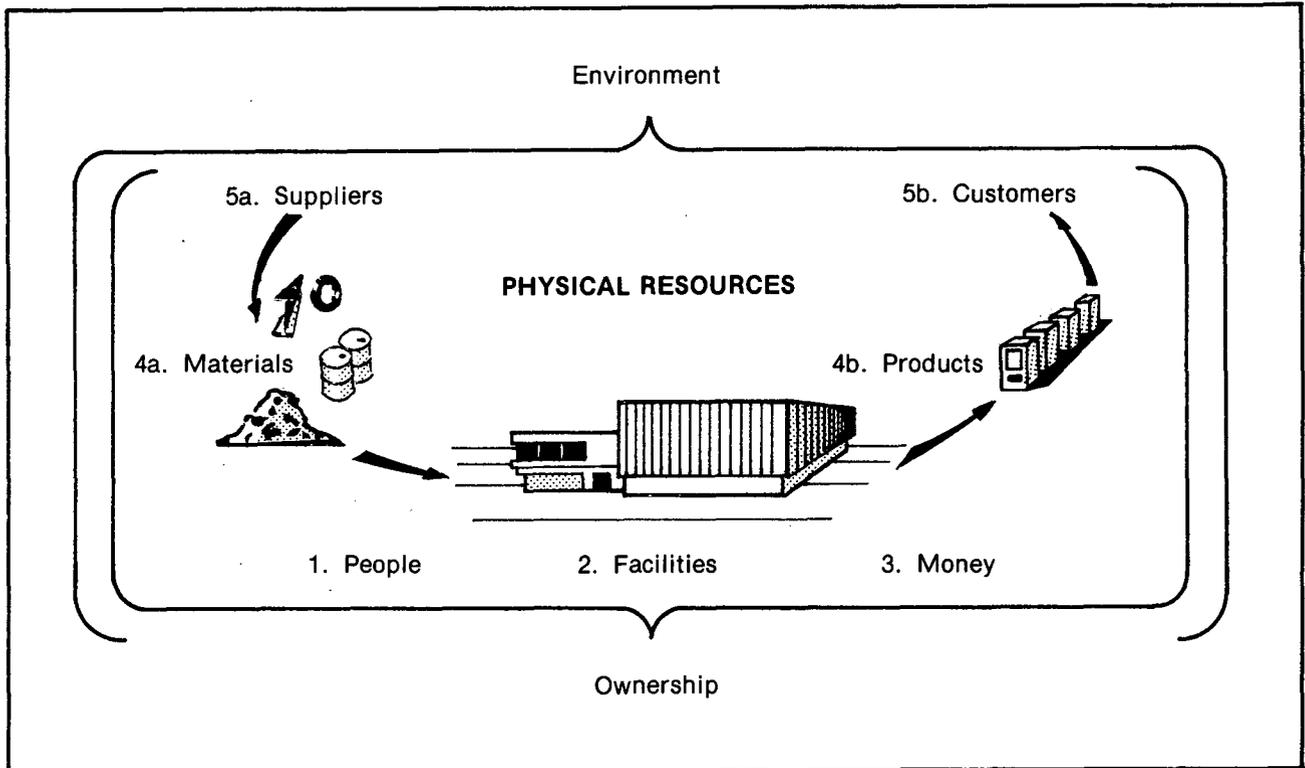


Figure 1-2. Industrial facilities are part of the larger sweep of total physical resources of industry.

Note further in Figure 1-2 that the physical resources of industry are encompassed by two surrounding agents: environment and ownership.

Environment is the total of external influences or considerations, both physical and non-physical. The former involves the physical direction of sunlight, prevailing winds, temperatures, and availability of power, water, sewage treatment, and the like. The latter includes the influences of legal, social, technical, ecological, emotional, and political considerations, as well as the economic ones. Attitudes of regulatory agencies, influence of surrounding land owners, posture of labor leaders, trends in neighboring cultures, plans of the municipality or regional development commission—these are all part of the environment which impacts on the plans for the facilities to be built or housed within that environment.

Ownership is the deciding or directing force of the enterprise; that is, the ultimate authority in providing guidance and funds for the facilities, and, therefore, the final decision maker. Management acts on behalf of the owners, presumably with their long-range best interests in mind. Often the ownership is the management, either by direct participation in small closely held companies or by dilution or default of shareholders in large widely held companies.

Ownership is chiefly concerned with the long-range aspects of the business. This involves the philosophies of owners, their training and prior experiences, their basic plans for future ownership, and all the varied considerations that impact on the financial returns expected from the enterprise. Ownership is thus directly related to money. Money is readily converted to a common denominator and provides the terms in which expenditures and returns therefrom are most frequently recorded. Even in times of war or in countries not supporting a capitalistic

philosophy, money is used as the convenient way of measuring things. Clearly then, its availability and justifying its use in facilities are major concerns of a company's owners.

WHY PLAN FACILITIES

The primary causes or stimuli that trigger new or altered facilities are:

1. Expanding production, based on increased demand.
2. Entering a new field of endeavor.
3. Replacing an obsolete or inadequate facility.
4. Reallocating or consolidating production facilities.
5. Improving service to market(s).

That facilities should be planned rather than simply placed where there happens to be room at the moment, is largely a matter of *economics*. Common sense, savings in time and effort, improved operating efficiency leading to profits, and plain convenience or appearance have all been mentioned as reasons for planning. Because the profits made through effective facility planning are deferred or delayed, planning is typically justified over a period of time by the future monetary savings it provides: savings in machinery and equipment replacement; in operating or maintenance costs; in management time and attention; in construction disruption or installation costs; and in subsequent planning and rearrangement time. These are important contributions to company profits. Consequently, industrial companies that have planned their facilities effectively in the past are today enjoying latent contributions to their profits.

Tied to this is the *protection of the company's investment*. All too many companies have been forced to close or to abandon sites prematurely because their disorganized complex of haphazard facilities cannot justify updating or modernization. Indeed, lack of adequate facilities planning is in reality planning lack of adequate facilities.

Additionally, most industrialized countries have laws restricting plant facilities and their planning. Environmental constraints are imposed on solid, liquid, and gaseous wastes of all kinds. Building construction codes or zoning regulations are often so written as to make managers or owners of industrial plants criminally liable for disturbing wet lands for construction, permitting unsafe working facilities, and overlooking setback of buildings from streets.

For growing companies, planning has special importance. Without available facilities, there may be lost opportunities for increased markets or new product lines. By advanced planning for additional plant capacity, even though still on paper, there is greater likelihood that management can respond to such occasions—which may be of one-time-only nature. Further, bankers and others who finance plant investment look favorably at both the value of well-planned facilities and the likelihood of retained worth in soundly planned future ones.

In more general terms, managements find the following *purposes* or *objectives* for having a sound program of facilities planning:

1. Plant facilities can directly and indirectly influence the costs of operating and therefore profits.
2. There are legal requirements. Planning allows facilities to comply with laws and/or regulations: structural safety, building codes, environmental restrictions, conditions suitable to personal safety, handicapped persons...
3. Facilities involve large sums of money and are high capital-cost expenditures.
4. Facilities by their nature are fixed investments, not readily convertible to money or resale.
5. Facilities are physically fixed in place and have limited opportunities to be changed. This inflexibility causes need for sound study.
6. Commitments for facilities are long term with protracted periods of financial return.
7. Facilities planning, design and construction require long lead times and are executed over relatively long periods of time.
8. Sound plans for implementation can avoid disruptions or interruptions for production, and discontinuities for shipping or delivery.
9. Operations often produce detrimental wastes that affect entire communities.
10. The safety, convenience, appearance, and comfort of industrial facilities influence the attitudes of and the ability to attract suitable employees.
11. Industrial facilities must be planned to meet anticipated future requirements yet compete profitably today. The long-term and short-term compatibility problem.
12. The basic needs or input requirements to which an industrial facility is planned are themselves changing continually--so facilities should be planned for an appropriate degree of flexibility, expandability, versatility...
13. Good planning buys time for making commitments; it minimizes being taken by surprise.
14. If plans are made, managements can react faster and take advantage of business opportunities that arise.
15. Good planning, especially if presented well visually, is an aid to obtain financing monies.
16. The single most important cause of high materials handling costs is 'ad hoc' expansion of plant facilities "in the absence of a strategic site-development plan."

Figure 1-3. Why planning facilities is particularly important.

- To arrange and integrate physical facilities so they are and can continue to be low-cost producers; so they can be changed readily or expanded practically; and so they maintain their value for possible resale.
- To provide better ways of reaching and revising capital-investment decisions, or contrarily, to lessen the degree of surprises and hastiness in committing expenditures.
- To optimize plant performance in an environment of change.

Figure 1-3 provides a more specific list of reasons why it's particularly important or of special benefit to industry to plan its facilities properly. These reasons apply to both large and small companies. Each individual company with its own set of circumstances and in its own situation has its particular mixture of reasons and advantages.

Actually, you cannot avoid the cost associated with facilities. You can pay once, to get a solid well-integrated facilities plan and plant; or you can pay many times over during the life of the facility in awkward materials flow, high maintenance, poor space utilization, reduced productivity, loose controls, costly expansion and rearrangement. . .

FACILITIES PLANNING PRACTICE

A recent study of facilities planning practice in U.S.A. indicated that industrial facility plans were projected approximately four years ahead. This came from reports of planners representing companies that have an organized facilities planning effort, so most companies undoubtedly fall short of this time period for their facilities planning.

Another study of 302 well-established North American manufacturing and processing firms, made in 1967-68, indicated that over 60% followed this typical site planning approach:

"We plan each expansion as needed, but we always look ahead with a few years projection of specific needs, and try to make the present facility plan fit into the next expansion(s) or rearrangement(s)."

Sixteen percent reported they didn't even do this. And only 22% indicated they had made any overall site plan which they attempted to follow.

A somewhat similar survey conducted in Scandinavia a few years ago revealed that only 29% of the industrial firms questioned had any facilities plan extending more than two years into the future. And only 15% had translated their long-range plan into specific form, i.e., into an overall master site plan.

Figure 1-4. Industry typically makes its facilities plans for rather short periods ahead and without comprehensive perspective.

A MANAGEMENT RESPONSIBILITY

At the risk of stating the obvious, we must point out that planning for adequate facilities is indeed a responsibility of management. And, the higher the level of management, the longer into the future and the more comprehensive the planning should be.

Studies show that the typical industrial enterprise makes its facilities plans hurriedly, for relatively short periods ahead, and for obvious rather than comprehensive needs. See Figure 1-4.

The reasons for this looseness in planning of industrial facilities—while in no way justifying the situation—seem to be the following:

1. Facilities planning is an intermittent type of activity. It tends to be associated with what might be called the happenstance of business. Managements are not used to it as part of their regular reoccurring responsibilities.
2. Facilities planning involves devoting time and effort to things in the future. It tends not to have urgent deadlines, to make obvious contribution to day-to-day operations, and to be immediately relevant. Managements, like most people, tend to “put it off” until the larger influencing factors are more clear.
3. Facilities planning conflicts with budgetary and accounting pressures on management for short-range profits. Facilities planning lacks finite measureable benefits or readily recordable savings. Managements want to show financial results now and profits this year.
4. Facilities planning is not generally recognized in the repertoire of management studies. Perhaps this is because it hasn’t been developed into an organized body of principles and logic. So, it tends not to be brought to the attention of managers through normal education. Managers tend to run into facilities planning through experience—all too frequently of the frustration or crisis kind.
5. Facilities planning is only part of general business planning. It tends to result from secondary, indirect, or less apparent objectives. Managements, often action-oriented, have difficulty enough in developing clear and consistent primary objectives, so the secondary planning is relatively disadvantaged.

Fortunately, executives are trained to ask, or instinctively come to realize they must ask, how future opportunities are to be met, if not by planning. So progressive industrialists are more and more applying their general skills in planning and analyzing facility problems in greater depth, with more attention, with improved planning methods, and with longer-range projections. And, this is as it should be if managers are to accept a long-term responsibility for profits.

Top managements should be most interested in the larger and longer-term aspects of facilities planning. They should delegate the smaller and shorter-term projects. But they should see to it that there is a consistent integration of the two.

ECONOMIC CONSEQUENCES OF FACILITIES PLANNING

A comparatively small investment in planning time, effort, and money can have major effects on future profits.

When bringing an operating facility into being, and leaving out the financing problem for the moment, there are four typical efforts: a. planning; b. designing; c. constructing and/or rehabilitating; and d. installing. See Figure 1-5.

A small effort in the planning stage—mostly in personal time and attention—has a major effect on the net result. The planning stage is where basic decisions are made; where wisdom and

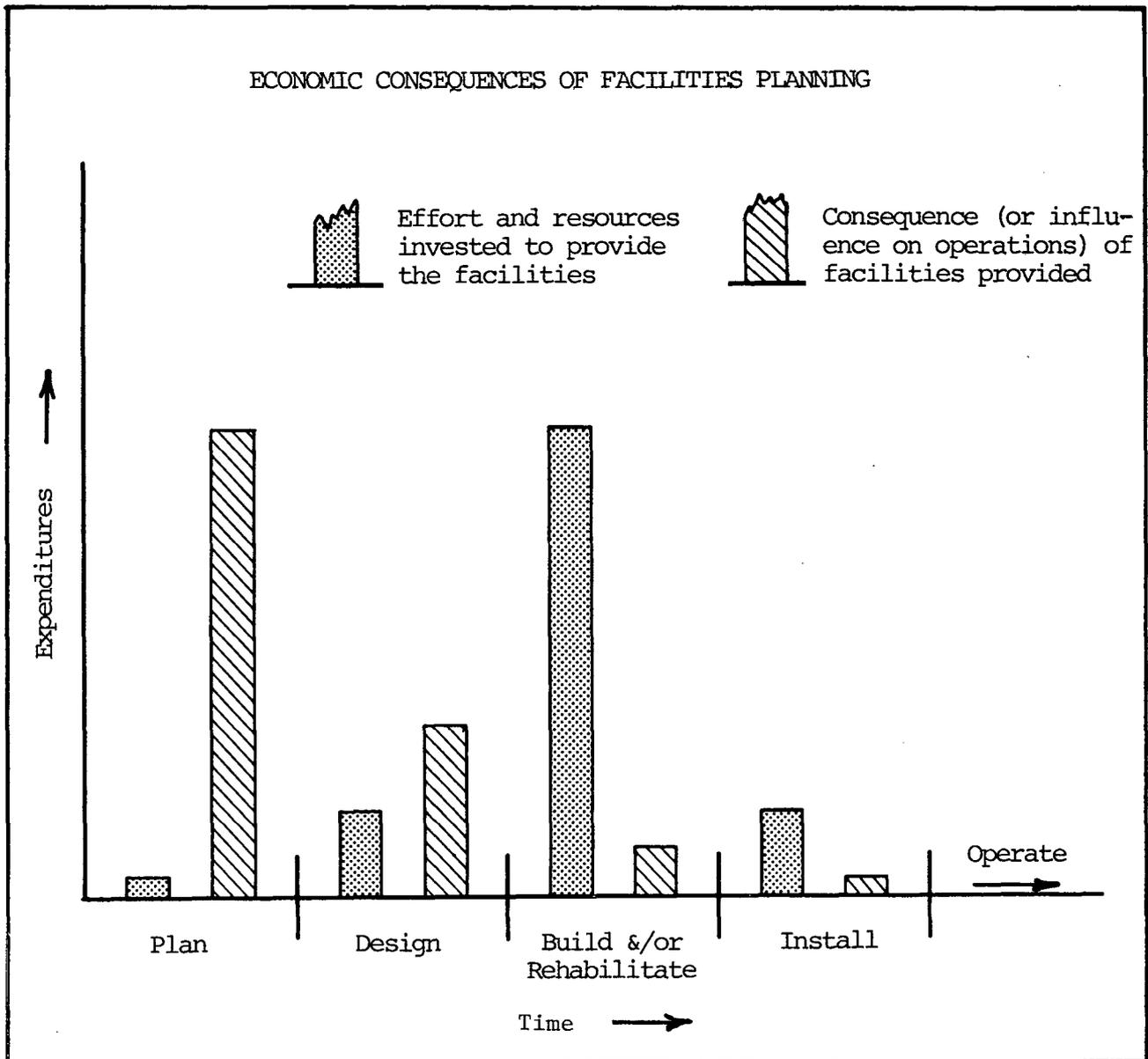


Figure 1-5. A comparatively small investment in planning time, effort, and money can have a major influence on the profitability of the facility during its useful life.

judgement are needed. Here is where major savings or losses in future operations are set. The designing stage is more finite and can exert less influence on overall results—even though it involves more effort. And, in the actual construction and/or rehabilitating stage, a large effort of time and money involved can have comparatively little economic effect on the operation of the facility. Conclusion: an investment of but 2% to 10% of total project cost—often less than the contingency factor for the construction or rehabilitation cost estimate—can be one of the best bargains a firm can make.

MANAGEMENT'S VIEWPOINT

But look at the situation from the top manager's viewpoint. He is responsible today for the success of the company. This month, he must meet employee payrolls, payments to suppliers, and returns for borrowed funds. And, when he cannot see ahead with assurance—as is always the case with planning—he is inclined to do nothing that would dilute his current position or jeopardize his shareholder's investments.

Additionally, he often finds himself in a position where he would like better planning but can't get it. His planners may talk well about planning but not produce plans that are sound and realistic. They may be off into a contagious outbreak of computerized modeling, or fragmented into isolated cells of part-of-the-picture-only analyses. Some planners get carried-off into esoteric exercises, lost in detailed calculations, or locked into "only one way to do it". And, remember, Mr. Planner, it's easy for you to be critical when it's not your money or your job that is involved.

We cannot ignore these problems or wish-away human shortcomings. And, we certainly will argue for responsible management. What we can do is to help the situation by offering ways to improve the planning by both business managers and facilities planners. We know from experience that Systematic Planning of Industrial Facilities (SPIF) can directly encourage better planning and, in turn, better facilities plans.

OPPORTUNITIES IN FACILITIES PLANNING

Admittedly, industry in general does not plan its facilities far enough ahead. There is a real contradiction in this: constructing a building good for thirty to fifty years based on planning for only three to five years ahead. This time gap is likely to cause a major discontinuity between the intended use, based on short-range visibility, and the actual use, based on the realities and variations of the future.

Closely related to this "time gap" is the "data gap"—the contradiction between the need to make plans for the future and the lack of known or reliable data, information or even criteria on which to base plans.

Because the future is largely unknown, uncertain, and subject to rapid change, there is an acceptance by many that planning far ahead is an idle exercise. Because products, sales volumes, processes, supporting services, and operating times are bound to change to something that we cannot foresee, there is a feeling by many that planning of facilities must be based on only the reasonably predictable changes that lie just around the corner.

Facing these very contradictions, the fully responsive manager and planner take an unconventional stance. They recognize the future savings to be gained; they acknowledge the gaps; and they establish a condition of facility planning that can be called flexible premeditated foresight. See Figure 1-6.

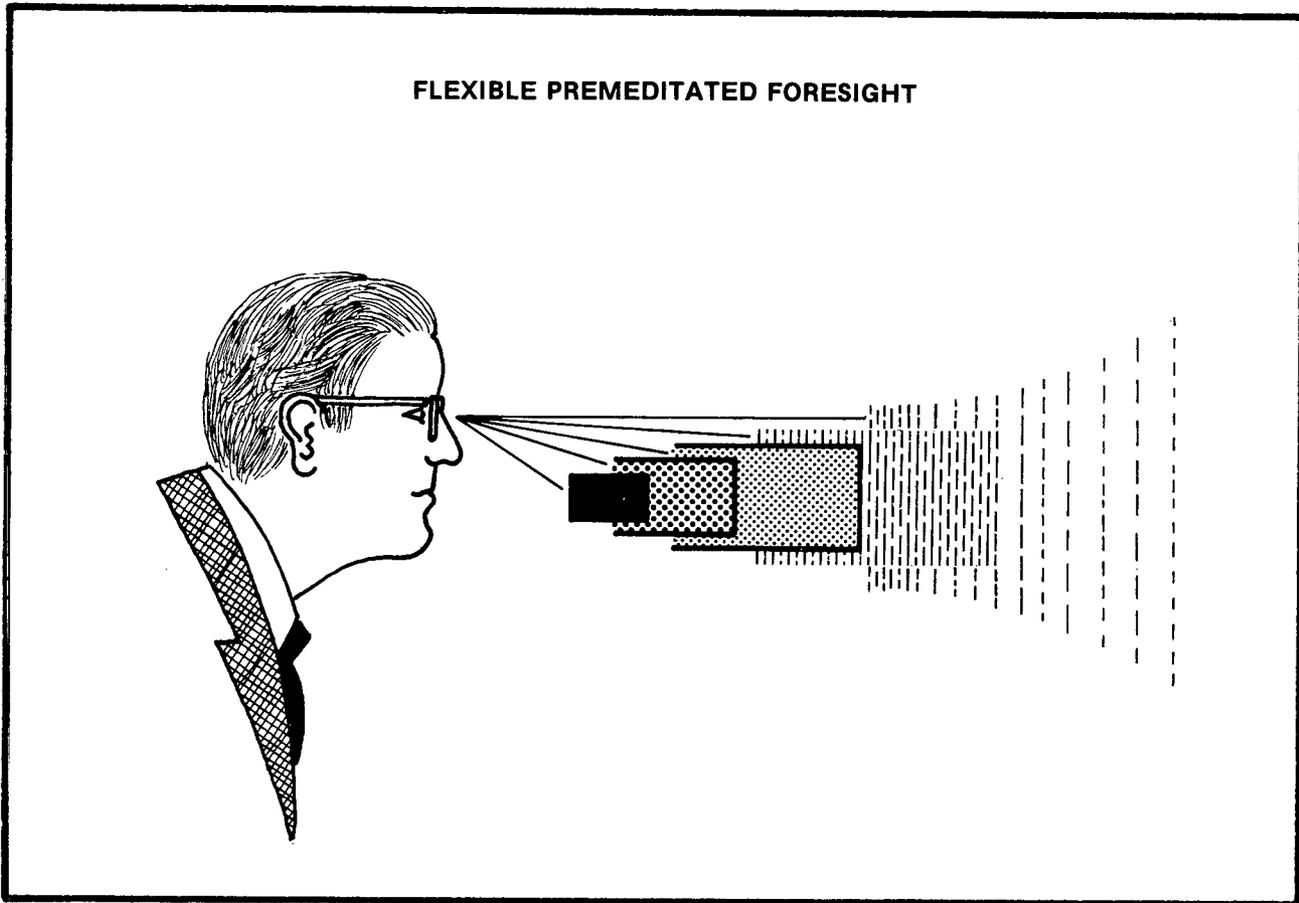


Figure 1-6. Flexible premeditated foresight involves a recognized belief that economies do indeed result from seeing the facilities problem in toto, from planning the total comprehensively, and programming the steps on how to get to these overall plans.

Essentially this means that:

- Management makes it clear that it believes economies do indeed result from seeing the big problem in toto, planning comprehensively, and programming steps on how to get to those overall plans.
- Management forces the creative capabilities of groups from different divisions, plants, and departments to be applied to projecting the likelihood of future changes in certain criteria.
- Planners concentrate in the long range on flexible options which are more fundamental and conceptual, and in the short range on disciplined analyses which are more specific and distinct.

- Periodic revisions are established that weigh against each other: the requirements (short- and long-term); the capacities and facilities (existing and planned); the costs, financing, and intangible considerations.

This provides both a challenge and an opportunity for facilities planners. Because industrial facilities are relatively long lived and time consuming to plan, the planner of these facilities should have more interest than anyone else in obtaining good long-range data on which to base his plans. He should take the lead in crusading for attention to long-range planning and its realistic integration with current, short-range plans. With this belief, with a capability to foresee “what might be”, and with semi-fluid alternative possibilities, industry can create plans which will achieve “that which should be” yet which will still allow “that which has not been foreseen at all”. This means imaginative overall planning which at the same time does not restrict one’s ability to adjust or modify as situations become increasingly more finite.

The following pages of this book are aimed directly at helping each industrial facilities planner to do just that:

- To understand the realities with which he is working.
- To organize a set of meaningful, consistent, and effective techniques of analysis and synthesis.
- To encourage him to get results that help his management respect the need for still better planning in all aspects of the business.

CHAPTER 2 . . . BASIC CONCEPTS FOR PLANNING

When planning industrial facilities, there are so many cross influences, time-varying factors, and levels of consideration—frequently complex and often conflicting—that it is little wonder planners sometimes become confused and managers sometimes become frustrated.

But, there are certain “realities” involved in planning—truisms or axioms that are generally known and accepted. They are not sufficiently provable to be considered theorems. Yet from them a series of companion “corollaries” can be deduced. These corollaries form the basic concepts which underlie Systematic Planning of Industrial Facilities (SPIF) and make it a realistic rationale.

“Once we accept the reality of certain basic concepts, we can use them to build a logical system of planning. And when, in turn, that system is accepted as sound and meaningful, we will have mastered a planning rationale that frees us from concern over the planning method. Now we breathe new confidence and focus our time and attention on the opportunities and problems of each particular project.”

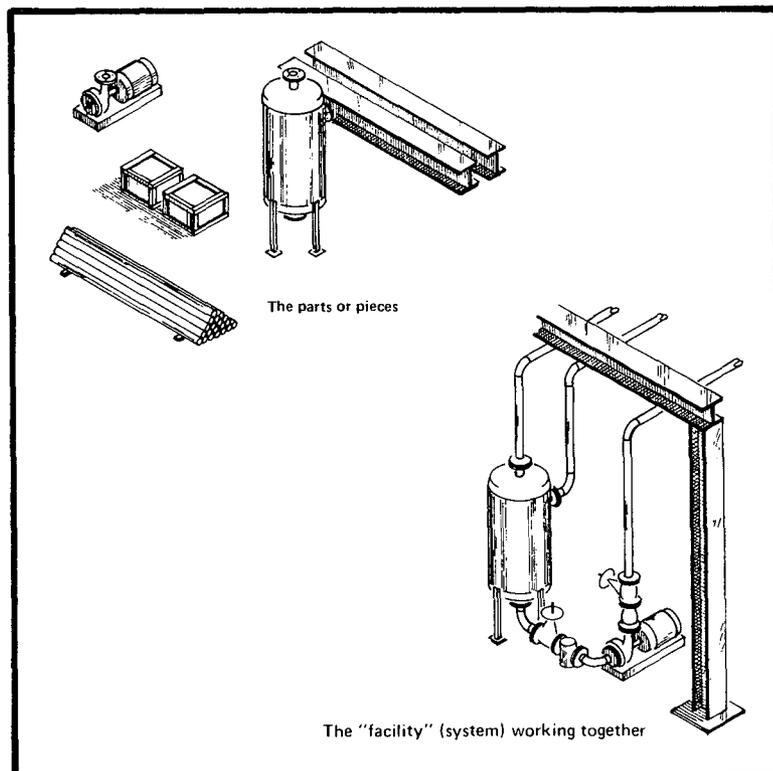
Richard Muther

Reality #1
FACILITIES ARE A COMBINATION OF PHYSICAL THINGS

Facilities are a combination of physical things working together.

The land, buildings, equipment and machinery that define facilities are finite physical things. For each planning project, they exist in different amounts, kinds, sizes, and proportions. But it is their interconnections, their working together, their functioning as an interacting combination, that allows the physical things to accomplish more than mere static or individual performance.

The significance of this is that industrial facilities accomplish their purpose only when functioning as a combination. An industrial facility is like a dynamic interacting organism.



Corollary #1
FIVE COMPONENTS OF AN INDUSTRIAL FACILITY

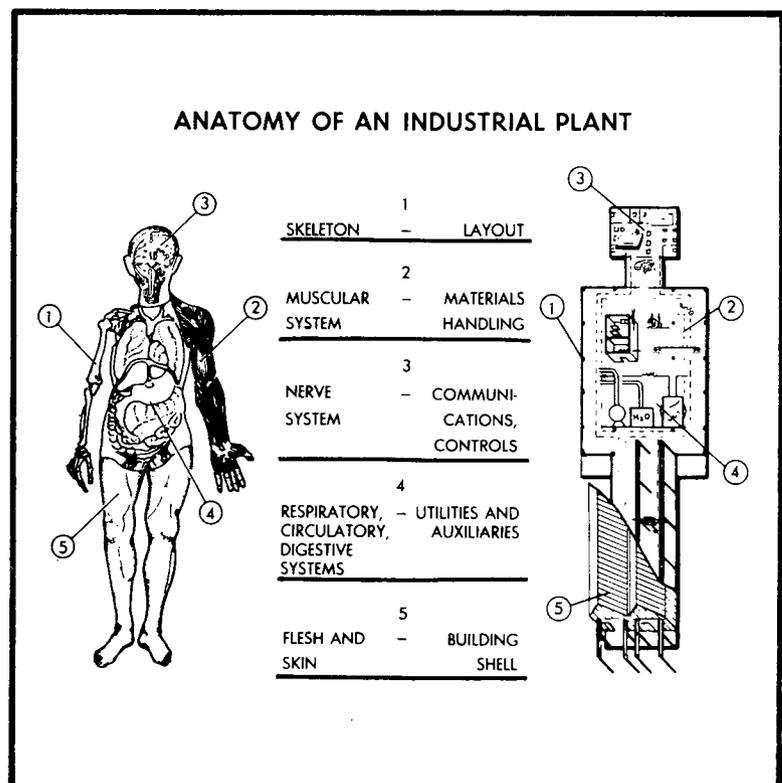
Projects of planning industrial facilities involve five interacting components. These components are: 1. Layout (or arrangement); 2. Materials Handling (or transport); 3. Communications (and procedures); 4. Utilities (and auxiliaries); and 5. Buildings (and structures).

These components make up the five basic physical systems to be planned in any industrial facility. As a result, the planning of these components—individually and jointly—allows the facilities to work together in a series of purposeful systems.

For planning purposes, an industrial plant can be compared directly with the anatomy of an animal:

- Skeleton or system of bones likened to *Layout* or system of related areas
- Muscular system likened to *Materials Handling* methods
- Nerve system likened to *Communications* and controls
- Respiratory, circulatory, digestive systems to *Utilities* and auxiliaries
- Flesh and skin likened to *Building* walls, roofs, and floor

While all five components must be provided, the planner places different importance on different components as called for by different situations.



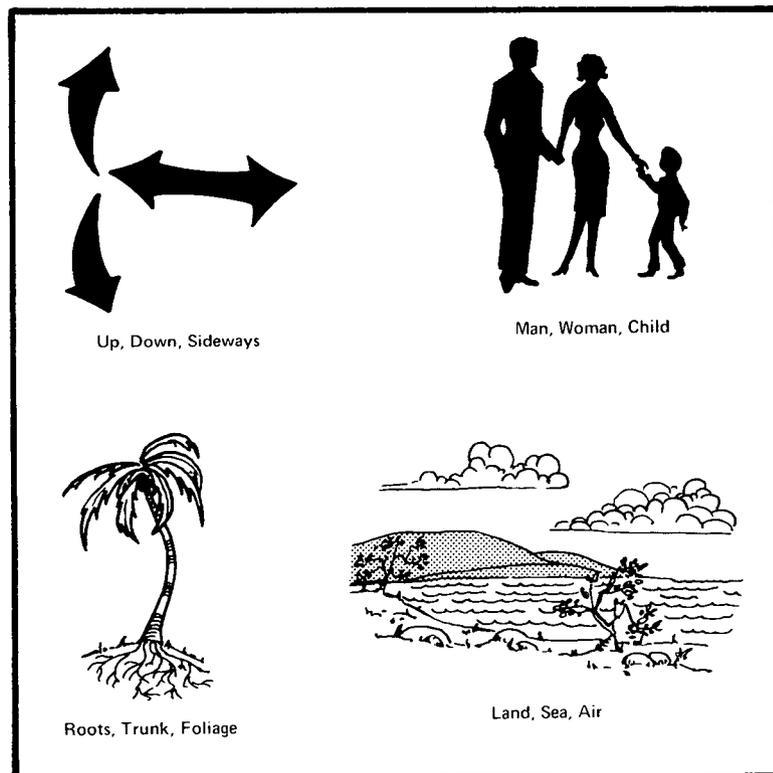
Reality #2**FUNDAMENTALS UNDERLIE ALL PLANNING**

Certain fundamentals or rudimentary elements underlie the planning of anything.

Typically these fundamentals run in sets of three:

- Land, sea and air
- Solid, liquid and gas
- Animal, vegetable, mineral
- Faith, hope and charity
- Offense, defense, umpiring

The significance of these underlying fundamentals to the planner is that it lets him concentrate on one element at a time and then put them together. He can cope with, break-down and analyze first one and then the others, progressively synthesizing them into a stronger combination.

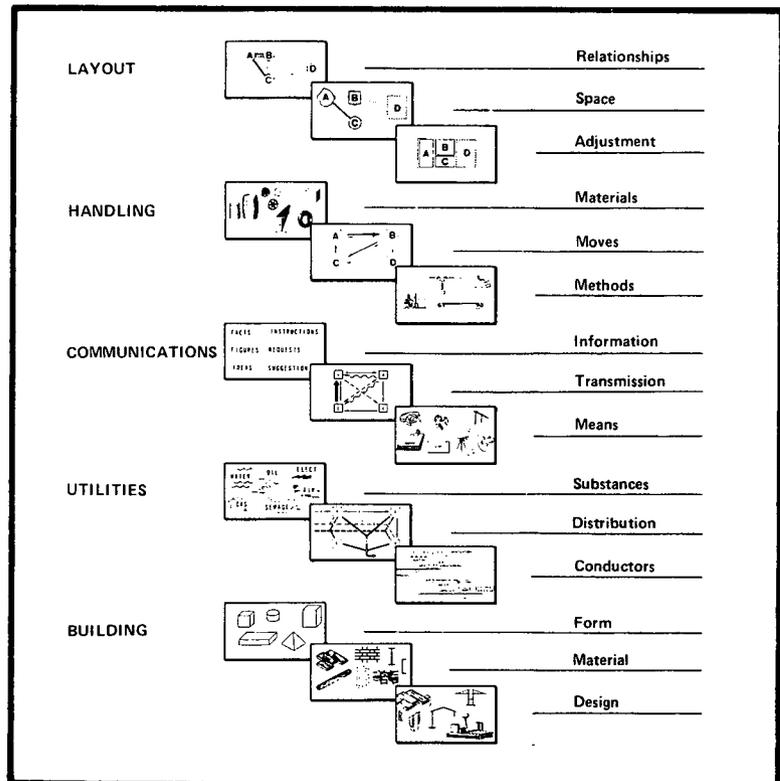


Corollary #2

THREE FUNDAMENTALS OF EACH COMPONENT

Projects of planning industrial facilities involve three fundamentals for each planning component.

- **LAYOUT**
 - Relationships* among functional areas (buildings, departments, workplaces)
 - Space* of each—in amount, kind, and shape
 - Adjustment* into an acceptable arrangement
- **HANDLING**
 - Materials*, products, pieces or items
 - Moves* between each origin and destination
 - Methods* of moving the materials
- **COMMUNICATIONS**
 - Information* like facts, figures, ideas, instructions, requests, suggestions. . .
 - Transmission* from one group or individual to others
 - Means* of transmitting the information
- **UTILITIES**
 - Substances* like heat, light, power, air, gas, sewage, waste. . .
 - Distribution*, accumulation or dispersal
 - Conductors*, carriers or means of distributing
- **BUILDING**
 - Form* or shape to reflect the function
 - Materials* with which to build
 - Design* or resolving the above into a safe, economic, harmonious structure



**Reality #3
PLANS ARE MADE AT MANY LEVELS**

There is a series of planning levels, classified primarily by size and importance of the thing(s) being planned.

The industrial facilities planner is most frequently involved in levels 9 and 10. He may plan extremely large sites, industrial parks, company towns, or mining settlements (levels 11 and 12). And he may be responsible for the plans delegated to subordinates (levels 9, 8, 7, and even 6). Notably, the higher the level of planning, the greater is the opportunity to make a contribution to profits (or a serious mistake).

The significance of this levels-of-planning concept is multiple: each facility falls within a larger "facility" in system-and-subsystem sequence; each plan falls within a larger "plan"; and each planning project itself breaks down into subprojects—facilities within facilities, plans within plans, and projects within projects.

| | |
|---|--|
| | 20. Universe |
| | 19. Solar System |
| | 18. World (planet or satellite) |
| | 17. Continent or continental plane |
| | 16. Country or less than continent |
| | 15. Multiple regions, territory, small country |
| | 14. Region or megalopolis |
| | 13. City or large community |
| | 12. Small community, town, or section of city |
| | 11. Neighborhood, zone or industrial district |
| | 10. Site, lot, or parcel of land |
| | 9. House, Factory, or single-building plant |
| | 8. Department (storey of house or factory) |
| | 7. Work area (room or group of workplaces) |
| | 6. Workplace (man, machine(s), plus...) |
| | 5. Machine (or man or animal) |
| | 4. Mechanism or assembly (2 or more things) |
| | 3. Piece, part, or thing--its design or form |
| | 2. Particle arrangement in a piece or thing |
| | 1. Molecular arrangement within each particle |
| Level of the MASTER Planner (Within man's <u>flight</u>) | |
| Level of the Regional or City Planner (Within man's <u>drive</u>) | |
| Level of the Building or Factory Planner (Within man's <u>walk</u>) | |
| Level of the Design Engineer or Scientist (Within man's <u>grasp</u>) | |

Corollary #3
FOUR PHASES OF FACILITIES PLANNING

Projects of planning industrial facilities involve four phases. These planning phases are:

- Phase I Orientation
(scope, requirements, location and external conditions)
- Phase II Overall Plan
(solution in principle—block layout, overall handling and communication methods, primary utilities and preliminary building plans)
- Phase III Detail Plans
(solution in detail—detail machine layouts, workplace-to-workplace handling, specific information equipment, finite piping or duct work, and detail construction drawings)
- Phase IV Implementation
(do or action—construction, rehabilitation, installation, and start-up)

These phases are directly in line with the levels-of-planning reality; each planning project fits into the hierarchy of planning levels.

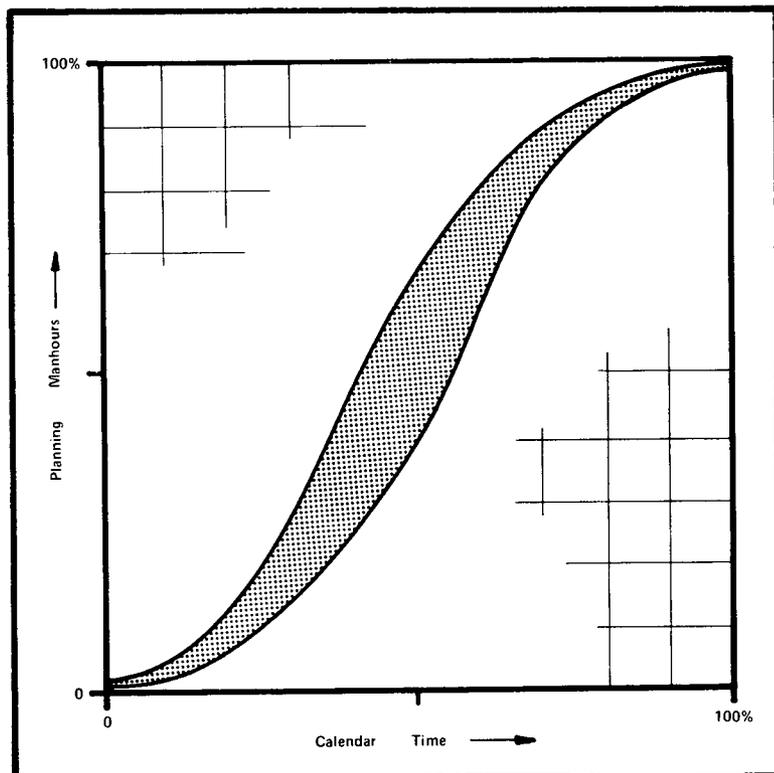
| <u>Number</u> | <u>Name</u> | <u>Basic Action</u> | <u>The Result</u> |
|---------------|----------------|----------------------------|---|
| I | Orientation | See it whole | The problem in its environment: requirements, physical location and external conditions |
| II | Overall | Plan it sound | The solution in principle |
| III | Detail | Make it real | The solution in detail |
| IV | Implementation | Do, act, follow it through | The plan accomplished or installed |

Reality #4**THE ACT OF PLANNING IS RELATED TO TIME AVAILABLE**

Each planning project is related to time.

On major projects, the planning may require several man-years of work. At the other extreme, planning time and effort may be close to negligible. Similarly, the planning may be deliberate with ample calendar time and adequate planning manpower; or limited time and/or staff may cause a crash effort of urgently hasty planning.

The significance of this is that each planning project must fit into a target time span or meet a deadline date—with the planning man-hours available apportioned accordingly.



Corollary #4 FRAMEWORK OF PLANNING PHASES

Projects of planning industrial facilities involve a time-related framework of phases.

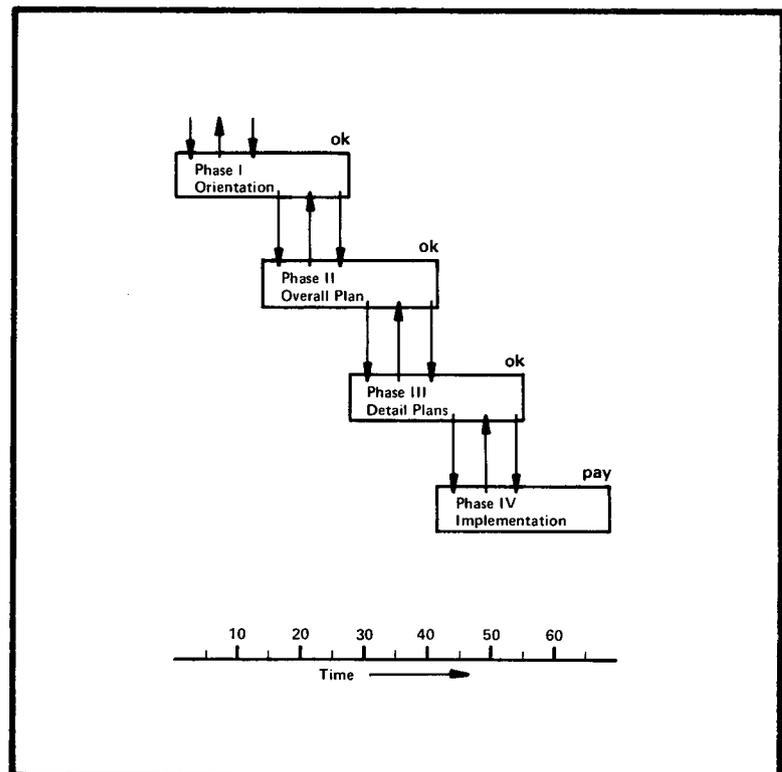
When related to time, the four phases take on additional meaning: 1. The phases come in sequence; 2. The phases should overlap; 3. The phases should be scheduled; 4. The phases form logical check points.

The phases form a logical *sequence* of planning events—from the whole to the parts, overall to detail. Phases I and IV box-in the strictly planning phases (II & III), forming a framework of phases.

Each phase influences the prior and following phase. So for best results, the phases should be encouraged to *overlap* each other.

A *schedule* helps assure the project's completion when wanted. The phases form a structure of planning steps against which man-hours needed, staff capabilities available, and calendar time can be assigned.

The phases constitute *check* points where the planner and his management can verify the status of the project, adjust the project's conditions, or reject the planning work done so far.

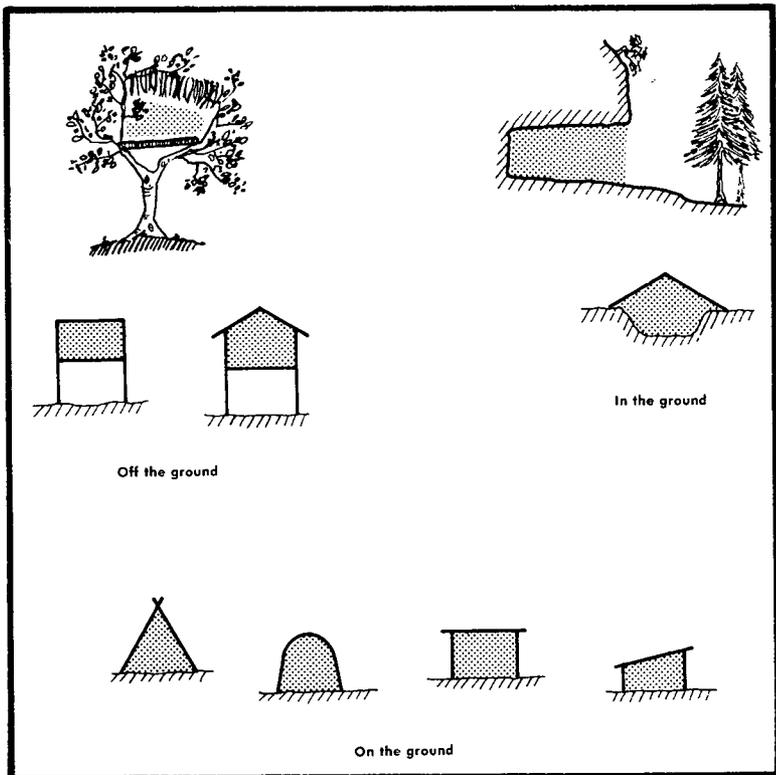


Reality #5
EVERYTHING IN LIFE FALLS INTO CATEGORIES

Everything in life falls into one or more categories. The classification of animals, types of weather, families of products, categories of celestial bodies are all examples.

Even the very earliest of domestic facilities could be put into categories: above ground, in or underground, and on the ground.

The significance of this is that the planner can classify his projects, his types of facilities, his types of industrial space, and the degree or extent of any condition, characteristic, or action.

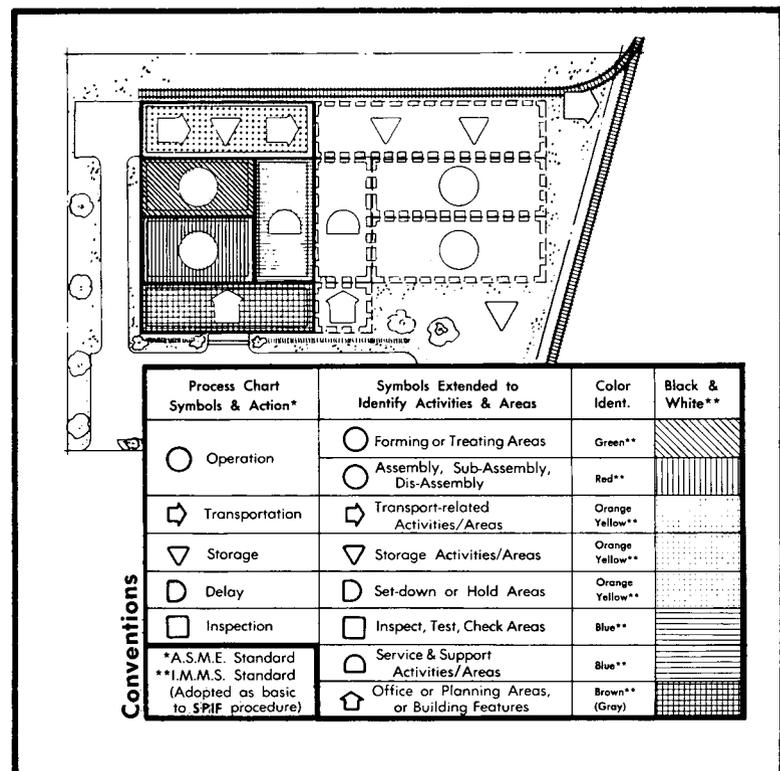


Corollary #5
CONVENTIONS FOR TYPE OF SPACE AND ORDERS OF MAGNITUDE

Projects of planning industrial facilities can be simplified through categorization and codings thereof.

Any classification and coding system should save time and promote clarity, convenience, and ease of recall. It should draw on already-established conventions developed or endorsed by leading groups. These officially approved conventions may be extended and modified to give them special meaning or value.

Facilities planners need ready conventions for class of space or type of use and for order-of-magnitude measurements. Sets of conventions involving symbols, colors, black-and-white shading, vowel letters, numbers, and number of lines can be partially cross-indexed to each other and partially tied to existing codes or common practice to form helpful working aids to better planning.



Reality #6
PLANS SHOULD MEET NEEDS OR REQUIREMENTS

A plan should meet and achieve a goal. Any facility, to be fully purposeful, must meet the requirements or fulfill the demand for the output of that facility.

More specifically, each facility should produce the market or contract quantity of planned-for-products. And it should do so with the anticipated processes, the appropriate supporting services, and in the operating or seasonal time(s) allocated. All of these vary for each situation, but information about them is generally needed or required in order to make sound plans.

The significance of this is that while each facility must be planned to its own unique needs or requirements, the planner can identify certain general input information that he knows will be relevant and applicable to his projects.

WHAT is to be produced (or made) at (or by)
the facility?

HOW MUCH of each "what" (product or item)
is to be involved?

HOW is each item to be produced or made?

WITH WHAT SUPPORT are items to be made?

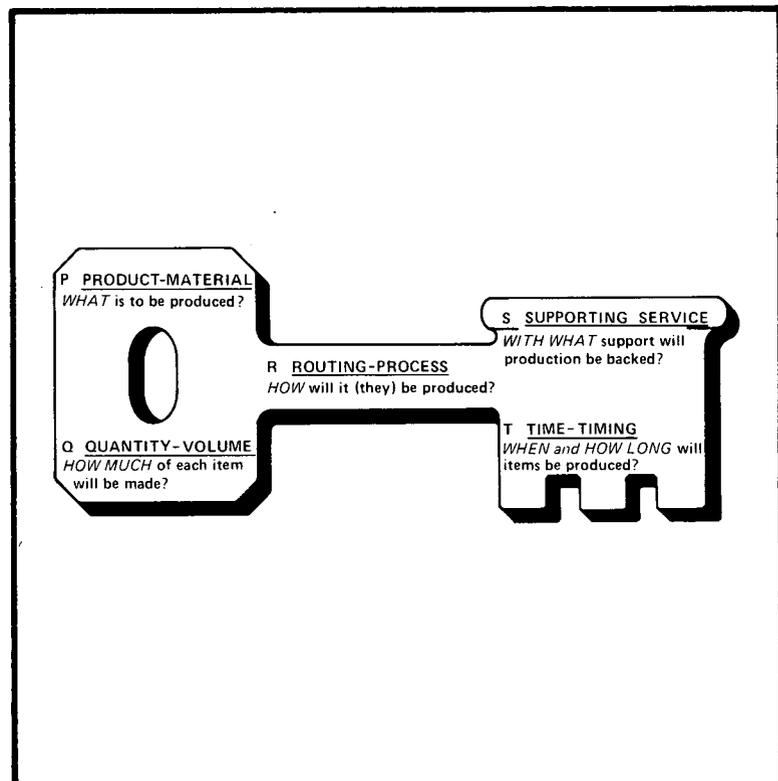
WHEN and for HOW LONG will the items be
produced?

Corollary #6 KEY INPUT DATA

Projects of planning industrial facilities rest on five key elements of basic input data. These data are:

- *Products* (or materials or services)
WHAT is the facility to produce?
- *Quantities* (or sales volume or contract amount)
HOW MUCH is the facility to produce?
- *Routings* (or processes of the operations necessary)
HOW will the facility produce them?
- *Supporting Services* (services supporting the plant, its personnel, its materials)
WITH WHAT SUPPORT will they be produced?
- *Timing* (operating hours, seasonal times, urgency. . .)
WHEN AND HOW LONG will the facility produce?

These five elements are the key input data a planner should have in order to plan his specific facility. For ease of recall, they have been illustrated in the form of a key.



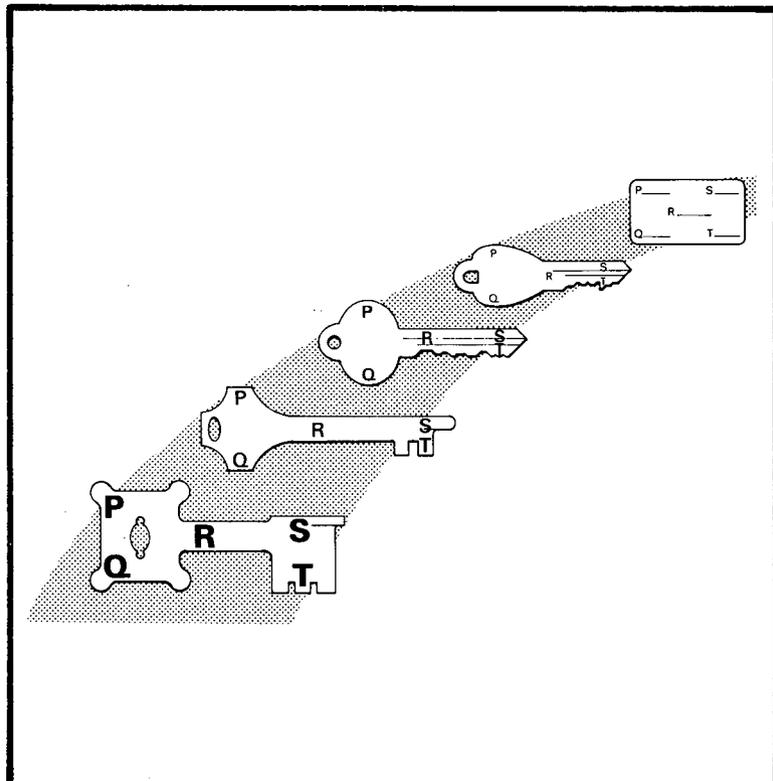
Reality #7**PRESENT CONDITIONS WILL CHANGE**

The future will bring changes.

Tomorrow's products will be different. Businesses will grow or contract. The market will vary. Processes will improve. Supporting services will change. Operating times and working hours will alter.

A facility planned to meet today's conditions only will be obsolete before it is implemented. Facilities involving investments that must return their money over many years should not be based on a single snapshot of the market, today's products only, or the company's current financial statement.

The significance of these future changes is that the planner should know or foresee them if he is to plan a facility to meet them. This means there is a need to project requirements into the future and to plan around forecast data.



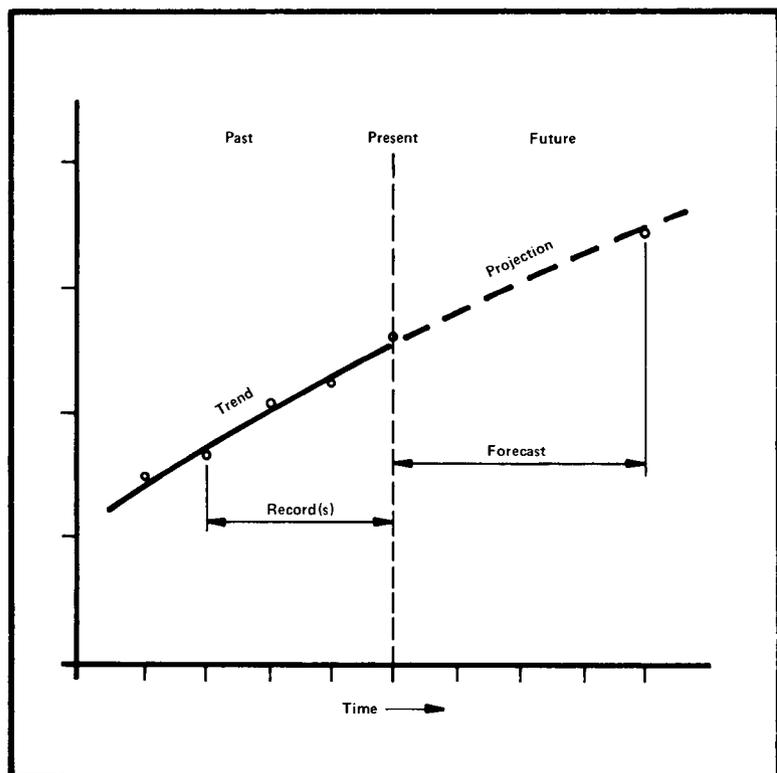
Corollary #7**PROJECTED FUTURE REQUIREMENTS**

Projects of planning industrial facilities involve projections into the future.

Planning future facilities can be based on projections of key input data. That is, if the planner can have available to him the future requirements for Products, Quantities, Routings, Supporting Services, and Times, he would have the basic specifications to plan his facility.

Projecting future requirements typically involves four steps:

- Collect historical data
(The record)
- Plot or otherwise interrelate the data
(The trend)
- Extend the trend
(The projection)
- Select adjusted or most likely projection
(The forecast)



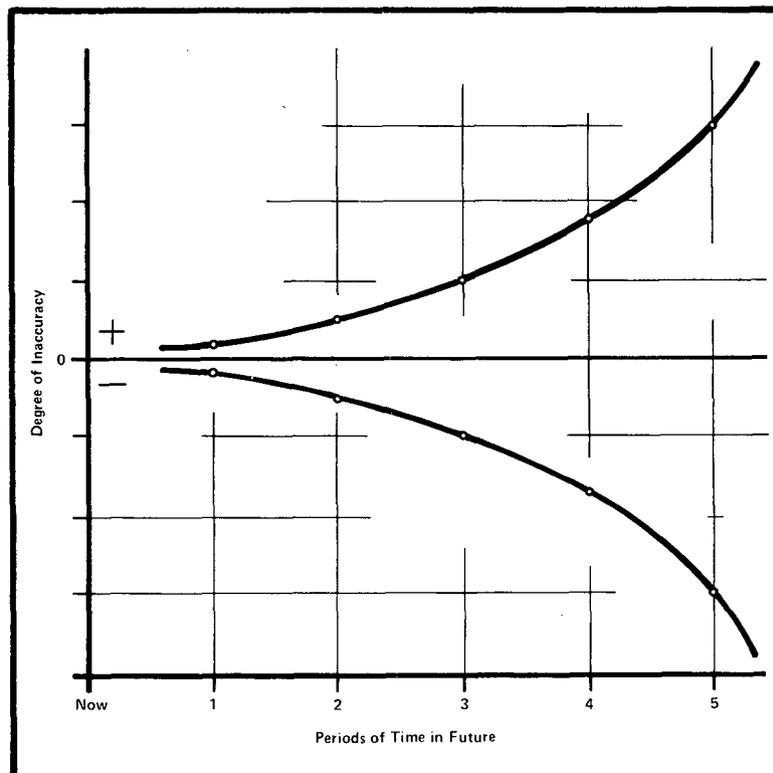
Reality #8**THE ACCURACY OF PLANS DIMINISHES IN THE FUTURE**

The accuracy of plans diminishes in the future, for the future is unknowable.

The near future is often easy to judge; the long-term forecast is more uncertain. The farther into the future one has to project, the less accurate his forecasts are likely to be. That is, the range of inaccuracy increases the farther out one goes.

Because of this inevitable inaccuracy in one's ability to foresee what is coming, many managers and planners consider long-range planning a lost cause. But this need not be so; first things first does not mean first things only.

The significance of this is that the farther the planner projects, the less reliable he should expect his forecasts to be and the more breadth, comprehension, and conceptualism his plans should contain.



Corollary #8**DIFFERENT TECHNIQUES FOR SHORT- AND LONG-RANGE PLANS**

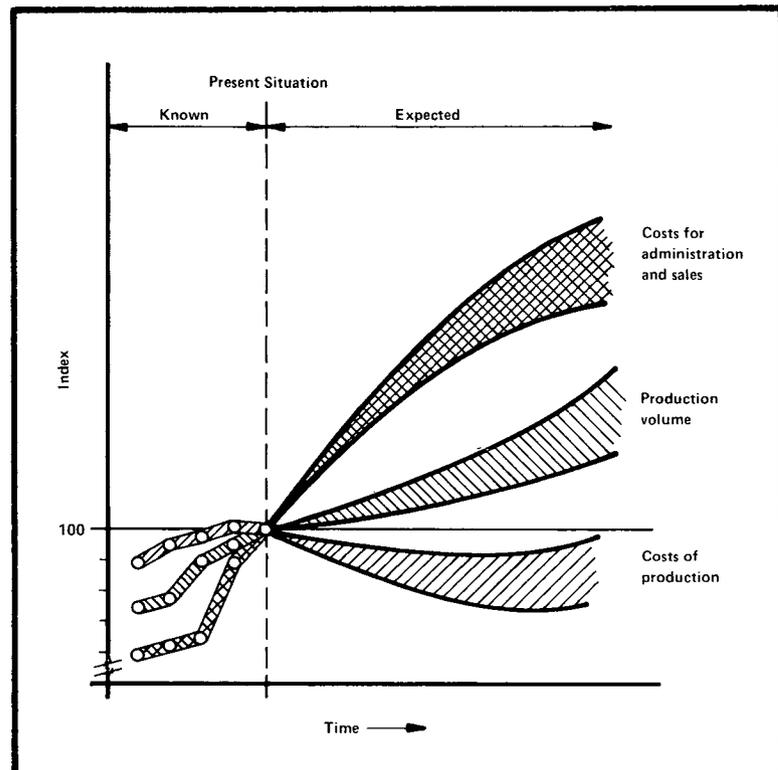
Projects of planning industrial facilities for the long term involve different techniques than for the immediate or short term.

Because the projecting of data known at the time is of diminishing value, the forecasting of finite input data is satisfactory only for fairly short or medium periods ahead. For periods farther in the future, the planner must adopt a more flexible attitude.

Specifically, long-term plans should be:

- Non-restrictive
(providing opportunities for change)
- Alternative
(proposing logical major options)
- Approximative
(professing conceptual, major features only)

To attain these results, the planner needs to project from more general data, to forecast in approximations or ranges, and to perceive with more adroitness.

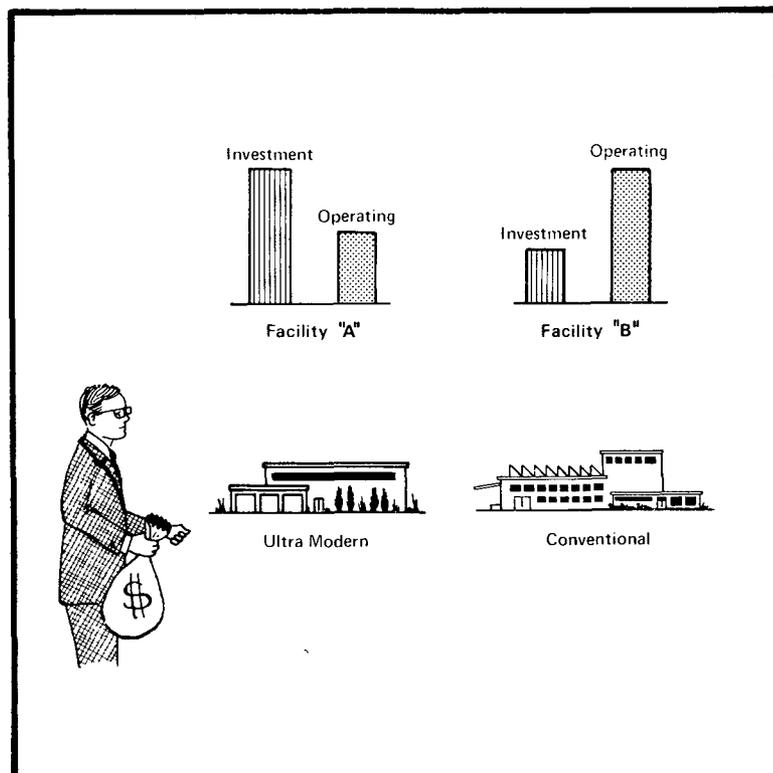


Reality #9
ALL PLANNING INVOLVES CHOICES

All planning involves choices. Usually the choice is from a number of alternatives, each with its own combination of benefits and shortcomings.

Actually, there are several possible solutions to most problems. But, decisions are not always easy to come by. Conditions vary from time to time; viewpoints of managers differ; availability of funds changes; urgency, legal, technical, and social emphases alter; and the relative importance of issues are often in conflict.

The significance of this is that each facility results from a series of compromises or give-and-take decisions. Therefore, the planner needs an organized way to evaluate his alternative choices.



Corollary #9 A WAY TO EVALUATE ALTERNATIVE PLANS

Projects of planning industrial facilities need an organized way to evaluate alternative plans.

Planning decisions usually involve three logical questions: (1) What is wanted? (2) What is or can be available? (3) Which is best suited to our situation?

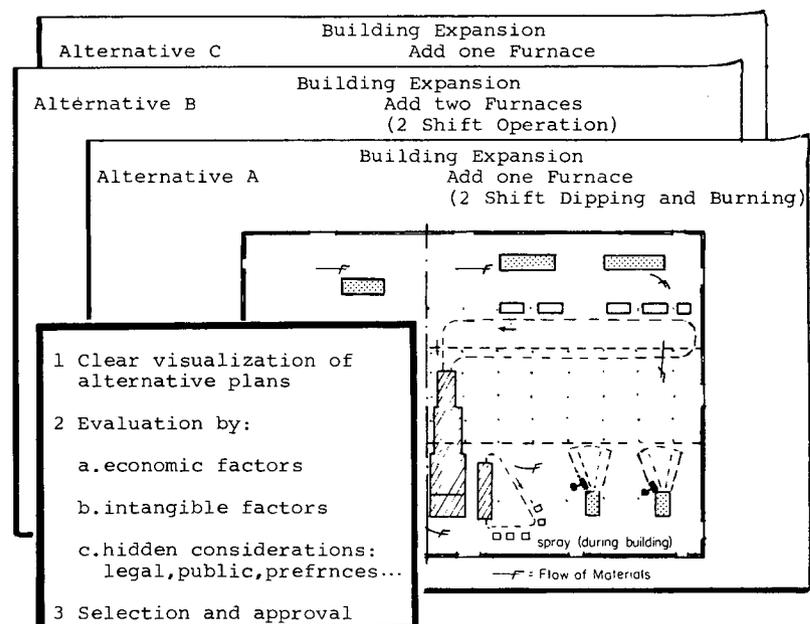
More specifically, facilities decisions divide into three types of considerations:

- Economic
- Intangible
- Hidden

Regarding *economics*, it is generally best for the planner to justify his plans by the method that the financial officer of his company advocates.

Regarding *intangibles*, experience shows they are equally as important as economics. The weighted factor method of evaluating alternatives is both organized and effective.

Regarding *hidden factors*, they tend to be overlooked, usually because they are hidden and because they are too indefinite to appraise. Soliciting top management for identification of these factors is highly advisable.



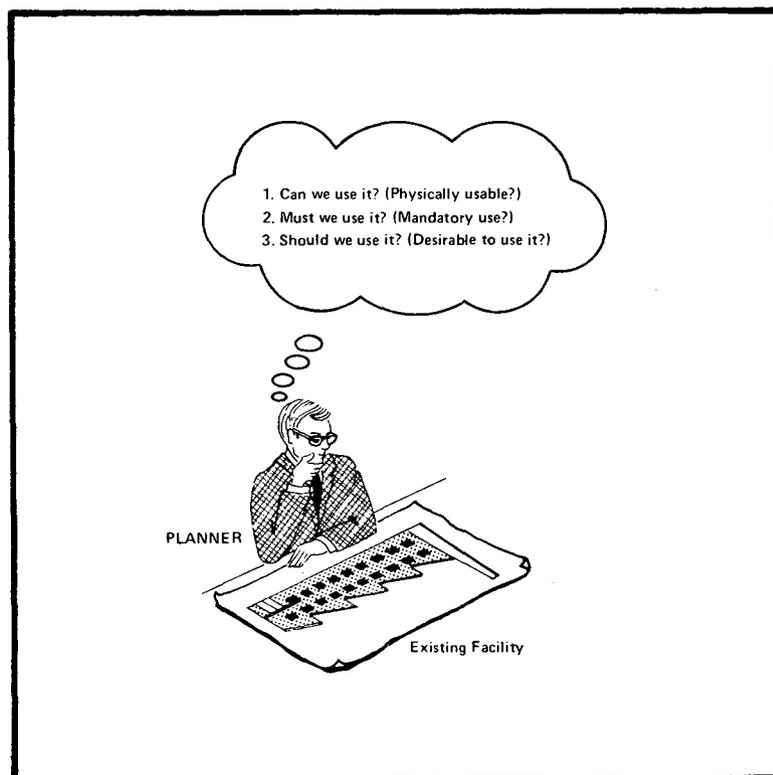
Reality #10**BOTH ANIMATE & INANIMATE THINGS HAVE SERVICE LIVES**

All things in life age. They have a beginning, a period of growth or development, a maturity, and a decline and departure.

Many insects, plants, coats of paint, and pairs of shoes survive but one season. And individual items of the same identical type have different lengths of life depending on their surroundings and the use to which they are put. Indeed, "age" is often measured by the condition or service life of the thing in question—its extent of service—ability or degree of being useful.

Facilities themselves can be old, new, merely contemplated or condemned for demolition. Even a young new company is likely to start in an old shed. Virtually every planning project involves the service lives of the existing and planned facilities.

The significance of this is that the planner must determine what he already has, what its condition is, and what service life expectancy his proposed facilities will have.



Corollary #10
CONDITION OF EXISTING FACILITIES

Projects of planning industrial facilities need a convention for rating or evaluating existing conditions.

There are usually three kinds of ratings: 1. actually measurable numbers; 2. general condition (as though considered for resale); and 3. suitability for a specific contemplated use.

More often than not, cost figures or actual numbers are unavailable or unsuited to appraising the usefulness of facilities. A synthetic scale for auditing and appraising is usually more meaningful.

A rating scale built around vowel-letter value sequence can be used. This way, rating letters are applied to particular facilities for each of several factors or criteria. Additionally, by weighting the importance of each factor, converting the vowel-letter ratings to number equivalents, and extending the weight times the rating number, a quantified total can be put on each facility for comparative purposes.

| FACTORS .Actual age .General condition .Suitability(particular use) | FACILITY BEING RATED | | | | |
|--|----------------------|------|------|------|-----|
| | P-8 | P-10 | P-11 | P-12 | T-1 |
| Age in years | 46 | 37 | 31 | 21 | 12 |
| Impact of age on physical condition | U | O | I | E | E |
| Annual cost of maintenance | O | I | I | E | I |
| Structural soundness including foundations | A | I | I | E | A |
| Utilities and ancillary equipment | I | X | O | E | E |
| Safe, convenient, clean, comfortable... | I | | | | |
| Other... <u>General appearance</u> | C | | | | |
| Suitability of facility 1) for: <u>Assembly and Packing</u> | E | | | | |
| 2) for: <u>Finished goods storage & Shipping</u> | C | | | | |

| Evaluating Description | Letter | Value |
|---|--------|-------|
| Almost Perfect Results (Excellent) | A | 4 |
| Especially Good Results (Very Good) | E | 3 |
| Important Results (Good) | I | 2 |
| Ordinary Results (Fair) | O | 1 |
| Unimportant Results (Poor) | U | 0 |
| Not Acceptable Results (Not Satisfactory) | X | ? |

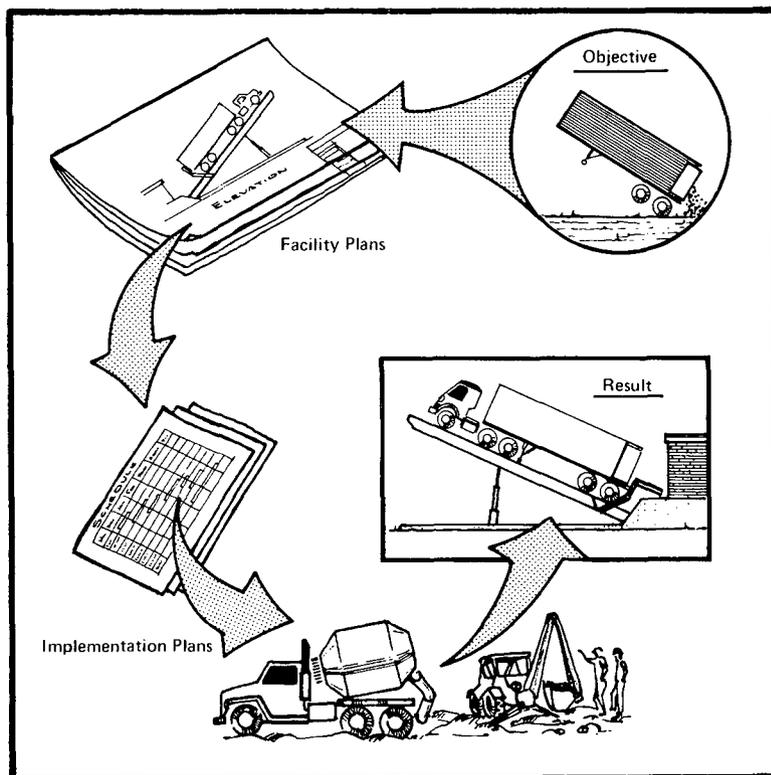
Reality #11**PLANNING INCLUDES A WAY TO EXECUTE THE PLANS**

Plans do not simply convert to physical facilities. Each facility plan must have a way to achieve its final result if the planning is to be fulfilled and the objective to be met.

Typically such plans are termed, on the one hand, implementation plans or construction-and-installation plans and, on the other, intermediate stages or phases of development.

The physical disruption of expanding a plant facility and the sequence of developing a piece of land very often affect the facility plans.

The significance of this is that facilities planners must consider these implementation and intermediate-stage plans, formally or informally, as part of each planning project.



Corollary #11 IMPLEMENTATION PLANS AND INTERMEDIATE STAGES

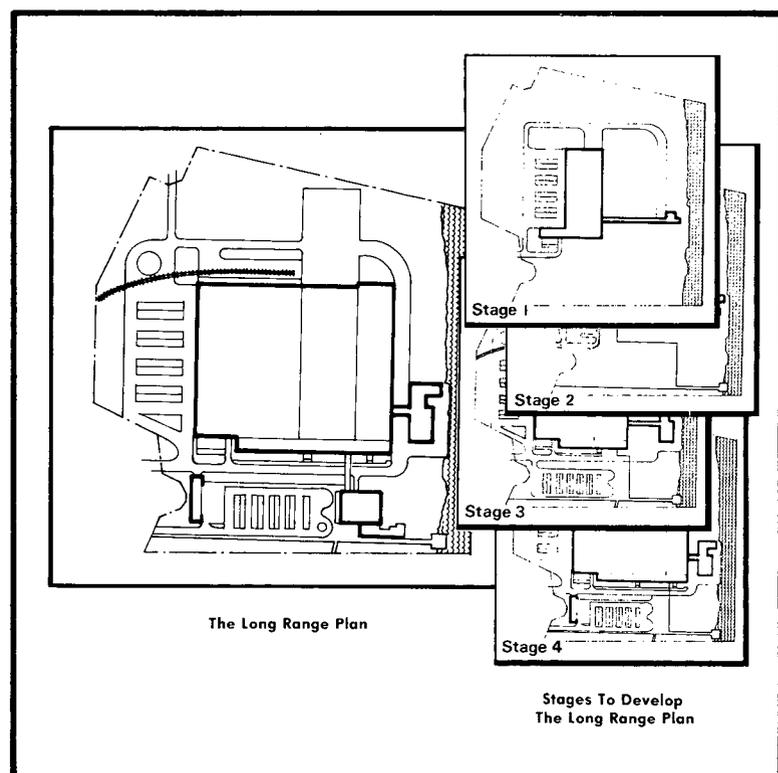
Projects of planning industrial facilities must provide implementation plans and/or intermediate-stage plans.

Note that there are two categories:

- Implementation—construction, rehabilitation, and/or installation plans
- Development—intermediate stages of a larger long-range plan

The planner should recognize both. The implementation planning is an established part of the framework of phases: Phase IV.

The development planning is typically set forth in three to five intermediate stages. Phases II and III of larger, longer-term plans should be expanded to incorporate this sequencing factor. Phase IV then becomes the planning for implementing the first stage of development.



Reality #12**PROJECT SUCCESS VARIES WITH EFFECTIVENESS OF ITS MANAGEMENT**

Facilities planning is done by people. These are human beings like you and I, with the same kinds of qualities and short-comings.

Human nature has a way of providing differences in individuals. And it has a way of causing us sometimes to defeat ourselves. Planners often tend to procrastinate; to be overly detailed; and to do what they like to do in the way they like to do it.

Social psychologists tell us that the effectiveness of any group is only as effective as its leadership. This leadership may be the manager element within an individual planner himself, the manager of facilities planning, the executive responsible for the facilities planning function, or all of them together.

The significance of this is that for success in facilities planning there must be some effective form of project management.



**Corollary #12
MANAGEMENT OF THE PLANNING WORK**

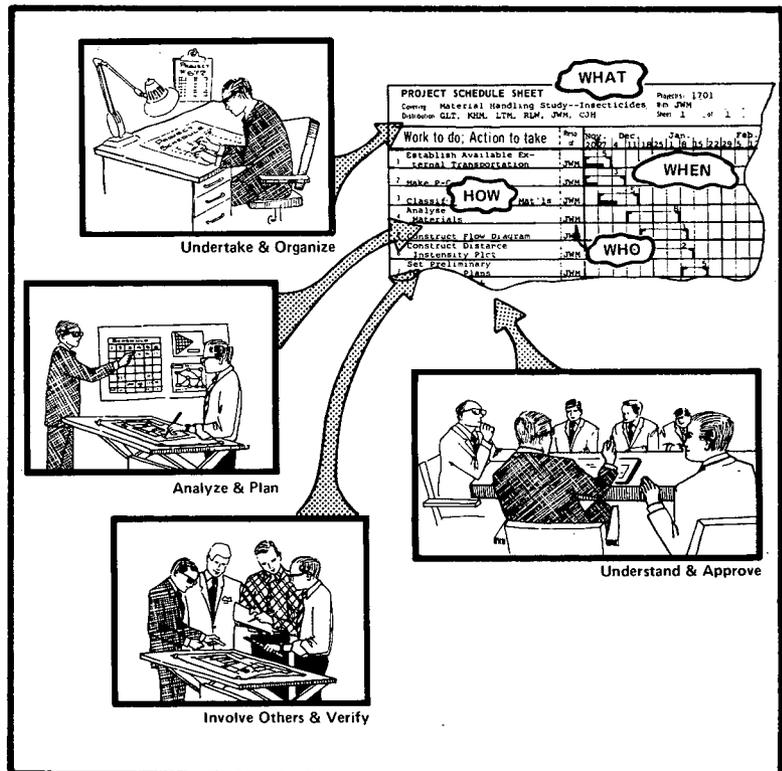
Projects of planning industrial facilities vary in success with the effectiveness of their management.

All well-managed projects should clearly identify the following:

- What is to be done?
The objective(s) and the anticipated results.
- Who is responsible?
A specific person should be identified.
- When is it to be done?
A completion or due date.
- How is it to be done?
The division into steps or subprojects, which identifies the “what” of each step.
- Who, When, and often How of each step or subproject.

These assignments are best synchronized with the framework of planning phases. The phases form a sequence of progressive refinement and provide logical times for review.

When the planner puts it all together on a project schedule sheet, he will meet the criteria for sound overall project management, and will have the mechanics for good administration and control.



INTRODUCTION TO PART TWO ... THE PROCESS OF PLANNING

The process of facilities planning is distinct from the plan itself. The latter is the result of the former. Planning is a how-to type of mental activity; the plan is a what-is, where-is, and when-is-to-be type of physical document.

The plan, or output of the planning effort, is a set of drawings and specifications. According to the plan, the physical facilities are constructed or installed, or the next level of planning is guided, or both. It seems obvious that good facilities follow good plans, that good plans derive from good planning, and that good planning results from knowing “how” and applying oneself effectively. This book is dedicated to assisting its readers in learning how and in applying themselves more productively.

Part One provided a basic understanding of facilities planning and a series of basic planning concepts. Part Two will put the process of planning into perspective and explain the working sequence, the planning pattern, and the documenting conventions that make-up Systematic Planning of Industrial Facilities (SPIF).

Part Two divides itself into four chapters—Chapter 3 through 6.

- *Chapter 3 defines and explains SPIF as a total system of planning.*
- *Chapter 4 describes the phases of typical planning projects*
- *Chapter 5 covers a step-by-step pattern of integrating facilities.*
- *Chapter 6 explains the conventions used when applying SPIF and its capsule summary.*

Each chapter in Part Two is supported in Part Three with explanations of the SPIF subsystems, and in Part Four by examples. In Volume II, the application of SPIF is described in detail.

CHAPTER 3 . . . SPIF AS A PLANNING SYSTEM

That *system* exists in the world is clear to every observer of nature. That system exists in working operations is equally obvious to every manager of people or planner of facilities. And, it is no longer so astonishing—as the complexities of the world have become increasingly revealed by better means of study and better modes of learning—that each ‘thing’ in the world is itself a system. Whether considering the molecules of some raw material or the planets of the solar system, there is a make-up or composition that involves interdependence among parts of the whole and interrelations between levels of structure.

Each thing (system or composition) has multiple interacting dependencies—from above by the influence of systems or compositions of a higher order and from beneath by bits and sub-bits of its own composition. This we recognized in Corollary #1—Five components of an industrial facility.

In working with, planning for, or designing any physical facility, there are certain major concerns: what is wanted, what one can afford, what already exists, what can be made to exist, the time considerations, the space limitations, the external constraints, and the resources at hand.

It is logical to conclude that some organized system of planning should be able to sort out these facilities interrelationships and determining influences. Such a sequence of organized planning is in reality a planning system. SPIF is just that: a system for planning physical systems—as applied to industrial facilities specifically.

SPIF is built around the 12 basic planning concepts or corollaries already defined in Chapter 2. Applying these, the process of planning should function as follows:

1. With the five physical components interacting and influencing each other.
2. With sound planning fundamentals.
3. At any recognized level of planning.
4. With a framework of overlapping phases.
5. With convention codings for type of space and orders of magnitude.
6. With realistic, approved-in-advance input data or capacity requirements.
7. With requirements projected into the future.
8. With long- and short-range integration.
9. With an organized way to evaluate alternatives.
10. With consideration for the condition of existing facilities.

11. For achievable plans with sequenced stages of future facilities.
12. With smooth coordination of objectives, schedules, people, checks and balances between specialists, and regular, consistent reviews and approvals.

SYSTEMATIC PLANNING OF INDUSTRIAL FACILITIES (SPIF) DEFINED

SPIF is an organized, structured system of determining for an industrial plant what its current and future facilities should be. It is an integrated approach to planning the land, buildings, machinery and equipment for an industrial enterprise, and in so doing, SPIF involves:

1. A framework of planning phases through which each project proceeds.
2. Five physical components of an industrial facility, each with its distinct sequence of planning fundamentals.
3. Certain short-range and long-range inputs.
4. Appropriate non-physical influences.
5. A sequential planning pattern that converts the inputs and influences to a facilities plan.
6. A set of conventions for rating, recording, and visualizing the analyses, work sheets, and planning documents.

When put together, the whole represents a total approach to planning, in a systematic way, the physical facilities of any industrial or industrial-type organization. See Figure 3-1 for a diagrammed definition of SPIF. The rest of this chapter explains further the six elements that form the structure of SPIF.

SYSTEMATIC PLANNING OF INDUSTRIAL FACILITIES (SPIF)

Systematic Planning of Industrial Facilities (SPIF) is an organized, structured system of determining for an industrial plant what its current and future facilities should be. SPIF includes a basic approach that:

1. Follows a framework of planning phases
2. Integrates five physical components
3. Investigates certain short- and long-range inputs
4. Considers the appropriate non-physical influences
5. Tracks through a sequential planning pattern
6. Uses a set of rating-recording-visualizing conventions

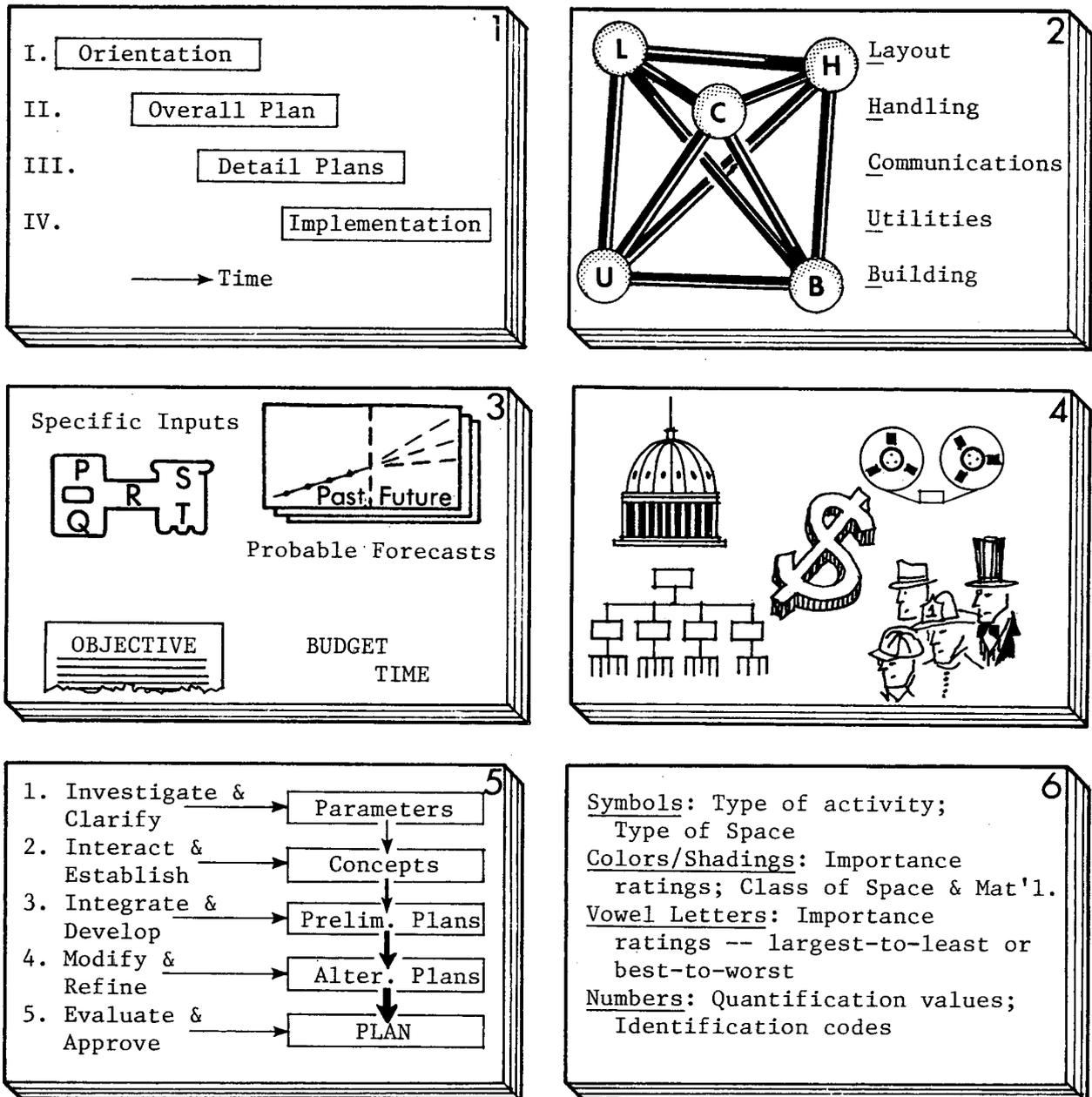
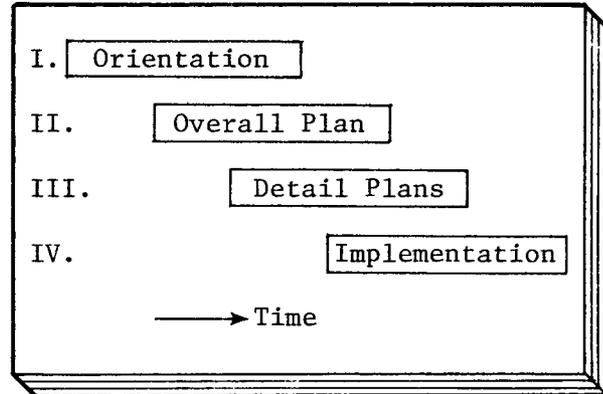


Figure 3-1. Definition of Systematic Planning of Industrial Facilities.

FRAMEWORK OF PLANNING PHASES

Corollary #3—Four phases of facilities planning—identified the four typical phases of a planning project. Corollary #4—Framework of planning phases—puts the planning events into a phased order of succession.

These phases come in sequence, overlap and influence each other, form logical break points for scheduling, and make realistic check points for review and approval.



Phase I – *Orientation* – involves scoping the extent of the project and setting a schedule; converting the needs and desires into tangible requirements; defining the location* of the facility to be planned; identifying the external physical influences; and establishing the non-physical influences external to the project and beyond the limits of the planner's involvement.

Phase II – *Overall Planning* – involves converting the tangible requirements, the external considerations, and internal influences into an overall or total plan for the facility.

Phase III – *Detail Planning* – involves converting the tangible requirements for each subdivided portion of the total facility and their surrounding constraints now imposed by the overall plan, into detail designs and more specific particulars.

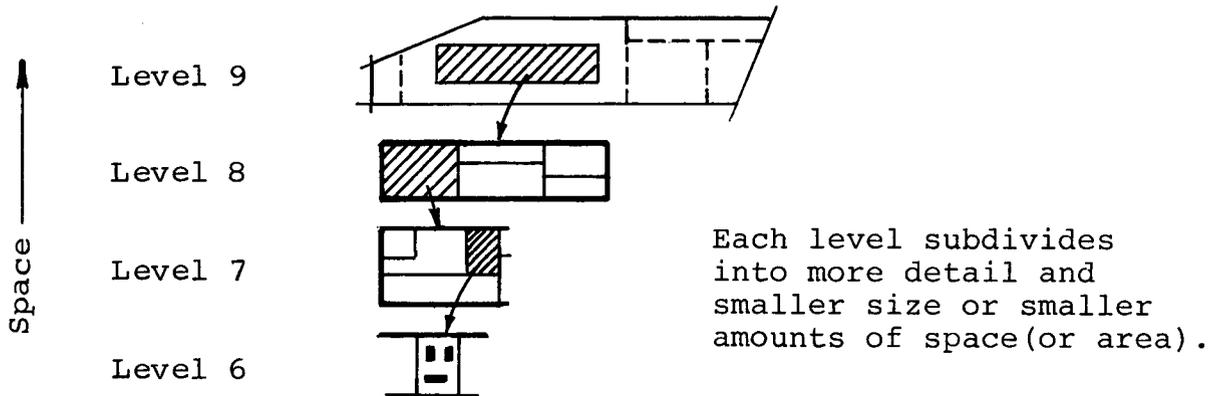
Phase IV – *Implementation* – involves converting the prepared plans for the facility into a program of action—construction, rehabilitation, renovation, and installation.

A project of facilities planning may call for beginning at any level of planning. Reference Reality #3—Plans are made at many levels. The levels of planning relate to space and size. The phases relate to time and sequence. Each planning project changes levels when it progresses from Phase II to Phase III. See [Figure 3-2](#).

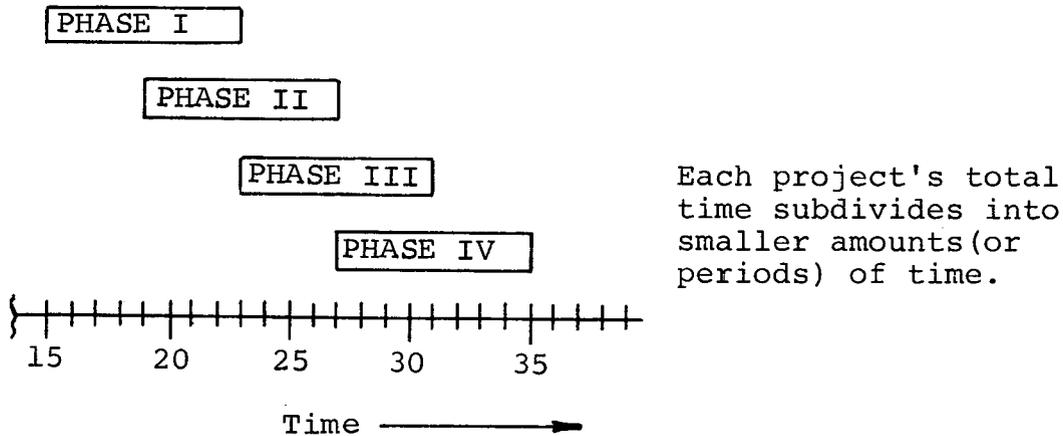
*“Location” here means the spot, place, or situation of the facility being planned. Seldom is this a total plant site.

FACILITIES PLANNING LEVELS AND PHASES

Levels of physical planning involve space and its subdivision. Levels are space related.



Phases of physical planning involve time and its subdivision. Phases are time related.



Both levels and phases are involved in projects of facilities planning. The levels (any two consecutive levels) and the phases (of any project) coincide at Phases II and III.

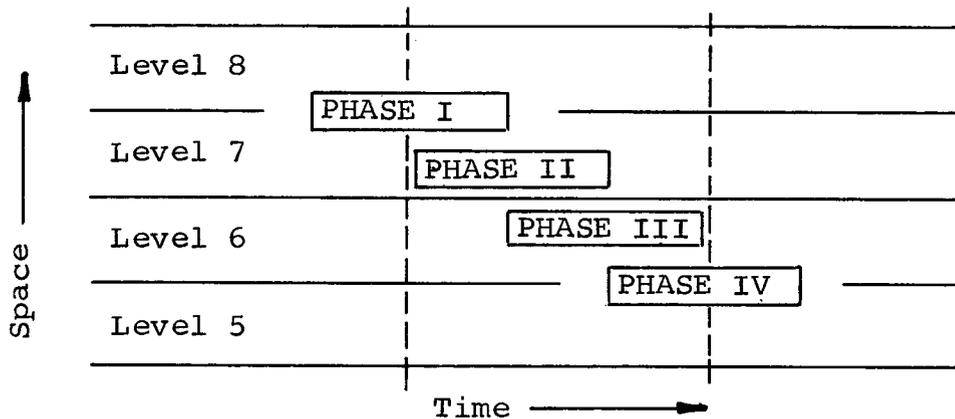
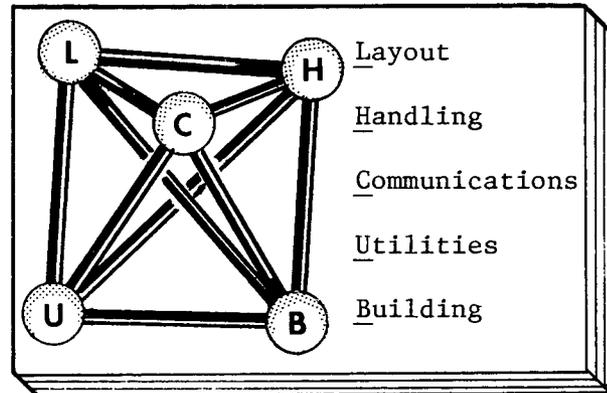


Figure 3-2. The phases of each project can tie to any size of project or any level of planning.

FIVE COMPONENTS IN EACH PHASE

Five components form the anatomy of an industrial plant. Refer to Corollary #1—Five components of an industrial facility.

Each component is a distinct planning discipline in itself. And, each of the associated planning disciplines has its own nomenclature or jargon. As a result, the terms used to describe the various phases are different for each component.



The *layout* planner considers his typical four phases as:

- I – Location (of the area to be laid out)
- II – Overall (or block) layout
- III – Detail Layouts (of individual pieces of equipment)
- IV – Installation (of the equipment)

The materials *handling* analyst considers his four phases as:

- I – External Integration (with outside transports)
- II – Overall Handling Plan (of moves between areas)
- III – Detail Handling Plans (of moves within areas)
- IV – Installation (including procure, train, hook-up. . .)

The *communications* planner considers his four phases as:

- I – External Integration (of communications and controls)
- II – Basic Plan (of communications and control means)
- III – Detail Plans (of communications and control equipment)
- IV – Implementation (including procure, instruct, hook-up. . .)

The planner of *utilities* considers his typical four phases as:

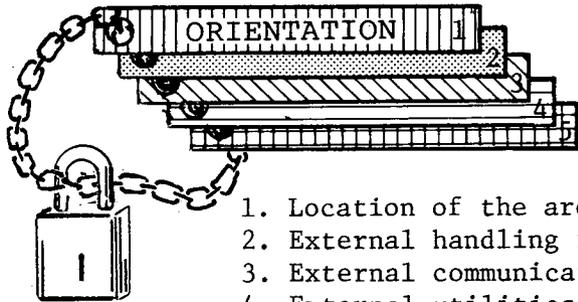
- I – External Access and Egress (of utilities and auxiliaries)
- II – Primary Distribution Plan (of utilities and auxiliaries)
- III – Secondary Distribution Plans (or specifications)
- IV – Installation (or renovation)

The *building planner* considers his typical four phases as:

- I – Program and Site Characteristics
- II – Preliminary Building Plans (or major design features)
- III – Detail Construction Documents
- IV – Building Construction and/or Rehabilitation

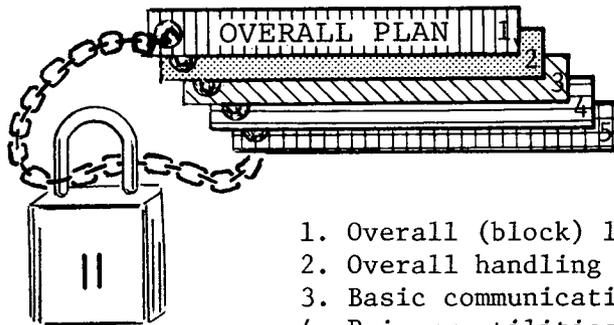
Integration of the planning for each of these five components is ensured by tying the five together at each phase. That is, the plans of all five components are related to each other at the conclusion of each phase and are at that time submitted for approval. An “OK” means that the planning up to that point looks satisfactory. Usually, authority is extended at this time, formally or by implication, to proceed with the next phase. This so-called locking together at each phase is illustrated in Figure 3-3. Additionally, turn to Part Four and refer to Example #1—A case in facilities planning—for an example of the output of each of the component’s planning at each of the first three phases.

LOCK TOGETHER AT EACH PHASE

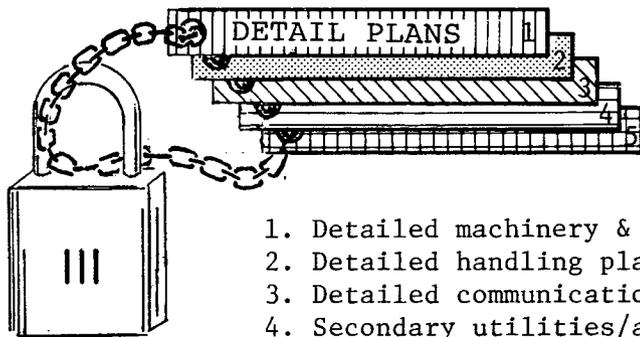


1. Location of the area to be planned
2. External handling integration
3. External communications/controls tie-in
4. External utilities/auxil. access & egress
5. Program and site characteristics

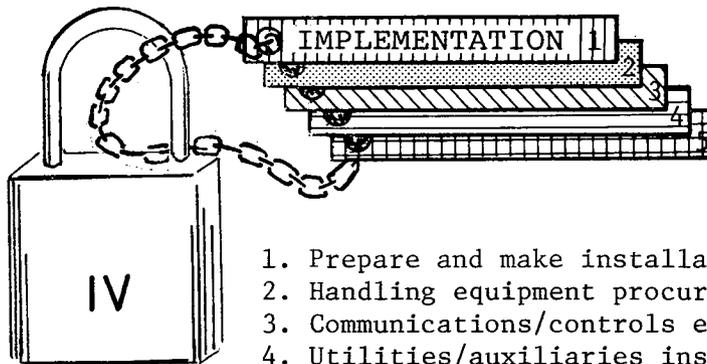
} = ORIENTATION



1. Overall (block) layout
2. Overall handling plan
3. Basic communications/controls plan
4. Primary utilities/auxil. distribution plan
5. Preliminary building plans



1. Detailed machinery & equipment layouts
2. Detailed handling plans
3. Detailed communications/controls plans
4. Secondary utilities/auxil. distribution plans
5. Detailed building (construction) documents



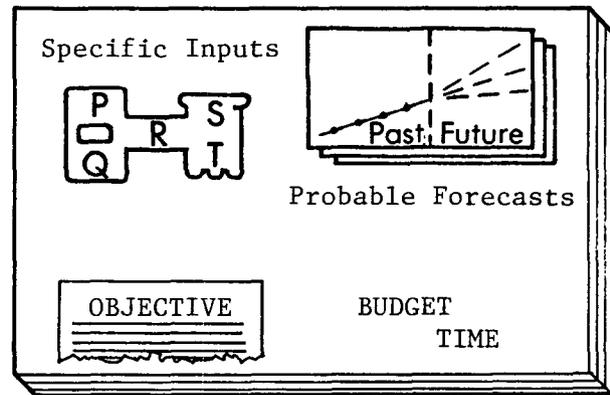
1. Prepare and make installation
2. Handling equipment procurement, training, hook-up
3. Communications/controls equipment installation
4. Utilities/auxiliaries installation
5. Building construction and/or rehabilitation

Figure 3-3. All five components are coordinated and approved at each planning phase.

SHORT- AND LONG-RANGE INPUTS

Inputs to the planning process are of two kinds:

1. Planning criteria requirements—the short-range specifics and longer-range forecasts.
2. Clear definition of the project—its description, objective, scope, anticipated time and cost.



The specific input data required for each project was identified in Corollary #6—Key input data:

- *Products* (or materials or services)
WHAT is the facility to produce?
- *Quantities* (or sales volume or contract amount)
HOW MUCH is the facility to produce?
- *Routings* (or processes of the operations necessary)
HOW will the facility produce them?
- *Supporting Services* (services supporting the plant, its personnel, its materials)
WITH WHAT SUPPORT will they be produced?
- *Timing* (operating hours, seasonal times, urgency. . .)
WHEN AND HOW LONG will the facility produce?

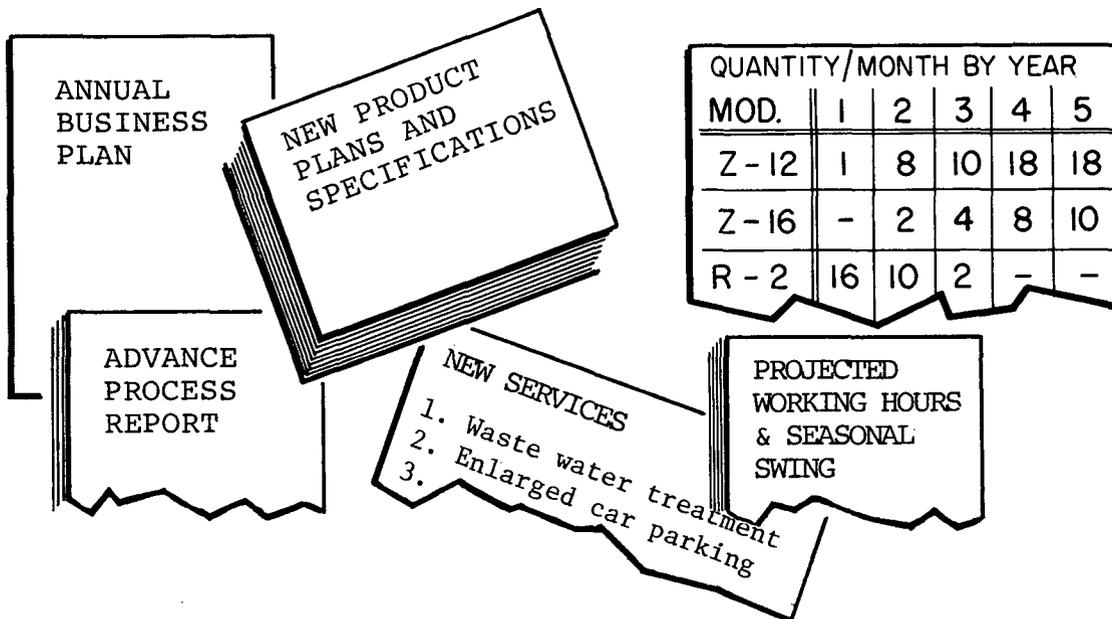
These five basic inputs follow the easy-to-recall alphabetical sequence P Q R S T. They form the criteria to which the planner will plan. They have a direct influence on the type and quantity of facilities, and they have a major bearing on operating costs. These so-called specific inputs should be provided to, or determined by, the planner at the beginning of each project.

For long-term projects, specific inputs are seldom available and if they are, they should be highly suspect. No one knows the future, so other less-tangible data are usually developed and used. This is in keeping with Corollary #8—Different techniques for short- and long-range plans. These long-term inputs are usually the result of some forecasting procedures. They can generally be termed probable forecasts or projected likelihoods.

Inputs related directly to the management of a project include the following:

- Title or brief description and usually a project number.
- Its objective or why it's being undertaken.
- Its scope or extent.
- Limitations or expectations as to money and time.

See Figure 3-4.



PROJECT #112233 Modernize Materials Handling

OBJECTIVE Establish the most effective transport and storing methods to support the Paris complex during the next 20 years.

SCOPE Project includes:

- . the total materials handling equipment and the facilities to support them, and
- . the movement of materials and products, work-in-process, tools and supplies, and spares.

The study will determine and evaluate the most cost-effective handling equipment, storing systems, and facilities to support the operation at the Paris complex.

BUDGET Allocation of \$100,000 for planning assistance including travel and living expenses. Total capital investment to be held under \$2 million.

TIME Review of Phase I--10 Aug.
 Review of Phase II--1 Oct.
 Review of Phase III--15 Jan.
 Appropriation Request--by 1 Mar.
 Installation complete--by one year later.

Figure 3-4. Clear inputs are essential to success.

NON-PHYSICAL INFLUENCES

Besides the physical features of each component that constitute the facilities and the input data to which the facilities will be planned and designed, the planner must consider a host of non-physical influences that affect his project. These may be both external and internal to the confines of the project.

Just as the physical anatomy of an animal was likened to the five components of an industrial plant, so the non-physical attitudes and behavior of an animal can be equated to the way the company is managed or operated. Such features as conscience, soul, philosophical beliefs, and personality or temperament can be likened respectively to company policy and operating procedures.

Additionally, the environment that surrounds the animal is comparable to the society in which the plant operates. Many of these non-physical influences affect the input data—modifying, tempering, or distorting them. This is especially true of the external influences over which the planner has no control. To insure that plans are sound, the planner should consult with others at various times throughout the project.

For ease of understanding, these non-physical influences may be grouped as follows:

1. Legal or regulatory
2. Economic or financial
3. Technical or scientific
4. Social or political
5. Ecological or environmental
6. Personal or emotional

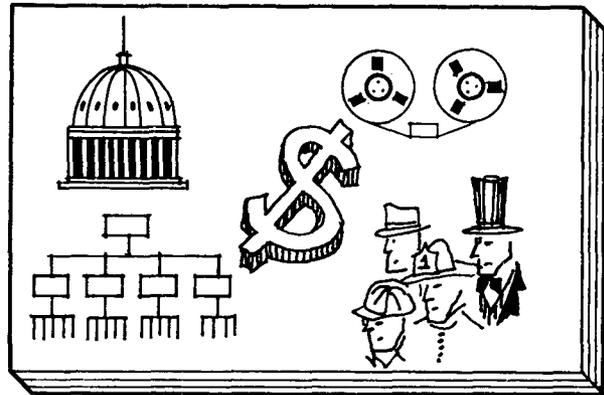


Figure 3-5 illustrates some of the typical non-physical influences with which facilities planners must cope.

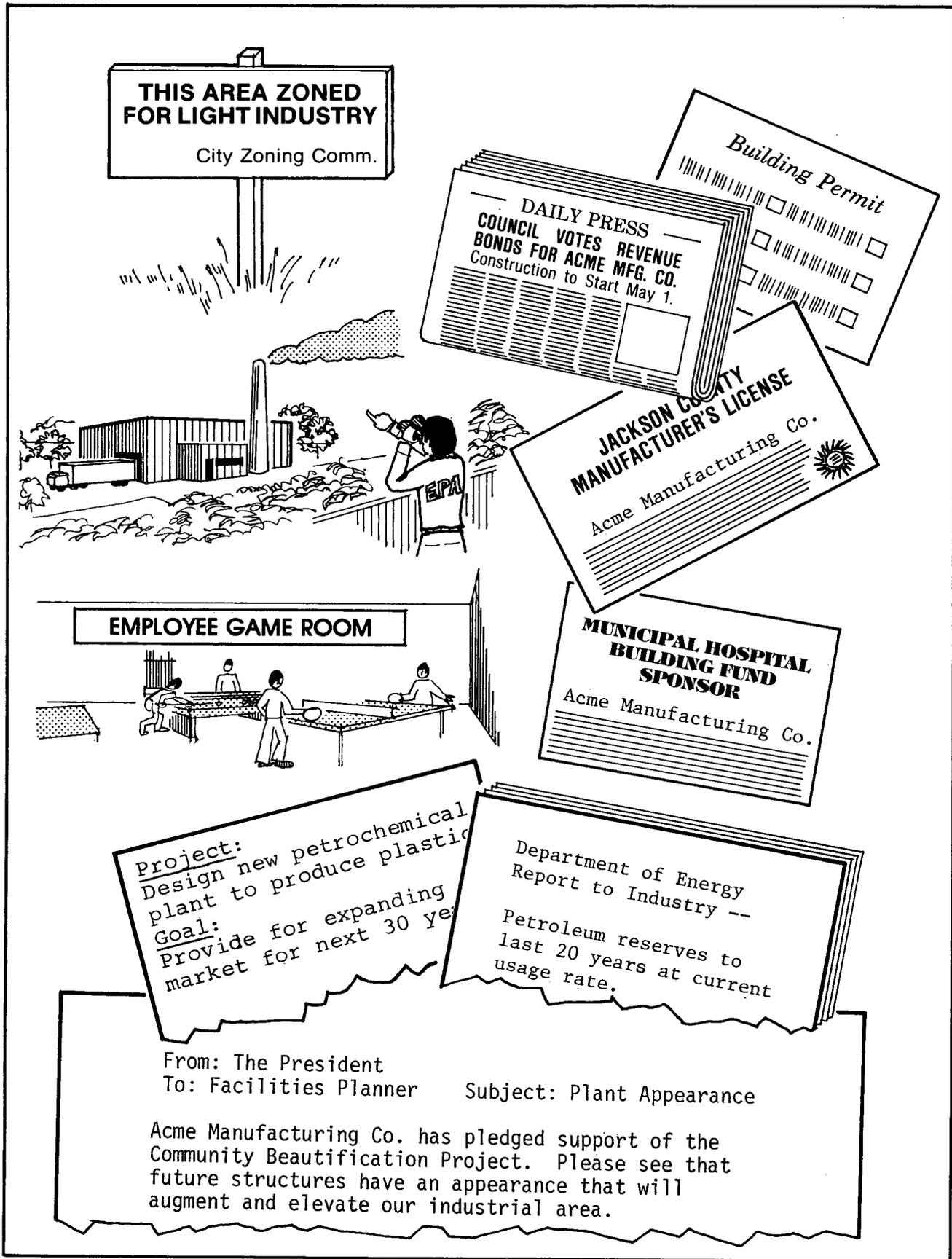
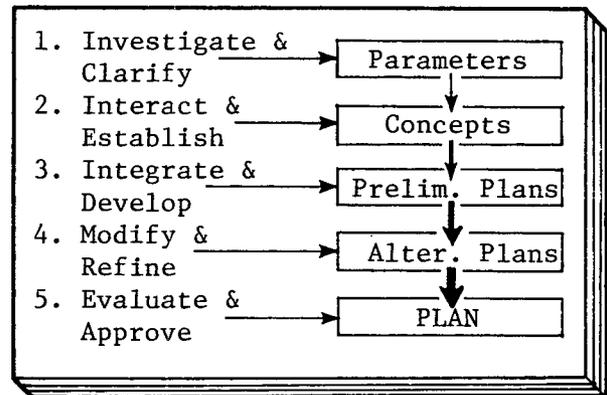


Figure 3-5. Example of non-physical influences.

SPIF PLANNING PATTERN

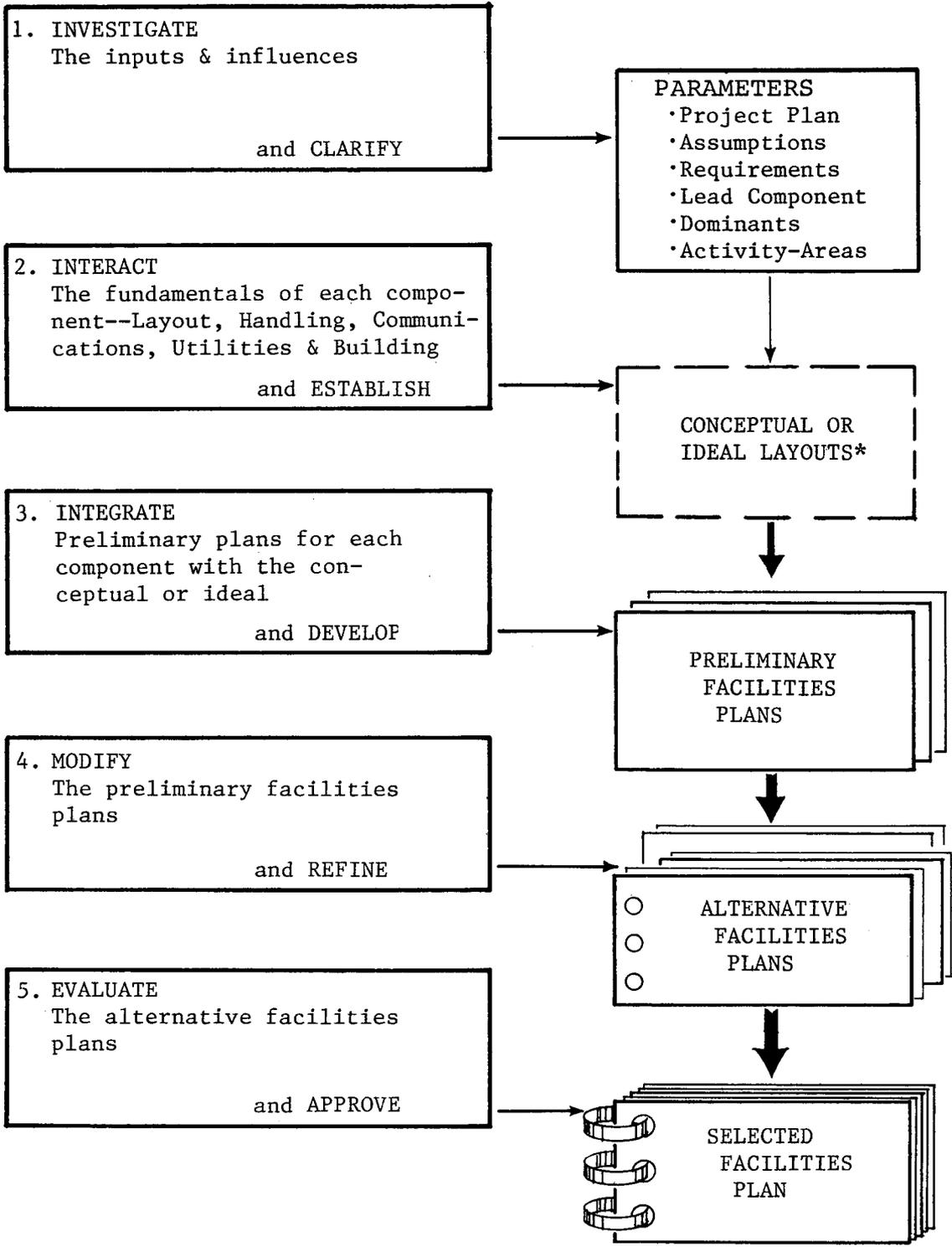
For each component, there is a step-by-step pattern of procedures. This pattern applies to Phase II and Phase III, the strictly planning phases; that is, the phases framed by Orientation and Implementation.

Actually, there are five patterns of procedures, one for each component. These are described in Chapter 7 through Chapter 11. Each of these patterns separately outlines a specific sequence of planning procedures for layout planning, handling analysis, communications analysis, utilities analysis, and building design. Each pattern is similar to the others. Each starts with inputs and their analysis. Each ends with an evaluation of alternative plans.



But, in facilities planning, these stand-alone patterns must be integrated. SPIF does this by structuring a combined, more simple-to-comprehend planning pattern. It consists of five basic steps. The full pattern is explained in detail in Chapter 5. For our purposes here, a condensed form of the SPIF planning pattern is outlined in [Figure 3-6](#). It sets forth the five main steps (of Phases II and III), indicating the progressive development and refinement that characterize any organized planning.

THE CONDENSED SPIF PLANNING PATTERN



* Assuming Layout is the lead component

Figure 3-6. The condensed SPIF planning pattern.

SET OF CONVENTIONS

SPIF includes several conventions for ease of recording, visualizing, and rating. These rest on the logic expressed earlier in Corollary #5—Conventions for type of space and orders of magnitude.

The SPIF conventions will be explained more fully in Chapter 6.

| |
|---|
| <p><u>Symbols</u>: Type of activity; Type of Space</p> <p><u>Colors/Shadings</u>: Importance ratings; Class of Space & Mat'l.</p> <p><u>Vowel Letters</u>: Importance ratings -- largest-to-least or best-to-worst</p> <p><u>Numbers</u>: Quantification values; Identification codes</p> |
|---|

For now, we need to recognize that these include conventions for:

- Defining processes.
- Identifying type of space or activity—both underroof and open-site land.
- Rating or evaluating—largest-to-least or best-to-worst—in vowel-letter, order-of-magnitude scale.
- Quantifying values and identification codes.

Use of these conventions are indicated simply in Figure 3-7.

This completes the definition of SPIF. The next three chapters will expand these initial explanations.

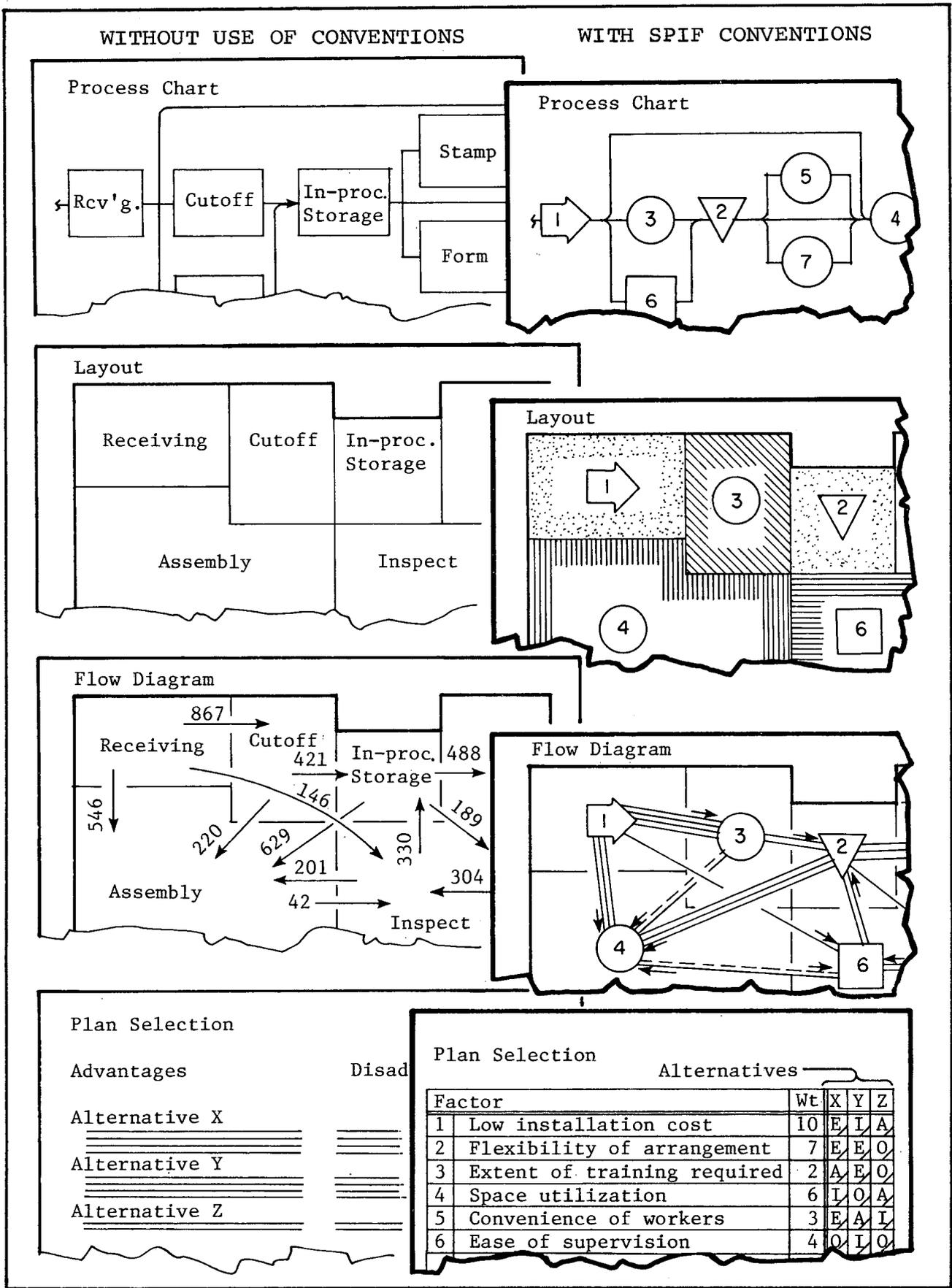


Figure 3-7. Conventions are used to ease and clarify analyses.

CHAPTER 4... THE EXTENDED FRAMEWORK OF PLANNING PHASES

In Chapter 3, we defined SPIF. We shall now expand the basic definition to explain the extended framework of phases.

THE BASIC PROCESS OF PLANNING

Let us follow the logical development of the framework.

Need and desire for an operating facility or its change.

Someone has to recognize a need or express a desire for the new or altered facilities. This may be a long cherished dream or a newly identified need for additional or modified output.

To attain the new or altered facility, there has to be some kind of planning. There has to be forethought as to what kind, how much, when, where, at what cost, and by whom the facility is to be provided. In application, the planner follows a sequence of phases. This planning sequence requires planning time. And the planning will involve a facility that is located somewhere physically; that is influenced by many external considerations; and that is constrained by certain management circumstances. The planning—if carried through to implementation—results in the planned-for facility in its physical setting. This physical locale, with its physical and non-physical influences on the facility, can jointly be termed the planning project's environment.

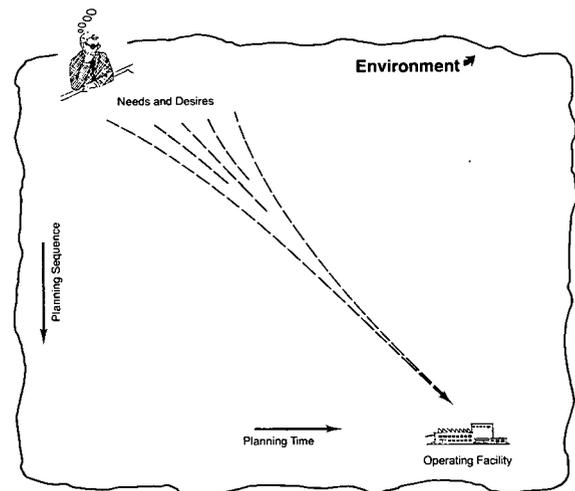


Figure 4-1a.

How to get there

The planning sequence and planning time form the rudiments of a planning project—the basic four phases through which the planning application typically passes.

SPIF extends the four basic phases in three dimensions: diagonal, vertical and horizontal. These form variations on the basic four-phase theme.

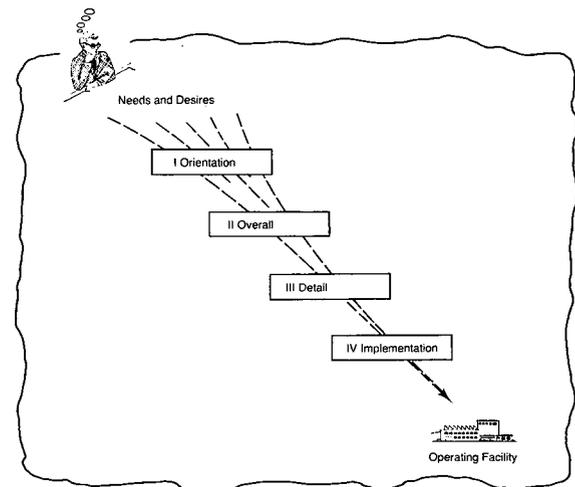


Figure 4-1b.

The diagonal variant

Corollary #1—Five components of an industrial facility—identified five components and likened them to the anatomy of an animal. In planning the whole, each component should be considered, although different projects and phases thereof will put more or less emphasis on each particular component as may be appropriate.

As pointed out earlier, each component is involved in each phase. This integrates at each phase the facilities being planned.

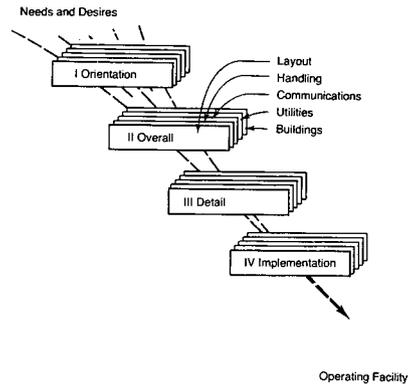


Figure 4-1c.

The vertical variant

The vertical variant recognizes an elongation of the planning sequence. This involves an upward stretch into the business plans of the company and a downward stretch into the physical construction, renovation and/or installation.

In order to get any logical input information from which to develop requirements, the facilities planner is dependent on knowing the company's business intentions. After all, providing facilities is only part (indeed but one device) in the whole set of management functions or business strategies. But, because of the time gap (or design-and-build gap), the planner must often push for this kind of information well before others are ready to release it. And, because of the data gap (or lack-of-information gap), the planner often finds himself pushing very hard for an understanding of plans that top management may or may not have clearly in mind.

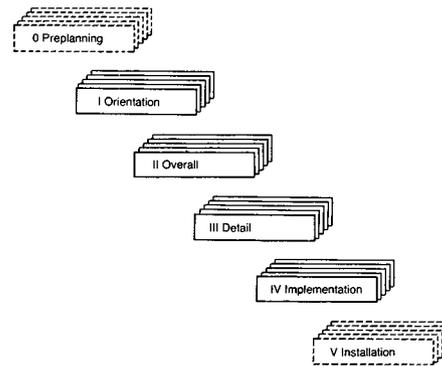


Figure 4-1d.

This preliminary planning work does not involve the planning of physical facilities; rather, it is a necessary prerequisite to the subsequent development of physical facility plans. It is, therefore, identified as “Phase 0” (zero) in the extended SPIF framework of planning phases. This preplanning phase should include a statement of business needs and desires—plans, objectives, and forecasts for the business—from which the planner and his management can develop tangible facility requirements.

The downward stretch involves the facilities planner in the actual execution of the construction and installation, or its direction and supervision. These acts of executing or directing the implementation are not part of planning; they are the action taken on the plans, the doing, or the end result of the plans. In its extended framework, SPIF recognizes that Phase IV is really the *planning* of the implementation and that executing the physical construction, renovation and/or installation is a separate, subsequent, post-planning phase—termed Phase V.

The horizontal variant

The horizontal variant involves two modifications:

1. Existing physical facilities.
2. Development of future facilities.

The capacity and physical condition of existing facilities are important influences on the planning of new or modified facilities. Seldom does the facilities planner have the opportunity to start from scratch with a new plant on a green-field site. But even in such cases he has existing facilities, for brand new sites have existing conditions of land contour, soil strengths, restrictive easements. . . More obvious, the planner may wish to weigh the possibilities of not moving some of his existing equipment and machinery to the new location.

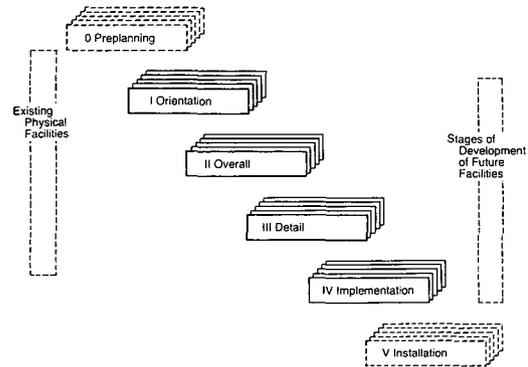


Figure 4-1e.

Virtually every planning project involves the service lives of both existing facilities and those to be provided anew. Corollary #10—Condition of existing facilities—identified the need for rating or evaluating their condition and suitability. Sometimes, the plans developed at each phase may not be realistically achievable because of existing facilities. Serious oversights include: the purchased site that can't effectively be used; the master site plan that can't realistically be developed; or the detailed plan that can't practically be sequenced.

Corollary #11—Implementation plans and intermediate stages—identified the need for having implementation plans. And, it distinguished between the immediate implementation of the plans and designs on the one hand and the intermediate stages of development of future facilities on the other. Planning of the former is identified already as Phase IV. The latter is the right-hand side of the horizontal variant of SPIF's extended framework of planning phases. Both development of future facilities and immediate implementation are part of the planning. Therefore, at each phase, the plan (or set of plans) should be checked for compatibility with both the larger plans for the development of future facilities and the practicality of its immediate implementation.

In Part Four, Example #2 and Example #3 illustrate respectively the kind of existing facilities and future-facilities development with which the planner will need to synchronize his current planning.

EXTENDED FRAMEWORK OF PHASES

From the unfolding logic above, we arrive at the extended framework of planning phases. See Figure 4-2. This puts together the overlapping of phases, the interaction of five components, and the cross-influences of existing, needed, and future facilities.

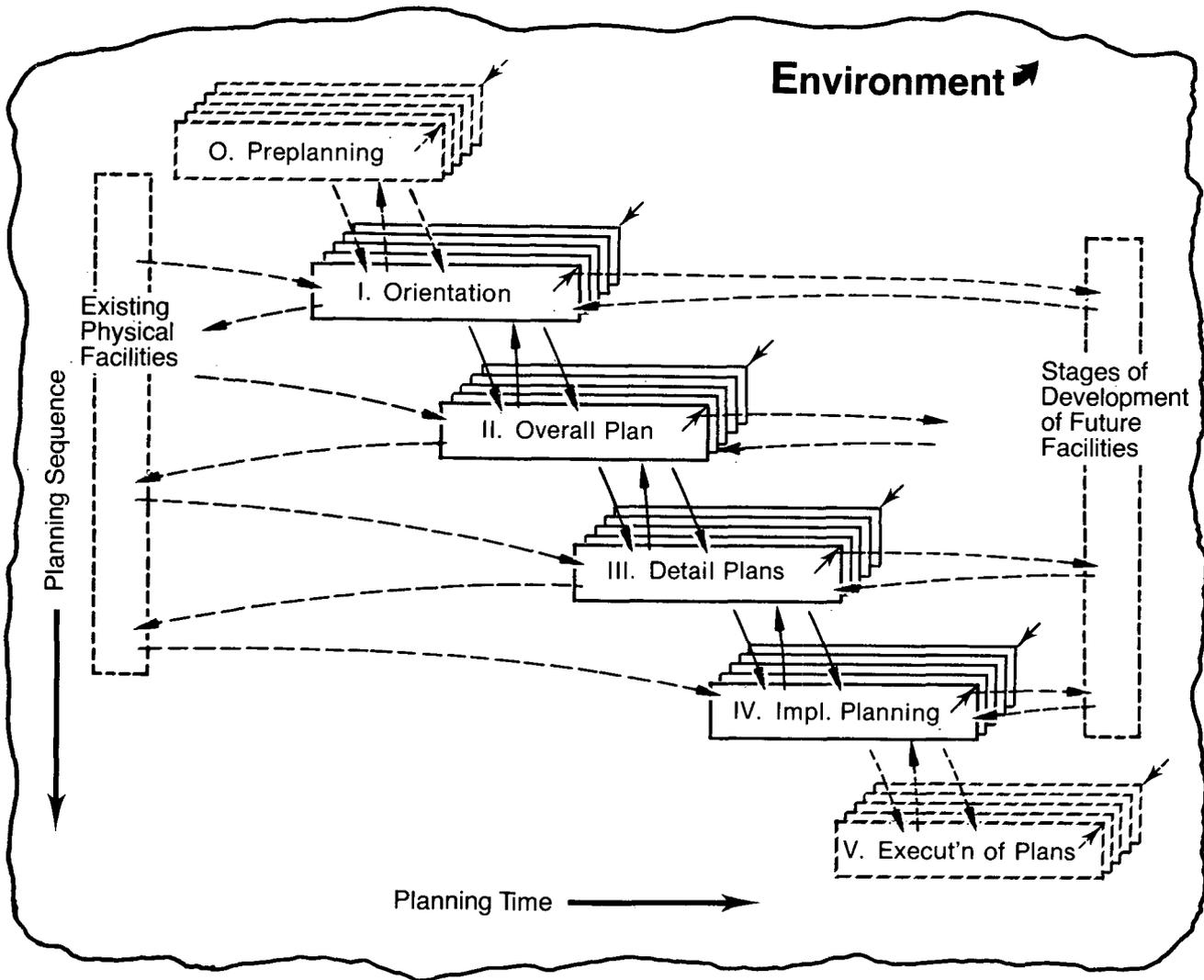


Figure 4-2. The SPIF Extended Framework of Phases. Note that the interaction and interdependence of specific influences are basic features of SPIF. The framework progresses from needs and desires of management to the physical operating facility. It proceeds sequentially from the big to the small, from the whole to its parts, from the idea to actuality--in a system of progressive refinements--interacting and integrating at each phase. Note further the diagonal, vertical, and horizontal variants to the basic four phases.

By way of further summary, see Figure 4-3. It abstracts the extended series of SPIF phases and the resulting output of each.

Note that the making of a planning-project plan and schedule, and the managing of a facilities-planning project are not indicated as part of the full framework of phases per se. This will be discussed in detail in Volume II. But, managing the project should not be overlooked, so we re-emphasize here that each phase should have an approval.

A comprehensive approval, with all interested persons represented, forces the integration of all five components. And particularly, it makes reasonably finite the bigger decisions so that

| EXTENDED FRAMEWORK OF PHASES SUMMARY | | | | |
|--------------------------------------|-------------------------|-----------------|---|---|
| PHASE | SPIF NAME | ACTION | RESULT/OUTPUT | GENERAL TERMINOLOGY |
| 0 | Preplanning | Preplan | Stated Needs of the Business | Business Planning |
| ----- | | | | |
| I | Orientation | Localize | Determined Location and External Considerations | } Physical Facilities Planning |
| II | Overall Plan | Plan the Whole | Overall Plan (Solution in Principle) | |
| III | Detail Plans | Plan the Parts | Detail Plans (Solution in Detail) | |
| IV | Implementation Planning | Plan the Action | The Plan for Implementation | |
| ----- | | | | |
| V | Execution of Plans | Act/Do | The Facility Completed, Ready to Operate | Constructing, Rehabilitating, &/or Installing |

Figure 4-3. Action and results of the extended framework of planning phases.

subsequent planning can be done with more dispatch and assurance. As we proceed, our plans are still on paper. Even though approved and locked together, we can fall back and change the plans to a reasonable extent should subsequent planning conditions or details justify.

CURRENT-PHASE FRAMEWORK

Let's look now at the condensed SPIF planning pattern as it relates to the framework of phases. Figure 4-4 illustrates the five steps of the pattern surrounded by the influences that impact the planning of that current phase. The current phase is that strictly planning phase (Phase II or Phase III) in which the project lies at the particular time.

The five surrounding influences include the following:

1. *Environment.* This includes the circumstances by which the entire planning project is surrounded or enveloped. It involves both the physical and non-physical considerations that influence or affect the the project, yet are outside or beyond its scope, and over which the planner has little or no control.

CONDENSED SPIF PLANNING PATTERN IN THE CURRENT-PHASE FRAMEWORK

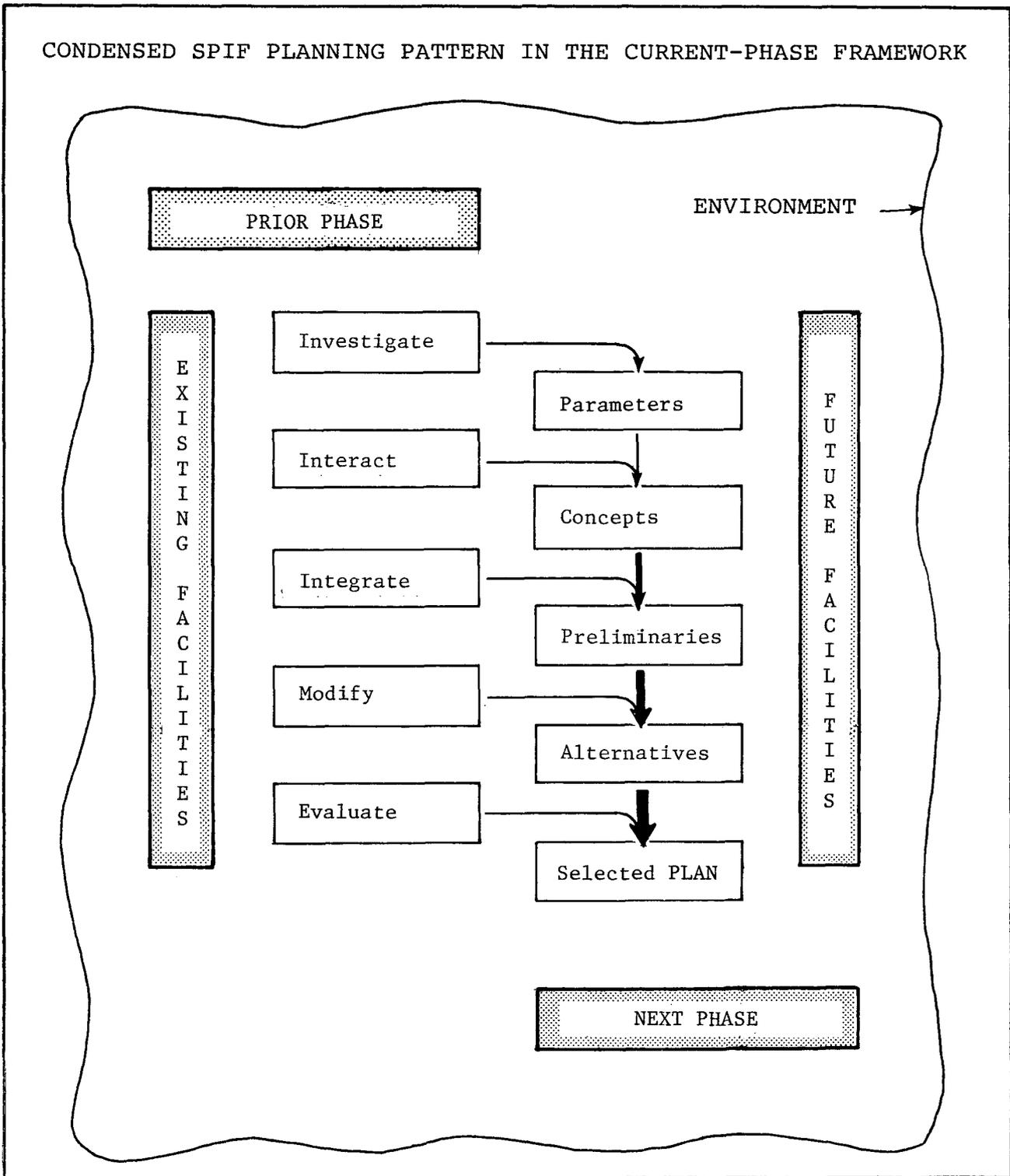


Figure 4-4. The condensed SPIF planning pattern shown in its current-phase framework. The physical influences that surround the current phase of any project include: The prior-phase (higher-level or larger area) decisions or constraints; the existing facilities, their capabilities, placement and condition; the future facilities or the opportunities and pending limitations of their development; the next-phase (lower level or subarea) plans that can provide reverse impact on the current phase. Surrounding all are the physical and non-physical influences of the project's environment.

2. *Prior phase.* The decision made in the previous phase, usually at a higher level of planning, constrain or limit the current phase. The location on the site, for example, of the building being planned, and its orientation to the rail spur (Phase I), will have a definite impact on the location of the receiving and shipping activities in the overall building plan (Phase II).
3. *Existing facilities.* These already exist and must be accommodated or changed. Their capability and condition must be evaluated. Even when there are no buildings on a new site, the slope of the land, the condition of the sub-soil, the prevailing storm winds are “existing facilities” in the bigger sense of the term.
4. *Future facilities.* These are the projected plans for the future facilities. Of a larger size and longer range than the current project, these master or comprehensive plans for the development of the entire site need to be met or developed as part of the current-phase plan.
5. *Next phase.* Some major features in the following or next-level phase may provide a reverse impact on the current phase. One piece of equipment, like a boiler, can effect the design of the entire powerhouse. The lift capacity and detail design of an overhead bridge crane may affect both the location of departments it serves and the preliminary building plans.

Thus, the current planning of Phase II or Phase III is constrained generally by the project's environment and boxed-in specifically by four physical influences, as it progresses through its sequential planning pattern. It should go without saying that each influence exerts more or less impact depending on the particulars of each project.

FRAMEWORK OF PHASES IN PRACTICE

The time for each project will, of course, vary. And, the time required for each phase will vary. They will be short or long depending on several factors.

It is generally best to have a regular sequence of overlapping phases. Certainly, the approval of the resulting plan at each phase falls in a mandatory sequence. Yet, the scheduling of each individual project may not follow the regular timing of the ideal framework of phases—and most frequently does not. Moreover, during the planning and its implementation, whenever unforeseen opportunities or overriding considerations arise, adjustments may be required. As a result, the actual schedule for each project must have the flexibility to depart from the suggested evenness of the basic framework. This is illustrated in [Figure 4-5](#).

Additionally, on big*, comprehensive projects, the overall planning (Phase II) may repeat itself. That is, the overall phase may be enlarged into two—or even three—repeated phases. Thus, there can be overall phases within an overall phase. Or, a series of overall plans, each at a

*“Big” here is not so much a function of the time to provide a facility or the man-days of planning as it is of: 1. The normal size of the conventional facilities-planning projects of the particular company, and 2. The actual size of the overall area relative to the size of each individual piece of equipment, machinery, or item of construction.

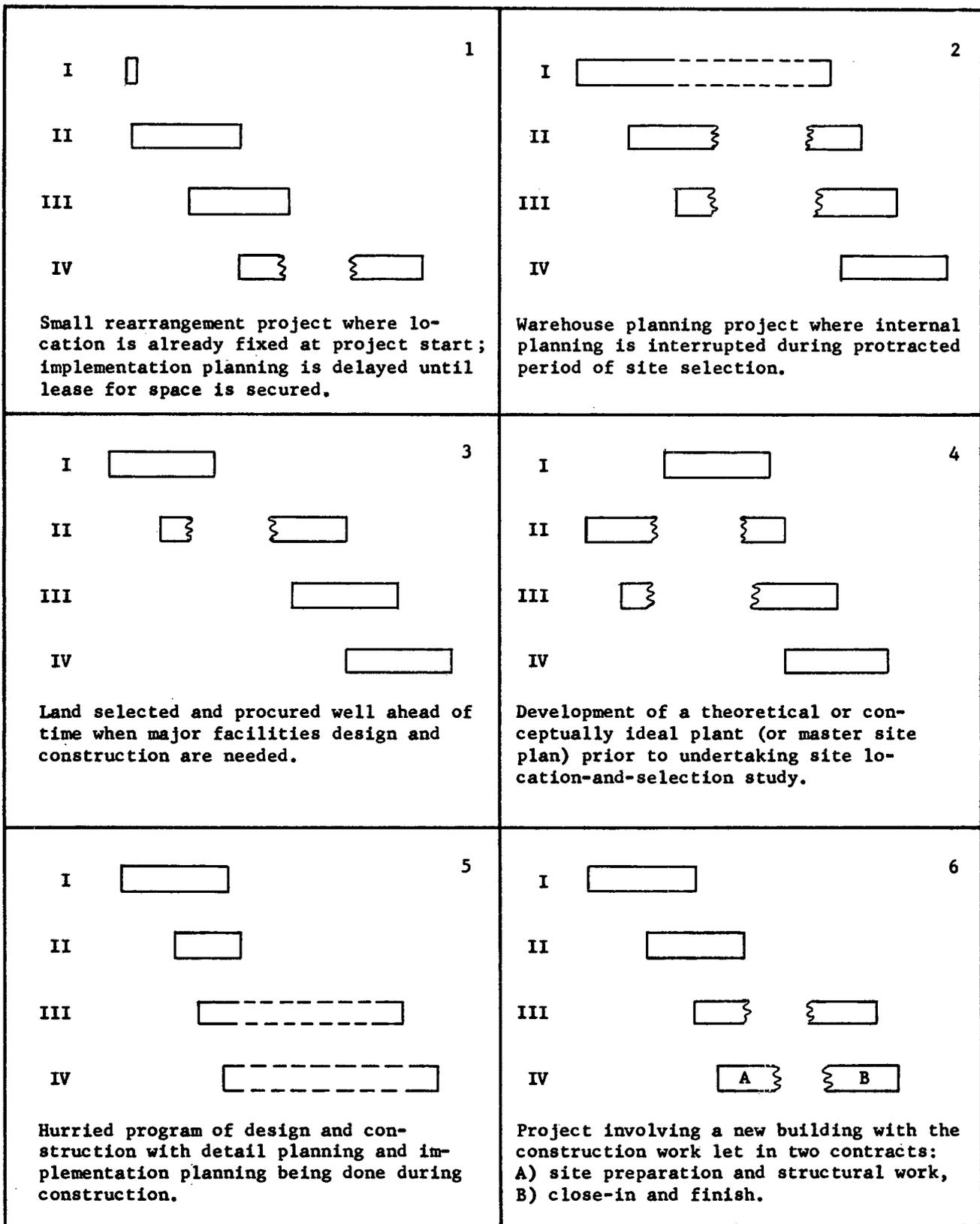


Figure 4-5. Typical adjustments of time and sequence. The practical ways industry operates and the need for flexibility in project scheduling typically cause departures from the regularity of a uniform time framework. Note, however, that the final closing of each phase must come in sequence.

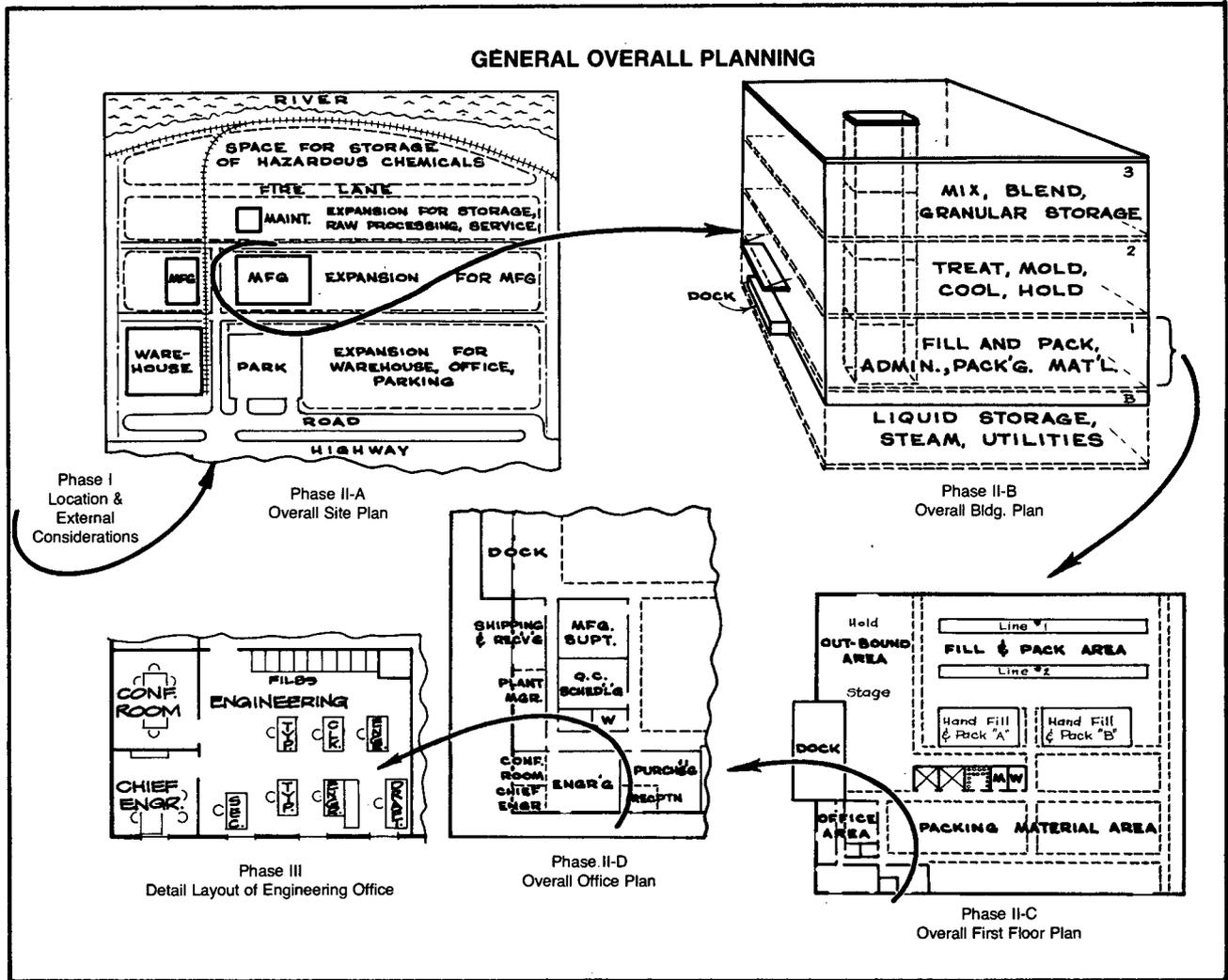


Figure 4-6. Phases within phases. An example of four overall planning phases within one large project that goes all the way to the detail facilities of each specific piece of equipment.

next-lower level, can be developed before each subarea is itself then planned in its Phase-III details. This supports the levels-of-planning reality; but it adds a variation to the basic four phases which may require Phase II-A, Phase II-B, and even Phase II-C on very large projects. See Figure 4-6.

On the contrary, when a project is very small, Phases II and III can be combined. This combining of the strictly planning phases occurs also when the size of the individual piece of equipment or machinery is relatively large compared to the size of the overall project, as when the project involves only the rearrangement of one small department. For instance, if the project were only to provide the engineering office of Figure 4-6, the blocking-out of the area would be combined with the fit and orientation of desks, files, and conference table.

CHAPTER 5 . . . FULL SPIF PLANNING PATTERN

Chapter 3 defined and explained SPIF. Chapter 4 extended the basic four phases and identified the five constraining influences that surround the current phase of planning. This chapter explains the full SPIF planning pattern.

Five planning steps have already been identified in the condensed SPIF planning pattern. These included:

1. Investigate and clarify
2. Interact and establish
3. Integrate and develop
4. Modify and refine
5. Evaluate and approve

These are the steps of planning within Phases II and III—the strictly planning phases: overall and detail planning. These same five steps apply in the full pattern. They are simply expanded. The full SPIF planning pattern is shown in Figure 5-1.

The full pattern covers the planning of all five components comprising an industrial facility. The reader will notice that the pattern is built around the three fundamentals of each component as set forth in Corollary #2—Three fundamentals of each component.*

Now let us note several features of the planning pattern.

1. It is applicable to Phases II and III.
2. There are five steps—providing a general sequence of planning—with a kind of check-and-coordinate at each step.
3. It starts with inputs and ends with a plan.
4. It involves all five components.
5. It shows the interaction, integration, and modification of each component.

*The reader should turn at this point to Part Three which explains the foundations on which the pattern is based and that it is indeed a comprehensive consolidation of five separate patterns of procedures—one for each component. If you are familiar with the disciplines SLP, SHA, SCA, SUA, and SBP, simply refresh your understanding by referring to the figures (-1 and -2) in each chapter in Part Three. Otherwise, take time here to read each chapter before continuing.

SPIF PLANNING PATTERN

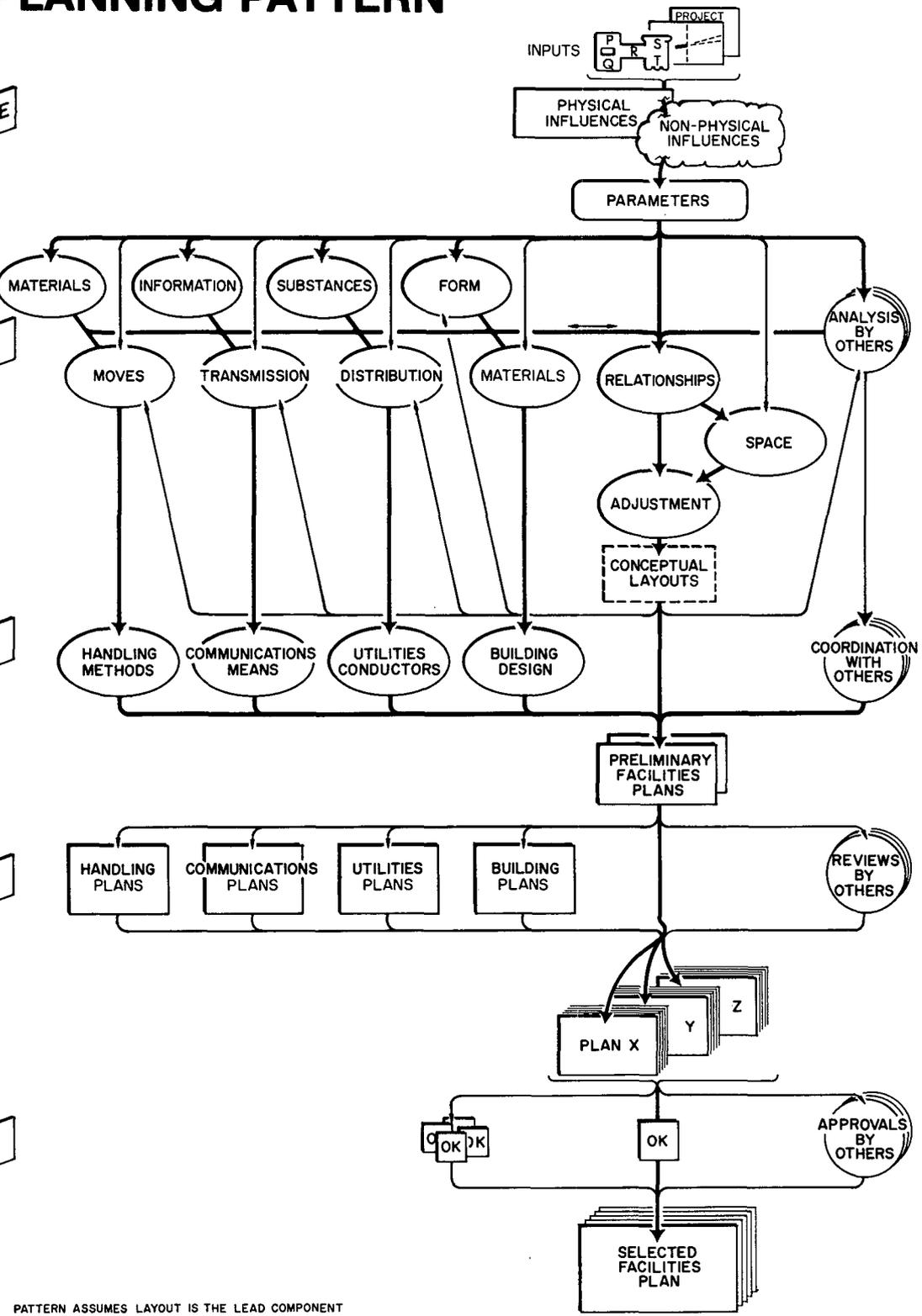
INVESTIGATE

INTERACT

INTEGRATE

MODIFY

EVALUATE



PATTERN ASSUMES LAYOUT IS THE LEAD COMPONENT

RICHARD MUTHER & ASSOCIATES

Figure 5-1. The five steps of the SPIF Planning Pattern.

6. It implies that layout is the predominant or lead component, which it generally is in industrial situations.
7. It shows the fundamentals of each component, rather than each specific box or procedure as in the individual pattern of procedures for each component's stand-alone sequence, described in Chapter 7 through Chapter 11.
8. There are two static components—layout and building—and three dynamic components—handling, communications, and utilities. Their feedbacks in the “integrate step” are slightly different. (Note that in the patterns of procedures for the five components, there are two different structures.)
9. The circles at the right represent the need for analysis, coordination, or control by agencies, individuals, and other interested parties outside the planning project, but related to it.

The rest of this chapter devotes itself to explaining each step of the planning pattern.

INVESTIGATE & CLARIFY (STEP 1)

The first step involves investigating the inputs and influences and clarifying the parameters. See [Figure 5-2](#).

Recognize that a prior phase has preceded this. So, some of the investigation is already done and much of the clarification is in reality reclarification. This is understandable because the phases should overlap. Also, it is logical to have a rereading or reclarification at the start of each phase.

The inputs have already been described in Chapter 3. The influences fall into three general classes:

- 1a. *External*—those things outside the particular project that relate to or constrain it. Usually, these are the influences that are geographically outside the location as defined in Phase I, and within what SPIF terms environment.
- 1b. *Internal*—those things within the particular project. These are the influences within the location defined in Phase I.
- 2a. *Physical*—the physical influences that affect the facilities—land, buildings, equipment and/or machinery. These are the surrounding physical constraints that form the current-phase framework.
- 2b. *Non-Physical*—the non-physical influences described in Chapter 3 as: legal, economic, technical, social, ecological, and personal.
- 3a. *Existing*—those considerations or conditions that exist now, at the present time.
- 3b. *Future*—those considerations that are likely to come to pass in the future as conditions change.

STEP 1 -- INVESTIGATE THE INPUTS AND INFLUENCES AND CLARIFY THE PARAMETERS

INPUTS

- . Project definition, Objective, Budget, Time
- . Key input data (Short-range specifics): PQRST
- . Probable forecasts (Long-range likelihoods)

PHYSICAL INFLUENCES

(External & Internal)

- . Location and external conditions (Prior-phase plans)
- . Existing facilities (Condition & capacity)
- . Future facilities (Master plan & its development)
- . Next-level plans (Next-phase planning)

NON-PHYSICAL INFLUENCES

(External & Internal)

- . Legal or regulatory
- . Economic or financial
- . Technical or scientific
- . Social or political
- . Ecological or environmental
- . Personal or emotional

PARAMETERS

PROJECT PLAN

| TASK | | This Year | | | | Next Yr. | | | | Yr. 2 | | | | Further | | | |
|-----------------------|----|-----------|----|-----|----|----------|----|-----|----|-------|----|-----|----|---------|----|-----|----|
| | | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV |
| 1. Plan reqmts. | AR | | | | | | | | | | | | | | | | |
| 2. Plan mtrl. handlg. | IO | | | | | | | | | | | | | | | | |
| 3. Plan equip. reqmt. | EV | | | | | | | | | | | | | | | | |

DOMINANT CONSIDERATIONS

| | EXISTING | | FUTURE | |
|--------------|---------------------|---|--------------------------|---|
| | | | | |
| PHYSICAL | adequate utilities | X | changes in utility rates | X |
| PHYSICAL | adequate main plant | | alter transport | |
| | adequate main plant | | alter transport | |
| NON-PHYSICAL | new installation of | | | |
| | adequate main plant | | | |

ACTIVITY-AREAS

1 MAIN ENTRANCE

for truck loads of raw materials including one truck and vehicle zone

2 RAIL ENTRANCE

for tank cars at yard raw material including one car and vehicle zone

ASSUMPTIONS

1. Use the same size carton and container for each brand to maximize use of each packing line and minimize the number of size change overs.
2. Use the same chemical and mixing equipment raw materials and produce diff.
3. Use manu product.
4. Use jiffy for finish avoid pus.

REQUIREMENTS

1. Produce 6 brands of synthetic detergent granules in 4 carton sizes.
 2. Provide methods and equipment to handle raw materials and finished products amounting to 20,000 cases per day now and expanded to 60,000 cases per day in 20 years.
- space to install 60,000 cases per day of additional brands.

LEAD COMPONENT

materials handling based on feeding material through products and in-process cases storage for 20 years. per day to 60,000 cases per day with 20 years.

Figure 5-2. Investigate and clarify.

The planner investigates the inputs and influences, and with his knowledge and understanding of facilities, he converts them into parameters. These are the essential dictates or determinations that direct his subsequent planning steps.

1. *Project plans*—the plan for accomplishing the planning. The input definition, objective. . .are now translated into a schedule of what, why, when, and how of each of the steps and subtasks thereof for the specific phase. This should include the dates for the coordinating meetings and the names of those who are to be involved.
2. *Assumptions*—the chief commands, premises, or ground rules that will govern the planning. These may be pronouncements of the top management, policy statements, or interpretations of governmental-agency regulations on the one hand. On the other, these may be preferences of the area manager, proposals of the inventory-control supervisor, or cautions of the city planning commission. And, the planner's own assumptions or self-developed understandings may be the most influential of all.
3. *Requirements*—the meaningful, workable data indicating the output wanted. Demand projections in money are converted to units; end products to components; hoped-for outputs to realistic capacity expectations. . .
4. *Dominant considerations*—the primary considerations or main factors that affect the project and, therefore, that must be taken into account or given specific attention during the planning. The planner converts his external-and-internal, physical-and-non-physical, existing-and-future influences into more selective considerations.
5. *Lead component*—the facilities component that will be the most important in the planning. In each project, there is a most-important component. In planning the control room for a modern cement-products mill, the communications component is likely to be most important. The planner should identify his lead component. In industrial situations, he should assume it is layout unless the burden of proof is otherwise. Then, he can follow the planning pattern with the fundamentals and pattern of procedures for that lead component, coordinating the other four components and the related outside agencies, offices, or individuals.
6. *Activity-areas*—the basic divisions of the facility. The term "activity-area" (or simply "activity") may be a machine in a department or a building on a site. . . Large or small, depending on the nature of the particular project, an activity-area is an identifiable place or spot or thing. It usually occupies space and it almost always forms the node to which other activity-areas are linked. We hesitate to use the term "areas" because sometimes an activity requires none; the terms department, building, cost center, work group, or even functional area will be incorrect at some levels of planning.

The identification of activity-areas involves analysis of how the facility is to be divided—by size of product, by type of material, nature of the process, skills of the people, quantities of production. . .or as is most usual, a combination of two or more. Once identified, the planner will use the same activity-area designation in planning all five components. Differing designations for the same activity-area add confusion and obviously make integration more awkward and time-consuming.

INTERACT & ESTABLISH (STEP 2)

The second step involves interacting among the major elements involved and establishing the conceptual or ideal facility for the lead component. See Figure 5-3.

Once the planning parameters are clear, they should be made available for any and all who are involved in the current phase of the project. So fortified, interaction can proceed in parallel. This includes:

- Interaction between the first two fundamentals of each component.
- Interaction among all components, including the lead component.
- Interaction with other related parties.
- Interaction between the three fundamentals of the lead component.

From this interaction, the conceptual or ideal facility for the lead component is established.

Recognize that the planning pattern shows the fundamentals for each component; but the planner will draw upon specific techniques of analysis as suggested by the pattern of procedures of each individual component, as indicated in Chapters 7 through 11.

Let us follow Step 2 for a typical facility, assuming that layout is the lead component.

1. Issue parameters to the persons directly involved and others related to the planning.
2. Analyze, or aid in the analysis of, the first two fundamentals for:

Handling—classify the *Materials*
—analyze the *Moves* required

Communications—Classify *Information*
—analyze the *Transmissions*

Utilities—classify the *Substances*
—analyze the *Distribution*

Building—analyze the *Form*
—study the building *Materials*

3. Involve other related parties in the analysis of the parameters so as to get their impacts on the facilities. These other related parties are essentially the same individuals or groups associated with the physical and non-physical influences of Step 1.
4. Establish the *Relationships* among activity-areas, based on a combination of flow of materials and other-than-flow considerations.

STEP 2 -- INTERACT WITH ALL COMPONENTS AND ESTABLISH CONCEPTUAL PLAN FOR LEAD COMPONENT

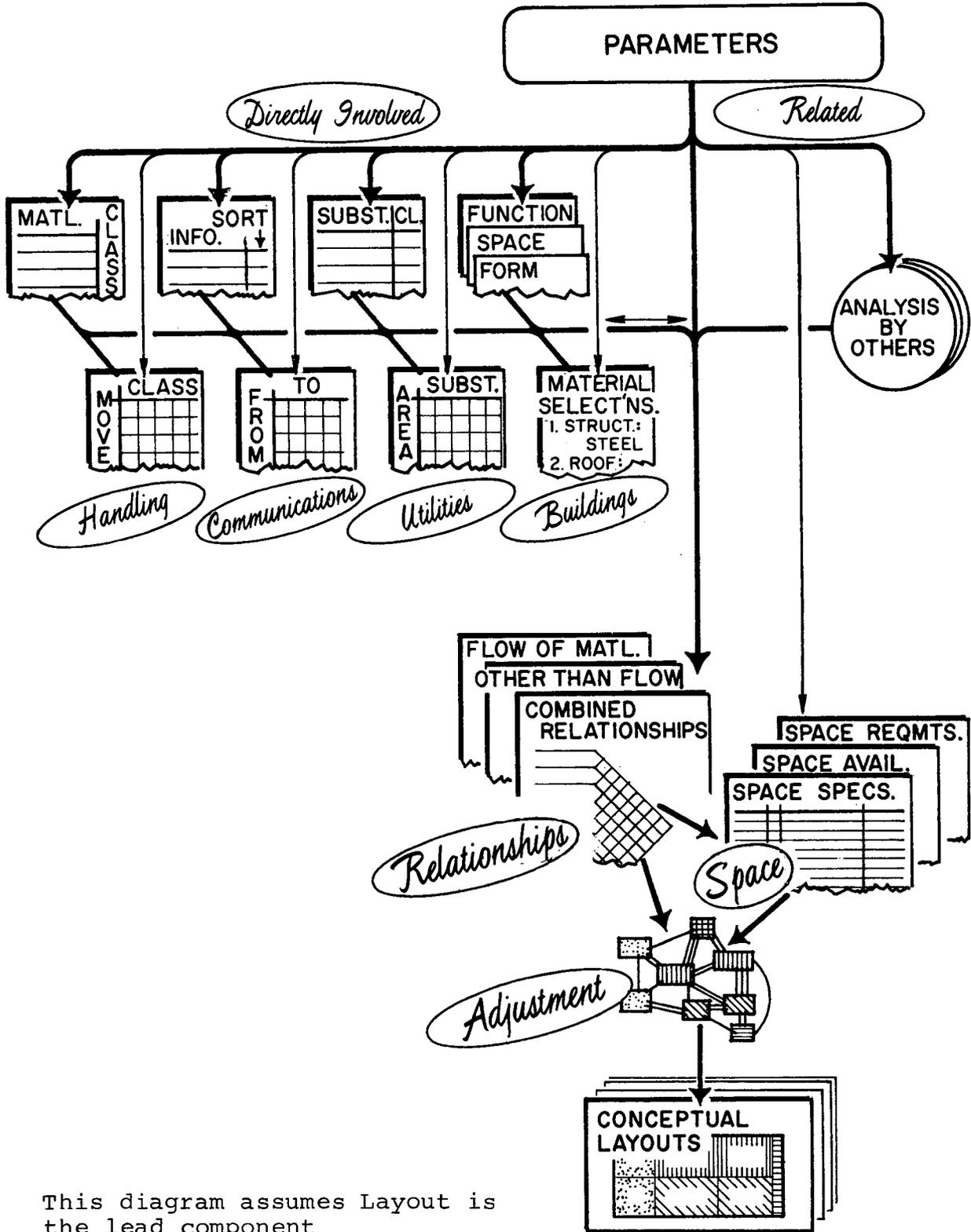


Figure 5-3. Interact and establish.

5. Establish the *Space* requirements for each activity-area, in amount, kind, and any mandatory shape or configuration.
6. *Adjust* the activity-areas into one or a few conceptual or ideal layouts, incorporating all the interactions as appropriate.
7. Visualize these conceptual layouts for ease of understanding.

Note that the conceptual layouts may very well be built around two or even three different concepts. This is good; plans should not pursue only one idea. And, the other components should not be precluded so early from having the opportunity to bring-out what is best from their viewpoints.

INTEGRATE & DEVELOP (STEP 3)

The third step involves integrating the conceptual or ideal facility of the lead component into plans for each component, and developing these into preliminary facilities plans. See [Figure 5-4](#).

The planner sends his conceptual or ideal plan or plans to those who are planning the other four components and to the other related parties. It is important to have a conceptual plan down on paper early. It lets the planner visualize what he is thinking and lets others react or respond to it. It helps sort-out policy questions in the minds of management and basic notions in the beliefs of operating supervisors.

Moreover, a layout (or if the building component is lead, the conceptual building plan) becomes input to the other components. So, lack of a clear conceptual lead-component plan can delay the planning of other components.

What actually happens is that in order to develop a facilities plan, or indeed even a final layout, the planner must include the effects of the other components. Therefore, he submits his conceptual layout(s) or lead-component plan(s) to the other four components. With something tangible to build around, each component's third fundamental is brought into play. Thus, that component's best plan is developed. Then, these plans are sent back to the lead component for integrating into preliminary facilities plans. This integrates the *Handling methods*, *Communications means*, *Utilities conductors* and *Building design* with the *Layout adjustment*.

Note that the conceptual plan is also submitted to the scrutiny and coordination of the related parties indirectly involved with the planning. They, too, should feed into the facilities development their reactions, suggestions, variations, or reservations.

MODIFY & REFINE (STEP 4)

The fourth step involves modifying the preliminary facilities plans and refining them into specific alternative plans. See [Figure 5-5](#).

Here the planner adjusts the preliminary facilities plans into specific solutions. He discards those ideas or suggestions that are not practical or realistic. He grooms his plans to more

STEP 3--INTEGRATE ALL COMPONENT PLANS AND DEVELOP PRELIMINARY FACILITIES PLANS

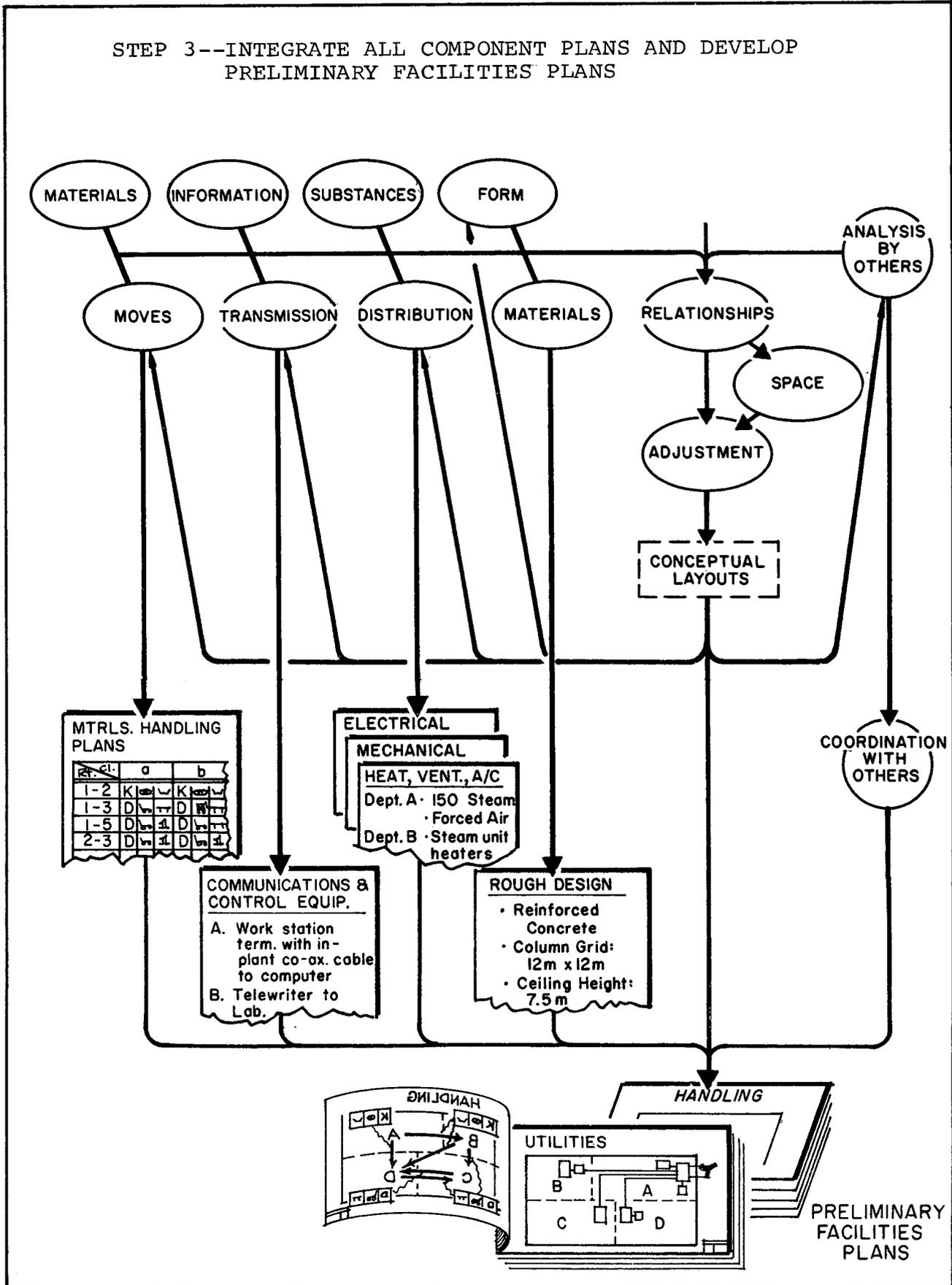


Figure 5-4. Integrate and develop.

STEP 4--MODIFY AND REFINE THE FACILITIES PLANS

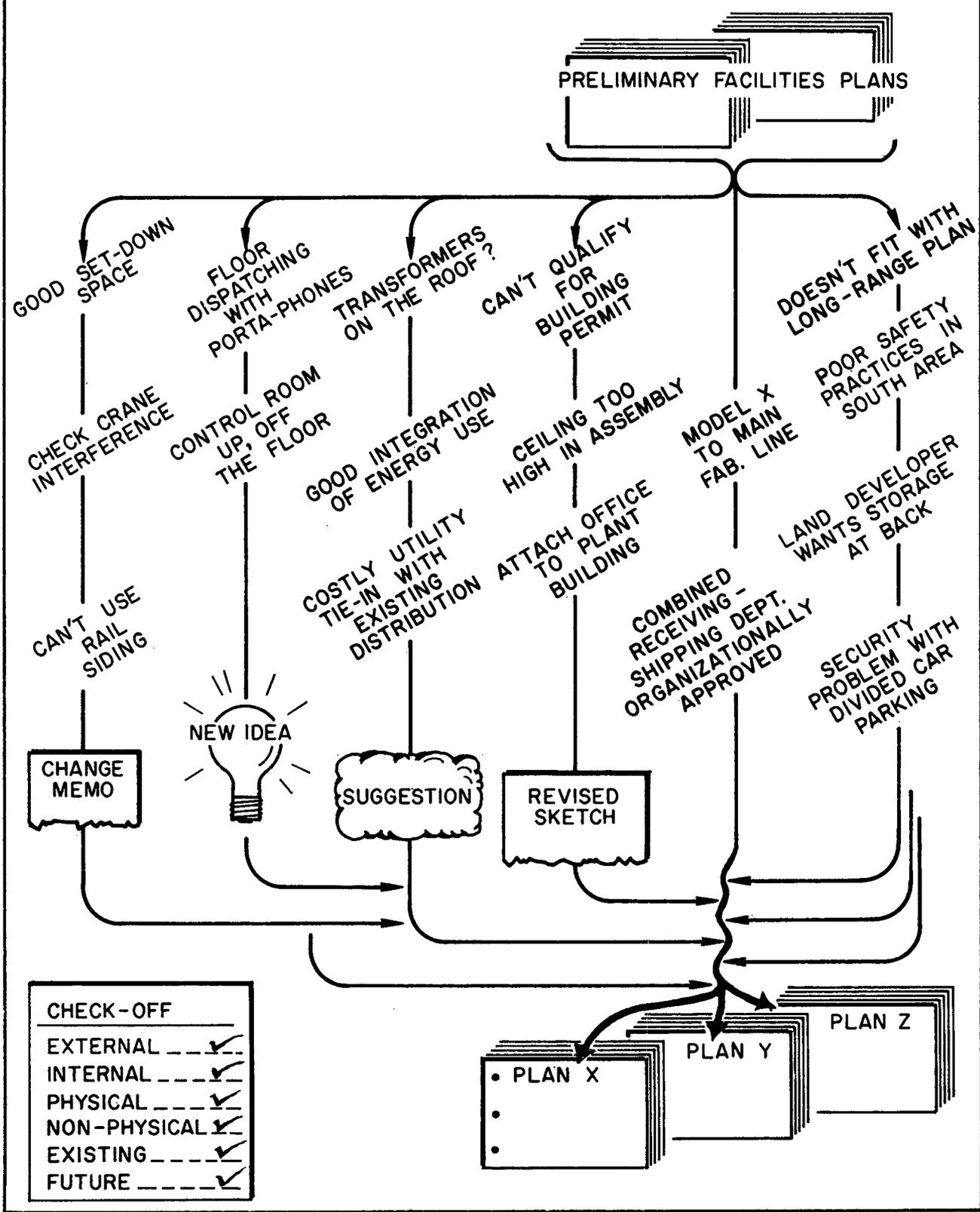


Figure 5-5. Modify and refine.

finite resolution. He makes sure that plans are made for each component's facilities and that they will function effectively when they become part of the whole facility. He makes sure he has met the constraints of the current-phase framework: environment, prior phase, existing facilities, future-facilities plans, and next phase. He submits his plans to the viewpoints of others related but indirectly involved: those representing conditions or requirements that are legal, economic, technical, social, ecological, and personal.

Now that the preliminary facilities plans are more visible, others can see things they might not have appreciated earlier. They give more time and attention to plans which they now more fully understand and with which they will be expected to live. Objective planners always try to get the operating people to scrutinize the plans, for they are the ones that will stay to make the facility work after the planner has moved to another project assignment.

And, the financial approver is usually involved, for he can best support a request for appropriating capital funds if he understands what is involved and has had the opportunity to make suggestions on economic trade-offs.

Thus, this step is largely one of coordination and willingly paying attention to any possible oversights, errors, misjudgements, or misunderstandings. Suggested modifications and refinements are coordinated into a series of improvements. And the total number of proposed variations is boiled down to usually two to five final alternative facilities plans. For lack of a better name, SPIF calls these alternatives Plan X, Plan Y, and Plan Z.

EVALUATE & APPROVE (STEP 5)

The fifth step involves evaluating the alternative facilities plans and approving a selected facilities plan. See [Figure 5-6](#).

As noted in Corollary #9—A way to evaluate alternative plans—facilities decisions typically involve three types of evaluations:

- Economic
cost comparisons and financial justifications
- Intangible
weighted rating of multiple factors or simple pros-and-cons listing
- Hidden
latent, unknown, or unanticipated factors, sometimes appearing at the last minute

This evaluation and approval will be discussed in Volume II, Part Six—Decisions in planning. For now, we want to note that a clear visualization of each alternative's plans is needed from the planner. Regardless of how familiar he is with his alternatives, others cannot be expected to comprehend them readily. Having satisfied himself that any of the alternatives can work, his problem is now to select that alternative which is best for the company, both short and long range. This is almost always a joint selection by several people and, therefore, it is the responsibility of the planner to make sure they do, indeed, understand what they are evaluating and approving. This can best be done by some form of graphic or pictorial presentations, appropriately colored, and suitably supported with adequately documented analyses.

STEP 5--EVALUATE AND APPROVE THE SELECTED PLAN

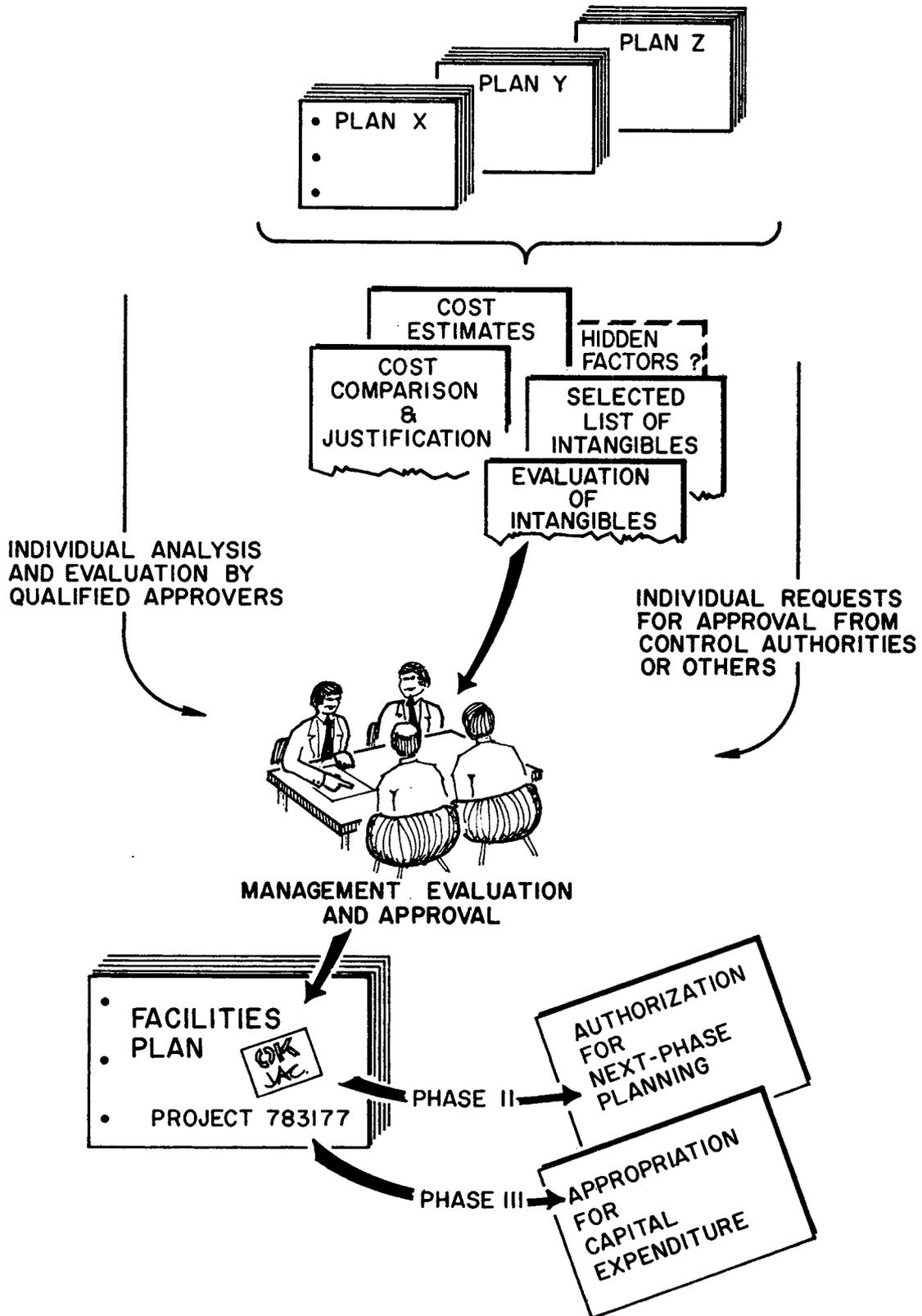


Figure 5-6. Evaluate and approve.

Inasmuch as the planner may be expected to make a recommendation, he will sometimes make his own evaluation with the involvement of others before he submits his plans for final approval.

We should add that most successful planners find it best to use both the evaluation of costs and intangibles.

LEAD COMPONENT OTHER THAN LAYOUT

When one of the components, other than layout, is of primary importance and, therefore, the lead component, it takes the central position in the planning pattern normally occupied by layout. That is, its three fundamentals are central to the planning and its conceptual plan(s) is submitted back to the other four components and the related other parties for their integration.

Example #4 in Part Four shows this: 4a. where the utilities are of major importance, and 4b. a case where the building dominates the planning. In each case, that component which is of major importance would become the lead component and would then take the central position in the planning pattern.

THE PLANNING PATTERN REPEATS

You recall that the planning pattern is applicable in the strictly planning phases: II and III. This means that we use the same pattern in both phases. That is, the pattern repeats itself in Phase III. See Figure 5-7.

You will also recall that the level of planning always changes between Phase II and Phase III. This means that the Phase III plans are more detailed, that is, smaller areas with a new set of smaller activity-areas and smaller physical features. This is readily apparent by the fact that planners usually use a different scale on their Phase III drawings from that used in the overall phase.

In Phase III, detail planning, we typically divide the facilities of Phase II into subfacilities. This can be done in two different ways: by area or by component.

Most commonly, the individual activity-areas of Phase II each become subprojects to which the planning pattern is applied. In this way, Phase II becomes the prior phase and there is a series of detail Phase III projects, one for each activity-area of Phase II. Not infrequently, two or three small activity-areas of Phase II are grouped in Phase III and considered together. On the other hand, one large activity-area in Phase II may occasionally be split in two or three Phase III subprojects.

In repeating, each subarea has its own new list of activity-areas. The inputs and influences for each of them may be different, and the lead component and other parameters for each may be different.

You will remember that the next level may have a reverse impact on the current phase. This is part of the overlapping of phases. So, for critical activity-areas of Phase II, the planner will already have dipped down into the detail planning.

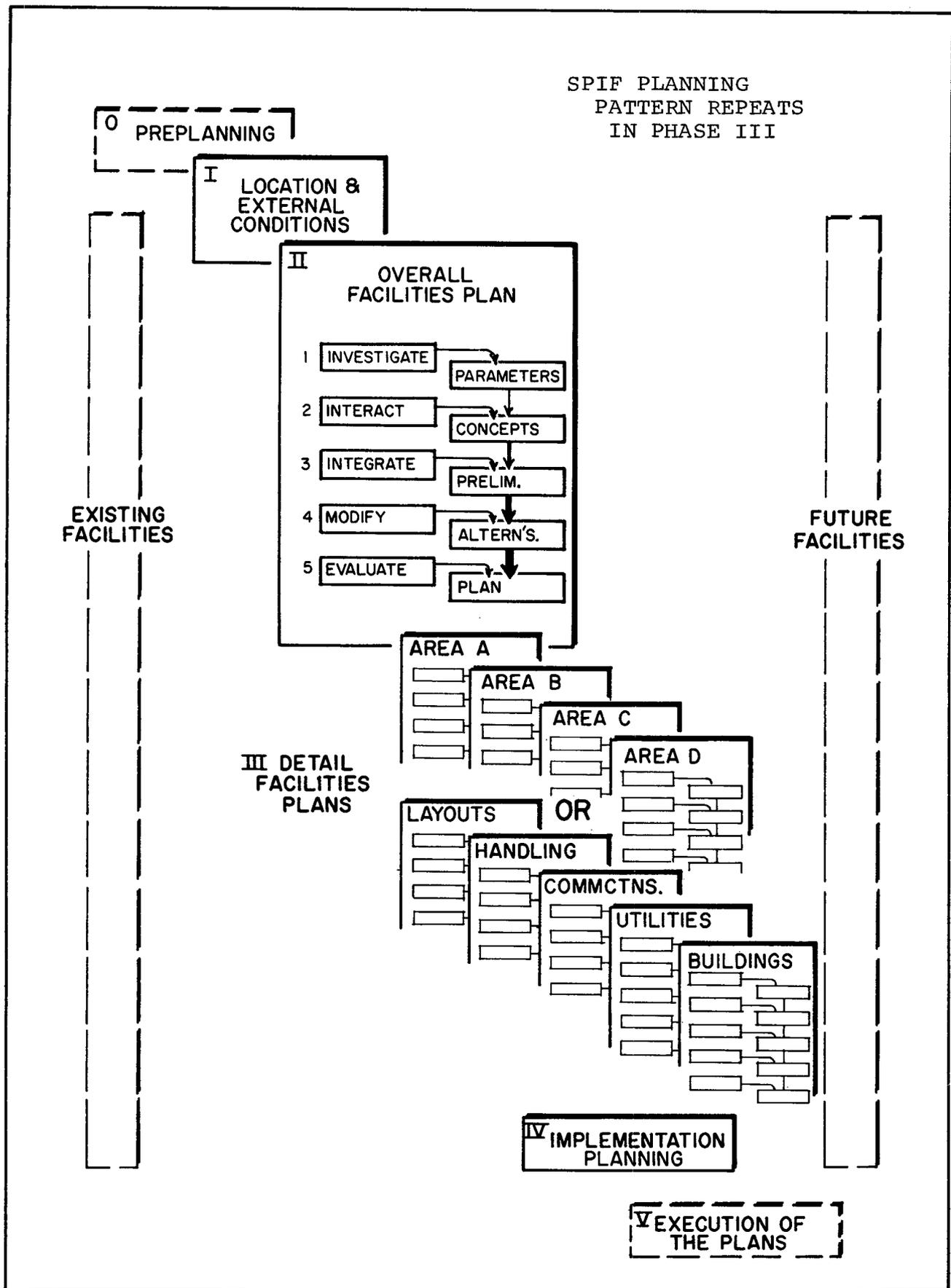


Figure 5-7. The SPIF Planning Pattern repeats itself in Phase III--Detail facilities plans.

This leads to an alternative to division by area—division by component. For example, a planner may establish his building design for Phase II—his overall preliminary drawings and outline specifications. Then, he may move right ahead with the detail design features of the office building, or the storage warehouse, long before the detail layouts of these areas are planned.

This situation happens when some component, other than layout, is of major importance and, therefore, dominates the planning—for instance, when planning a speculative warehouse where there is no clear layout, handling, communication, or utility requirements yet established. Or, where there is a heavy utility concentration in a number of activity-areas in Phase II. In such cases, it is easier to look at the utility component for a group of activity-areas, all with the utilities as the lead component, rather than divide the facilities by area.

So, it is very common for one building system (roof, walls. . .), or the distribution of one utility substance, or the telephone facilities, to be planned in detail as a whole physical system covering all or many activity-areas.

Chapter 5 has taken us through the full SPIF planning pattern. Chapter 6 will explain the set of conventions.

CHAPTER 6... CONVENTIONS AND CAPSULE SUMMARY

In Chapters 3, 4, and 5 of this Part Two, we have defined and explained SPIF, clarified the extended framework of planning phases, and described the full planning pattern. In this Chapter 6, we shall cover the SPIF conventions and summarize Part Two with a ready-reference capsule summary and other diagrammatic representations.

SET OF CONVENTIONS

SPIF includes several conventions for ease of recording, visualizing, and rating. They serve as both a set of short-hand tools to save time and a means of quick communication to others. They provide planners a consistency in their planning and managers a logic to their understanding.

Corollary #5—Conventions for type of space and orders of magnitude—identified the conceptual need for conventions. This is further illustrated in Figure 6-1.

Following this corollary, the conventions adopted by SPIF are those that have been developed over many years, that are already in use by many practical planners, or that are established standards approved by professional societies.

SPIF uses two general types of conventions:

1. Types of process, functions, space, materials, information, utilities, and
2. Relative importance, or order of magnitude, of values or rating judgements.

These are signified by symbols, colors or shadings, vowel letters, and number values.

For type of *process*, SPIF follows the process chart symbols standardized by the American Society of Mechanical Engineers (ASME). These are shown on the left-most column of Figure 6-2 and designated by a single asterisk.

SPIF includes a modified process symbol for “Handling”, as distinguished from Transportation or Operation. It involves loading, unloading, placing, sorting, stacking. . . In analyzing flow and material movement, it’s helpful to be able to distinguish those parts of the process that are pick-up and set-down (or load and unload, place and pick), especially as sometimes they are overlooked when considering strictly transports over some distance. This handling symbol was originally described in the book *Systematic Handling Analysis (SHA)*. See Chapter 8.

For ease of recall, the following reminders are suggested:

| | | |
|----------|--------------------------------|---------------|
| Circle | – “O” for operation | Does |
| Arrow | – implies movement | Moves |
| Triangle | – inverted, like a hopper | Holds |
| Delay | – capital D | Waits |
| Square | – everything squared up | Verifies |
| Handling | – half a circle, half an arrow | Loads/unloads |

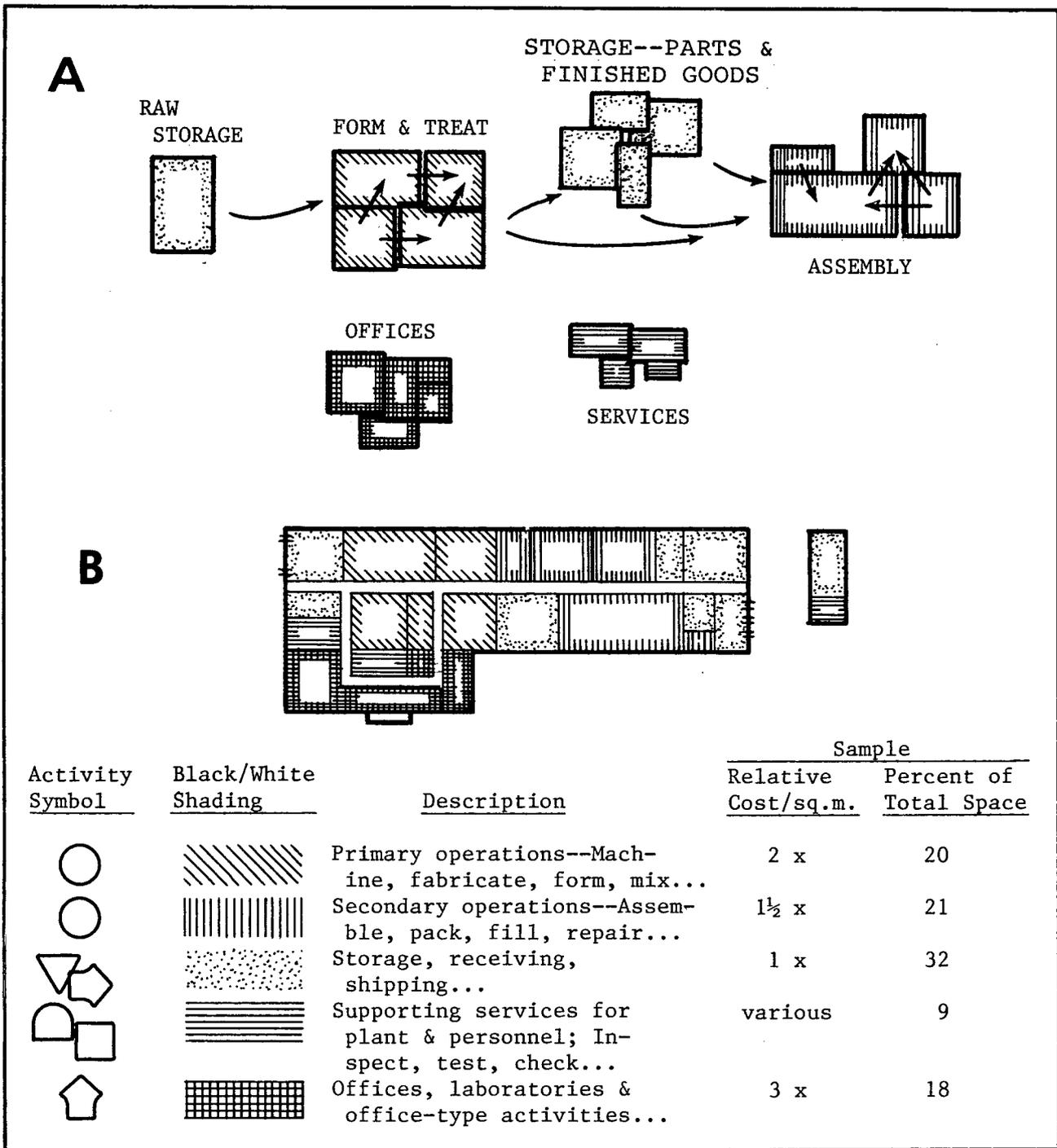


Figure 6-1. Industrial facilities are typically composed of several general types of space. (A)

Similar types of space, usually housing similar functions, tend to go together. (B) It is frequently less expensive and more flexible to combine similar types of space.

These general types can be coded--by symbol, color, or shading. Moreover, the cost of construction per square meter tends to be more-or-less the same within each type of space. And, so long as the business continues to be operated the same way, the percentage of space for each type tends to remain about the same.

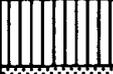
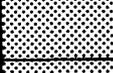
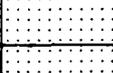
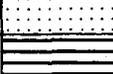
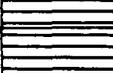
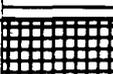
| Process Chart Symbols & Action | Underroof Functions, Activities, Areas | Color Ident. | Black White ** |
|---|--|--------------------|--|
| ○ Operation* | ○ Primary Operat'ns: Mix, Form, Treat, Process | Green** |  |
| | ○ Secondary Operations: Assemble, Fill, Pack | Red** |  |
| ◻ Transportation* | ◻ Transport-related Activities/Areas | Orange Yellow** |  |
| ○ Handling | ○ Handling Areas | Orange Yellow** |  |
| ▽ Storage* | ▽ Storage Activities/Areas | Yellow** Orange |  |
| ⊖ Delay* | ⊖ Set-down or Hold Areas | Yellow** Orange |  |
| □ Inspection* | □ Inspect, Test, Check Areas | Blue** |  |
| *A.S.M.E. Standard **I.M.M.S. Standard (Adopted as basic to SPIF procedure) | ⌒ Service & Support Activities/Areas | Blue** |  |
| | ⌒ Offices, Laboratories, & Office-type areas | Brown** (Gray) |  |

Figure 6-2. Symbols to indicate type of process and type of space housing typical industrial functions. Type of occupancy is cross-indexed by color and black-and-white shading.

SPIF extends these symbols so they represent the *areas* in which these processes take place (O for operating area. . .). However, this covers only the process-related areas, and much of one's facilities are in functions or areas that support the process operations (maintenance, tool room, toilets, lunch room, laboratory. . .) Therefore, two additional symbols are provided:

- Rolled-over D – haystack or beehive Services
- Vertical arrow – looks like a house Offices/labs

These additional symbols can be made with the same template or die-cut ruler that makes the process-chart symbols. The symbol is simply rotated 90 degrees from the axis employed for process charting.

To identify these areas by color, SPIF adopts the color-code approved (after a seven-year study) by the International Materials Management Society (IMMS):

- Green – Primary operations, fabrication, treating. . . Converting materials or process-oriented operations. (Many process machines are painted green.)

Red – Secondary operations, assembly, subassembly, packing. . . Modifying materials or assembly-oriented operations. (Red because the heat is on to get them made and shipped.)

Yellow or Orange – Handling, storage and transport-related functions or activity-areas. (Aisles and materials-handling equipment are typically colored orange-yellow.)

Blue – Service and support areas, for plant and people. (Plant utilities flowing through pipes, wires, and ducts, not unlike the flow of water which is typically blue.)

and

Inspection, test, check areas. (Cool functions done away from the heat of production, often in air-conditioned rooms.)

Brown or Gray – Offices, laboratories and office-type areas. (The earthy over-burden of business, or “mahogany”.)

Back in the ages of heraldry, a black-and-white shading code was established to indicate colors. The IMMS color-code standard endorses almost directly the black-and-white cross-meaning of the heraldic tincture code. SPIF simply adopts these already-established standards:

Green – Parallel lines sloping down to right

Red – Vertical parallel lines

Orange or Yellow – Stippled or dotted area

Blue – Horizontal parallel lines

Brown or Gray – Perpendicular lines forming a grid

Purple – Parallel lines sloping down to left

SPIF integrates the processes (or functions) and classes (or types) of space with the symbols, colors, and shadings. Thus, a code language is made available that saves time and builds consistency into analyses and visual presentations. This is not unlike what cartographers have been doing for centuries.

The above colors or shadings are usually adequate to cover underroof space. When developing site plans, it is best not to confuse the colors for underroof functions with outdoors' colors. Therefore, for site plans, all production or plant space should be assigned purple and the balance of the site be colored in more or less self-evident natural colors. Therefore, for site and land-occupancy plans, SPIF uses the color code as defined in Figure 6-3.

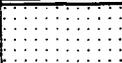
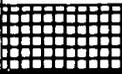
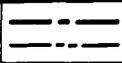
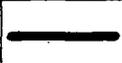
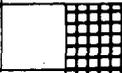
| Site/Land Occupancy, Activities and Areas | Color Ident. | Black & White |
|---|-------------------|---|
| Underroof Land Areas (or Production Space) | Purple |  |
| Green Areas, Grass, Beautification, Setback, Open Areas | Green |  |
| Water, Pond, Stream, plus Service Outbuildings or Utility Lines | Blue |  |
| Outdoor or Yard Storage | Orange Yellow |  |
| Office Buildings, Laboratories, Administration, and Personnel-Service Buildings | Brown or Gray |  |
| Property Lines and Easements | Red |  |
| Building Outlines | Black |  |
| Personnel Roads and Car Parking | Uncolored or Gray |  |
| Rail, Truck Roads, Truck Parking | Yellow or Gray |  |

Figure 6-3. Conventions for coloring and/or shading site or land space.

Colors are also used for classes of materials moved, classes of information transmitted, and types of utilities distributed, and indeed for any other visualization that will help the planner or his audience.

The second general type of convention is for relative importance or order-of-magnitude ratings. Here a vowel-letter code is employed:

A - E - I - O - U - X

A is always most or best. U is always least or worst. X always indicates negative or not acceptable. See Figure 6-4.

Regardless of the specific values in any project, there is always a most and least and a spread of values in between. By using vowel-letters, the planner can quickly put measurements or evaluations into categories of importance. From that point on, he doesn't have to read each number and compare it with others. And, he automatically knows that vowel-ratings are rounded-off or judgment values.

The vowel-letters also have a meaning in English language, which makes them easy to recall:

| Rating & Evaluating Scale | Vowel Letter | No. Value | No. of Lines | Color Code |
|--|--------------|----------------|--|-----------------|
| Most Best ↓ ↓ To To ↓ ↓ Least Worst ↓ ↓ ----- Negatives | A | 4 |  | Red** |
| | E | 3 |  | Orange Yellow** |
| | I | 2 |  | Green** |
| | O | 1 |  | Blue** |
| | U | 0 | | Un-colored** |
| Negatives | X | -1 |  | Brown** (Gray) |
| | XX | -2,-3 -4, ? |  | Black |

Figure 6-4. Conventions for relative importance or order-of-magnitude rating and evaluating. These are cross-indexed by vowel letter, number value, number of lines and color. Double asterisk indicates approved standard of the International Material Management Society.

A – Absolutely necessary, Abnormally high, Almost perfect

E – Especially important, Especially high, Especially good

I – Important relationships, Important intensities of movement, Important results provided

O – Ordinary closeness is OK, Ordinary intensities of movement, Ordinary results achieved

U – Unimportant relationships, Unimportant or negligible intensities of movement, Unimportant benefits attained

X – Not desirable to be close, Negative requirements, Not acceptable as a candidate

Double X can also be used if a thing is absolutely or completely negative.

This order-of-magnitude scale provides a distinguishable means of taking abstracts (judgments, feelings, and other non-finite or not-readily-quantifiable appraisals) into a scale of measurement—one that has similar relative meaning on each project regardless of actual values. Typical terms such as “I like it”, “it’s not so important”, and “that’s a pretty high intensity of flow” are forced into more quantified judgments.

Since the original development of the vowel-letter’s rating scale by one of your authors back in the 1950’s, it has been accepted as common usage by experienced layout and materials handling planners in most industrialized countries.

Cross-indexed with the vowel-letter sequence are a set of numbers (4, 3, 2, 1, 0, -1), a number-of-lines count (4, 3, 2, 1), and the sequence of the spectrum (red, orange-yellow, green, blue, no color for U, and brown or gray for X). This sequence-of-color code was also approved in IMMS.

All of these approved or logically derived conventions are put together and cross-indexed in SPIF. They are similar to the conventions established for Systematic Layout Planning (SLP) and Systematic Handling Analysis (SHA). Planners already know most of them or can learn them about as fast as they can understand them. Actually, the planner has considerable choice of which conventions to use, so he can select the ones most meaningful to each particular project. For instance, a planner will seldom use both color and shading for the same purpose. His choice of which to use is influenced by how he intends to reproduce his work, what materials he has readily available, and if there is color-blindness among his key approvers.

CAPSULE SUMMARY

In summary, the SPIF process of planning identifies a sequence of planning phases. It integrates five physical components of every facility at each phase. It provides a step-by-step planning sequence for planners to follow. It includes a set of working conventions. And, it recognizes the many considerations of input data, influences, and approvals by others.

Figure 6-5 shows a one-page Capsule Summary. It recaps the essence of SPIF—its structured approach and organized methodology.

Also Example #5 in Part Four—SPIF in action—shows in pictorial form the application of the SPIF methodology to the planning of a heavy-truck manufacturing facility. This example illustrates the six SPIF planning phases, the existing and future facilities influences, the steps of the planning pattern in Phases II and III, and the integration of the five components. As in the capsule summary, Example #5 shows layout as the lead component.

PLANNING PATTERN IN HORIZONTAL MODE

As a further aid to planners who are accustomed to thinking of project sequence in a horizontal mode, Figure 6-6 diagrams the planning pattern in horizontal orientation.

CAUTION

While this Part Two has set forth a systematic method of planning, your authors recognize full well that:

For successful facilities planning, it's not so much the process—much less the need for a structured one—as the experience and capability of the planner.

This concludes Part Two. Its four chapters were devoted to an explanation of SPIF.

Figure 6-5. The Capsule Summary pulls together a condensed description of Systematic Planning of Industrial Facilities (SPIF). This is not supposed to be fully complete. Note, for instance, that only the basic four phases are shown and the interacting refinements of existing facilities and future facilities are omitted.

The five components subdivide into their three fundamentals. These fundamentals divide again into specific steps of the planning pattern. It, in turn, is supported by the five individual patterns of procedures, one for each component. At the bottom are shown the SPIF conventions. —————>

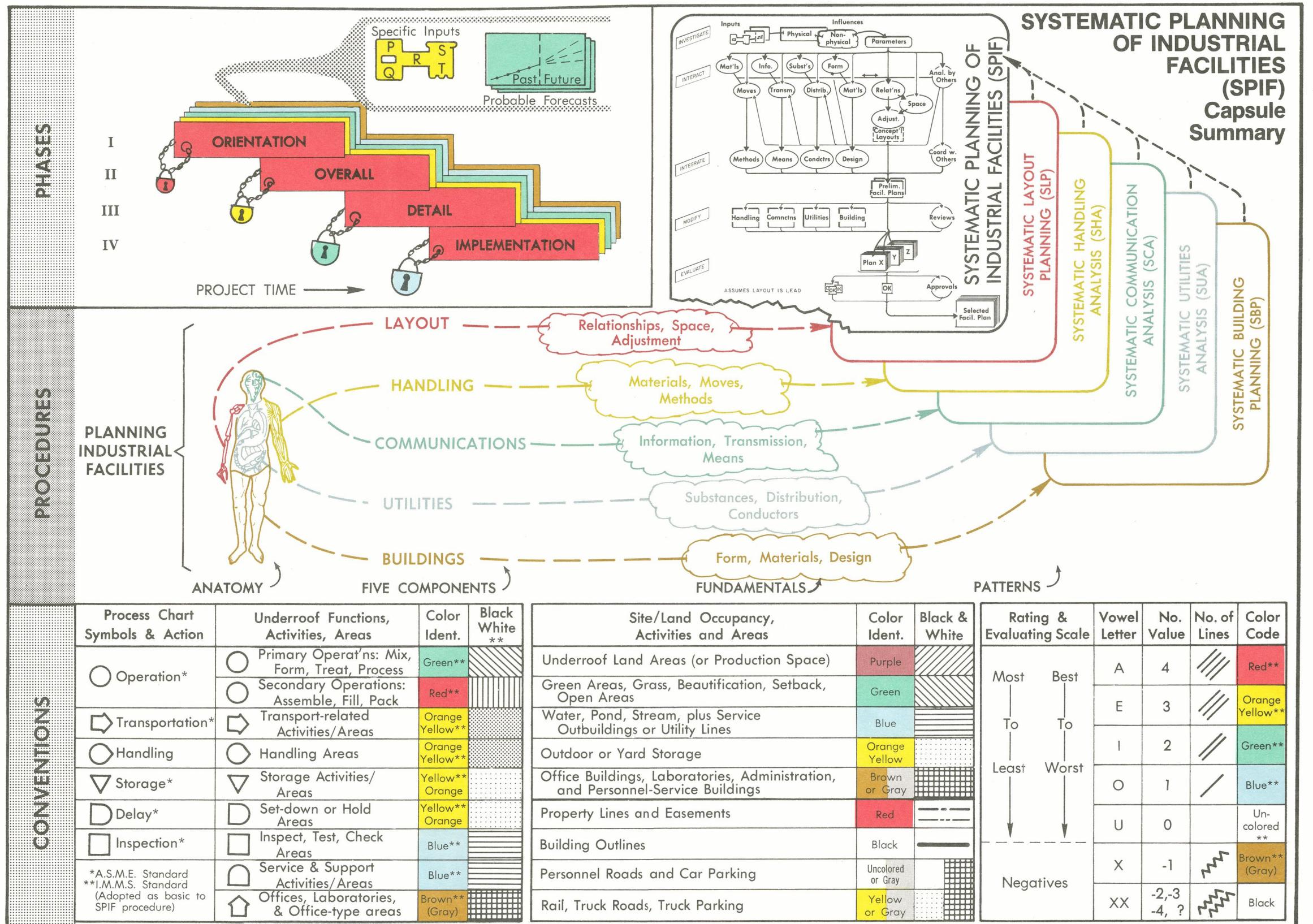


Figure 6-5. SPIF capsule summary.

CHAPTER 7 . . . CONDENSATION OF SYSTEMATIC LAYOUT PLANNING (SLP)¹

Systematic Layout Planning (SLP) is an organized, universally applicable approach to any layout-planning project.

It is equally applicable to office, laboratory, service area, warehouse, or manufacturing operations. It is also equally applicable to minor and major rearrangements, existing facilities, or new-plant site planning.

SLP consists chiefly of: a framework of phases, a pattern of procedures, and a set of conventions.

THE FOUR PHASES OF LAYOUT PLANNING

As each layout project runs its course—from initial stated objective to its installed physical reality—it passes through the four phases of layout planning.

Phase I is that of *Location*. Here must be decided where the area to be laid out will be. This is not necessarily a new-site problem. More often, it is one of determining whether the new layout (or relayout) will be in the same place it is now, in a present storage area which can be made free for the purpose, in a newly acquired building, or similar type of potentially available area.

Phase II is that of planning the general *Overall Layout*. This establishes the basic flow pattern(s) for the area being laid out. It also indicates the size, relationship, and configuration of each major activity, department or area.

Phase III is the preparation of *Detail Layout Plans*, and includes the planning where each piece of machinery, equipment, or furnishings will be placed.

Phase IV is the *Installation*. This involves both planning the installation and physically making the necessary equipment-relocation moves.

These phases come in sequence and, for best results, they should overlap each other.

Phases I and IV are frequently not part of the layout planner's responsibility—even though his project must in every case pass through these first and last phases. Therefore, we shall concentrate our attention on the strictly layout-planning phases: II, Overall Layout, and III, Detail Layout plans.

¹ A condensation of the book *Systematic Layout Planning (SLP)*. R. Muther, Boston: CBI Publishing Co., Second Edition 1973...and eight foreign-language editions. In this chapter, the planning pattern for SLP has been revised for the third edition of *Systematic Layout Planning - SLP*, although this third edition is not yet published in book form.

BASIC INPUT DATA FOR LAYOUT PLANNING

Before looking at Phases II and III more closely, we should pause to recognize the basic input data needed for layout planning. These are easy to remember when we key them to the "alphabet of the facilities planning engineer" – P Q R S T.

Practically every layout plan starts, or at least relies on, these elements as a basis for its planning.²

P – Products or materials including variations and characteristics

Q – Quantity or volume of each variety or item

R – Routing or process, i.e. the operations, their sequence, and the process machinery

S – Supporting services or activities which back up the producing operations

T – Time or timing considerations – hours worked, seasonality...

Layout planning early-on involves investigation of these elements – particularly the product mix or P-Q (volume-variety) analysis. Considering the classical types of layouts (by fixed position, by process, or by product), we establish the activity-areas (functional divisions or cost centers) to be laid out.

THE PATTERN OF PROCEDURES - PHASE II - OVERALL LAYOUT

The analytical part of planning the general overall layout begins with the input data. Then we follow box-by-box the five sections of the pattern of procedures. See Figure 7-1. Note that this pattern is derived directly from the three fundamentals of layout planning: *RELATIONS*, *SPACE* and *ADJUSTMENT*.

First comes analysis of the input data and the possible types of layout (the left-hand box of Section D). From this, the division of the total space being laid out is clarified. The output of this section of the application is a list of activity-areas (department, work groups, product breakouts, and physical features such as shipping docks and main entrance).

The second section involves tying together the two primary fundamentals: relationships and space. It establishes: (1) the closeness, that is, desired relationships based on flow of material and nonflow considerations; (2) the space to plan for based on space needed and space available; and (3) a combination of the two, usually shown in a space-relationship diagram.

Determining relationships between activity areas must deal with both flow and nonflow factors. Heavy industry is based virtually entirely on flow; offices and laboratories almost entirely on non-flow-material considerations. The typical manufacturing layout involves both.

The flow and other-than-flow investigations are combined and visualized in an activity relationship diagram. In this process, the various activity areas or departments are geographically diagramed without regard to the actual floor space each requires.

² The reader will recognize P Q R S T as the SPIF inputs, defined here specifically for layout-planning projects.

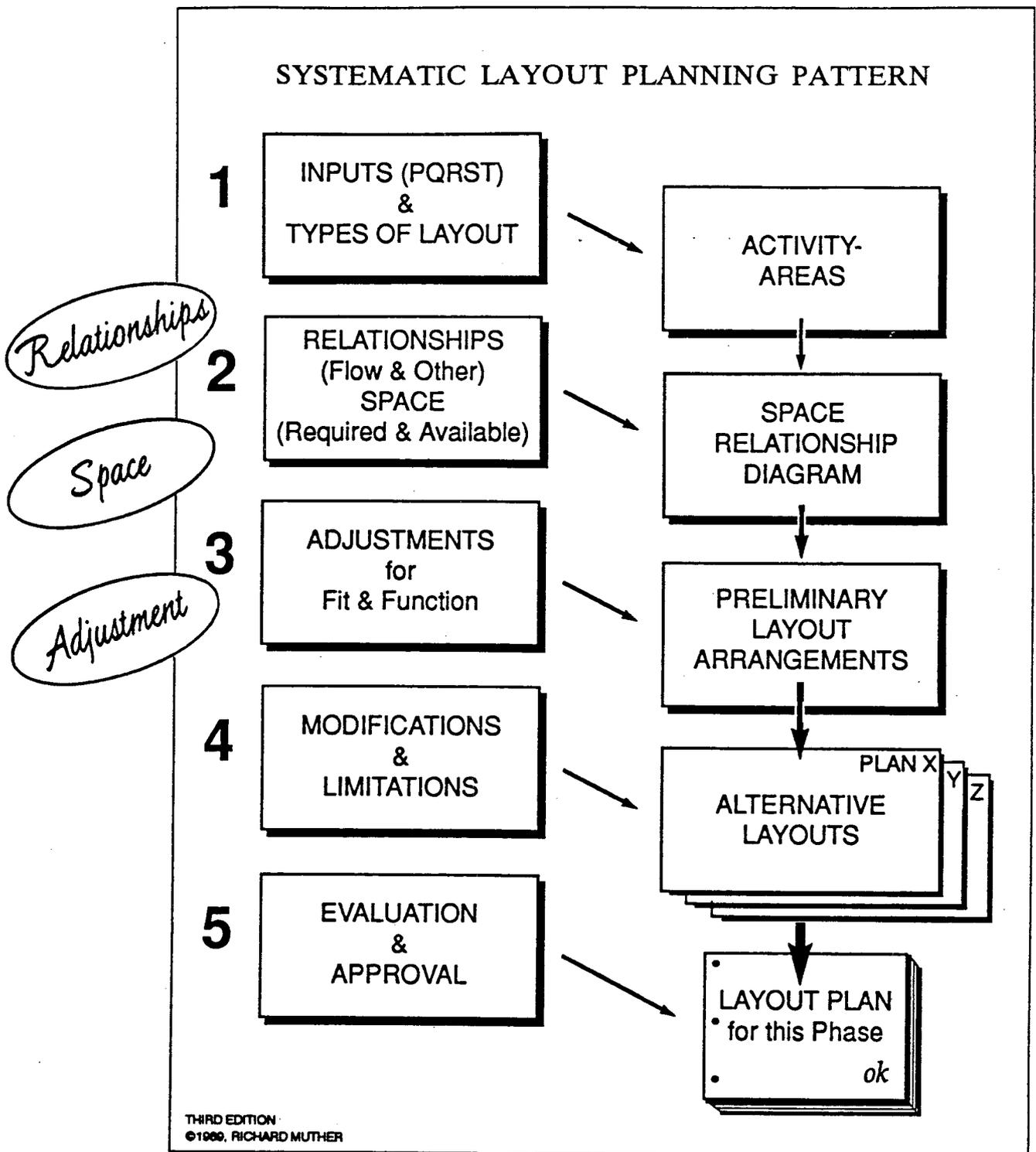


Figure 7-1. The pattern of procedures for Systematic Layout Planning (SLP).

To arrive at the space requirements, analysis must be made of process machinery and equipment necessary and of the service facilities involved. These area requirements must be balanced against the space available. Then the area allowed for each activity will be "hung on" the activity relationships diagram to form a space relationships diagram. This is the output of Section 2 of the pattern shown in Figure 7-1.

Relationships and space are essentially married at this point. The space relationship diagram almost becomes a conceptual layout. But it is not an effective layout until it is adjusted and manipulated to ensure good fit-and-function effectiveness. Practical shaping of the activity areas, deciding how to handle material, and adjusting to allow for main aisles and building features are part of this third section of the planning pattern. This leads to several preliminary layout arrangements.

In the fourth section, further modifications are considered for reasons of safety, control, convenience of operation, and so forth. As each potentially good idea is proposed, it must face the challenge of practicality. Modifying considerations and practical limitations are worked out as one idea after another is probed and examined. The ideas that have practical value are retained, and those that do not stand the test are discarded. Finally, two, three, four, or maybe five viable alternative layout proposals may remain. Each of these will work; each has value.

The problem, in the fifth section, lies in deciding which of these alternative layout plans should be selected. At this point, a cost justification should be made, together with an evaluation of intangible factors. As a result of this evaluation, a choice is made in favor of one alternative or the other, although in many cases the evaluation process itself suggests that a new, even better layout could be a combination of two or more of the alternative layouts.

THE PATTERN OF PROCEDURES – PHASE III – DETAIL LAYOUT PLANS

The next phase – Phase III – is that of making the detailed layouts. This involves the spotting of each piece of machinery and equipment, each working aisle, each storage rack, or service fixture – and doing this for each of the activity areas or departments which have been blocked-out generally in the overall plan.

Note that Phase II overlaps Phase III. This means that before actually finalizing the overall layout, certain details will have had to be looked into. For example, the actual orientations of a major conveyor may have to be analyzed before we can decide on the overall layout. This kind of overlapping investigation takes the layout planner into detail planning of certain areas before his Phase II is selected. This overlapping should not be lost sight of merely because we have discussed earlier the general overall layout planning as a distinct pattern, separate from Phase III – the detail layout plan.

Note also that a detail layout plan must be made for each of the departmental areas which are involved. This means that some adjustment may have to be made between departmental blocks as the detailed areas are being planned; that is, some readjustment of the overall layout may be called for. Indeed, it is important not to be governed by too rigid an application of the overall layout worked-out in Phase II. It can be adjusted and changed within limits – as the details within each area are worked out.

As for planning each detail layout, the same pattern of procedures used in Phase II is repeated. However, the flow-of-materials now becomes the movement between machines or work areas and the other-than-flow relations are those within the department in question. Similarly, the space requirement now becomes the space required for each specific piece of machinery, equipment or furniture and its immediate supporting areas. And, the space relationship diagram now becomes a rough arrangement of templates, rough drawing of equipment placement, or other replicas of machinery and equipment, men, and materials or containers of products.

Again, for each departmental area, we develop several alternative layouts. This leads to an evaluation to select the most satisfactory. Thus, the same procedure pattern followed in Phase II is repeated for planning the details of each departmental area, although to be sure, the data and the emphasis will be different for planning each specific layout.

SLP provides a universal pattern that still allows for logically different content of input data. And, just as the flow-of-materials analysis will become less important and the activity relationship study will become more important in office or laboratory areas, so the entire pattern of procedures has the flexibility to be modified for the needs of any layout project. It becomes a matter of adjusting the importance of each step or box rather than changing the sequence or arrangement of steps.

A SET OF CONVENTIONS

A set of conventions is used to aid in planning, understanding, and communicating. The conventions are used throughout each step of the previously described pattern of procedures for diagramming, rating, visualizing, and evaluating. The conventions are shown, in part, in the conceptual example in [Figure 7-2](#). They consist of: symbols, vowels letters, evaluation rating values, colors, plus black-and-white shading.³ These are cross-integrated for multiple use in any layout-planning project employing SLP.

CONCLUSION

Systematic Layout Planning (SLP) is based on the three fundamentals of layout planning: Relationships, Space and Adjustment. SLP puts into proper structure the many procedures and techniques which can be used in layout-planning work. It forms a useful guide in scheduling and programing plant layout work. Users commend its plain logic and straight-forward sequence. Once mastered, it can save many hours and avoid many delays and misunderstandings.

SLP was developed from actual planning projects; it has been proved by use in thousands of cases. When followed, it can bring sequence and clarity to what on each project seems a "different" problem. True, every layout project is different – for no two layouts are exactly alike. But, herein lies the very value of SLP: it provides a framework, a pattern, and a set of conventions which can be used on any layout-planning project without imposing constraints or restrictions on the handling of data or on the individual requirements of each discrete layout project.

³ The reader will recognize these as the regular SPIF conventions.

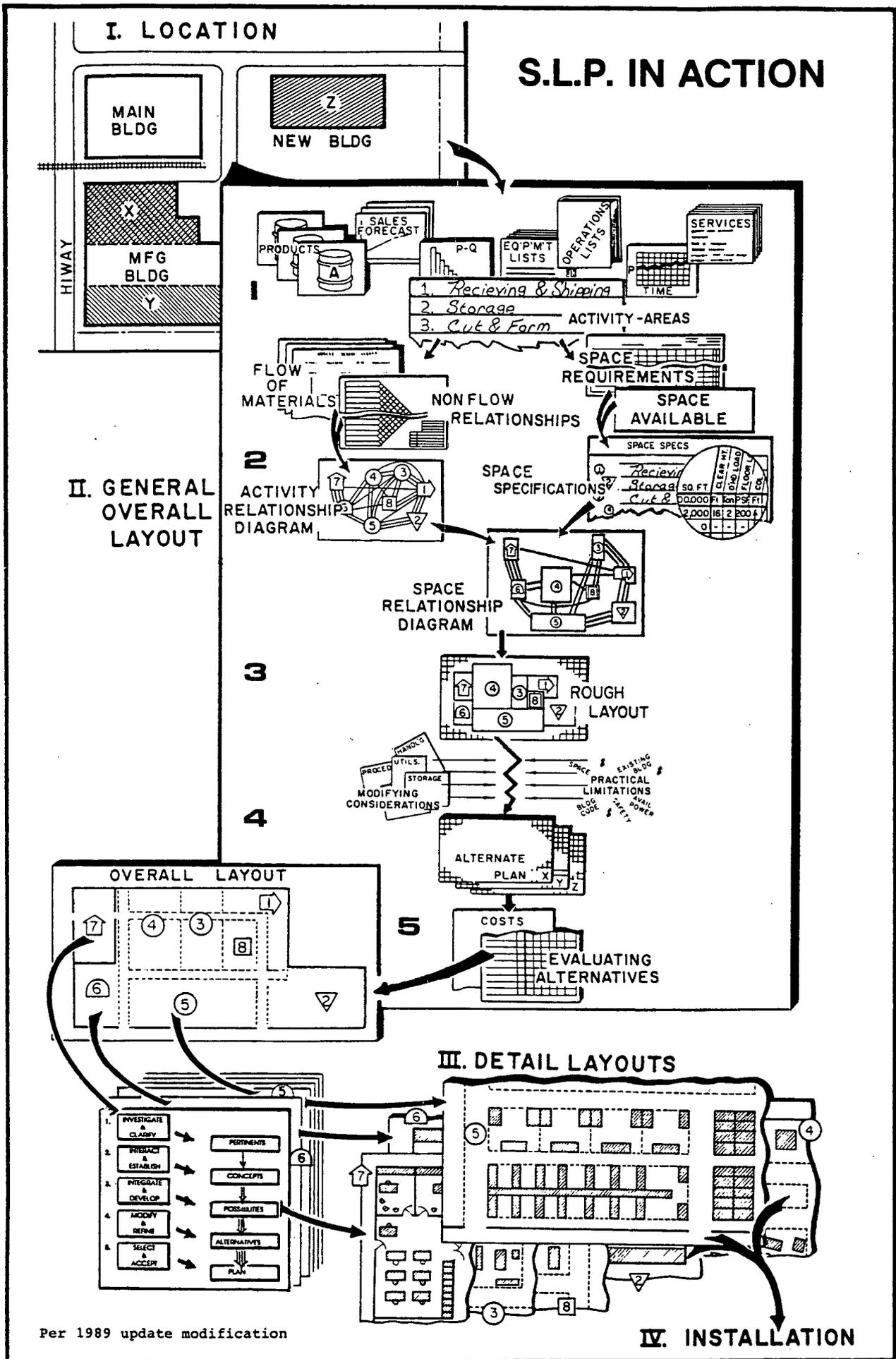


Figure 7-2.

CHAPTER 8 . . . CONDENSATION OF SYSTEMATIC HANDLING ANALYSIS (SHA)¹

Materials handling is the handling of materials. Or more fully, it is: *Materials*, products, items, or things which are being moved, transported, or physically relocated.

These *Moves* involve something and/or somebody to physically *do* the moving. This “doing” generally requires equipment, containers, and a working system involving people, procedures, and physical layout of facilities. The equipment, containers and system of moves are called the *Methods* of handling.

As a result, the basic fundamentals of materials handling—and, therefore, the basis on which any handling analysis must depend—are: *MATERIALS*, *MOVES*, and *METHODS*.

Systematic Handling Analysis (SHA) is an organized, universally applicable approach to any materials handling project. Like SLP, SHA consists of: a framework of phases, a pattern of procedures, and a set of conventions.

THE FOUR PHASES OF SHA

As each handling project runs its course—from initial stated objective to installed physical reality—it passes through four phases.

Phase I is *External Integration*. Here we appraise the movements to and from the total area, or areas being studied. We first consider the movement of material outside or external to our problem area. In this way, we correlate our specific handling problem with outside situations or external conditions, over which we may or may not have control. For example, this means identifying and possibly changing our over-the-road vehicle access or our rail facilities or barge docks so the handling on our property or within our factory or warehouse will integrate with these larger external transports.

Phase II involves the *Overall Handling Plan*. Here we establish the method(s) of moving the materials *between* the major areas. Overall decisions must be made on the basic system of moves, the general type(s) of equipment, and the transport units or containers to be used.

Phase III is the developing of *Detail Handling Plans*. It concerns the movements of materials between various points *within* each major area. In this phase, we must decide on the detailed handling methods such as the specific system of moves, equipment, and containers to be used between individual work places. While Phase II related to moves between departments or buildings on a site, Phase III always relates to moves from one specific work place or piece of equipment to another.

¹ A condensation of the book *Systematic Handling Analysis (SHA)*. R. Muther & K. Haganäs, Boston: originally distributed by CBI Publishing Co., 1969...and four foreign-language editions. Currently out of print.

Phase IV is *Installation*. Here we plan the necessary make-ready, procure the equipment, complete the training of personnel, schedule and implement the installation of the physical handling facilities. After this, we complete the try-out of our planned handling methods, release to operating people, and monitor the completed installation to be sure it is operating properly.

These four phases follow each other in sequence chronologically. For best results, they should overlap, and approval should be obtained at the completion of each phase.

Phase I and Phase IV are frequently not part of the materials handling analyst's specific problem. In a sense, they "frame" the strictly planning phases II and III. For this reason, SHA concentrates its attention on the strictly planning phases: II, the Overall Handling Plan, and III, the Detail Handling Plans.

BASIC INPUT DATA FOR HANDLING ANALYSIS

The key input elements or preliminary information needed to analyze a materials handling problem include:

P – Products or materials (parts, items, commodities)

Q – Quantities (sales-or-contract volume)

R - Routing (operating sequence and process requirements)

S – Supporting Services (such as inventory control, order processing, maintenance, lunch room, powerhouse. . .)

T – Time or timing (operating times, seasonal or monthly peaks. . .)

These letters form an alphabetical sequence for ease in remembering them.²

THE SHA PATTERN OF PROCEDURES—PHASE II—OVERALL HANDLING PLAN

Materials handling is based on the fundamentals of Materials, Moves, and Methods. Materials handling analysis, therefore, involves analyzing the materials to be moved, analyzing the moves that must be made, and establishing practical economic methods to accomplish the movement of the materials. The SHA Pattern of Procedures rests squarely on these three fundamentals. This is indicated graphically in Figure 8-1.

The pattern of Systematic Handling Analysis is a step-by-step series of procedures to follow. The more complicated the problem, the more useful and timesaving this pattern becomes.

The analytical part of making a handling plan begins with the study of the materials

²The reader will recognize P Q R S T as the SPIF inputs defined here specifically for material handling projects.

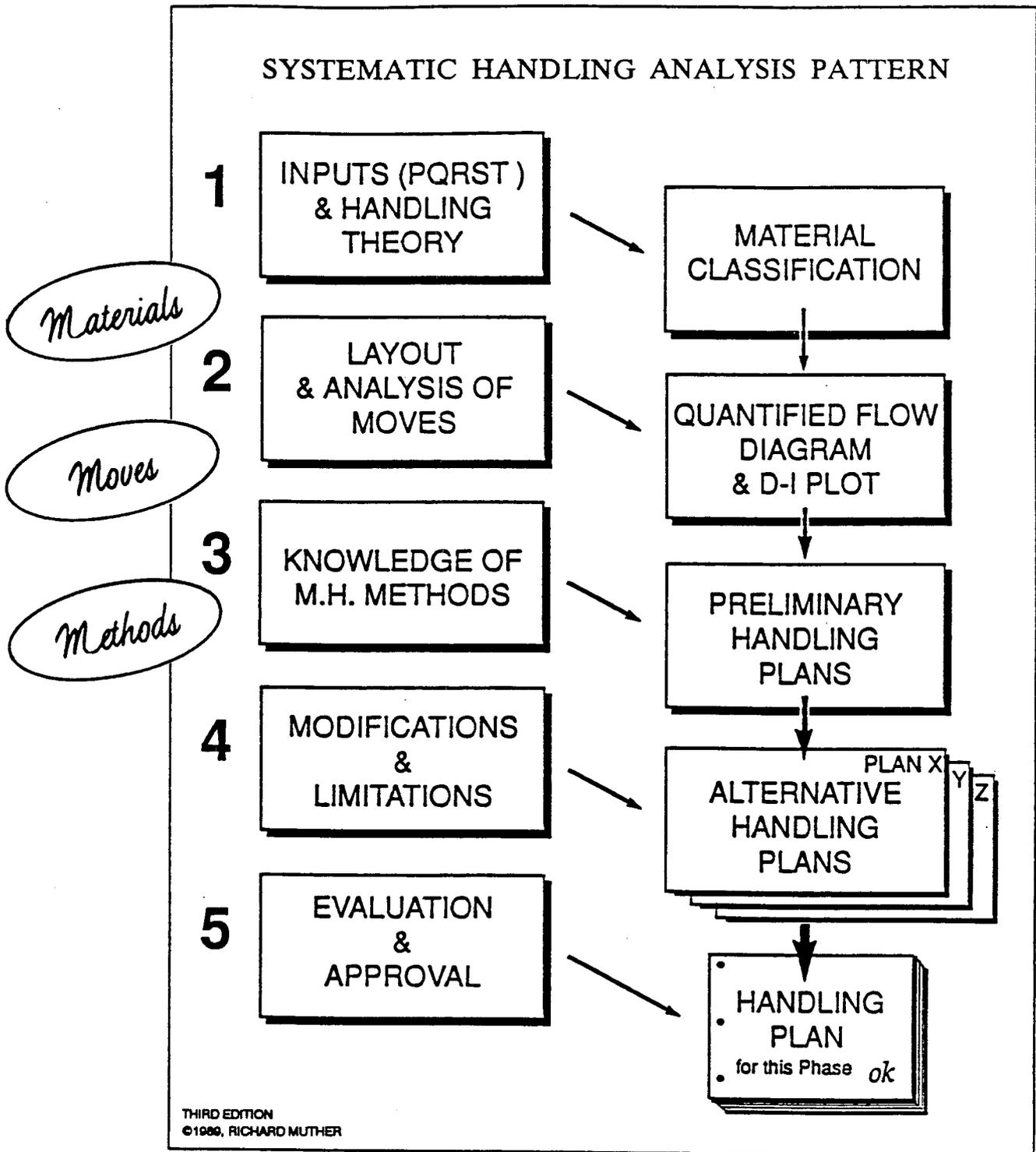


Figure 8-1. The pattern of procedures for Systematic Handling Analysis (SHA).

(products or items). This involves a *Material Classification* (Section 1 of the Pattern). Classes of materials are based on common or similar physical characteristics and on their quantities, timing, or special control requirements.

Before we can fully analyze or visualize the moves, we need a *Layout* (Section 2) within which our handling methods must work. As a result, the layout plan – real or on paper, existing or projected – provides the context for our analysis and visualization of moves.

Next comes the *Analysis of Moves*. The type or method of analysis depends on whether we have one material only or whether we have a multi-material situation. But basically, the analysis of moves involves determining the intensity and character of moves required to be made for each material on each route (origin to destination).

The next step is to translate our analysis into a visual “picture”. This is commonly done by a quantified flow diagram or a distance-intensity plot.

Before we can develop a solution, we need some *Knowledge of Materials Handling Methods* (Section 3). We apply this knowledge to our analysis of moves and set *Preliminary Handling Plans*. This is, we make a systematic engineering tie-in of the system of moves, the handling equipment and the transport unit (or container). It is here that we tie-together all the information gathered and translate it into physical methods. Actually, we develop a number of logical preliminary possibilities.

In Section 4 we adjust our preliminary plans by considering all relevant *Modifications and Limitations*. Here we modify and adjust each plan, converting what is possible to what is practical.

The purpose of adjusting or modifying the preliminary plans is to eliminate all ideas which are not workable. But, before we can make any real selection of the best methods, we need to calculate the number of pieces of equipment or transport units, the costs involved, and the operating times involved.

We are now ready for the last steps in the pattern (Section 5). Here we make an *Evaluation* of alternative plans. This is usually an evaluation of costs and intangibles. As a result of this evaluation, an *approval* is made of one of the alternatives – although in frequent cases a combination of two or more plans may result from the evaluation process itself.

By this evaluation, one of the alternative plans is now chosen. This becomes our *Handling Plan* for Phase II.

SHA PATTERN APPLIES TO BOTH PHASES II AND III

The SHA Pattern applied to both Phase II – Overall Handling Plan – and to Phase III – Detail Handling Plans. This is to say, the same pattern of steps prevails, although the degree of applications will be more detailed and finite in Phase III.

The handling methods for the detailed areas themselves will have to integrate with the more important overall handling methods selected in Phase II. Additionally, they will have to integrate with other physical facilities: layout, communications equipment, utilities, and the building(s).

SHA CONVENTIONS

In applying the techniques in each step of the SHA pattern, we use certain conventions to identify various origins and destinations, to visualize our moves, to rate alternatives, to sort into orders of magnitude, and the like. These conventions include various symbols, vowel letters, lines, numbers, colors and black-and-white shadings.³

CONCLUSION

To help understand the SHA pattern, a conceptual example is shown in Figure 8-2. This is condensed from a specific project which followed the pattern during the planning of the handling methods.

In reality, SHA is an approach to solving problems, a series of steps to follow, and a set of recording, rating, and visualizing conventions. Basically, it includes a framework of four phases of analysis, each of which overlaps with the preceding and following phases. It includes a pattern of step-by-step procedures to follow in Phase II and Phase III, the steps being enlarged from the fundamentals: Materials, Moves, Methods. This pattern ties-in with the larger phases influencing it and integrates with the planning of the layout, communications and controls, utilities and auxiliaries, and the site or building features. It draws directly on the five key input elements needed to analyze a handling problem.

You may already have recognized the similarity of approach of SHA with its companion approach to layout planning known as Systematic Layout Planning (SLP). Its similarity to the planning of other components of each facility is described in Chapters 9, 10, and 11. All five integrate into the larger approach: Systematic Planning of Industrial Facilities (SPIF).

³The reader will recognize these as the regular SPIF conventions.

I. EXTERNAL INTEGRATION

S.H.A. IN ACTION

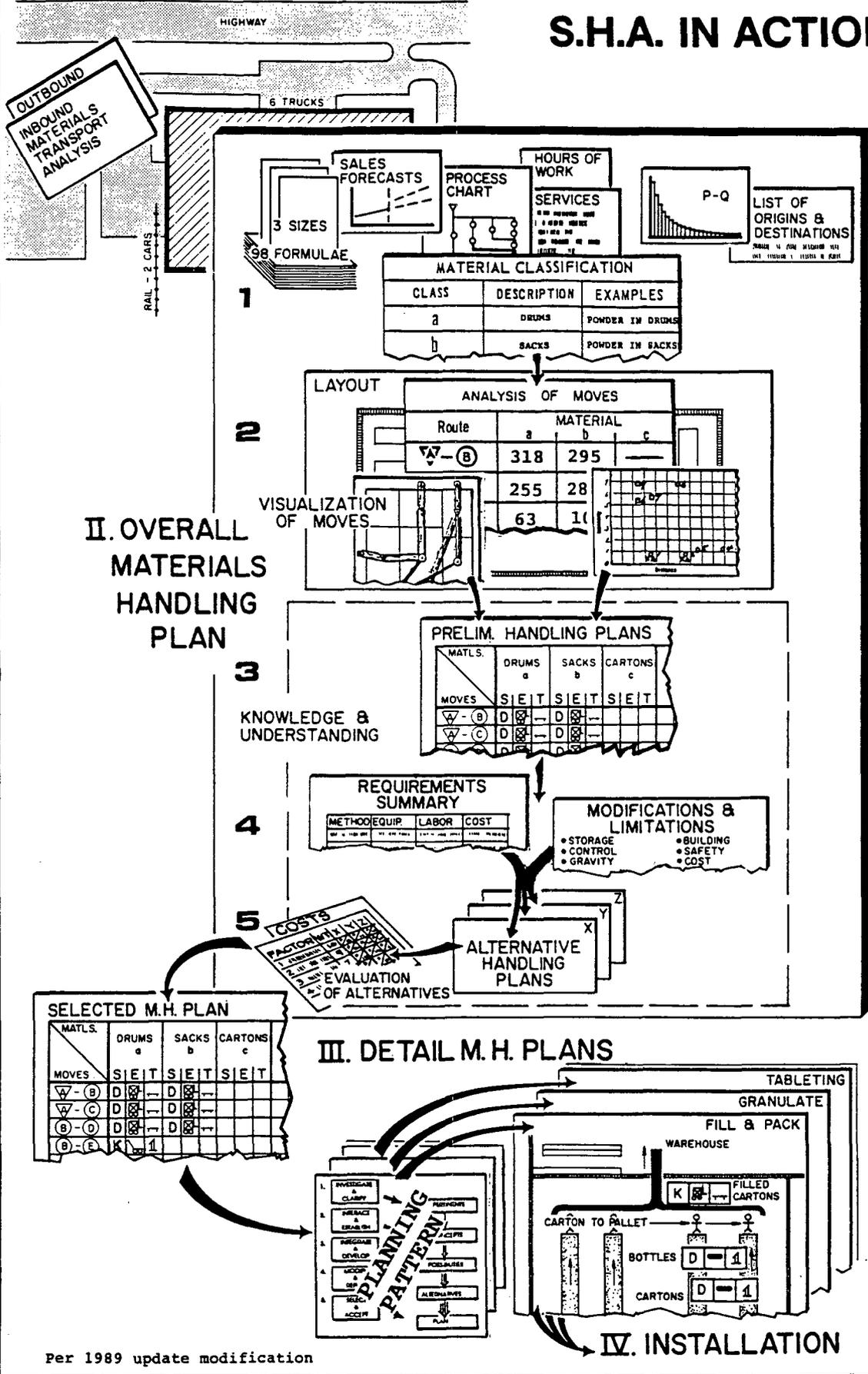
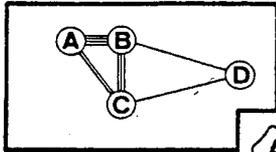
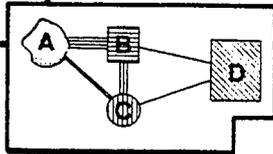


Figure 8-2.

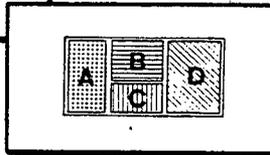
Layout or Arrangement



Relationships

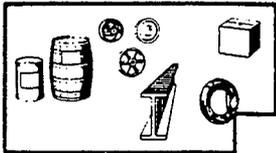


Space

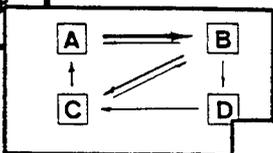


Adjustment

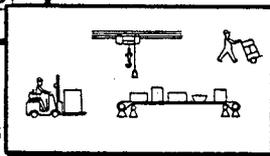
Handling and Storing



Materials



Moves

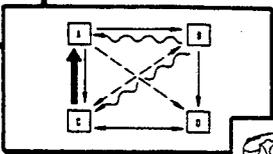


Methods

Communications and Controls

FACTS INSTRUCTIONS
 FIGURES REQUESTS
 IDEAS SUGGESTIONS

Information

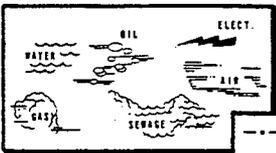


Transmission

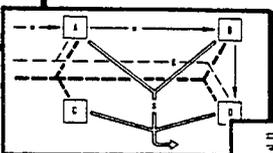


Means

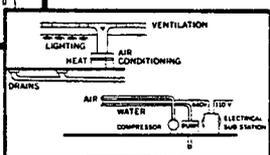
Utilities and Auxiliaries



Substances

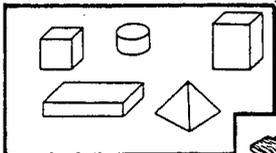


Distribution

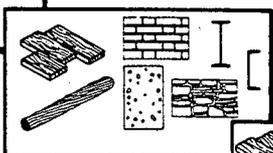


Conductors

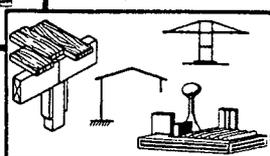
Buildings and Structures



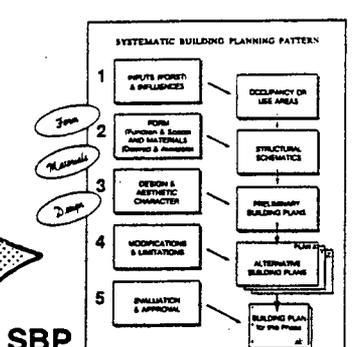
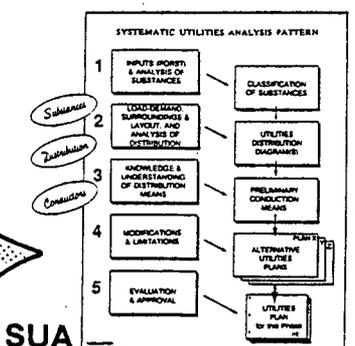
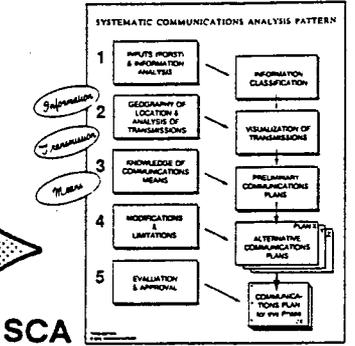
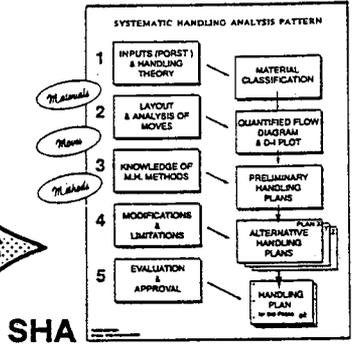
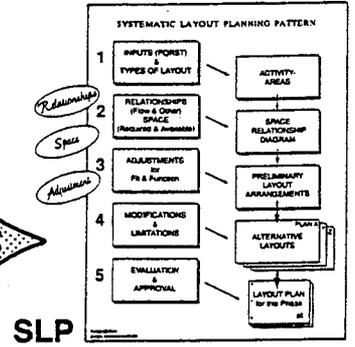
Form



Materials



Design



DEVELOPMENT OF SPIF PLANNING PATTERN

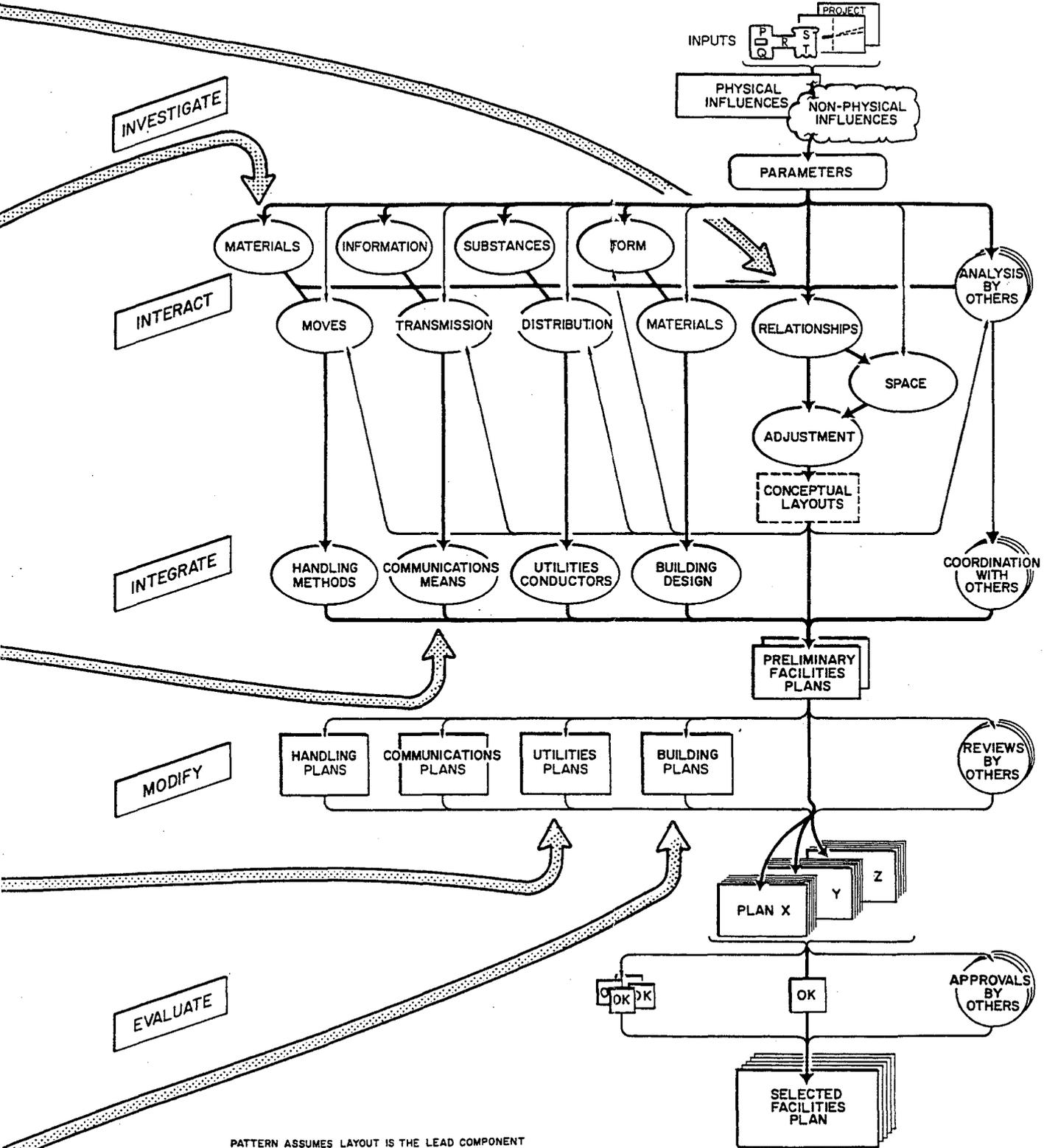


Figure Introduction to Part Three. The SPIF planning pattern is based on the three fundamentals of each of five facilities components and integrates the patterns of planning procedures for all five components.

INTRODUCTION TO PART THREE . . . THE COMPONENTS OF PLANNING

Part Two set forth a description of SPIF. Part Three serves as support to that description—especially for the full planning pattern.

This Part Three briefly explains the five supporting disciplines—one for each of the five physical components in the anatomy of an industrial plant. Reference Corollary #1—Five components of an industrial plant.

Each chapter in this part explains how to analyze that component individually, as though it were essentially standing alone or were serving as the primary planning discipline dominating the others.

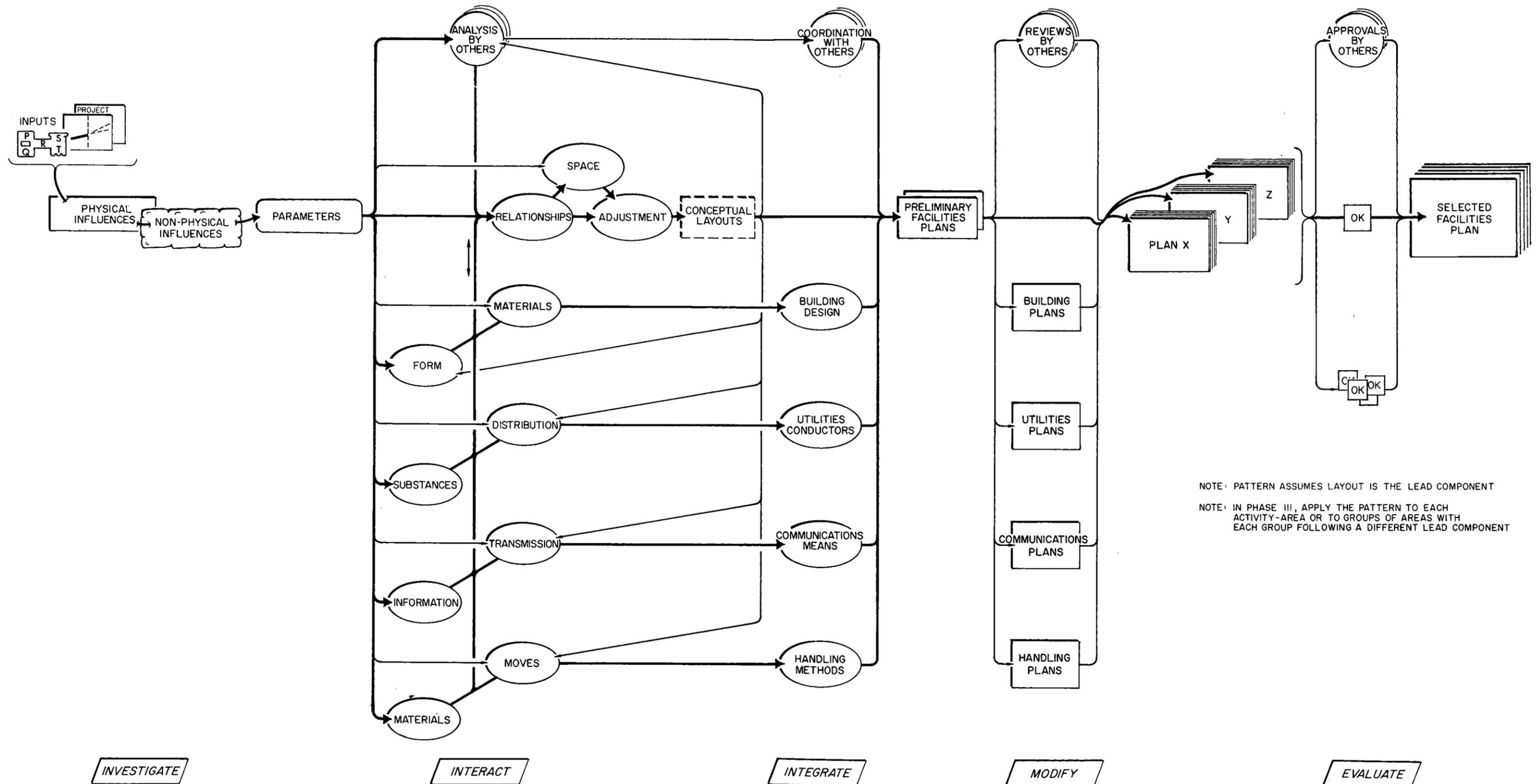
Specifically, these disciplines are:

- 1. Systematic Layout Planning (SLP) . . . Chapter 7.*
- 2. Systematic Handling Analysis (SHA) . . . Chapter 8.*
- 3. Systematic Communications Analysis (SCA) . . . Chapter 9.*
- 4. Systematic Utilities Analysis (SUA) . . . Chapter 10.*
- 5. Systematic Building Planning (SBP) . . . Chapter 11.*

The reader will note the similarity of these disciplines—in their phases, patterns of procedures, and conventions. Each pattern of procedure derives from the basic fundamentals of that component. Reference Corollary #2—Three fundamentals of each component. This development is clearly shown in Figure Introduction to Part Three.

Although SPIF puts all five together, it is easier to understand each component's discipline when presented individually. Additionally, for those projects that call for a major or extraordinary emphasis on one of the components, the planner will directly draw upon the discipline of that individual component—as sole guide to his project or as “lead component” to which he blends the others.

SPIF PLANNING PATTERN IN HORIZONTAL MODE



RICHARD MUTHER & ASSOCIATES

Figure 6-6. The SPIF Planning Pattern in a horizontal orientation as an aid to planners accustomed to a horizontal progression in project planning.

CHAPTER 9...SUMMARY OF SYSTEMATIC COMMUNICATIONS ANALYSIS (SCA)

Planners and management are faced with an often bewildering number of choices of communications and control equipment – particularly when planning a new facility. Systematic Communications Analysis (SCA) is an organized approach to making choices and determining the physical means of communicating throughout an industrial facility or complex. Like its companion approaches SLP and SHA, SCA also consists of: a framework of phases, a pattern of procedures, and a set of conventions.

THE FOUR PHASES OF SCA

Following SCA, the communications planner proceeds through four phases on each planning project. Phase I is *External Integration*. Here we examine the transmission of information to and from the facility being planned. Much of this is beyond the control of the planner, but its influenced on the facilities may be critical. The means of transmission to or from off-site locations will often dominate the choice of means for in-plant transmissions. Typically, we will not change the methods of external communications. Rather, we have the task of establishing what the external methods are and how they affect the in-plant transmission between and within activity-areas.

Phase II is *Overall Communications Plan*. The overall plan encompasses the transmission of information between activity areas of a single site or building. This includes inbound and outbound transmission insofar as it moves through the facility to and from its ultimate sending or receiving area. For example, the consideration of voice grade transmission between a plant and remote warehouse is part of Phase I, but the planning of such transmission from the plant switchboard to the plant shipping dock is part of Phase II. In Phase II, the planner is primarily concerned with the level of service to be provided to each activity-area, the “trunk” pathways of any physical networks required, and the primary means of transmitting the information.

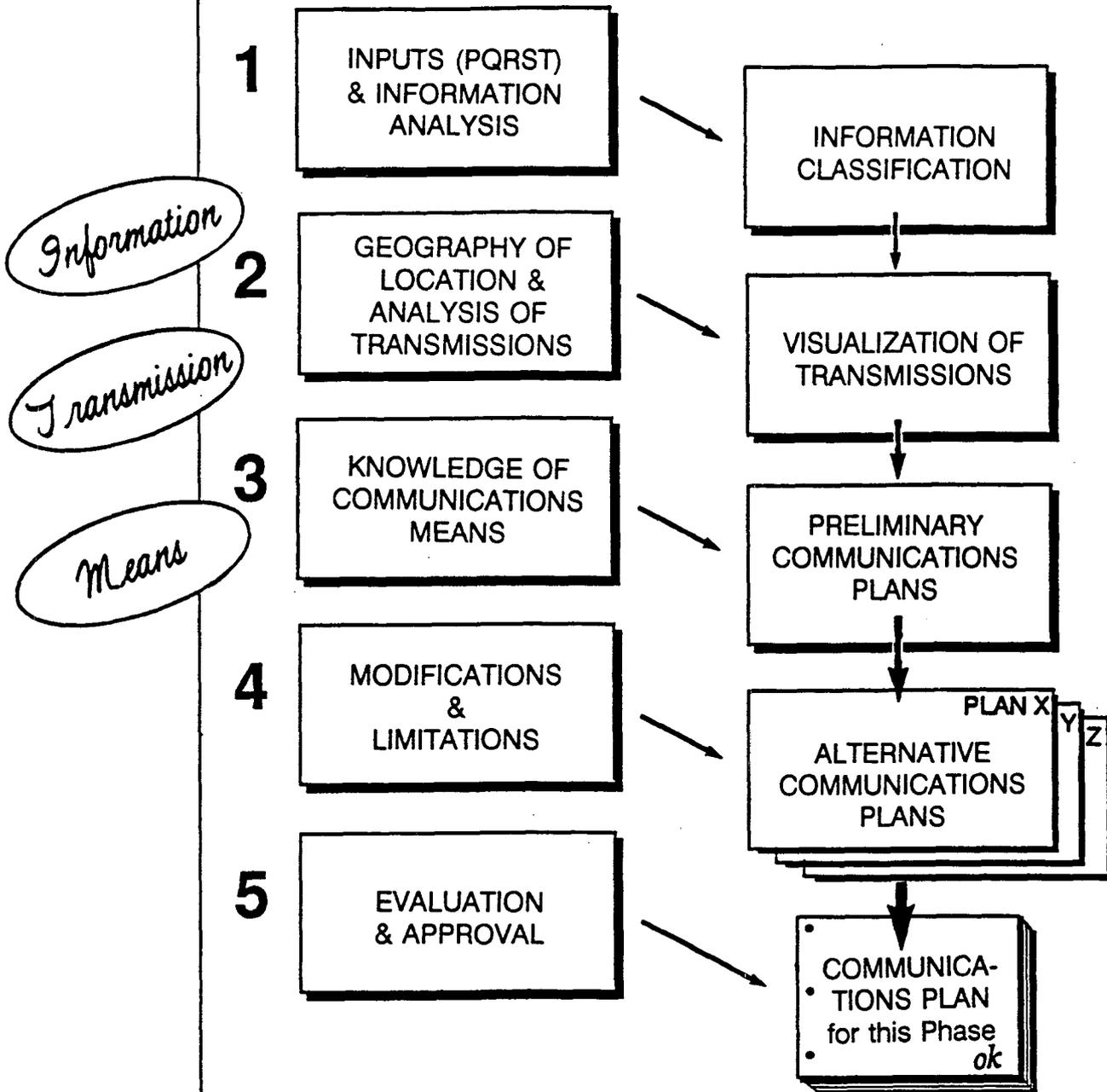
Phase III involves *Detail Communications Plans*. Here the planner is concerned with the transmission of information within each activity-area. This transmission can be final “delivery” of inbound information from outside the area. It can also be outbound information moving from origins within the area to access points for transmission beyond. And, of course, much of the transmission considered in Phase III will be between pints only within its particular activity-area.

Phase IV is *Installation*. Here the planner is concerned with procuring, scheduling the delivery and placing of equipment, and also with the orientation and training of equipment users. This can be a lengthy phase, especially if it involves development and start-up of real-time computer systems or conversion from one system to another.

THE SCA PATTERN OF PROCEDURES – PHASE II

Like its companion approaches, SCA begins with the analysis of the SPIF inputs P Q R S T. SCA then follows the pattern of procedures shown in Figure 9-1. The reader will recognize it as

SYSTEMATIC COMMUNICATIONS ANALYSIS PATTERN



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Figure 9-1. The pattern of procedures for Systematic Communications Analysis (SCA).

the same pattern structure as Systematic Handling Analysis (SHA). The pattern rests upon the three fundamentals of *INFORMATION*, *TRANSMISSION*, and *MEANS*. It is used, as shown, in both Phases II and III, although the specific features and the degree of application will differ in the two phases.

Information includes all the messages, figures, ideas, data, instructions, results, measurements, suggestions, reports, and the like, to be passed between activity-areas in the facility. Transmission is the sending, receiving, conducting, storing, and processing of information. Means are the physical equipment, people, and the configurations thereof that do the transmitting of information.

The type of information to be transmitted is the most important factor in the choice of transmission methods. SCA recognizes this importance in its Section 1 – *Information Classification*. Information is first classified according to its basic purposes – discoursing, advising, requesting, reporting, controlling – and also according to any required or mandatory form – words, symbols, impulses, measurements, and the like. Within broad categories of purpose and form, information is next classified on the basis of physical and other special characteristics. Among these are: language, size or length, urgency, volume or quantity per period of time, complexity, security, and accuracy. The purpose of classifying, of course, is to group information which might be transmitted by common means.

The location of sending and receiving points is the basis of analysis of transmissions. In Section 2 – *Geography of Locations* the planner identified sending and receiving points, thus defining the possible paths over which transmission can take place.

Once the geography of locations is established, the planner makes an *Analysis of Transmissions* (also Section 2). Here we are concerned with quantitative and qualitative variables that will influence the selection of transmission methods. The analysis may be conducted, in turn, for each class of information, or it may be conducted path by path. Most projects will require both approaches, with analysis by class favored when there are only a few heavily used or specialized information classes. Analysis by path is more practical if there are a large number of classes, some of which may be similar and ultimately transmitted by the same means.

The qualitative portion of the analysis concerns the volume, speed, and duration of transmission required. The qualitative portion concerns the physical situation of each path, the conditions of transmission (regulations, policies, and control practices), and the characteristics of the sender and receiver.

When complete, the analysis provides the planner with a comprehensive description of the transmission requirements for each information class over each path or route.

Visualization of Transmissions (the output of Section 2) is accomplished in several ways. Graphs and tables are the most common, but schematic diagrams drawn on scaled layouts often have more explanatory value, especially for large sites when visualizing an overall plan. Visualization is an important step in understanding and interpreting the many quantitative and qualitative pieces of information developed during the analysis of transmissions.

To develop a plan, the planner must have some *Knowledge and Understanding of Communications Means* (Section 3). Typically this involves gaps in the knowledge and understanding of each planner. Such gaps are to be expected with rapid technological changes in

the field of communications. There are a host of devices available for transmission of information within industrial facilities. The planner must be aware of their technical capabilities and their cost – both fixed and variable, terminal and line.

The planner makes *Preliminary Communications Plans* (output of Section 3) by applying his knowledge of communication means to the transmission requirements identified in his analysis and visualization. Preliminary plans are conceptual and typically represent the theoretically best methods. Preliminary plans describe the form of each transmission, how it will be routed, switched and controlled, and what types of line and terminal equipment will be used.

Preliminary communications plans state the theoretically best or ideal methods to be used. These are adjusted to what is practical in Section 4 – *Modifications and Limitations*. Here the planner incorporated such modifying considerations as: user skill, security or privacy, extent of combining several transmissions, compatibility with existing equipment, and the like. Other practical limitations to be considered include: space to install, straightness of path, contaminants and dirt, reliability, tariff, regulations, and codes. Here, too, is where the planner considers the modifying influences, in any, of the other four components – layout, handling, utilities, and building. Refinements to the preliminary plans will result in several, more practical alternatives.

Up to this point, the planner has simply identified the types of equipment to be used. There may be some rough estimates of the sizes and numbers of devices required, but now these need refinement for purposes of cost comparison.

Calculation usually begins with averages and ranges of requirements and capacities. This gets the planner to the general size of equipment, number of devices, and operating requirements. Rough figures will then usually be refined. Calculations establish both equipment and manpower requirements and also the need for any modification to existing or planned facilities. From these, the planner estimates fixed and variable, capital and operating costs for each valid alternative, to develop each into a limited number of viable alternative plans.

At this point, the planner will have several alternative communications plans – say, Plan X, Plan Y, Plan Z. He is now ready to evaluate them. This evaluation – usually of costs and intangibles – is made in Section 5 – *Evaluation & Approval*.

After comparing the costs and intangibles, the planner and his management are in a position to select the best overall communications plan.

THE PATTERN OF PROCEDURES—PHASE III – DETAIL COMMUNICATIONS PLANS

Phase III is the making of detail plans for communications and controls. This involves identifying and selecting the specific communications equipment and control facilities within each activity-area.

In Phase II of the project, the means of transmitting information to and from each activity-area will have been fairly well established. “Delivering” inbound information to its final receiving points within the activity-area will often be extensions of networks established in Phases I and II. The same is true of outbound transmission destined for other activity-areas.

In many cases, however, there will be a change of means as transmission enters or leaves an activity-area. In shop-floor data collection, for example, the information may be collected within a production area by radio transmission, but transmitted outside the area via a network. Or, information may be displayed locally on a visual display. The same information reported outside the area may be distributed via computer network or printed reports.

Phase III typically involves transmission of information between senders and receivers both of whom are within the activity-area. In all these cases, the planner follows the SCA pattern of procedures, picking up the adjustments and modifications for line of sight, audible range, scanning range, cleanliness of the control room ... as he proceeds through the pattern.

Out of Phase III planning come detail plans, extensions, or subnetworks within each activity-area that integrate with the plant-wide or overall communications plan established in Phase II. The plans would state the collection, display, and line transmission equipment to be used, and any special methods of switching, routing, or control.

SCA CONVENTIONS

SCA makes use, wherever meaningful, of the regular SPIF planning conventions. In addition, of course, SCA requires use of accepted electrical and systems engineering symbols and notations.

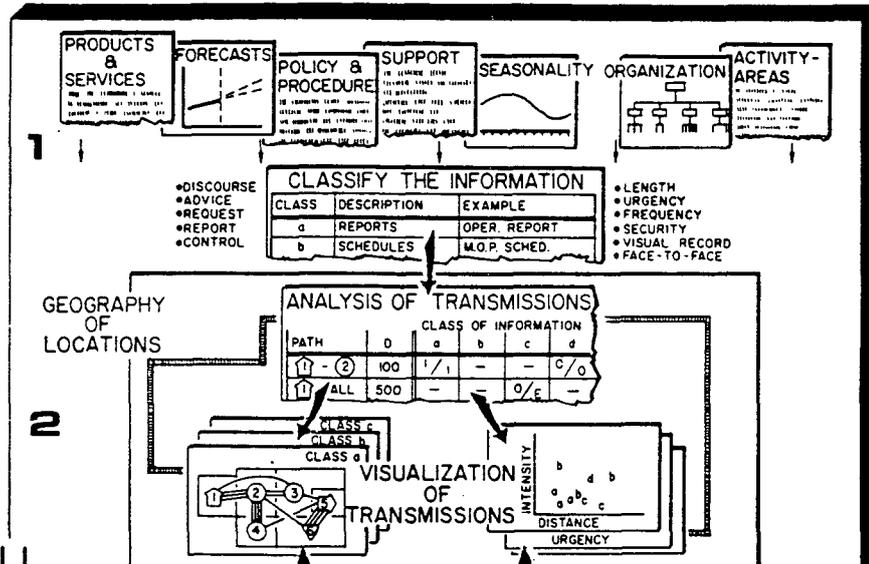
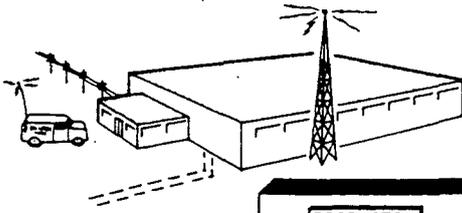
CONCLUSION

To help understand the SCA pattern, a conceptual example is shown in [Figure 9-2](#).

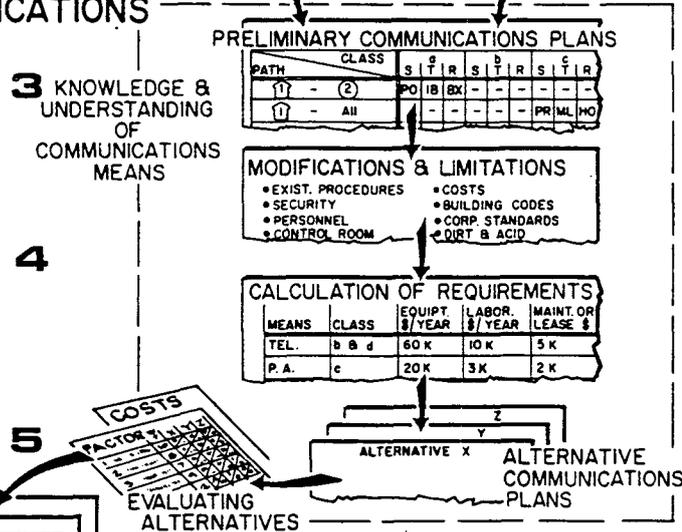
Like its companion techniques, SCA is a way of approaching problems. It includes a framework of four overlapping phases; a pattern of procedures to follow in Phases II and III, with the procedures resting upon three fundamentals of information, transmission, and means; and a set of meaningful conventions used to aid in analysis, visualization, and evaluating.

I EXTERNAL INTEGRATION

S.C.A. IN ACTION



II OVERALL COMMUNICATIONS PLAN

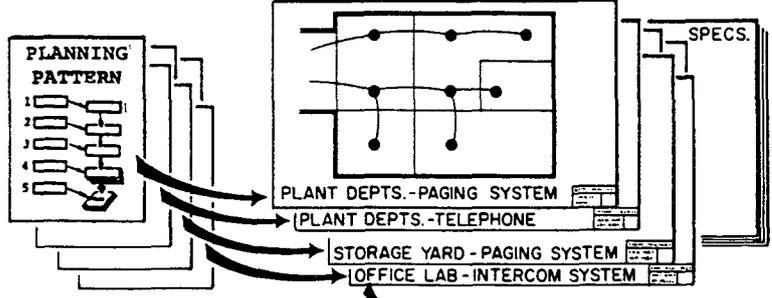


PAGING & INTERCOM, INTRA-PLANT MAIL, MANAGEMENT REPORTING

| PATH | CL | MEANS | |
|-------|----|--------------|------|
| | | SEND. TRANS. | REC. |
| 5 - 1 | b | CRT | COM |
| 6 - 1 | b | CRT | COM |

SELECTED COMMUNICATIONS PLANS

III DETAIL COMMUNICATIONS PLANS



IV INSTALLATION

Per 1992 update modification

Figure 9-2.

CHAPTER 10... SUMMARY OF SYSTEMATIC UTILITIES ANALYSIS (SUA)

Utilities include such necessary services as heat, light, water, power, and gas as in-bound substances; sanitary and storm sewage, industrial wastes, exhaust fumes, and the like, on the out-bound side. Auxiliaries and stand-by facilities like L-P gas storage tanks, pump houses, fire-protection sprinklers, and refuse disposal are also included in this general term "utilities and/or auxiliaries". Telephones, personnel paging system, personnel vehicular traffic, and the like, are more a problem of communications analysis, but they may be planned in a very similar way.

Systematic Utilities Analysis (SUA)—is an organized universally applicable approach to any utilities planning project. It may be applied to the planning for new construction, or for the rearrangement of an existing facility. SUA is equally applicable to office, laboratory, service, warehouse, or production operations—though in process-oriented industries, when the utilities are often commanding, SUA is of special value.

Systematic Utilities Analysis consists of: a framework of phases, a pattern of procedures, and a set of conventions.

THE FOUR PHASES OF UTILITIES ANALYSIS

Each utilities planning project, from initially stated objective to installation of the selected equipment, passes through four phases.

Phase I is *External Access and Egress*. Here we collect the data on the planned requirements for utilities and auxiliaries in the proposed project, the sources of supply, external capacities and load variability, environmental impacts, and the points of availability or access and the places for disposal or egress of effluents.

Phase II is *Primary Utilities Distribution Plan*. Here we plan the basic distribution for each utility, from supply entrance to major areas of usage, or from areas of origin to points of dispersal or disposition on the out-bound side.

Phase III is *Secondary Utilities Distribution Plans*. This includes the planning for utility flows to or from the specific points of need within each major area.

Phase IV is *Installation*. Here the planning is done to provide the utilities equipment and the action is taken to install them: authority for expenditure is approved, equipment is procured, installation of equipment is scheduled and implemented, testing is completed, and the utility systems are released for use by operating people.

These phases come in sequence. For best results, they should overlap and be approved at the completion of each.

Phase IV is both a planning and doing phase—except when the latter may be broken out into a Phase V. This installation phase may not be the facility planner's specific responsibility;

rather, its implementation is frequently transferred to others. Also, Phase I is, to a large extent, beyond the control of the planner – the external conditions being already in existence and typically part of a larger distribution plan. For this reason, SUA concentrates on Phase II, Primary Utilities Distribution Plan, and Phase III, Secondary Utilities Distribution Plans. Phases I and IV thus form a framework of phases surrounding the strictly planning phases: II and III.

Note that because of the variety of utilities, it is very common to divide the planning workload by actual substance distributed (or accumulated). Thus, heating, ventilating, and air conditioning may be assigned to one person or group, electrical utilities to another, and water and sewage to still a third. Regardless of this breakdown of tasks by specialty knowledge or skill, from the total project standpoint, these assignments should be integrated and coordinated at each phase.

SUA PATTERN OF PROCEDURES – PHASE II – PRIMARY UTILITIES DISTRIBUTION PLAN

Like its companion approaches, SUA begins with the gathering and analysis of the key inputs, P Q R S T. Then it follows the five sections in the SUA pattern of procedures. See [Figure 10-1](#).

There are three fundamentals involved in every utilities analysis: *SUBSTANCES*, *DISTRIBUTION*, and *CONDUCTORS*. We are trying to plan conductors, carriers or means of distributing, dispersing or accumulating the various utility substances. The procedural analysis rests directly on these three fundamentals.

The various utility substances must be sorted out and put into categories or classes. This is Section 1 of the pattern of procedures: *Classification of Substances*. This classification is based upon physical characteristics such as various voltages, pressure, flow rates, temperatures, hazards, timing of needs, special requirements, and the like.

Next comes the analysis of distribution. This is Section 2 in the pattern. This analysis involves determining usage requirements and character of each distribution or accumulation route which each class of substance must follow from origin to destination through the major areas of the total facility.

In order to analyze or visualize this distribution, information about the surroundings, layout and construction, existing or projected, is required. Then the analysis is done with distances and physical conditions of the optional routes more clearly known.

The output of Section 2 is Utilities Distribution Diagram(s). This involves picturing the quantified flow of each class of substance on a floor plan, building plan or site plan, as the case may be. Usually, this is superimposed upon the facility layout plan, making the utilization or distribution requirements and optional solutions more clearly understood.

Before a plan can be fully developed, there is a need to have a *Knowledge and Understanding of Utility Distribution Means*. This is indicated by Section 3. “Means” and “conductors” are interchangeable terms. The Planner may not be familiar with all the means of distribution or their various technical aspects, and may wish to draw upon more specialized outside sources.

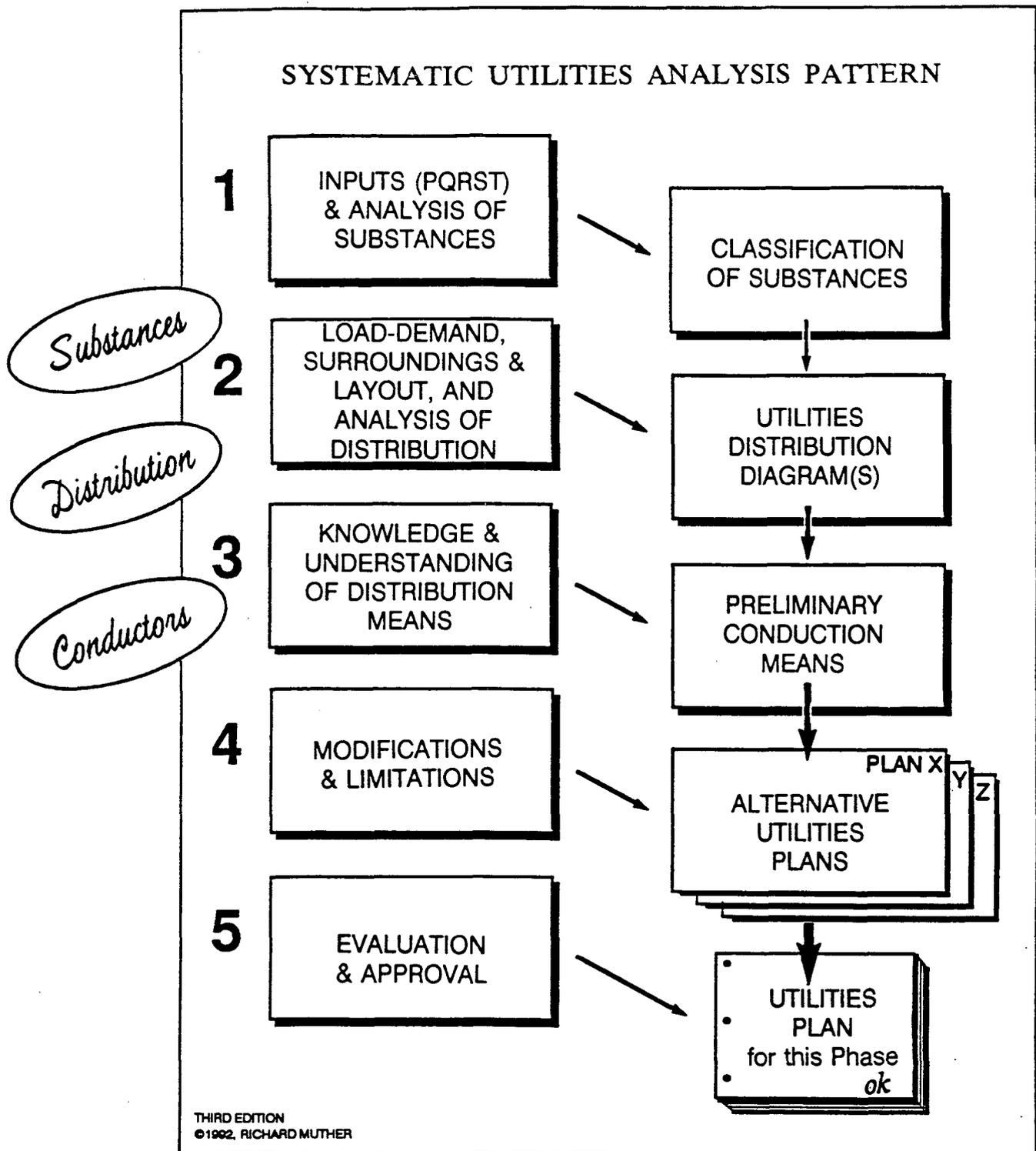


Figure 10-1. The pattern of procedures for Systematic Utilities Analysis (SUA).

The output of Section 3 is *Preliminary Conduction Means*. Here a systematic engineering tie-in is made, bringing together all substances on all the paths or routes of distribution, and selecting several logical preliminary possibilities as means of distribution.

In Section 4, the preliminary plans are adjusted by considering the *Modifications and Limitations*. This adjusts each preliminary plan, converting what is possible to what is practical. Here is where other components of facilities planning, like the layout or arrangement, handling and storing, communications and controls, and building or structure will be integrated. Impractical plans are eliminated at this stage. Typically, some kinds of calculations are involved here for types and amounts of equipment, the purchase costs, installation costs, and the operating and maintenance costs for each alternate plan. The output is two or more viable *Alternative Utilities Plans*.

Section 5 is *Evaluation and Approval*. Here we select the optimum or most appropriate utility distribution plan. The evaluation is usually based on costs and intangibles, and may result in a combination of features from two or more plans. The output is an approved utilities plan.

THE PATTERN OF PROCEDURES—PHASE III – SECONDARY UTILITIES DISTRIBUTION PLANS

The SUA pattern of procedures applied to the secondary distribution planning as well as that for the primary. Phase III – Secondary Utilities Distribution Plans – requires the development of more detailed plans for each utility within each department or using-or-generating area. That is, we follow the same thinking process for distribution *within* each activity-area as we did to determine the conductors of utilities *between* activity-areas. The degree of application may be slightly different in Phase III. But, the pattern of procedures is very much the same. Each of the utility plans must integrate with the plans for the other utility substances as well as with the primary distribution plans for their own substance, and with the other four components: layout, handling, communications, and building construction.

In planning secondary or detail utilities distribution, there is a common option: divide the planning by area or divide it by utility substance. Inasmuch as different utilities call for different knowledge and training, it is quite logical to divide the project into electrical planning, mechanical engineering, sanitary planning...In these cases, all areas or a grouping of several of them would be planned for each utility and then coordinated with other utilities plans.

SUA CONVENTIONS

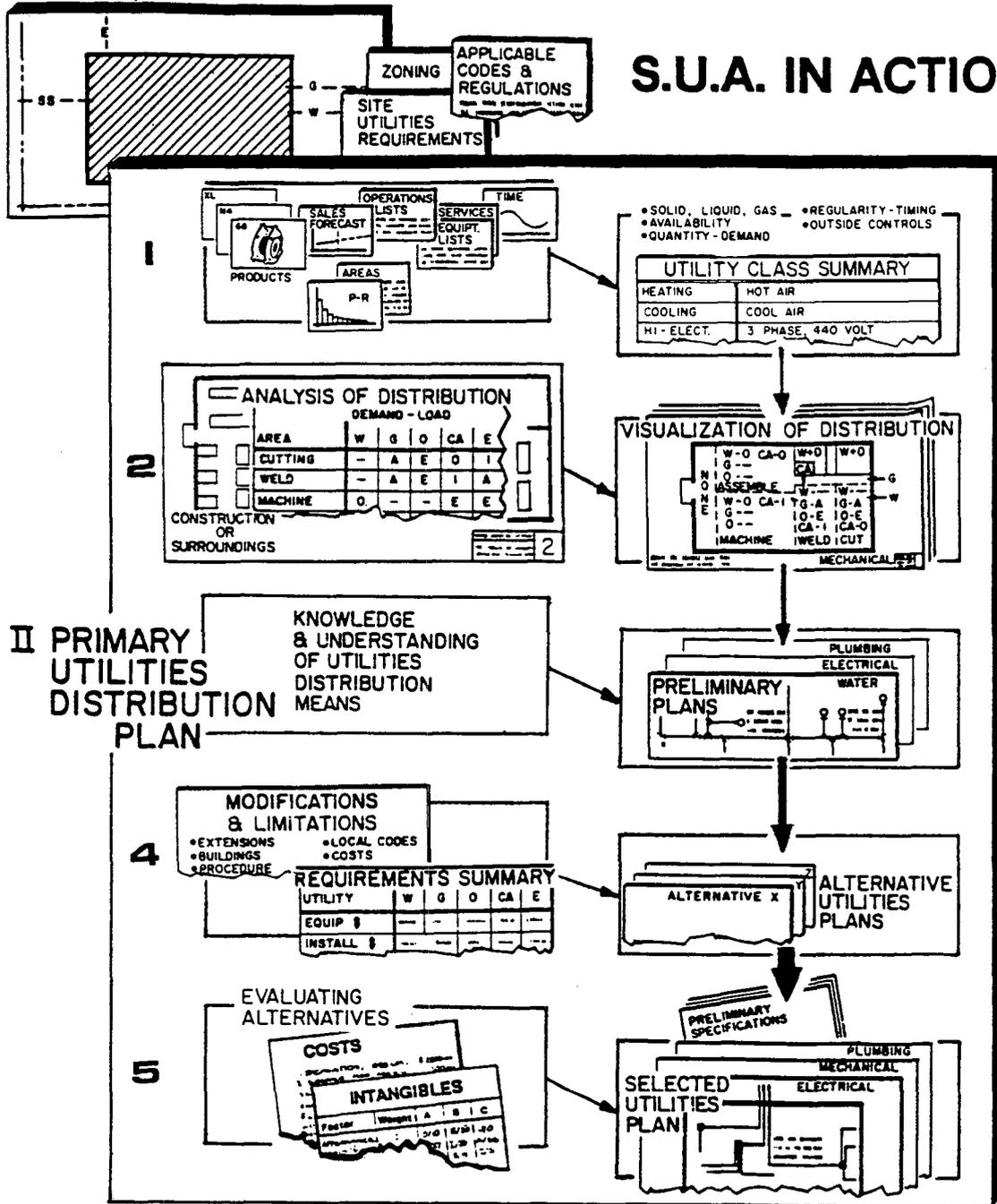
SUA makes use, whenever meaningful, of the regular SPIF planning conventions discussed elsewhere. In addition, of course, SUA uses accepted symbols and notations of various engineering disciplines.

CONCLUSION

Figure 10-2 shows a conceptual example of how utilities are planned following SUA.

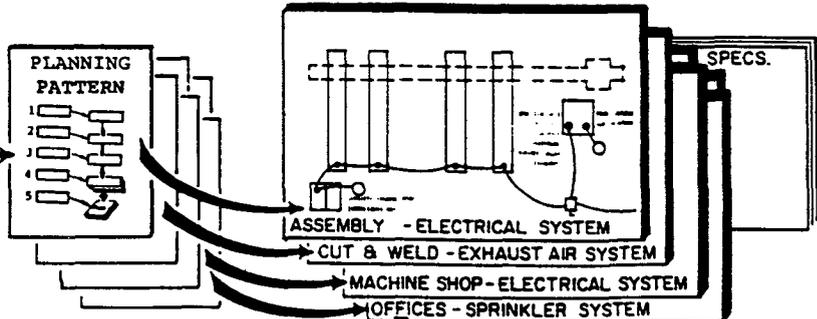
I EXTERNAL UTILITIES ACCESS & EGRESS

S.U.A. IN ACTION



II PRIMARY UTILITIES DISTRIBUTION PLAN

III SECONDARY UTILITIES DISTRIBUTION PLAN



IV INSTALLATION

Per 1992 update modification

Figure 10-2.

SUA is a companion approach to Systematic Layout Planning (SLP), Systematic Handling Analysis (SHA), Systematic Communications Analysis (SCA), and Systematic Building Planning (SBP). It involves a series of planning steps based directly on the fundamentals of Substances, Distribution, and Conductors; a set of recording, rating, and visualizing conventions; and a framework of four phases of analysis, each overlapping the previous and following phases.

CHAPTER 11 ... SUMMARY OF SYSTEMATIC BUILDING PLANNING (SBP)

Systematic Building Planning (SBP) is an organized approach to planning and designing all kinds of buildings and structures. It is applicable to offices, warehouses, production buildings, and supporting structures like water towers, transformer pads, or even bridges across a drainage ditch. It is useful for building additions, new buildings, and complete site plans.

SBP is a system of planning. And, like its companion approaches to layout, handling, communications, and utilities, SBP consists of a framework of phases, a pattern of procedures, and a set of conventions. These encompass the architectural and engineering work involved in planning and designing new construction and rehabilitation of existing buildings or structures. In practice, the work encompassed by SBP will often be done by an outside architect-engineer rather than by the industrial facilities planner himself.

THE FOUR PHASES OF SBP

As each building project runs its course—from initial concept to completed construction—it passes through four phases of planning and design.

Phase I is *Program and Site Characteristics*. In this phase, the facilities planner or the architect-engineer retained will establish basic goals or desires, philosophies, concepts, and budget or cost guidelines. The site and its surroundings are also investigated. This may include topographic and utility surveys, soil test borings, traffic studies, and the like. The influences on the planned construction of the surrounding community and the applicable zoning and codes of regulatory agencies are also established.

Phase II is *Preliminary Building Plan*—or the development of the overall design. This phase establishes the size, shape and character of the structure as well as the materials to be used. Outline specifications are also developed in this phase.

Phase III is *Detail Building or Construction Drawings*, including final specifications. These are the documents upon which contractors' bids will be based and the construction done. This phase will typically require the involvement of specialists and prospective suppliers to refine and detail the overall plans and concepts established in Phase II.

Phase IV is *Construction or Rehabilitation*. This phase includes bidding, contractor selection, and scheduling, as well as construction and occupancy.

The four phases come in sequence and should overlap, with each phase providing a check point for approval.

THE SBP PATTERN OF PROCEDURES—PHASE II—PRELIMINARY BUILDING PLANS

The design of a building or structure occurs in Phases II and III, and follows the pattern of procedures shown in Figure 11-1. Like its companion approaches, SBP begins with the

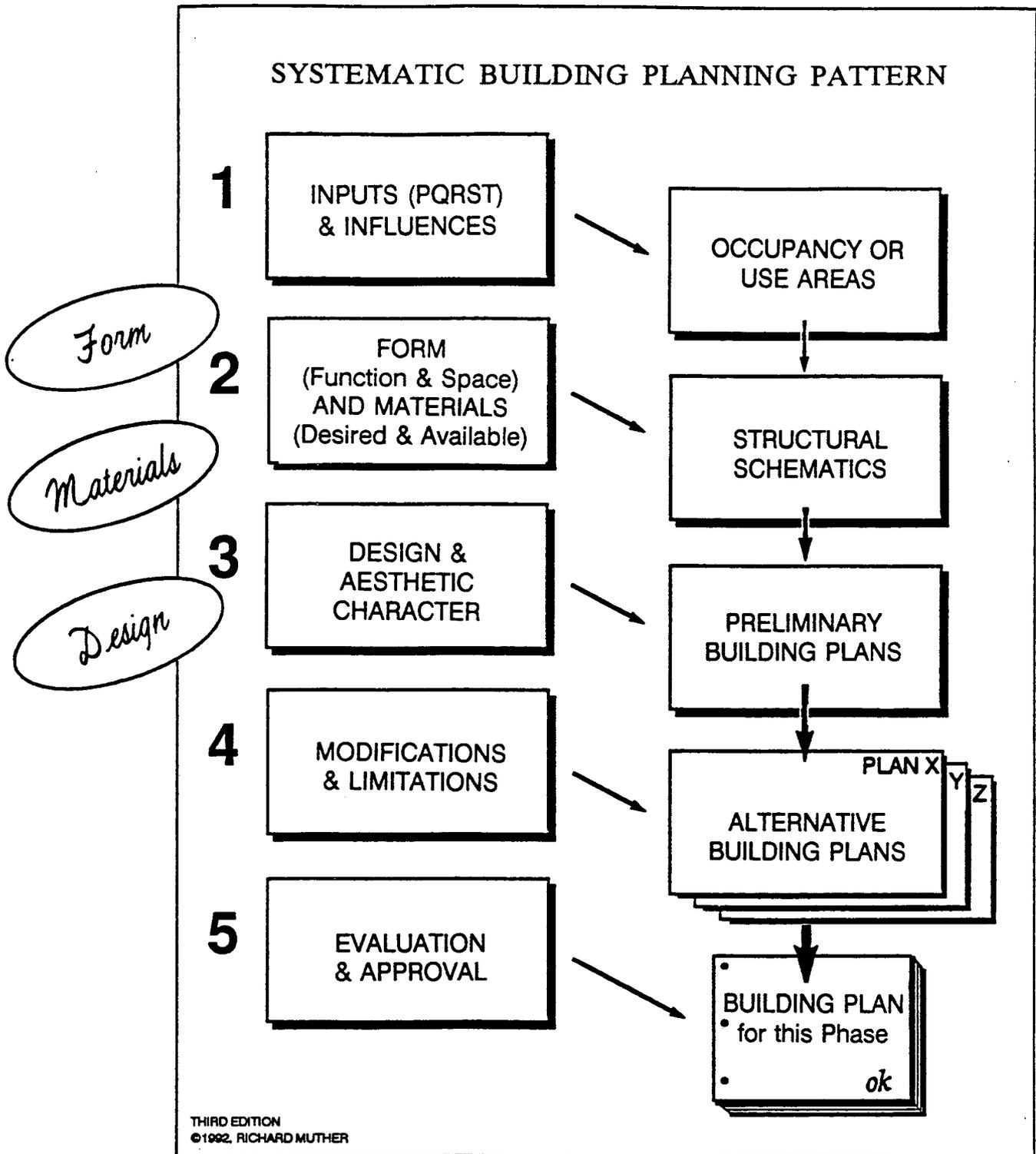


Figure 11-1. The pattern of procedures for Systematic Building Planning (SBP).

analysis of the inputs, P Q R S T – products, quantities, routing (process), supporting services, and time. The pattern of procedures rests upon the three fundamentals of building planning: *FORM, MATERIALS, and DESIGN*. The reader will recognize the structure of the pattern as the same used in Systematic Layout Planning (SLP).

In Section 1, *Inputs & Influences*, the planner or architect establishes the various functions or work that will take place within the contemplated facility. That is, the areas of use are identified and understood.

The *Function* of each use area and the *Space* to support it is determined in Section 2. Function and space are frequently joined to form the basis for an Enclosure Schematic. This is a rough or conceptual drawing or sketch indicating the basic form and arrangement of the facility. The program and site characteristics considered in Phase I, together with the enclosure schematic will lead to determining the *Materials* of construction – both *Desired* and *Available*. These will be determined by the budget, delivery lead time, and the materials used in any existing facilities to which the one being planned must relate. As the materials are determined, a *Structural Schematic(s)* is prepared as the output to Section 2.

The structural schematics will still be rough drawings or sketches. But now the planner or architect-engineer pulls together other *Design* and *Aesthetic Characteristics* to form *Preliminary Building Plans* – Section 3 output.

The preliminary plans are refined – based on *Modifications* and *Limitations* into several viable *Alternative Building Plans*. These modifying considerations and practical limitations are essentially requirements or constraints imposed by other components: layout, material handling, controls, utilities, and site considerations, costs, availability of materials and code limitations.

In Section 5, *Evaluation and Approval*, the alternative plans are subjected to various costs analyses, performance comparisons, and approval meetings – leading to a selected building plan.

This plan shows the major features of the building or structure – the basic dimensions (like size, shape, ceiling heights, column spacing, floor loading), and the primary features (like main materials of construction, floor elevation(s), major openings, type and extent of walls and roofing, and the general location of major items of machinery and equipment). Usually, outline specifications and estimated probable costs accompany these preliminary design drawings.

THE PATTERN OF PROCEDURES – PHASE III – DETAIL BUILDING OR CONSTRUCTION DRAWINGS

The division of work in Phase III can be by subareas (different departments, bays or floor levels) or it may be by specific building “subsystem” (foundation, structural, roof system, walls...) In either case, the preliminary building plan will be detailed with the same general pattern of procedures followed in Phase II.1 Now, however, we are involved with such specifics as pits in the floor, individual machine foundations, and columns to support a local mezzanine.

In Phase III, when considering each subarea of the building or structure, different emphasis is placed on different sections of the planning pattern. In a production area, the functions of individual machines and their space may be very clearly defined; in fact, the layout planner may have this so well detailed the the building planner can almost skip any analysis of Form (Sections 1 & 2) and move directly to the questions of Materials and Design (Sections 2 through 4).

Although the steps and sequence of planning repeat in Phase III, the actual techniques of developing the detail construction documents will be different from those used to develop the overall design. Larger scales are used for drawings. Cross and longitudinal section drawings are required. Specific details like doors, windows, localized heavy floor...are established. Constraints will now be imposed by the larger decisions made in Phase II. Moreover, the work sheets will be more routine, not infrequently on standardized forms issued by the company, the city, the association of architects, or building constructors.

Inasmuch as the overall dimensions and major materials were established in Phase II, the evaluation of alternatives in Phase III is, in part, a matter of choosing between specific construction techniques and grades of material. In Phase III, the writing of final building specifications receives as much attention as the preparation of drawings.

SBP CONVENTIONS

Like its companion approaches, SBP makes use wherever meaningful of the regular SPIF planning conventions discussed elsewhere. In addition, of course, SBP uses appropriate symbols and notations from the architectural and engineering professions.

CONCLUSION

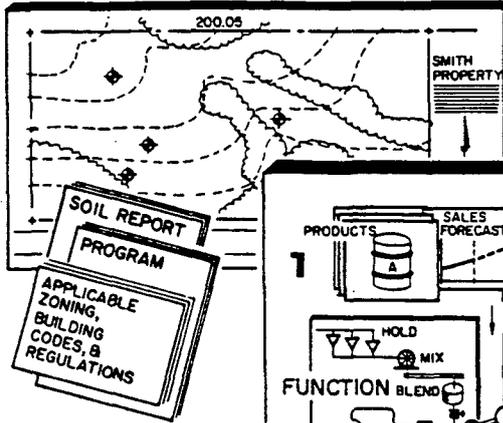
Figure 11-2 shows a conceptual example of how buildings and structures are planned and designed following SBP. This assumes that planning the building or structure is a more-or-less stand alone project, or that it dominates the planning.

Recognize that on large projects, the Phase II pattern may be repeated (in a Phase II-A and Phase II-B sequence) before moving to the planning of detail construction drawings. That is, the planner may first develop a long-range master site plan together with a plan for sequential development of it (Phase II-A). Then, he moves into the designing of his first building or structure (Phase II-B). On the contrary, on small projects, the planner may combine Phases II and III.

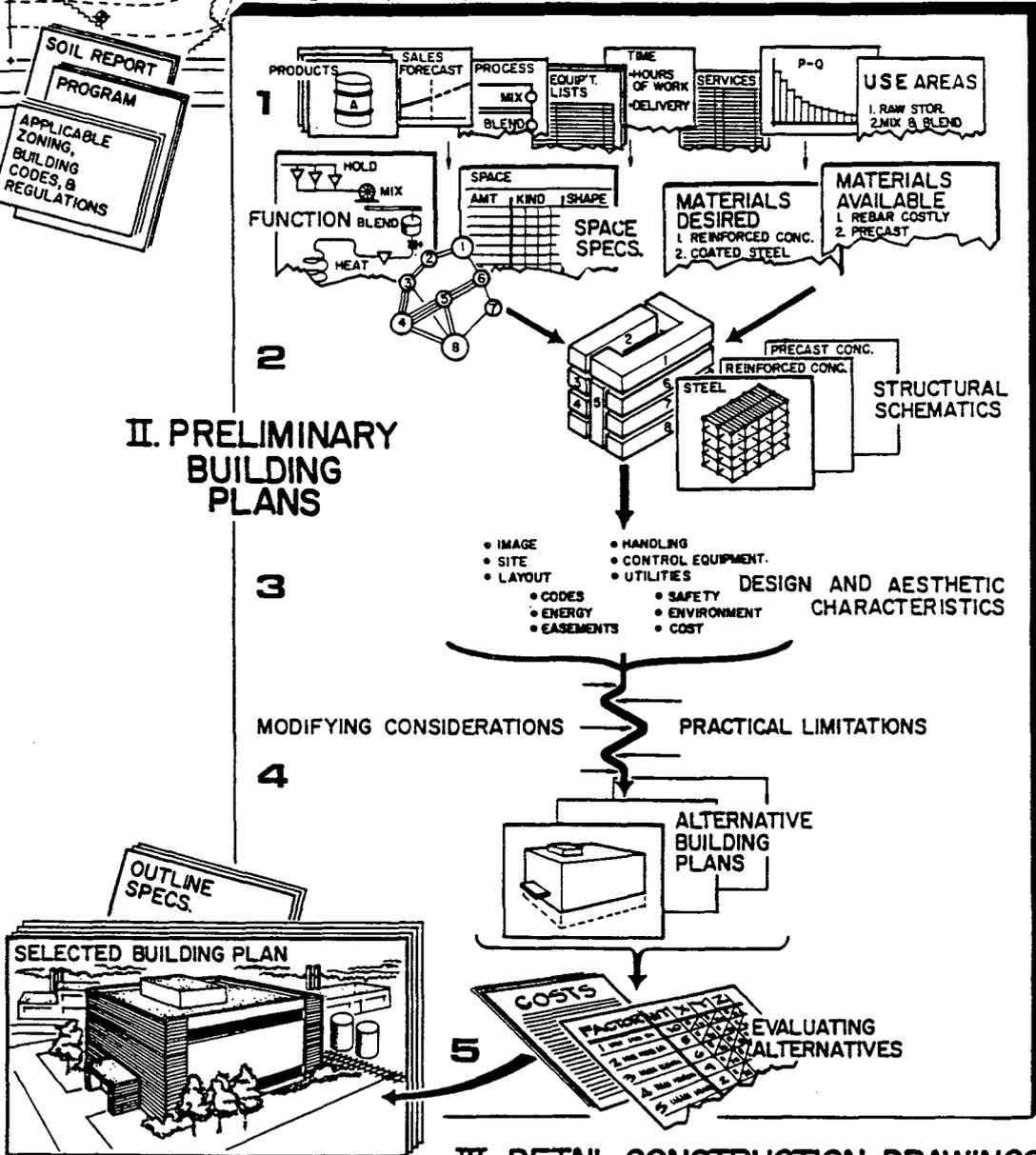
Like its companion techniques, SBP is a way of approaching problems. It includes a framework of four overlapping phases; a pattern of procedures to follow in Phases II and III, with the procedures resting on the three fundamentals of form, materials, and design; and a set of meaningful conventions to aid in analysis, visualization, and evaluation.

I. PROGRAM & SITE CHARACTERISTICS

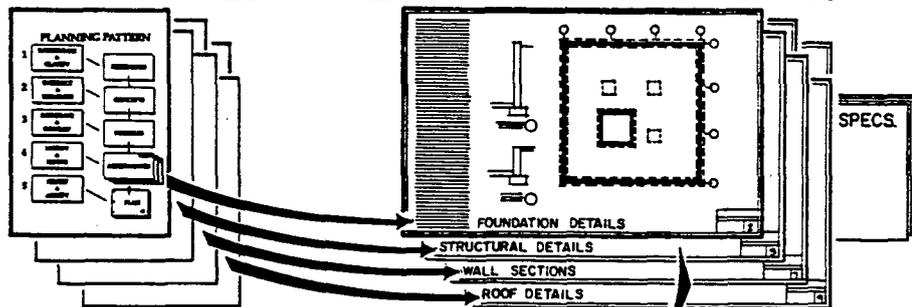
S.B.P. IN ACTION



II. PRELIMINARY BUILDING PLANS



III. DETAIL CONSTRUCTION DRAWINGS



IV. CONSTRUCTION OR RENOVATION

Per 1992 update modification

Figure 11-2.

INTRODUCTION TO PART FOUR . . . EXAMPLES OF PLANNING

Part Four presents a number of examples. These should help planners understand more clearly the concepts and structure of SPIF.

These examples vary, but they should help explain the analysis, synthesis and systematic logic that makes up the SPIF planning system.

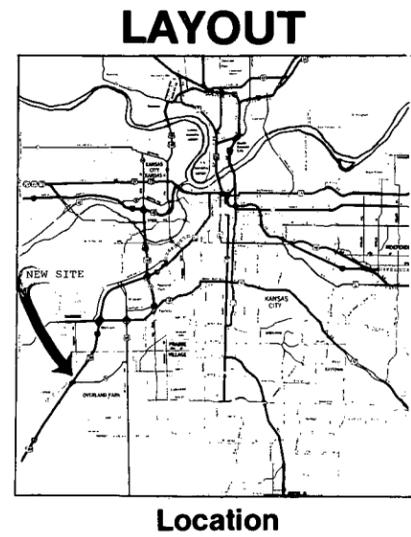
| <i>Example Number</i> | <i>Description</i> | <i>Reference Chapter</i> |
|-----------------------|---|--------------------------|
| 1. | <i>A case in facilities planning</i> | 3 |
| 2. | <i>Definition of existing facilities</i> | 4 |
| 3. | <i>Stages of future facilities development</i> | 4 |
| 4. | <i>When the lead component is other than layout</i> | 5 |
| 5. | <i>SPIF in action (in separate fold-in)</i> | 3 through 6 |

Example #5 is folded into a separate envelope, for it is too big to bind normally. Here, on one sheet, is shown each step of SPIF as applied to one project. The reader is advised that Volume II of this book will show many other examples of specific application.

A CASE IN FACILITIES PLANNING

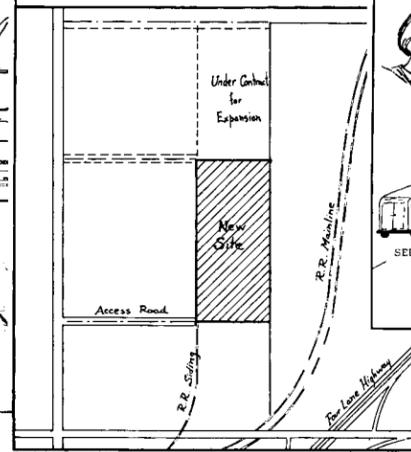
Facilities planning as applied to a specific project: the planning of 40,000 sq. ft. of fabricating-and-repair shop.

Note the integration of the five basic components of facilities planning at each of the phases and the overlap of phases as the project developed from initial planning to the details.



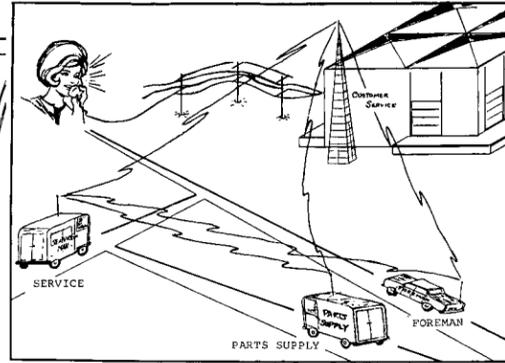
Location

HANDLING



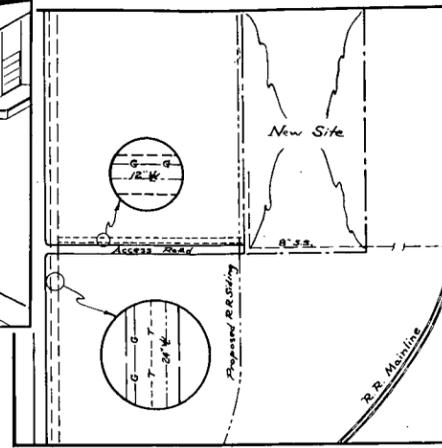
External Handling Integration

COMMUNICATIONS



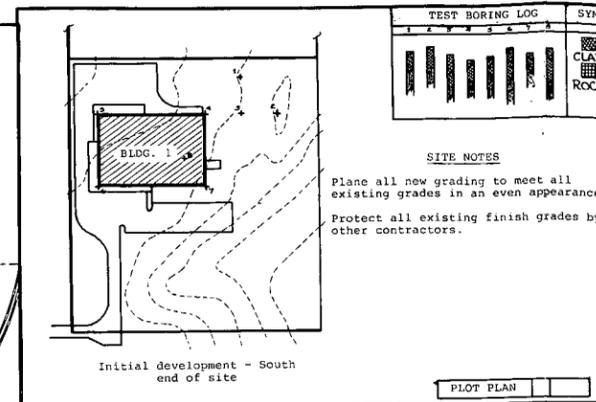
External Communications & Controls

UTILITIES



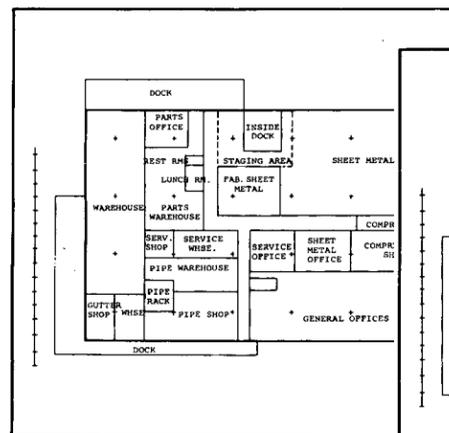
External Utils./Auxil. Access & Egress

BUILDINGS

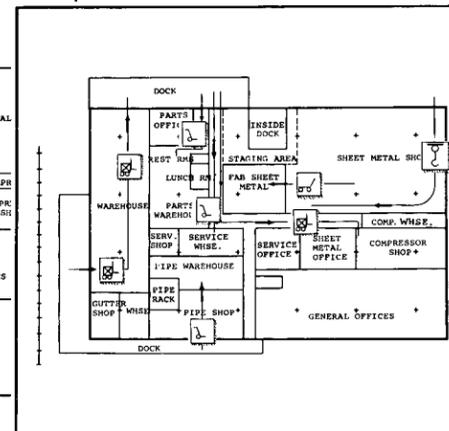


Site Characteristics

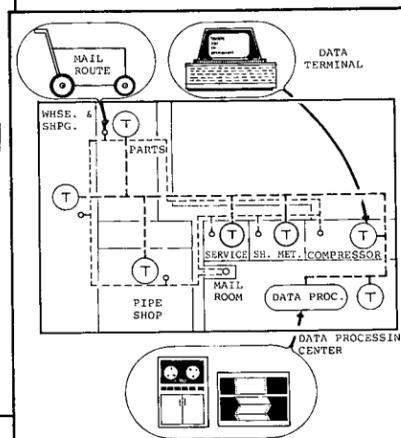
PHASE I



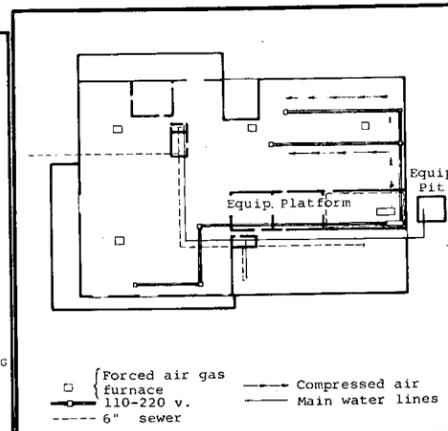
Overall (Block) Layout



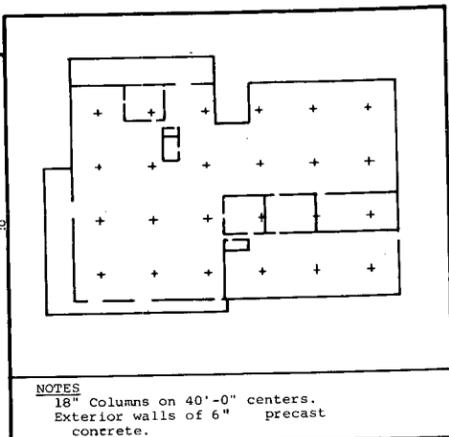
Overall Handling Plan



Basic Communications & Controls

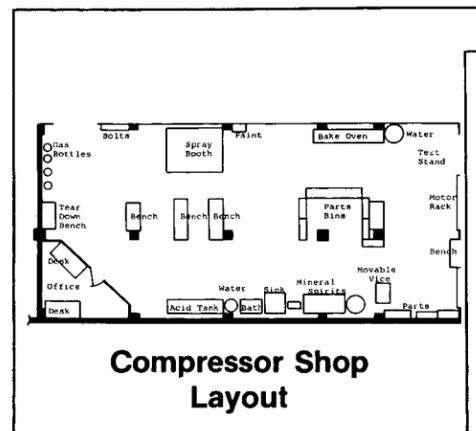


Primary Util. & Auxil. Distribution

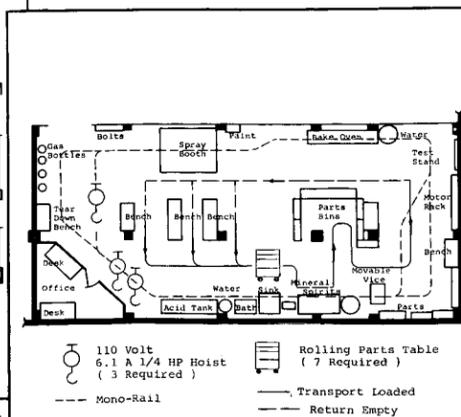


Primary Bldg. Features

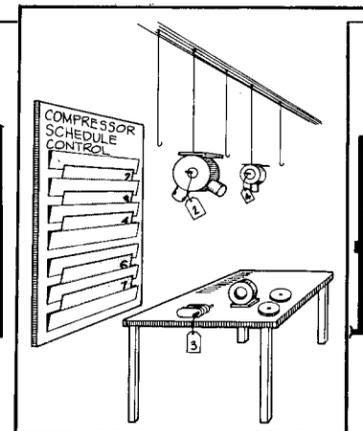
PHASE II



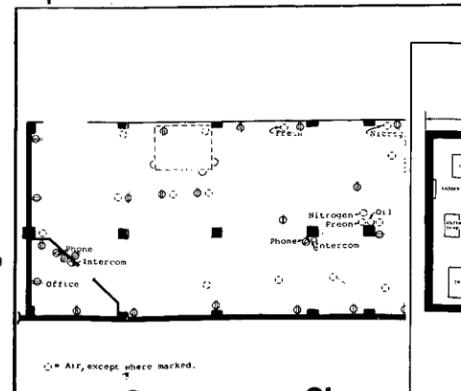
Compressor Shop Layout



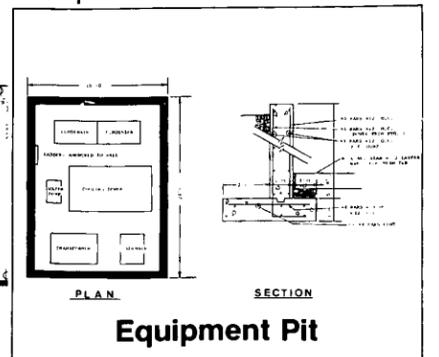
Detail Mach'y & Equip. Layout



Detail Communications & Controls Plans



Secondary Util. & Auxils. Plans (outlets only, shown)



Equipment Pit

Detail Bldg. Plans

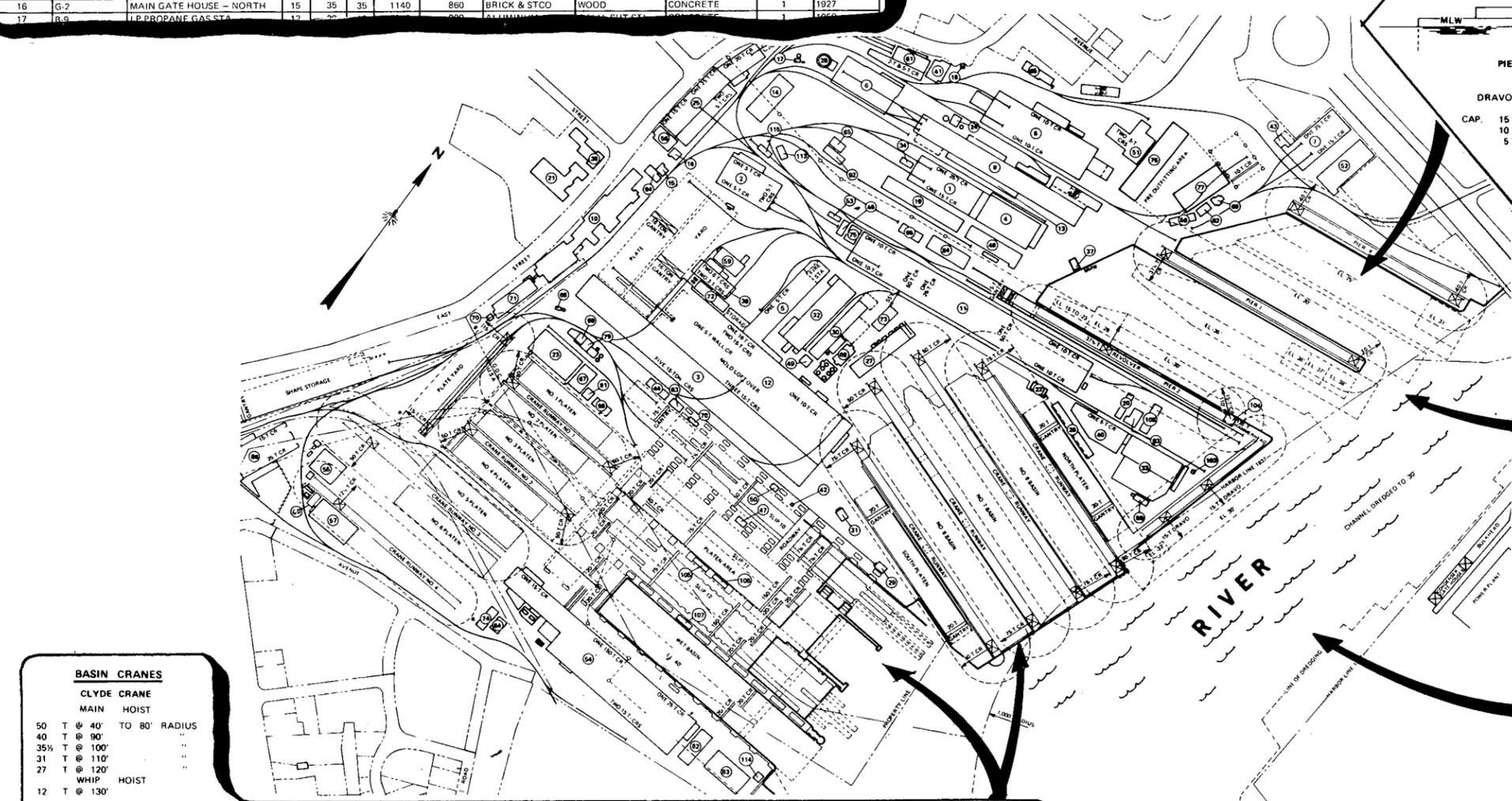
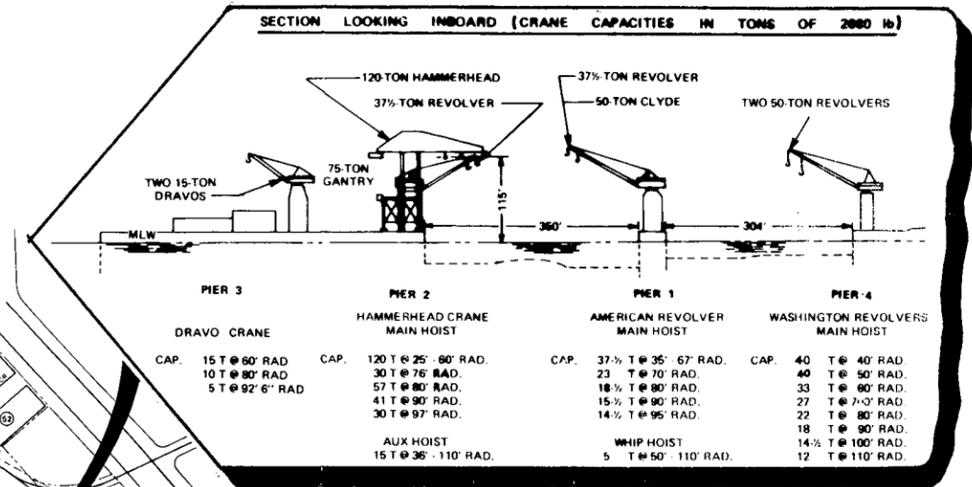
PHASE III

DEFINITION OF EXISTING FACILITIES

Existing facilities will always influence the planning. So a specific description of existing facilities is needed. Here, the materials handling equipment and the dimensions of building slips and outfitting berths are major considerations.

GENERAL DESCRIPTION OF BUILDINGS & STRUCTURES

| INDEX NO. | GRID LOCATION | BLDG. NO. & NAME | DIMENSIONS | | | AREA SQ. FT. | USABLE SQ. FT. | TYPE OF CONSTRUCTION | | | NO. STORIES | YEAR BUILT |
|-----------|---------------|-------------------------|------------|------|-----|--------------|----------------|----------------------|--------------|---------------|-------------|--------------|
| | | | H | L | W | | | STRUCTURE | ROOF | FLOORS | | |
| 1 | B-4 | NO. 6 WAREHOUSE | 42 | 244 | 99 | 24160 | 21740 | BRICK & STL | TAR & GRAVEL | CONCRETE | 1 | 1951 |
| 2 | B-5 | NO. 2 WAREHOUSE | 60 | 201 | 109 | 24660 | 22190 | STEEL & WOOD | WOOD | CONCRETE | 1 | 1911, 51 |
| 3 | D-12 | WELD ASSEMBLY BLDG. | 78 | 1014 | 102 | 103430 | 87810 | BRICK & STL | PROT METAL | DIRT | 1 | 1951 |
| 4 | C-6 | NO. 4 WAREHOUSE | 48 | 232 | 102 | 23570 | 21210 | BRICK & STL | TAR & GRAVEL | CONCRETE | 3 | 1941, 58 |
| 5 | E-14 | SHAPE FAB. BLDG. | 39 | 316 | 72 | 22750 | 19340 | STEEL & WOOD | TAR & GRAVEL | CONC & WOOD | 2 | 1911, 51 |
| 6 | L-22 | LUMBER STORE | 34 | 215 | 110 | 25370 | 22830 | WOOD & ASB | WOOD | CONC & DIRT | 1 | 1926, 52 |
| 7 | C-16 | NO. 8 WAREHOUSE | 60 | 224 | 100 | 22660 | 20390 | BRICK & STL | TAR & GRAVEL | CONC & WOOD | 2 | 1951 |
| 8 | F-16 | PIPE & COPPER SHOP | 46 | 395 | 129 | 66890 | 56860 | STEEL & GLASS | TAR & GRAVEL | CONCRETE | 1 | 1927, 53, 70 |
| 9 | G-12 | JOINER & SHEET METAL | 31 | 643 | 72 | 53620 | 45580 | BRICK | TAR & GRAVEL | CONC & WOOD | 2 | 1926, 49 |
| 10 | A-12 | MAIN OFFICE | 66 | 483 | 102 | 35290 | 26470 | CONC-BR STL | TAR & GRAVEL | CONC & GYP PL | 4 | 1921, 54, 68 |
| 11 | H-8 | MACHINE SHOP | 55 | 892 | 120 | 107040 | 90980 | WOOD-BR STL | WOOD & I & G | CONC & WOOD | 2 | 1911, 51 |
| 12 | G-16 | FABRICATION SHOP - A | 70 | 766 | 188 | 154040 | 130930 | BRICK & STL | TAR & GRAVEL | CONC & WOOD | 2 | 1926, 49 |
| 13 | B-20 | PAINT SPRAY SHOP | 15 | 280 | 20 | 5600 | 4760 | BRICK | STL VEE SIDE | CONCRETE | 1 | 1968 |
| 14 | B-14 | MAINT. BLDG. & GARAGE | 32 | 167 | 70 | 11690 | 9940 | BRICK & STL | TAR & GRAVEL | CONCRETE | 2 | 1947 |
| 15 | A-11 | MAIN GATE HOUSE - EAST | 16 | 35 | 34 | 1110 | 830 | BRICK & STCO | WOOD | CONCRETE | 1 | 1927 |
| 16 | G-2 | MAIN GATE HOUSE - NORTH | 15 | 35 | 35 | 1140 | 860 | BRICK & STCO | WOOD | CONCRETE | 1 | 1927 |
| 17 | B-8 | L.P. PROPANE GAS STA. | 17 | 37 | 37 | 1221 | 890 | CONCRETE | CONCRETE | CONCRETE | 1 | 1927 |



BERTHING SPACES

| PIER NO. | LENGTH | DREDGED AREA |
|------------|--------------|-----------------------|
| PIER NO. 1 | SOUTH | 900' x 140' - 35' |
| | NORTH | 701' |
| PIER NO. 2 | LENGTH | 864' |
| | DREDGED AREA | 834' AV. x 100' - 30' |
| PIER NO. 3 | LENGTH | 560' |
| | LGTH BMD | 115'-TOT. 675' |
| | DREDGED AREA | 825' 125' - 30' |
| PIER NO. 4 | LENGTH | 712' |
| | DREDGED AREA | 750' AV. x 165' - 25' |
| WET BASIN | LENGTH | 812' |
| | WIDTH | 156' |
| | DREDGED AREA | 892' x 156' - 40' |

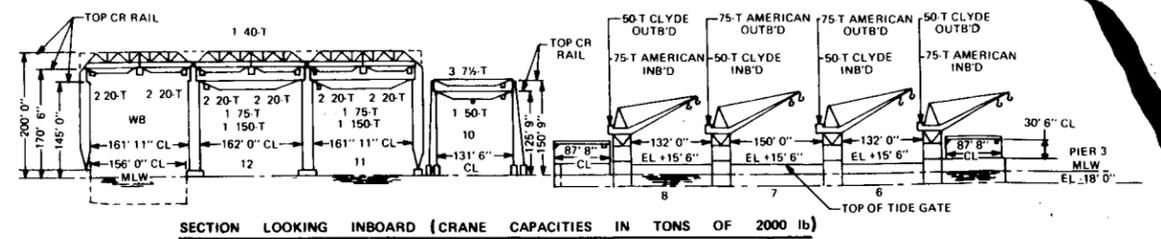
BASIN CRANES

CLYDE CRANE
MAIN HOIST

- 50 T @ 40' TO 80' RADIUS
- 40 T @ 90' "
- 35 1/2 T @ 100' "
- 31 T @ 110' "
- 27 T @ 120' "

WHIP HOIST

- 12 T @ 130' RADIUS



MAXIMUM SIZE SHIPS THAT CAN BE LAID DOWN IN SLIPS

| SLIP | LENGTH | BEAM | HEIGHT FROM BOW BLOCK TO HOOK |
|---------|--------|------|-------------------------------|
| 10 | 645 | 84 | 78 |
| 11 | 875 | 150 | 83 |
| 12 | 875 | 150 | 83 |
| BASIN 6 | 860 | 118 | - |
| 7 | 940 | 137 | - |
| 8 | 860 | 118 | - |

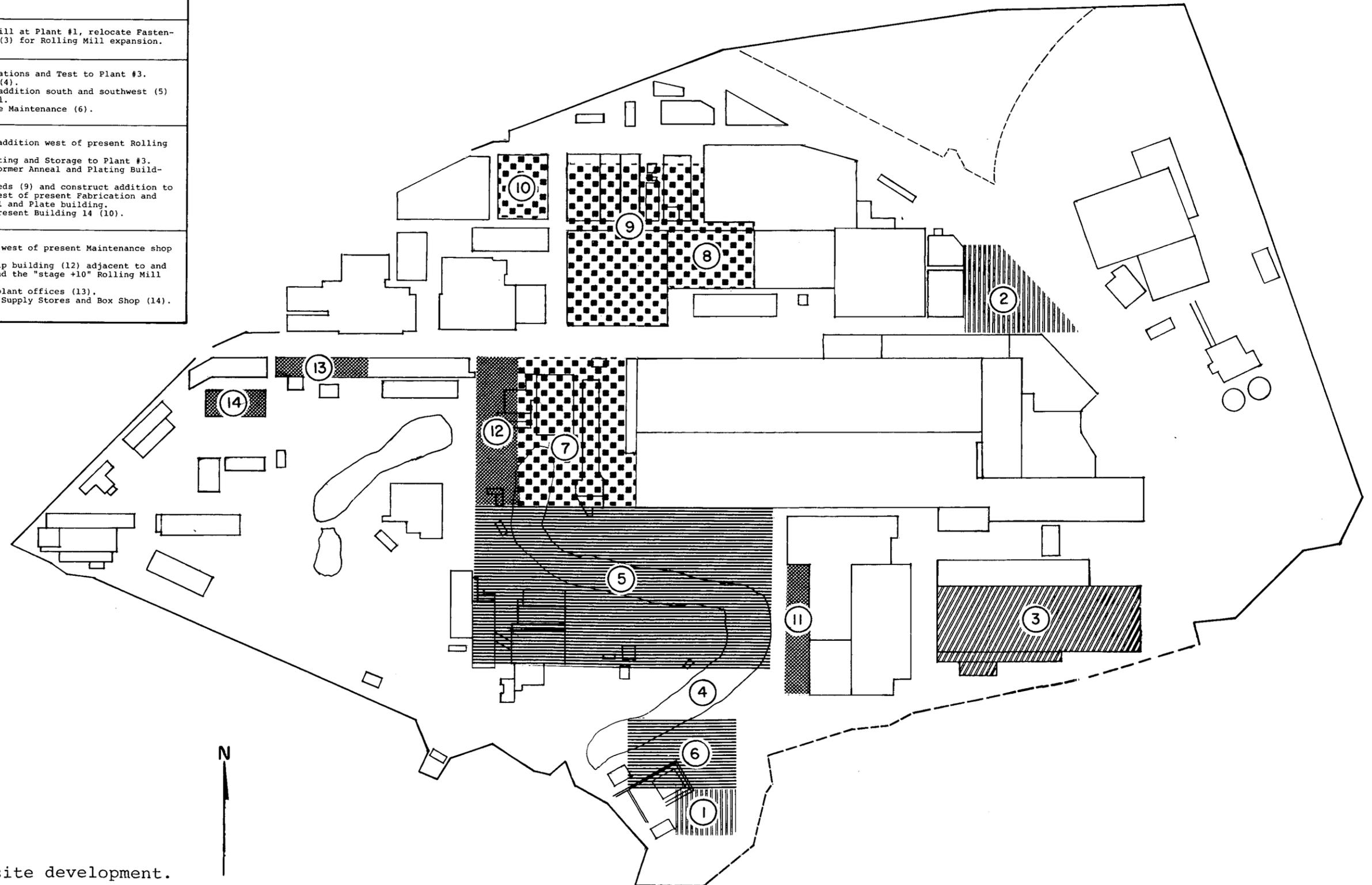
Example #2. Definition of existing facilities.

Courtesy: Quincy Shipbuilding Division of General Dynamics.

STAGES OF FUTURE FACILITIES DEVELOPMENT

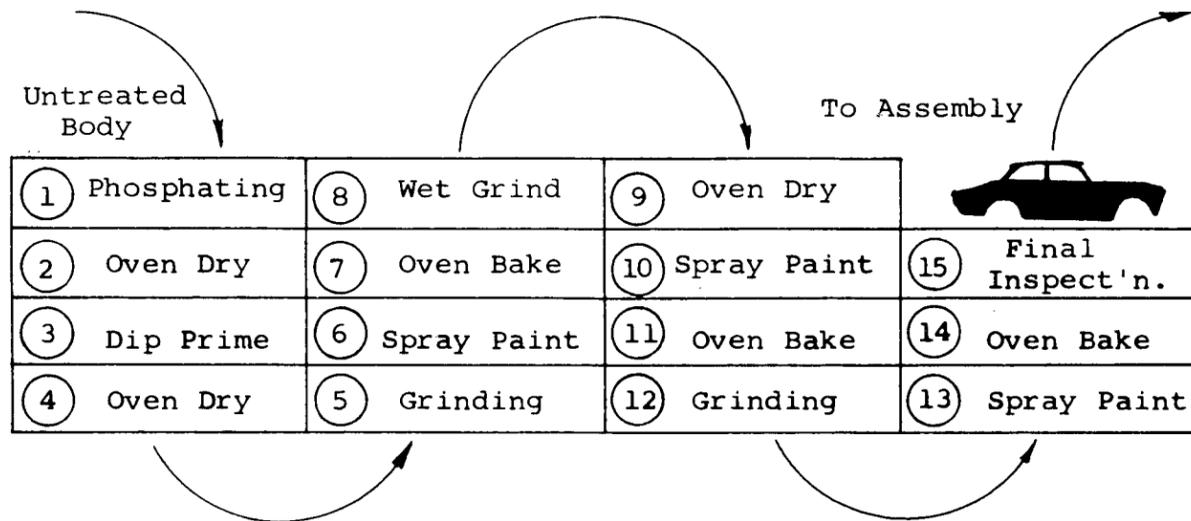
Projects of planning industrial facilities should provide for both short-term implementation and long-term stages of future development. Here, the stages of intermediate development to attain a long-range expansion-and-redevelopment plan are indicated by shading code, number, and brief plan-of-action description.

| PLANT TWO DEVELOPMENT STAGES | | |
|---|-----------|--|
| STAGE | YEAR | PLAN OF ACTION |
|  | Next Year | Relocate Weld shop (1) Expand slitting (2) |
|  | +2 | Construct new Rolling Mill at Plant #1, relocate Fastening and convert space (3) for Rolling Mill expansion. |
|  | +5 | Relocate Secondary operations and Test to Plant #3. Fill in cooling lagoon (4). Construct Rolling Mill addition south and southwest (5) of present Rolling Mill. Relocate and consolidate Maintenance (6). |
|  | +10 | Construct Rolling Mill addition west of present Rolling Mill (7). Relocate Anneal and Plating and Storage to Plant #3. Expand Fabrication to former Anneal and Plating Building (8). Demolish old storage sheds (9) and construct addition to Fabrication building west of present Fabrication and north of present Anneal and Plate building. Relocate cafeteria to present Building 14 (10). |
|  | +20 | Extend Roll Grinding to west of present Maintenance shop (11). Construct new Pack & Ship building (12) adjacent to and west of Rolling Mill and the "stage +10" Rolling Mill addition. Convert Building #7 to plant offices (13). Convert Building #22 to Supply Stores and Box Shop (14). |

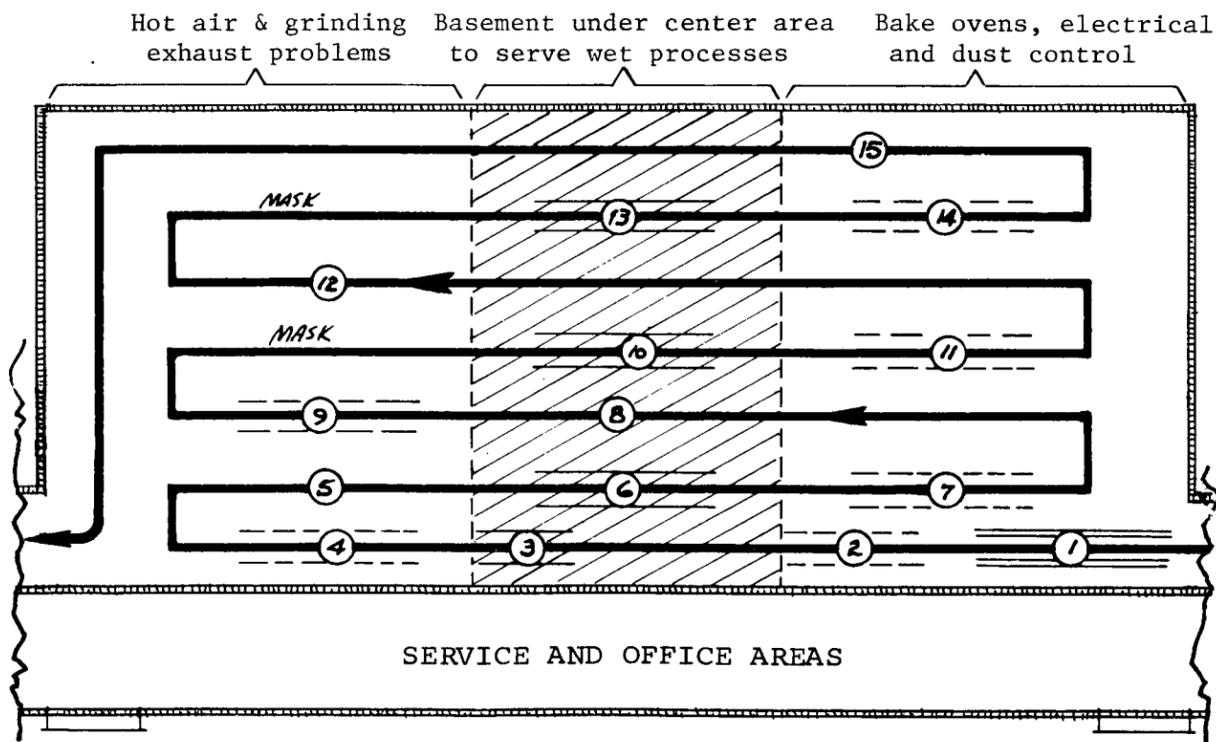


Example #3. Stages of site development.

Thorough rust-proofing and painting of the body increases the life of automobiles. High demands for dust-free conditions, lighting, product quality are important to any new paint facility. The main operations in the painting processes are shown in the diagram below.

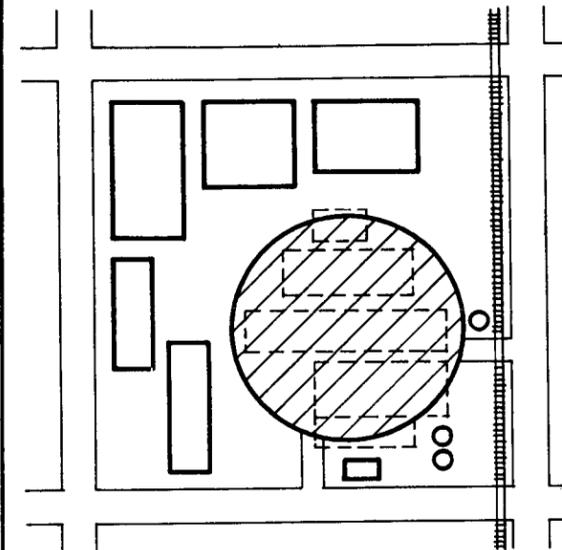


The facility plan (below) threads the body back and forth in order to keep the major spray paint booths and critical baking ovens in sequence yet allowing the water, drains, pumps, air ducts, exhaust, electrical lines, blowers, and the like, to be kept together with resultant savings in installation and maintenance.



Example #4a. Utilities and auxiliaries as lead component.

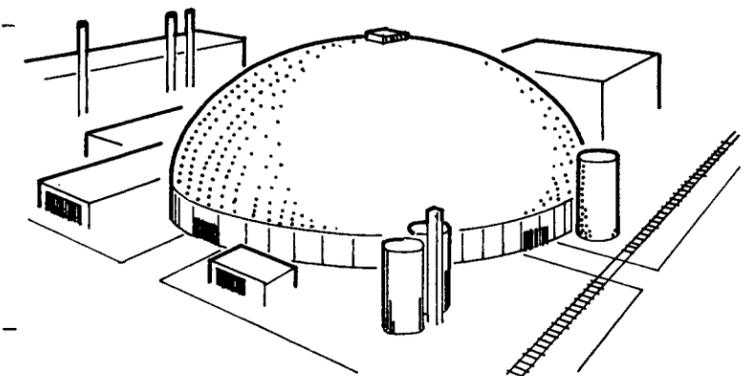
In bulk processing of granular materials, where operating equipment and holding bins can effectively be mounted on structural framing, high, open, unconstrained space reduces the cost of operations and provides flexibility for rearrangement.



The old buildings, shown with broken lines at the left, have limited space, inability to house high structures, constrained equipment locations, and segregated controls. Clearly, the buildings themselves are the chief problem.

In planning the new facilities, the lead component is the building. Especially is this so because many different arrangements of process and handling equipment, and their supporting controls and utilities, will be erected within the building during its service life.

As a result, the planners concentrated on the building--its form, materials and design. A new building housing all the process operations was selected, one large geodesic dome.

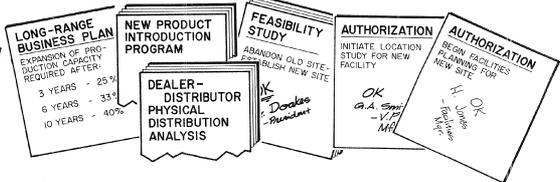


Note: The crosshatched circle in the first drawing shows where the circular building was to be erected on the site.

Example #4b. Building or structure as lead component.

Example #5 S.P.I.F. in Action

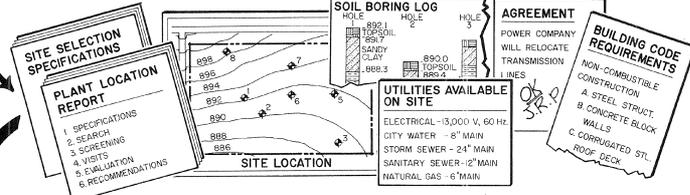
PHASE 0 PREPLANNING



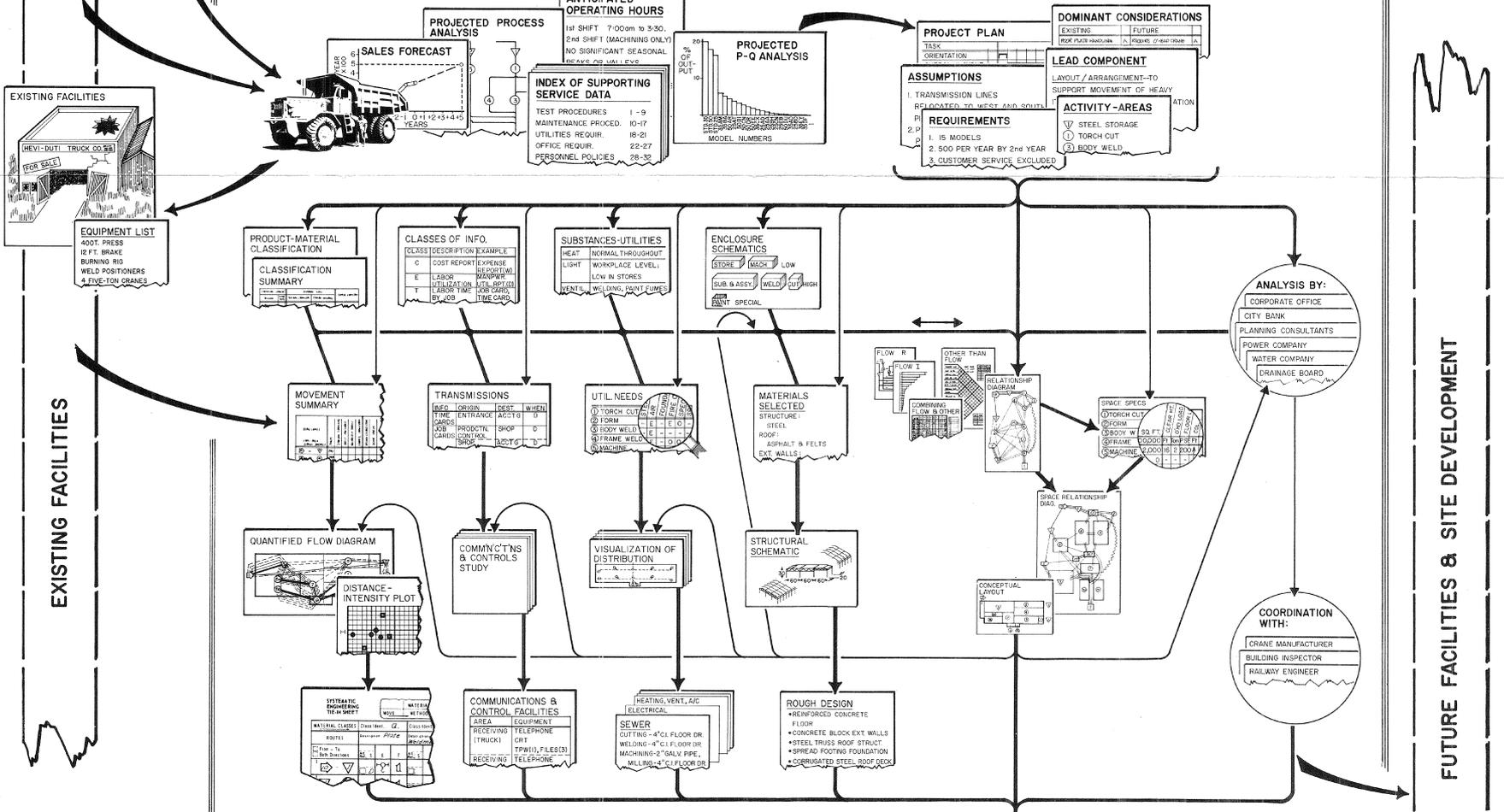
S.P.I.F. IN ACTION

A pictorial illustration of the application of SPIF—the planning of an industrial facility to manufacture heavy-duty, off-highway motor trucks. Note the six planning phases (including O and V), the influences of existing and future facilities, the steps of the planning pattern for Phases II and III, and the integration of the five physical components.

PHASE I ORIENTATION

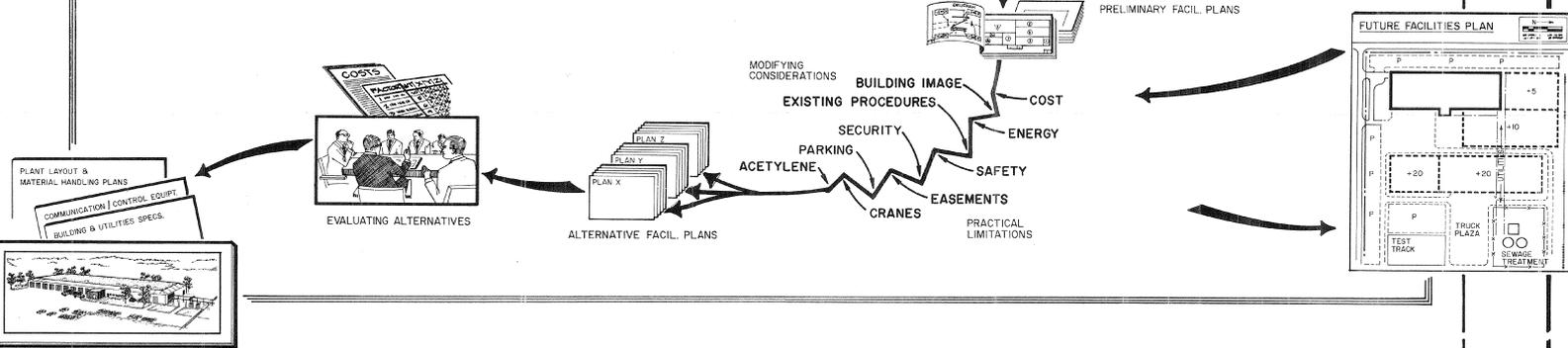


PHASE II OVERALL PLAN

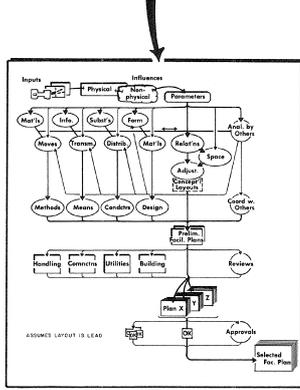


EXISTING FACILITIES

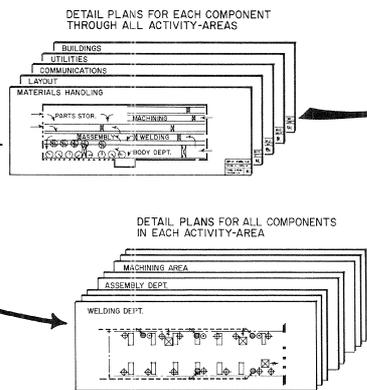
FUTURE FACILITIES & SITE DEVELOPMENT



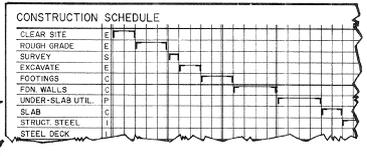
SELECTED OVERALL FACILITIES PLAN



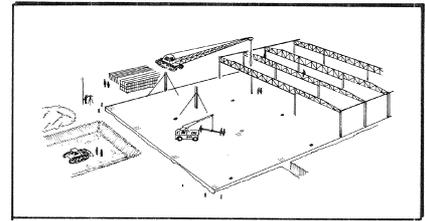
PHASE III DETAIL PLANS



PHASE IV IMPLEMENTATION PLANNING

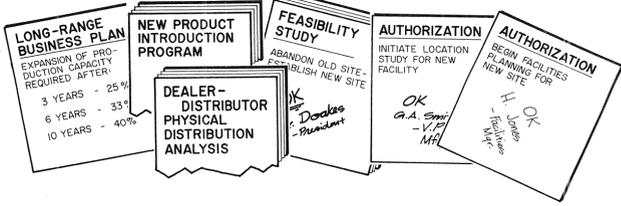


PHASE V CONSTRUCTION & INSTALLATION



Example #5 S.P.I.F. in Action

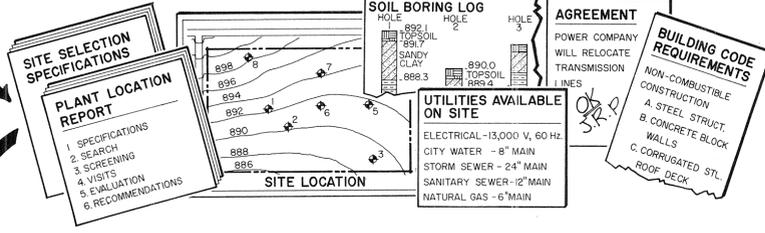
PHASE 0 PREPLANNING



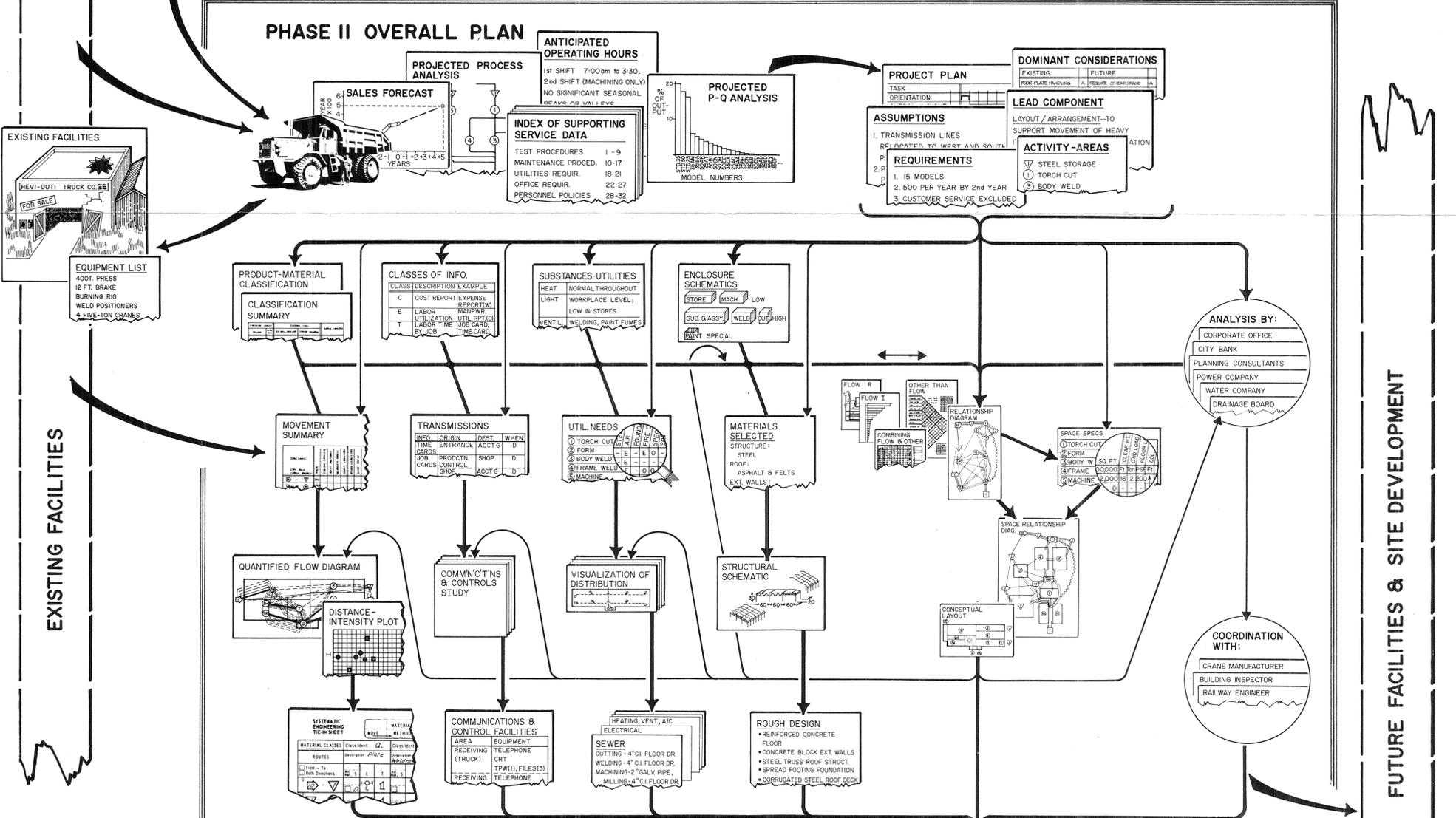
S.P.I.F. IN ACTION

A pictorial illustration of the application of SPiF—the planning of an industrial facility to manufacture heavy-duty, off-highway motor trucks. Note the six planning phases (including O and V), the influences of existing and future facilities, the steps of the planning pattern for Phases II and III, and the integration of the five physical components.

PHASE I ORIENTATION

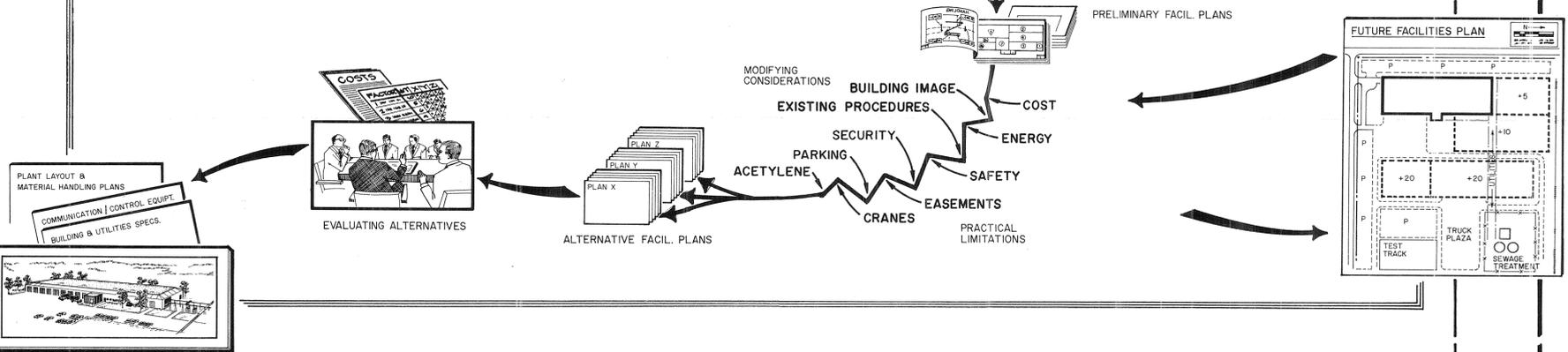


PHASE II OVERALL PLAN



EXISTING FACILITIES

FUTURE FACILITIES & SITE DEVELOPMENT



SELECTED OVERALL FACILITIES PLAN

PHASE III DETAIL PLANS

PHASE IV IMPLEMENTATION PLANNING

PHASE V CONSTRUCTION & INSTALLATION

SPIF PLANNING PATTERN

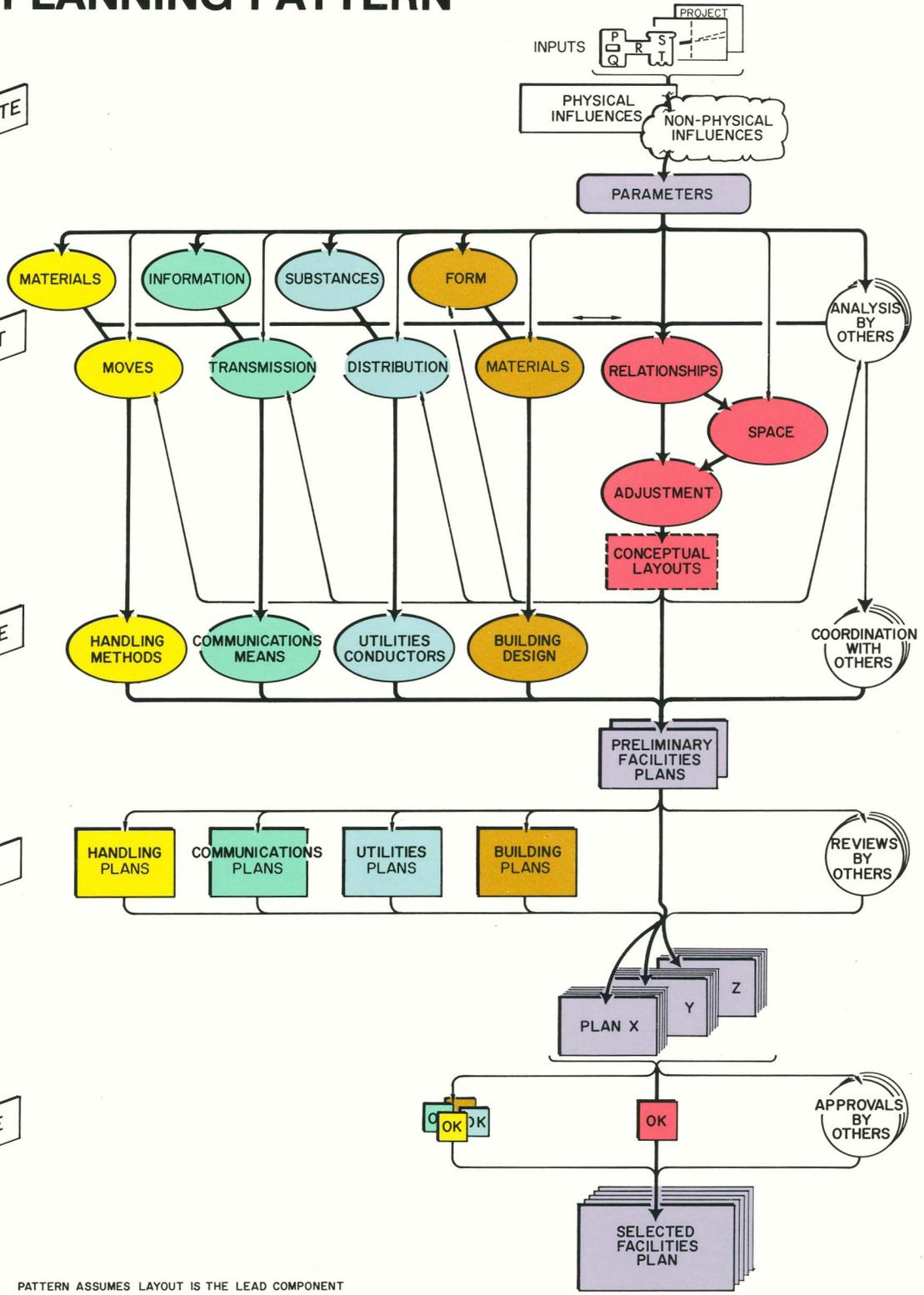
INVESTIGATE

INTERACT

INTEGRATE

MODIFY

EVALUATE



PATTERN ASSUMES LAYOUT IS THE LEAD COMPONENT

RICHARD MUTHER & ASSOCIATES

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