Managerial and Leadership Think-Work Functions

and
Associated Concepts and Practices

Planning

Strategies/Tactics, Programs/Projects, and Action Plans

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Basic Perspectives

General Definition

Planning basically means formulating (alternative) courses of action for reaching goals. More specifically, it means thinking about and outlining in advance what should be done, who should do it, when it should be done, and how it should be done in order to reach goals. Planning should involve doing all the following:

* formulating **Strategies** (the broad WHAT To Do in order to reach goals);
* formulating **Tactics** (the specific WHAT To Do in order to carry out strategies);
* designing **Programs** and component **Projects** (the broad HOW To for carrying out strategies and tactics); and
* formulating step-by-step **Plans of Action** (the specific HOW To for implementing programs and projects).

In a problem-solving context, formulating (alternative) solutions (including plans for their implementation) is equivalent to planning.

Purposes and Benefits of Planning

1. To bridge the gap between the present situation (where things are now) and the desired situation (where things are intended to be once goals are achieved).

2. To means-orient (and also help goal-orient) activities.

   a. To help focus people's attention on goals (the ends toward which plans are aimed).

   b. To channel people's activities toward achieving the desired end results—e.g., solving problems, making improvements, and coping with or purposefully bringing about change.

   c. To establish frameworks for utilizing the means (the what, who, when, and how) that will be necessary in order to reach goals.

   d. To chart the course(s) of action to be taken in order to get from point A (the present position) to point B (the goal or desired end result).

3. To crystallize and specify the means.

   a. To specify the tasks or activities that must be performed in order to reach goals.

   b. To identify who should be responsible for performing which tasks or activities.

   c. To identify the most effective and efficient sequence(s) of activities.

   d. To identify who must do what before someone else can begin their task/activity (in order to coordinate groups' and individuals' planned activities).

4. To maximize the effectiveness and efficiency with which activities are performed, thereby helping to save time, effort, and money.

   a. To assure that activities will be directed and coordinated rather than being unfocused, disjointed, uncoordinated, and piecemeal.

   b. To assure that people will act on deliberate decisions rather than simply reacting or making snap judgments.

   c. To even out the work flow and work load.

   d. To anticipate and deal with the uncertainties and changes that often interfere with "the best-laid plans" (i.e., to increase the probability that events will occur as intended and will not be disrupted by chance events).

5. To identify the activities necessary to change the organizational structure or to staff the organization.

6. To help communicate the what, who, when, and how throughout an organization.

7. To establish bases for measuring and evaluating (a) progress toward end results, and (b) the end results themselves.

To review the basic purposes/benefits and principles of planning, see pages PP-1 and PP-2.

Types of Plans
in Terms of Their Contexts

Just like goals, plans can be categorized in several ways. They can be typed in terms of the time period they cover—e.g., long-range, intermediate-term, and short-term. They can also be typed in terms of the contexts involved.

Below we discuss strategies ("grand Strategies" and associated "substrategies"), tactics (and associated "subtactics"), programs and projects, and plans of action. All of these types of plans deal with reaching goals, but they do so within different contexts and in slightly different ways.

Strategies

Strategies are essentially broad, competitive approaches (large scale means) for performing successfully in the marketplace and accomplishing one or more major goals. They constitute the broad "WHAT To Do" in order to achieve long- and short-term goals.

They primarily deal with competitive phenomena (market-related factors); but they also deal with technological forces, economic forces, productive capabilities, and financial considerations, which all affect organizational performance and success in various ways.

Strategies are usually oriented to the long term, but they can also involve the short and intermediate terms. In fact, some long-term combinations or sequences of strategies involve implementing a particular (sub)strategy during one or more of the next several years.

As shown in **Figure 7-A** on page PP-4, organizational strategies . . .

a. are derived from (formulated based on) organizational goals; and
b. provide a context for formulating (and implementing) associated substrategies, tactics, programs and projects, and plans of action.

The major strategies—sometimes called "grand strategies"—are: stable growth; significant/accelerated growth; retrenchment; and combinations. Associated with each are several alternative substrategies.

Stable Growth Strategy

This strategy involves continuing to pursue objectives aimed at achieving a steady improvement in performance and a slow but steady market expansion.

Reasons for using this strategy include:

a. The organization is doing rather well in a healthy industry or marketplace.
b. Management prefers an easy, comfortable, low-risk course of action.
c. Managers are resisting change.

The alternative substrategies associated with stable growth are:

1. Incremental growth — Increasing market share by about the same percentage each year, perhaps initially concentrating on one product line, and then slowly adding goods or services to expand the market.

2. Harvest profit — Trying to generate cash/profits by (a) pricing selectively; and (b) raising prices (without necessarily lowering costs)—perhaps at the expense of market share. (This is also called "milking cash cows.")

3. Pause — Switching from a growth strategy to a stable growth strategy so as to concentrate on obtaining economies of overhead and production scale (perhaps to "take a breather" from too rapid expansion).

4. Sustainable growth — Simply attempting to maintain market share in mature markets when (a) the market is stagnant, and/or (b) it is thought that resources necessary for growth are unavailable.

Significant/Accelerated Growth Strategy

This involves attempting to increase market share significantly and/or more quickly, usually by concentrating on

achieving major improvements in various performance areas.

Reasons for using this strategy are:

a. Growth can be necessary to survive in volatile industries where stability can mean short-term success, but long-term death.

b. The market is not yet stagnant, and there is room to grow (i.e., to increase sales at competitors' expense).

c. Management equates growth with effective performance and success.

d. Growth often enables an organization to achieve economies of scale.

e. Growth enterprises tend to be better known, attract better personnel, offer greater financial rewards, and provide means for satisfying managers' needs for power.

f. Managers believe that society benefits from business growth.

Alternative substrategies associated with the growth strategy are:

1. Increase sales of line — Increasing sales of present single product/service line in order to increase market share. (This is the most frequently used substrategy.)

2. Diversify line — (Internally) adding products/ services or product/service lines to the present line, especially when the principal product/service line is approaching market saturation or obsolescence and depending entirely upon it would be risky.

3. Entry — Expanding products and markets (and therefore sales volume) by expanding into another (perhaps related) product or service line (that preferably involves using similar marketing approaches, production processes and facilities, and channels of distribution).

4. Acquisition — Acquiring (purchasing and absorbing the assets of) another enterprise for one or more of the following purposes: (a) to strengthen the business base by obtaining key personnel, assets, and/or purchasing power; (b) to expand or enter certain markets (perhaps to diversify product lines); (c) to avoid a takeover; (d) to improve financial posture; and/or (e) to take advantage of tax benefits. Although the acquired enterprise may be in a different industry, the chances of success are often increased if the acquired firm's operations involve familiar markets, materials/parts sources production processes, and channels of distribution. (When a supplier or distributor is acquired, the acquisition amounts to vertical integration.)

5. Merger — Combining (the assets of) two or more enterprises and restructuring them into one new enterprise—in order to (a) diversify a product/ service line, (b) increase market share, (c) increase synergy of marketing efforts and customer/channel relationships, (d) create economies of scale, (e) increase/guarantee access to customers/ suppliers, (f) increase financial resources, and/ or (g) increase stock price and P/E ratio. Mergers with either suppliers or distributors/retailers can amount to vertical integration.

6. Joint venture — Creating a mutually beneficial business arrangement between two or more enterprises in order to (a) share the costs of a business venture, or (b) combine strengths or skills.

7. Vertical integration — Although this strategy normally involves acquisition, it is aimed more at acquiring operations that either precede or follow a firm's original operations. It is often undertaken in order to (a) extend operations, (b) gain greater control over quality and costs, (c) minimize uncertainties, and/or (d) realize various operational efficiencies.

Backward integration usually involves acquiring sources of supply.

Forward integration often involves acquiring distribution channels and/or sales outlets. It can also occur when a raw materials producer or a parts manufacturer acquires a finished product manufacturer.

8. Grow-to-sell-out — Developing an enterprise to the point where it can be sold at a substantial profit.

Retrenchment Strategy

This involves concentrating on improving performance and increasing cash flow.

Several <u>reasons for using</u> this strategy:

a. The organization is performing poorly [is experiencing declining sales and is losing money—perhaps because it (a) maladapted to the marketplace, (b) took excessive risks, (c) ineffectively controlled operations, and/or (d) could not adequately cope with adverse outside forces].
b. The organization's attempts to implement other strategies have failed.
c. The organization's resources are limited.
d. The organization's shareholders and creditors are concerned.
e. The organization is trying to survive in the industry.

This is basically a short- to intermediate-term strategy. It tends to be used when a product is becoming obsolete or a market is stagnating.

The alternative <u>substrategies</u> associated with the retrenchment (or survival) strategy are:

1. <u>Turnaround</u> — Increasing the efficiency of an enterprise by . . .

   a. <u>Reducing costs</u> (e.g., paring the workforce by attrition and layoffs, cutting maintenance, reducing promotions/advertising, limiting expense accounts, leasing equipment, purchasing less expensive raw materials or parts, etc. —which may quicken an organization's demise if it has done so unwisely.

   b. <u>Reducing assets</u> (e.g., selling selected buildings, equipment, proprietary rights, or other assets—in order to generate enough cash to continue operating).

   c. <u>Increasing revenues</u> (making a last-ditch effort to increase sales without incurring increased expenses—e.g., by reintroducing products dropped earlier, selling to new geographic markets or market segments, and taking on subcontract business).

   d. <u>Selective product/market pruning</u> (e.g., dropping unprofitable products, reducing product line depth and/or breadth, dropping products that are meeting decreasing demand and stiff competition, and dropping products that have a competitive disadvantage).

If problems are relatively mild, a revenue push and a cost-cutting effort may suffice. However, if the problems are serious, major turnaround efforts may be necessary.

2. <u>Divestiture</u> — Selling an ailing subsidiary, division, subdivision, or product line (in order to shed a loser and/or generate cash).

3. <u>Liquidation</u> — Selling out or closing a failing enterprise (usually when the alternative is bankruptcy).

4. <u>Captive company</u> — Selling the majority of products to a single customer—preferably to a "captor" who is is friendly, supportive, and strong in the market.

Combination Strategy

This involves using some combination or sequence of the above strategies.

1. Using two or more strategies at the same time. *Examples*:

   a. Grow through diversification of the present line, acquisitions, and joint ventures.
   b. Retrench through reducing costs, pruning losing products, and divesting.

2. Using two or more strategies in some sequence. *Examples*:

   a. Utilize the stable growth strategy in the short term (perhaps to retire debt, to build financial resources, to solidify market position, and/or to develop new products and programs), and then embark on the more aggressive significant/accelerated growth strategy over the intermediate and long terms.

   b. Use the pause substrategy to regroup in the short term, and then, in the intermediate and long terms, return to the significant/accelerated growth strategy.

   c. Try the turnaround substrategy first (in the short term), and then, if that does not work, either divest, become a captive, or liquidate (in the intermediate term).

Perspectives on the Above Strategies

Stable growth and significant/accelerated growth strategies tend to revolve around marketing-oriented approaches (but can also involve R&D, production, facilities, and financial considerations). This is particularly true of the significant/accelerated growth strategy, which generally embodies more aggressive marketing approaches. On the other hand, because the stable growth strategy is not as aggressive, it can often lead an organization toward the need to use more defensive strategies (against the industry leaders, who tend to use the significant/accelerated growth strategy).

By contrast, the retrenchment stends to be less marketing-oriented and generally places greater emphasis on increasing productive efficiency, improving performance, and improving financial conditions.

Combination strategies usually involve the use of several substrategies.

Perspectives on Strategies at Organizational and Unit/Departmental Levels

The grand strategies and associated substrategies discussed above are essentially organizational strategies. As shown in **Figure 7-A** on page PP-4, they are derived from (formulated based on) organizational goals. In turn, they are translated into broad organizational tactics and programs and projects.

Units such as the marketing, R&D, production, human resources, and financial departments usually have their own, more specific strategies. As shown in **Figure 7-B** on page PP-5, unit strategies are influenced by (are refined derivations or translations of) both organizational strategies/tactics and specific unit/departmental goals. For example, if the overall organizational strategy were significant/accelerated growth, certain units/departments might have these "functional" (unit/departmental) strategies:

Marketing department: Significantly increase unit sales by (a) increasing the sales of the present line, and (b) diversifying into related product lines.

R&D department: Support the marketing effort by (a) designing products similar to competitors' products (without infringing on patents), or (b) originate designs that leapfrog competitors' designs.

Production department: Support increased sales by (a) increasing production capacity for the present line, and (b) acquiring the capability to produce other lines.

Finance department: Support increased operations by (a) increasing long-term debt to finance facilities expansion, and (b) increase working capital to support marketing, R&D, and production requirements.

Figures 7-A and 7-B also show that there can be organizational and unit/departmental strategies dealing with facilities, structural change, human resources, and financial matters. These are generally influenced by (translations of) organizational and unit/departmental facilities, structural, human resources, and financial goals.

Note that, just as marketing goals tend to influence other goals, marketing-oriented strategies tend to influence R&D, pProduction, human resources, and financial strategies.

Tactics

These are more specific or detailed means (smaller scale maneuvers or actions) for accomplishing specific goals (within the context of broader strategies). They constitute the specific "WHAT To Do" in order to meet long- and short-term goals. Like strategies, they are usually competitively oriented.

As shown in **Figures 7-A and 7-B**, tactics . . .

a. are derived from (formulated based on) strategies and substrategies;
b. are aimed at supporting strategies and substrategies; and
c. provide a context for formulating (and implementing) programs and projects.

(Market-oriented) organizational tactics can be placed into three major groups, each having a military connotation: offensive or attack; preemptive; and defensive. Associated with each are several alternative subtactics.

Offensive/Attack Tactics

These tactics are generally used in conjunction with the significant/accelerated growth strategy.

1. Target(s) of attack

   a. Attack the market leader(s)
   b. Attack enterprise(s) of similar size
   c. Attack smaller/smallest firm(s)

2. Approach(es) employed

   a. Frontal attack — pitting strength(s) against strength(s). [As a rule of thumb, "going head to head" with a (strong) competitor usually requires using two to three times the resources that the competitor can bring to bear.]

   b. Flanking attack — pitting strength(s) against a competitor's weakness(es).

   c. Encirclement — attacking on all fronts (product, pricing, promotion, etc.).

   d. Bypass attack — going into products or geographical areas in which the competition is not active.

   e. Guerilla warfare — harrassing and demoralizing the competition (e.g., confounding the competitor's test markets).

Preemptive Tactics

These tactics are generally used in conjunction with significant/accelerated growth strategies.

They are aimed at gaining early competitive advantages over competitors (and keeping them at a disadvantage) by blocking any of the the following points along the industry chain: supply systems; product; production; customers; and distribution/service systems.

Preemptive tactics have several characteristics:

   a. They can exploit competitors' strengths as well as weaknesses.
   b. To work, they need not preempt all competitors.
   c. Their benefits are not permanent; competitors will respond sooner or later.
   d. They are not risk free.

To be most effective, a preemptive move should also have these characteristics:

   a. It should be possible to occupy the preemptive position quickly.
   b. Once the move has been made, it should be difficult for rivals to follow.
   c. Circumstances should exist that will slow the rate at which any rivals can respond.
   d. The move should be easily reversible.
   e. The move should be legal.

Preemptive tactics can be utilized in various areas:

1. **Preemptive Supply Systems Tactics**

   a. Secure main or sole access to materials/parts sources (e.g., make a major source a captive supplier; obtain a long-term contract for a high % of the major source's output).

   b. Preempt materials/parts processing/production capabilities (e.g., patent the equipment/process; buy the patent(s); acquire the major or sole producer of production equipment).

   c. Dominate supply logistics system(s) (e.g., obtain priority access with shippers).

2. **Preemptive Product-Related Tactics**

   a. Introduce new product line(s) (e.g., be first and become known as a successful innovator).

   b. Develop a dominant design (e.g., develop a design that incorporates all the desirable features/benefits, and, in effect, embodies the next generation of designs).

   c. Position product (e.g., establish dominance in a market segment that is characterized by a particular price range, geographic market area, set of customer demographics, etc.).

   d. Secure accelerated approval from authorities (e.g., in regulated industries, gain virtual exclusivity in the marketplace by obtaining early approval/licensing).

   e. Secure product research and development skills (e.g., recruit and/or hire away the most skilled and/or innovative R&D and engineering specialists).

f. <u>Expand scope of the product</u> (e.g., offer one-stop service, market-basket sourcing, package or tie-in deals, etc.).

3. **<u>Preemptive Production Systems Tactics</u>**

a. <u>Establish proprietary ownership</u> (e.g., obtain patents on equipment/machinery and/or the production process).

b. <u>Expand capacity aggressively</u> (e.g., expand ahead of demand in order to intimidate and discourage less aggressive or resource-capable rivals from adding capacity).

c. <u>Integrate with key suppliers</u> (e.g., acquire or merge with major suppliers).

d. <u>Secure critical production skills</u> (e.g., recruit and/or hire away the most skilled production engineering and manufacturing specialists).

4. **<u>Preemptive Market/Customer-Oriented Tactics</u>**

a. <u>Establish dominance in a particular market segment</u> (characterized by a particular product type, price range, customer profile, channel of distribution, etc.).

b. <u>Capture key accounts</u> (e.g., by offering special pricing deals, special services, guaranteed delivery, guaranteed replacement/return, etc.).

c. <u>Build early/dominant brand awareness/loyalty</u> (especially with major, opinion-leading customers (e.g., by promoting heavily, offering special deals and/or services, and guaranteeing performance).

5. **<u>Preemptive Distribution/Service Systems Tactics</u>**

a. <u>Occupy prime locations</u> (in regions, states, counties, metro areas, neighborhoods).

b. <u>Develop exclusive or preferential relationships with key distributors</u>.

c. <u>Dominate distribution logistics</u> (e.g., establish a well-designed and well-deployed warehousing and shipping system).

d. <u>Gain/deny access to superior service facilities</u> (e.g., establish a network of superior facilities, acquire a leading service network organization, or develop an exclusive relationship with such an organization).

e. <u>Develop distributors' skills and loyalty</u> (e.g., by providing business and/or technical training — at company schools).

Defensive Tactics

These are generally used in conjunction with Stable Growth and Retrenchment Strategies.

1. <u>Position defense</u> — involves fortifying the front line (e.g., improving the competitiveness of elements that are key to success—such as the product line itself, pricing, the R&D effort, distribution efforts, etc.).

2. <u>Mobile defense</u> — involves employing an in-depth or across-the-board defense (in terms of all competitive aspects, including R&D, production, facilities, marketing, and financial resources).

3. <u>Preemption</u> — involves employing the offense as the "best defense." (See preemptive tactics.)

4. <u>Flank defense</u> — involves hedging bets (e.g., by diversifying, and fortifying markets).

5. <u>Counteroffensive</u> — involves using offensive/attack tactics in order to retalliate and/or intimidate.

6. <u>Hedgehog defense</u> — involves making a "tactical withdrawal." (See divestment and selective pruning substrategies.)

Perspectives on Tactics

Like strategies, many if not most tactics tend to revolve around market-related (competitive) considerations. This, of course, is especially true of marketing tactics.

Figures 7-A and 7-B indicate the following: Organizational strategies for various areas are usually translated into general/broad organizational tactics for those areas. In turn, organizational tactics are used to influence the formulation of more specific unit/departmental tactics (which are also

influenced by unit-specific strategies). For example, if departmental strategies and tactics were geared to an organizational significant/accelerated growth strategy, the various departments might adopt these and other tactics:

Marketing department: (a) use a flanking approach to attack competitors of similar size; (b) preempt product line markets by capturing key accounts; and/or (c) preempt distribution/ service systems.

R&D department: (a) preempt products by developing a dominant design; (b) obtain intelligence concerning competitors' present and future designs; and/or (c) establish particularly advantageous relationships with university research teams.

Production department: (a) expand capacity aggressively with respect to new product lines; (b) develop state-of-the-art machinery/processes (perhaps by establishing particularly close relationships with machinery manufacturers); and/or (c) obtain priority access with materials/parts shippers.

Finance department: (a) issue stock; (b) negotiate a larger line of credit; (c) decrease inventories and account receivable; and/or (d) borrow funds.

Note in Figures 7-A and 7-B that there can also be physical resources (facilities/equipment) tactics, structural change or modification tactics, and human resources (staffing and development) tactics.

Programs and Projects

Programs are essentially large or broad, structured (coordinated) undertakings that constitute the broad "HOW To" for reaching goals. They . . .

a. involve groups of people;
b. are derived from (formulated based on) goals, strategies, and tactics;
c. are aimed at actually implementing strategies and tactics (so as to achieve goals); and
d. provide contexts and frameworks for formulating more detailed plans of action.

For example, an organization might create a program to reduce costs organization-wide, a program to introduce a new product line, a program to expand its oper-

ating facilities, or a program to generate more operating capital.

Projects are essentially subsets or component parts of programs.

For example, an organizational program to introduce a new product line might include the following: an R&D project to design the product line; an engineering project to design production facilities; and a marketing project to establish means for introducing the product line into the marketplace (perhaps through sub-projects involving pricing, packaging, promotion, and distribution).

Note that a program or project . . .

a. is established to . . . (accomplish something); and
b. has a name that broadly describes the nature, scope, and end result of some group effort.

Figures 7-A and 7-B on pages PP-4 and PP-5 indicate the following:

a. Broad organizational programs/projects in various areas are formulated based on organizational strategies and tactics for those various areas.

b. Units/departments can have their own program and projects. Many if not most of these, however, are formulated based on broad organizational programs and projects, portions of which are assigned to the appropriate responsibility centers. Others are formulated based on specific unit/departmental strategies and tactics (which may also be related to, or sub-sets of, organizational strategies and tactics).

Plans of Action

Plans of action are predetermined, coordinated sequences of specific steps (tasks or activities) for actually carrying out and completing undertakings (such as programs and projects). Thus, they constitute the specific "HOW To" for implementing programs/projects and reaching goals.

Well-conceived programs and projects—whether organizational or functional (unit/departmental)—contain plans of action for their implementation. In other words, plans of

action are not really separate from programs or projects. They are an integral part of them—or at least they should be.

Without doing formal planning of this kind, people usually have only vague impressions of how to proceed. It is during the process of formulating plans of action that the following are actually crystallized and then outlined or specified:

    a. what specific activities are to be performed;
    b. who is responsible for performing which tasks or activities;
    c. the logical, effective, and efficient sequences of activities to be performed;
    d. who must do what before someone else can do something.

Plans for implementing programs or projects—and even plans for implementing solutions to day-to-day problems—can be extremely complicated. For this reason, a number of planning tools have been developed to help people outline, coordinate, perform, and keep track of activities. These tools are essentially visual diagrams or models of activities. The major tools are Gantt (bar) charts, CPM (Critical Path Method) networks, and PERT (Program Evaluation and Review Technique) networks. We will discuss bar charts and PERT networks immediately after describing several other types of plans.

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Types of Plans
In Terms of
to Whom and What They Apply

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In terms of <u>to whom</u> they apply, plans can be categorized as (broad/general) organizational plans, (unit- or sub-unit-specific) functional/departmental plans, or individual plans. In terms of <u>to what</u> they apply, plans can also be categorized as (specific types of) operating plans or (specific types of) resources/structural plans.

All of these types of plans can be formulated for the long term, the intermediate term, and/or the short term. Thus, they can also be categorized as long-term, intermediate-term, or short-term.

Here the term "plans" is used in an all-inclusive manner. It refers to groups or sets of related strategies, tactics, programs and projects, and plans of action. (When some peo-

ple use this term, they are including goals along with these plans. We prefer not to do so.)

Since an organization and its units can have the same types of plans, it is important to specify the particular type to which one is referring. Not being specific causes confusion.

Organizational Plans

"Organizational plans" is an encompassing term. It refers to the sets of broad or general strategies/tactics and associated programs/projects that are aimed at enabling an organization to achieve its goals (desired end results or levels of performance) in various operational areas and in various supporting resources/structural areas.

Organizational/Corporate Operating Plans

These sets of broad or overall organizational strategies, tactics, programs, and projects are aimed at actually bringing about desired end results in various operational areas.

A. **Organizational/Corporate "Profitability Plan"**: Especially when they are highly concerned about their profitability, some organizations develop what they call a "profitability plan." Rather than being a single plan, this is actually a package containing (a) operating and resources/structural goals, and (b) the various associated operating and resources/structural plans described below. Such a package focuses almost entirely on achieving some desired level of profitability.

B. **Organizational/Corporate Marketing Plans**: This set of broad or general organizational strategies/tactics and supporting programs/projects deals with ways and means for actually bringing about the desired level(s) of, for example, total unit sales, total sales revenue, and/or market share.

    1. As shown by the two downward-pointing bold arrows in the two top panels of Figure 7-A on page PP-4, the formulation of broad organizational marketing strategies/tactics is primarily based on (a) more basic organizational strategies/tactics relating to either stable growth, significant/accelerated growth, or retrenchment, and (b) basic organizational marketing goals. However, as indicated by light arrows in the second panel,

their formulation can also be influenced by organizational strategies/tactics in other operational areas (and in certain resources/structural areas).

2. In turn, as shown by the single downward-pointing bold arrow from the second panel to the third panel in Figure 7-A, the formulation of broad organizational marketing programs/projects is primarily based on broad organizational marketing strategies/tactics. However, as shown by the light arrows in the third panel, their formulation can also be influenced by (a) broader organizational programs/projects (such as those relating to cost cutting or expansion), and (b) organizational programs/projects in other operational areas (and in certain resources/structural areas).

C. **Organizational/Corporate Innovation Plans**: This set of broad or general organizational strategies/tactics and supporting programs/projects can be aimed at actually bringing about innovations in several areas. These areas can include: research and development (e.g., the development of new products and/or technologies; marketing (e.g., the development of new marketing techniques); production (e.g., the development of new processes and/or machinery); and organizational structure/systems (e.g., the modification of organizational structure and/or the development of new information, compensation, and performance appraisal systems). Nevertheless, since many organizations' innovation plans mostly revolve around the R&D area, we will focus on organizational R&D strategies/tactics and programs/projects. (Innovations in other areas are generally incorporated into those areas' goals, strategies/tactics, and programs/projects.)

1. As shown by the downward-pointing bold arrow in the two top panels of Figure 7-A, the formulation of broad organizational R&D strategies/tactics is primarily based on organizational R&D goals. However, as indicated by light arrows in the second panel, their formulation can also be influenced by (a) more basic organizational strategies/tactics relating to growth or retrenchment, and (b) organizational strategies/tactics in other operational areas (and in certain resources/structural areas).

2. In turn, as shown by the single downward-pointing bold arrow from the second panel to the third panel in Figure 7-A, the formulation of broad organizational R&D programs/projects is primarily based on broad organizational R&D strategies/tactics. However, as shown by the light arrows in the third panel, their formulation can also be influenced by (a) broader organizational programs/projects (such as those relating to cost cutting or expansion), and (b) organizational programs/projects in other operational areas (and in certain resources/structural areas).

D. **Organizational/Corporate Productivity Plans**: Like the previous set, this set of broad or general organiza-

tional strategies/tactics and supporting programs/projects can be aimed at actually bringing about productivity or performance improvements in several areas. However, many if not most organizations' Productivity Plans deal with the production (or service) area. (Productivity or performance improvements in other areas are generally incorporated into those areas' goals, strategies/tactics, and programs/projects.)

1. As shown by the downward-pointing bold arrow in the two top panels of Figure 7-A, the formulation of broad organizational production (or service) strategies/tactics is primarily based on organizational production (or service) goals. However, as indicated by light arrows in the second panel, their formulation can also be influenced by (a) more basic organizational strategies/tactics relating to growth or retrenchment, and (b) organizational strategies/tactics in other operational areas (and in certain resources/structural areas).

2. In turn, as shown by the single downward-pointing bold arrow from the second panel to the third panel in Figure 7-A, the formulation of broad organizational production (or service) programs/projects is primarily based on broad organizational production (or service) strategies/tactics. However, as shown by the light arrows in the third panel, their formulation can also be influenced by (a) broader organizational programs/projects (such as those relating to cost-cutting or expansion), and (b) organizational programs/projects in other operational areas (and in certain resources/structural areas).

E. **Organizational/Corporate Social Responsibility Plans**: This set of broad or general organizational strategies/tactics and supporting programs/projects deals with ways and means for carrying out an organization's perceived public responsibilities.

1. As shown by the downward-pointing bold arrow in the two top panels of Figure 7-A, the formulation of broad organizational social strategies/tactics is primarily based on organizational public responsibility goals. However, as indicated by light arrows in the second panel, their formulation can also be influenced by (a) more basic organizational strategies/tactics relating to growth or retrenchment, and (b) organizational strategies/tactics in other operational areas (and in certain resources/structural areas).

2. In turn, as shown by the single downward-pointing bold arrow from the second panel to the third panel in Figure 7-A, the formulation of broad organizational social programs/projects is primarily based on broad organizational social strategies/tactics. However, as shown by the light arrows in the third panel, their formulation may also be influenced by (a) broader organizational programs/projects (such as those relating to cost cutting or expansion), and (b) organizational programs/projects in other operational areas (and in certain resources/structural areas).

**Organizational/Corporate
Resources/Structural Plans**

These sets of broad or overall organizational strategies, tactics, programs, and projects are aimed at actually bringing about the desired results in various resources/structural areas—areas that support or facilitate efforts to implement organizational operating plans and achieve organizational operating goals.

A. **Organizational/Corporate Physical Resources Plans** This set of broad or general organizational strategies/tactics and supporting programs/projects deals with designing/developing, procuring, and constructing/installing physical resources such as offices, warehouses, sales or service centers, computer hardware, plant facilities, machinery, and equipment.

1. As shown by the downward-pointing bold arrow in the two top panels of Figure 7-A, the formulation of broad organizational physical resources strategies/tactics is primarily based on organizational physical resources goals. However, as indicated by light arrows in the second panel, their formulation also tends to be influenced by organizational strategies/tactics in operational areas (and can be influenced by organizational strategies/tactics in other resources/structural areas).

2. In turn, as shown by the single downward-pointing bold arrow from the second panel to the third panel in Figure 7-A, the formulation of broad organizational physical resources programs/projects is primarily based on broad organizational physical resources strategies/tactics. However, as shown by the light arrows in the third panel, their formulation also tends to be influenced by organizational programs/projects in operational areas (and can be influenced by organizational programs/projects in other resources/structural areas).

B. **Organizational/Corporate Structural/Systems Plans**: This set of broad or general organizational strategies/tactics and supporting programs/projects deals with actually (a) modifying the organizational structure, and (b) improving internal systems (such as the information, control, procurement, goal-setting and planning, and performance evaluation systems).

1. As shown by the downward-pointing bold arrow in the two top panels of Figure 7-A, the formulation of broad organizational structural/systems strategies/tactics is primarily based on organizational structural/systems goals. However, as indicated by light arrows in the second panel, their formulation also tends to be influenced by organizational strategies/tactics in operational areas (and can be influenced be organizational strategies/tactics in other resources/structural areas).

2. In turn, as shown by the downward-pointing bold arrow from the second panel to the third panel in Figure 7-A, the formulation of broad organizational structural/systems programs/projects is primarily based on broad organizational structural/systems strategies/tactics. However, as shown by the light arrows in the third panel, their formulation also tends to be influenced by organizational programs/projects in operational areas (and can be influenced by organizational programs/projects in other resources/structural areas).

C. **Organizational/Corporate Human Resources Plans**: This set of broad or general organizational strategies/ tactics and supporting programs/projects deals with ways and means for actually bringing about desired results involving, for example, (a) the staffing of managerial/supervisory, technical/professional, staff/clerical, and workforce positions; (b) the development of a participative organizational atmosphere; (c) personnel's training and development; (d) personnel's job satisfaction (motivation/morale); and (e) personnel's compensation.

1. As shown by the downward-pointing bold arrow in the two top panels of Figure 7-A, the formulation of broad organizational human resources strategies/tactics is primarily based on organizational human resources goals. However, as indicated by light arrows in the second panel, their formulation also tends to be influenced by organizational strategies/tactics in operational areas (and can be influenced by organizational strategies/tactics in other resources/structural areas).

2. In turn, as shown by the single downward-pointing bold arrow from the second panel to the third panel in Figure 7-A, the formulation of broad organizational human resources programs/projects is primarily based on broad organizational human resources strategies/tactics. However, as shown by the light arrows in the third panel, their formulation also tends to be influenced by organizational programs/projects in operational areas (and can be influenced by organizational programs/projects in other resources/structural areas).

D. **Organizational/Corporate Financial Plans**: This set of broad or general organizational strategies/tactics and supporting programs/projects deals with ways and means for actually bringing about desired results involving assets, liabilities, cash flow, financial ratios, stock ownership, stock prices, and related financial matters.

1. As shown by the downward-pointing bold arrow in the two top panels of Figure 7-A, the formulation of broad organizational financial strategies/tactics is primarily based on organizational financial goals. However, as indicated by light arrows in the second panel, their formulation is also influenced by organizational strategies/tactics in operational areas and in other resources/structural areas.

2. In turn, as shown by the single downward-pointing bold arrow from the second panel to the third panel in Figure 7-A, the formulation of broad organizational financial programs/projects is primarily based on broad organizational financial strategies/tactics. However, as shown by the light arrows in the third panel, their formulation is also influenced by organizational programs/projects in operational areas and in other resources/structural areas).

Unit and Sub-Unit Plans (Functional Plans)

Since units and sub-units perform specialized functions or responsibilities, their plans are commonly called either "unit and sub-unit plans," "functional plans," or "departmental plans." All of these terms refer to the unit- and sub-unit-specific sets of strategies, tactics, programs, projects, and plans of action that outline ways and means for enabling units and sub-units to achieve their goals (desired end results or levels of performance) in their own specialized operational areas and in various supporting resources/structural areas.

In organizations that use the top-down/bottom-up goal-setting and planning process illustrated in **Figure 8** (page PP-6), the following points apply to the top-down steps of the process:

a. Major units translate their unit-specific goals into unit-specific plans after . . .
   1. (tentative) organizational goals and plans have been formulated for the organization as a whole;
   2. (tentative) organizational goals and plans have been translated into guideline goals and plans for the major units; and
   3. the major units have more fully developed and refined their (guideline) goals.

b. In their turn, sub-units translate their sub-unit-specific goals into sub-unit-specific plans after ...
   1. the major units have translated their goals and plans into guideline goals and plans for each of their sub-units; and
   2. the sub-units have more fully developed and refined their (guideline) goals.

While the formulation of major units' plans is directly influenced by broad organizational plans, the formulation of sub-units' plans is less directly influenced by organiza-

tional plans and more directly influenced by the more detailed and unit-specific plans of the higher-level units (or sub-units) of which they are sub-units.

Unit/Sub-Unit (Functional) Operating Plans

These unit- and sub-unit-specific sets of strategies, tactics, programs, projects, and plans of action outline ways and means for actually bringing about desired end results in various operational areas.

Because all units and sub-units perform their own specialized functions or operations, they can and should have such plans. This applies to line/operating units (such as the marketing and production divisions/departments), to staff units (such as the finance and human resources departments), and to the sub-units of these major units.

Unit/sub-unit operating plans normally deal with specialized functional operations. However, as indicated in **Figure 7-B** (page PP-5) by the letters "P," "I," and "SR" underneath the departmental boxes, they can include unit- and sub-unit-specific innovation plans and social responsibility plans.

A. **Unit/Sub-Unit (Functional) Productivity/Performance (Operating) Plans**: These unit- and sub-unit-specific sets of strategies/tactics and supporting programs, projects, and plans of action outline ways and means for actually bringing about desired results in the units' or sub-units' specialized areas of responsibility.

   1. Marketing department performance/productivity (Operating) plans: Marketing department operating strategies/tactics and supporting programs, projects, and plans of action usually deal with changing or improving "marketing mix" factors (product design, packaging, pricing, promotion, and distribution), all of which influence sales and market standing.

   2. Research and development department performance/productivity (Operating) plans: R&D department operating strategies/tactics and supporting programs, projects, and plans of action outline ways and means for actually bringing about technological, product, and/or process innovations.

3. <u>Production/service department performance/productivity (operating) plans</u>: These departmental operating strategies/tactics and supporting programs, projects, and plans of action outline ways and means for actually bringing about changes or improvements in materials, materials handling, manufacturing/assembly processes, machine operation, service operations, and other production (or service) factors—all of which influence product (or service) quality and operational efficiency.

As shown in **Figure 7-B**, the three line/operating units mentioned above develop their unit-specific plans based on several inputs:

a. As indicated by the three downward-pointing bold arrows from the top panel to the second panel, and by the rightward-pointing bold arrow at the edge of the second panel, the formulation of marketing department, R&D department, and production/service department operating strategies/tactics is primarily influenced by (a) refined, unit-specific marketing department, R&D department, and production/service department operating goals (respectively); and (b) unit-oriented guideline translations of broad organizational market-related, R&D, and production/service strategies/tactics (respectively). However, as indicated by the light arrows in the second panel, their formulation can (should) also be influenced by the operating strategies/tactics of other major units.

b. In turn, as indicated by the three downward-pointing bold arrows from the second panel to the third panel, and by the rightward-pointing bold arrow at the left edge of the third panel, the formulation of marketing department, R&D department, and production/service department operating programs, projects, and plans of action is influenced by (a) marketing department, R&D department, and production/service department operating strategies/tactics (respectively); and (b) unit-oriented translations of broad organizational market-related, R&D, and production/service programs and projects (respectively). However, as indicated by the light arrows in the third panel, their formulation can (should) also be influenced the operating programs and projects of other major units. (In turn, as shown by the downward-pointing bold arrows from the third to the fourth panel, the formulation of these departments' operating budgets is largely based on their departmental operating programs/projects.)

c. Later in the top-down portion of the organizational process illustrated in **Figure 8** (page PP-8), these departments' operating strategies/tactics and supporting programs, projects, and plans of action are translated into guideline operating strategies/tactics and supporting programs, projects, and plans of action for sub-units such as the sales and advertising departments, the research and the development departments, and the engin-

eering, manufacturing, and shipping departments (respectively).

4. <u>Human resources department performance/productivity (operating) plans</u>: These departmental operating strategies/tactics and supporting programs, projects, and plans of action outline ways and means for actually bringing about the desired results in areas such as staffing, training and development, and compensation.

5. <u>Finance department performance/productivity (operating) plans</u>: These departmental operating strategies/tactics and supporting programs, projects, and plans of action outline ways and means for actually changing or improving results involving assets, liabilities, financial ratios, and other financial matters.

As shown in **Figure 7-B**, the two staff units mentioned above develop their unit-specific plans based on additional inputs:

a. As indicated by the two downward-pointing bold arrows from the top panel to the second panel, and by the rightward-pointing bold arrow at the left edge of the second panel, the formulation of human resources department and financial department operating strategies/tactics is largely influenced by (a) refined, unit-specific human resources department and finance department operating goals (respectively), and (b) unit-oriented guideline translations of broad organizational human resources and financial strategies/tactics (respectively). However, as indicated by the light arrows in the second panel, their formulation is also largely influenced by the human resources and financial strategies/tactics of other major units (especially line/operating units).

b. In turn, as indicated by the two downward-pointing bold arrows from the second panel to the third panel, and by the rightward-pointing bold arrow at the left edge of the third panel, the formulation of human resources department and financial department operating programs, projects, and plans of action is influenced by (a) human resources department and financial department operating strategies/tactics (respectively), and (b) unit-oriented guideline translations of broad organizational human resources and financial programs and projects (respectively). However, as indicated by the light arrows in the third panel, their formulation is also largely influenced by the human resources and financial programs and projects of other units (especially the line/operating units). (In turn, as indicated by the downward-pointing bold arrows from the third to the fourth panel, the formulation of these departments' operating budgets is largely based on their departmental operating programs and projects.)

c. Later in the Top-Down portion of the Organizational Process illustrated in Figure 8, these departments' operating strategies/tactics and supporting programs, projects, and plans of action are translated into guideline operating strategies/ tactics and supporting programs, projects, and plans of action for sub-units such as the Employment and Training Departments and the Accounting and Data Processing Departments (respectively).

B. **Unit/Sub-Unit (Functional) Innovation Plans**: In some organizations, units have their own unit- or sub-unit-specific sets of strategies, tactics, programs, projects, and plans of action that outline ways and means for actually bringing about beneficial innovations in their specialized responsibility areas.

C. **Unit/Sub-Unit (Functional) Social Responsibility Plans**: In general, units and sub-units do not have their own social responsibility plans. Most organizations assign their social programs and projects to the human resources or personnel department for implementation.

Unit/Sub-Unit Resources/Structural Plans

These unit- and sub-unit-specific sets of strategies, tactics, programs, projects, and plans of action outline ways and means for actually bringing about desired results in various operations-supporting resources and structural areas.

These sets of plans are denoted in **Figure 7-B** (page PP-5) by the letters "FE" (for facilities/equipment or physical resources plans), "SS" (for structural/systems plans), "HR" (for human resources plans), and "F" (for financial plans) underneath the departmental boxes.

A. **Unit/Sub-Unit (Physical Resources) Facilities/ Equipment Plans**: These unit- and sub-unit-specific sets of strategies/tactics and supporting programs, projects, and plans of action outline ways and means for actually bringing about changes or improvements in the facilities and equipment utilized by specialized units and sub-units. Individual units and sub-units usually have such plans. However, in many organizations, certain aspects of these plans—such as those pertaining to design and procurement—are consolidated at the end of the top-down/bottom-up process and are actually administered by the engineering and/ or purchasing department(s).

B. **Unit/Sub-Unit Structural/Systems Plans**: These unit- and sub-unit-specific sets of strategies/tactics and supporting programs, projects, and plans of action outline ways and means for actually bringing about changes or improvements in the structure and internal systems of units and sub-units. Individual units and sub-units often have such plans. However, in many if not most organizations, certain aspects of these plans—such as those that will affect organization-wide structures and systems—are consolidated at the end of the top-down/bottom-up process and are implemented in a coordinated, systemic manner. Units and sub-units are permitted to implement those aspects of their structural/systems plans that will not adversely affect operations in, or working relationships with, other units and sub-units.

C. **Unit/Sub-Unit Human Resources Plans**: These unit- and sub-unit-specific sets of strategies/tactics and supporting programs, projects, and plans of action outline ways and means for actually bringing about changes or improvements that mostly involve staffing positions, training and developing personnel, and establishing more satisfying jobs and working conditions. Individual units and sub-units usually have such plans. However, in many if not most organizations, certain aspects of these plans—such as those involving hiring, compensating, and training personnel—are consolidated at the end of the top-down/bottom-up process and are actually administered by the human resources or personnel department.

D. **Unit/Sub-Unit Financial Plans**: These unit- and sub-unit-specific sets of strategies/tactics and supporting programs, projects, and plans of action outline ways and means for actually achieving financially-oriented results that will contribute to organizational financial goals. In general, most individual units and sub-units do not have their own financial plans—unless they are large, autonomous profit centers such as GM Divisions. Normally, an organization's finance department administers organizational financial plans, which take into account the financial resources needed to sustain units' and sub-units' operations.

Figure 7-B on page PP-5 illustrates the following:

a. As indicated by the downward-pointing bold arrows from the top panel to the second panel, and by the rightward-pointing bold arrow at the left edge of the second panel, units' development of detailed, unit-specific facilities/equipment, structural/systems, human resources, and (perhaps) financial strat-

egies/tactics is largely based on (a) the unit-specific goals that they have developed for these areas, and (b) unit-ori-ented guideline translations of organizational resources/structural strategies/tactics for these areas.

b. In turn, as indicated by the downward-pointing bold arrows from the second panel to the third panel, and by the rightward-pointing bold arrow at the left edge of the third panel, units' development of detailed, unit-specific facilities/equipment, structural/systems, human resources, and (perhaps) financial programs, projects, and plans of action is largely based on (a) the strategies/tactics that they have developed for these areas, and (b) unit-oriented guideline translations of organizational resources/structural programs/projects for these areas. (In turn, as indicated by the downward-pointing bold arrows from the second to the third panel, units' development of resources/structural budgets for these areas is largely based on their departmental resources/structural programs and projects in these areas).

c. Later in the top-down portion of the organizational process illustrated in **Figure 8** (page PP-8), major units translate their resources/structural strategies/tactics and supporting programs, projects, and plans of action for these areas into guideline resources/structural strategies/tactics and supporting programs, projects, and plans of action for their sub-units.

Individual Plans

At the end of the top-down portion of the organizational process in **Figure 8**, individual plans are developed by each individual and his/her immediate superior based on (a) individual goals, and (b) individual-oriented guideline translations of unit or sub-unit plans in various areas.

Individual Performance Plans

These individualized plans outline ways and means for actually achieving the kinds of performance goals mentioned on page GS-14. While they sometimes summarize the timing and sequences of tasks or activities that the individual is to perform during the implementation of his/her unit's or sub-unit's various (operational) projects, they usually outline performance-enhancing steps that the individual is to take in order to, for example, improve personal work procedures, improve equipment maintenance, reduce personal errors, and minimize materials costs. (The less technical and more developmental and motivational aspects of performance improvement are generally covered in the next two sets of plans.)

Individual Development Plans

These individualized plans deal with ways and means for actually achieving the kinds of developmental goals mentioned on page GS-14. While they sometimes outline career/promotion strategies and long-term development programs, they usually contain an annual training program that schedules formal and on-the-job training sessions aimed at developing various technical/professional and/or supervisory/managerial skills.
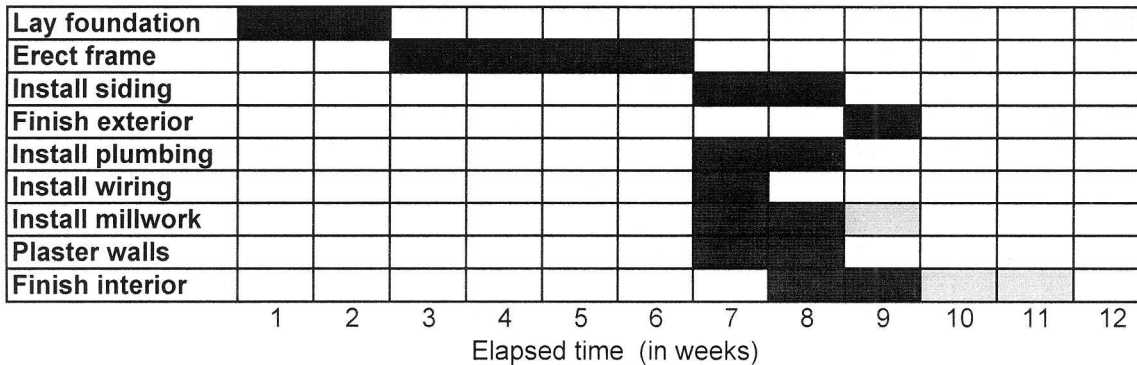
Individual Satisfaction Plans

These individualized plans deal with ways and means for actually achieving the kinds of satisfaction goals mentioned on page GS-14. In general, rather than containing any strategies, tactics, or programs, they simply outline job-related and interpersonal activities that can help increase the individual's job satisfaction, morale, and motivation.

Figure 10: Simplified Gantt (Bar) Chart for the Construction of a House

	1	2	3	4	5	6	7	8	9	10	11	12
Lay foundation	██	██										
Erect frame			██	██	██	██						
Install siding							██	██				
Finish exterior									██			
Install plumbing							██	██				
Install wiring							██					
Install millwork							██	██	░░			
Plaster walls							██	██				
Finish interior								██	░░	░░	░░	

Elapsed time (in weeks)

Planning Tools

Introduction

One of the main reasons for using these tools is the same as that for using analytic tools: they put information into a visual, diagramatic format that enables individuals to think about, keep track of, and communicate an enormous number of details. In the case of planning, the information includes: (a) activities; (b) who is responsible for which activities; (c) events (start and completion times of activities); (d) time frames of activities; and (e) sequences of activities.

Here we will describe two types of diagrams: Gantt charts and PERT networks. These diagrams are widely used to plan and then control large, complex projects. They break down a project into a number of simpler parts: (a) subprojects; (b) work packages (series of similar or directly related activities); and/or (c) more finite or specific activities. Such diagrams can also be used—and should be used more often—to plan, and to manage the implementation of, solutions to everyday problems.

Gantt Charts

Also called bar charts, these were developed in the early 1900s by Henry L. Gantt,[28] a pioneer in scientific management. They illustrate the performance of various activities over time (from left to right). Note the following **in Figure 10**:

a. A bar denotes either a specific activity or a work package. The left end of a bar denotes the activity's start time; the right end denotes its completion time. The length of a bar denotes the scheduled time frame for the activity. (It should be noted that the work packages in Figure 10 can be broken down into more finite activities. For example, erecting the frame can be broken down into erecting the walls and erecting the roof frame.)

b. Time frames are indicated shown along the bottom of the chart. Although elapsed time is generally shown in weeks, it can also be shown in days, months, or even years. As shown in **Figure 10**, the construction of the house occurs over a twelve-week period.

c. During some time frames, only one activity can be performed (e.g., laying the foundation during weeks 1 and 2, and erecting the frame during weeks 3 through 6). During other time frames, a number of activities can be performed concurrently—e.g., installing millwork (shelving, cabinets, interior doors, etc.), installing wiring, installing plumbing, plastering walls, and finishing the interior. Activities can be performed concurrently to the extent that it is possible for them to overlap. (For example: Plumbing and wiring must ordinarily be done before interior walls can be plastered;

Figure 11: Gantt-Like Project Schedule with Milestones
(Adapted version of a product development schedule for a personal copy machine)[29]
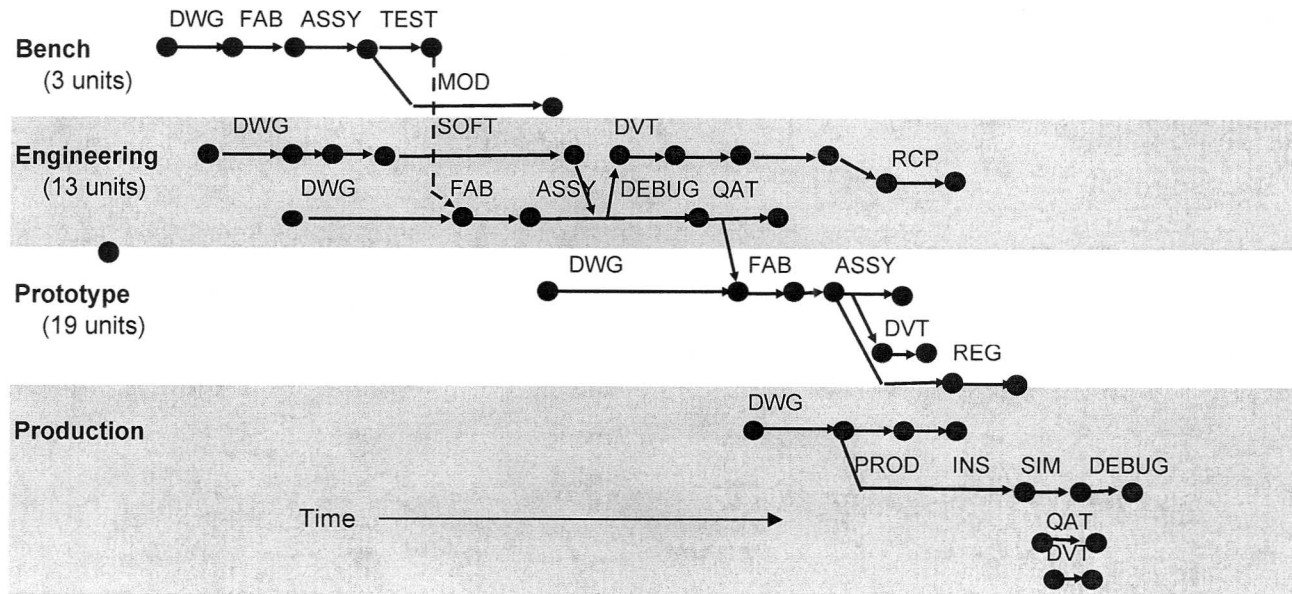
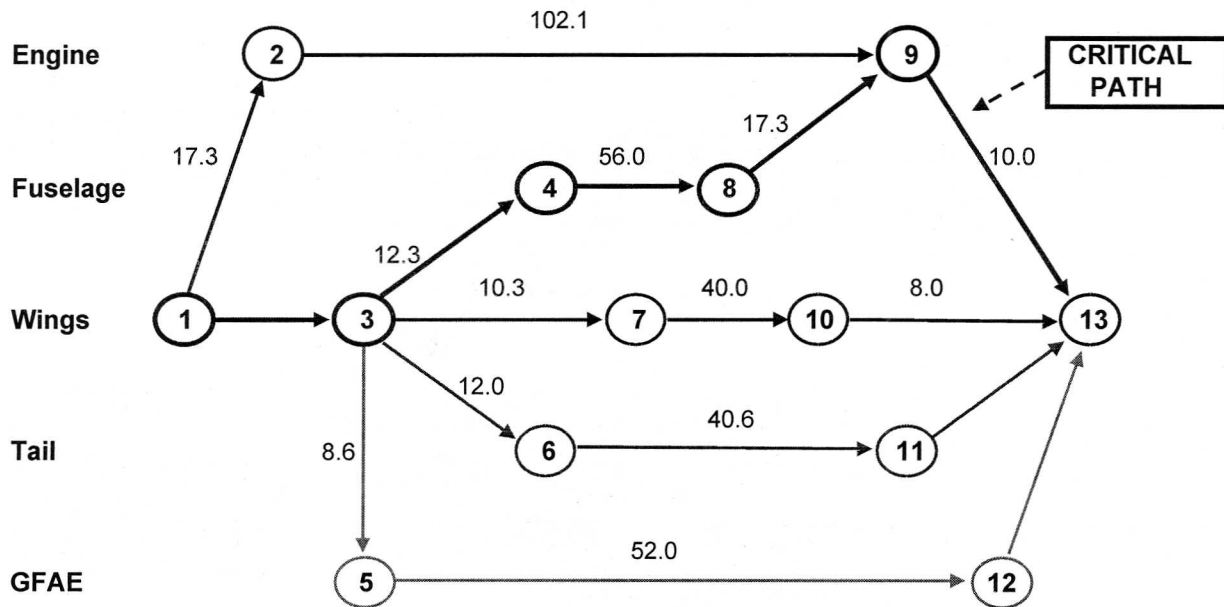| DWG: Design/drawing | MOD: Modification | DEBUG: Debugging | PROD: Production |
FAB: Fabrication	SOFT: Software devel't	QAT: Quality assur. test	INS: Inspection
ASSY: Assembly	DVT: Design verif'n test	REG: Pass Gov't	SIM: Simulate mass
TEST: Testing	RCP: Reliability of critical parts	regulations	production

but, since workers can complete one room and then go on to another, there can be some overlap in the schedule.)

d. Activities represented by nonoverlapping bars must be performed in the sequence indicated. For example, the foundation must be laid before the frame can be erected; and the frame must be erected before the other activities can be performed.

e. In Figure 10, the scheduled time for an activity is indicated by a shaded bar, while progress toward scheduled completion of that activity is indicated by the darkened portion of the shaded area. Here the project is in the tenth week. The installation of millwork is one week behind schedule. (However, since millwork installation can be completed without delaying other activities, and since there are still two weeks remaining for project completion, there is plenty of time to complete this activity.)

Over time, bar charts were further developed and became more sophisticated. Some planners (a) replaced the bars with lines, and (b) used boxes, circles, or large dots on the lines to denote "milestones" toward the completion of work packages. In Figure 10, for example, the bar denoting "erect frame" could have been a line having two large dots on it—one to denote the completion of "erecting the walls," and a second to denote the completion of "erecting the roof frame."

Figure 11 is an example of a Gantt-like schedule for performing work packages involving (a) bench design, (b) engineering design, (c) prototype development, and (d) production preparations. These work packages have been broken down into more finite or specific activities. The large dots denote start and/or completion times of the specific activities that make up the work packages. (A dot can denote a start time only, or it can denote the completion time of one activity and start time for the next.) Note that lines with arrows indicate the work flow. In doing so, they

Figure 12: Simplified PERT Network for Building a Military Aircraft[30]

1. Program Go-Ahead
2. Initiate Engine Procurement
3. Complete Plans/Specifications
4. Complete Fuselage Drawings
5. Submit GFAE (Government Furnished
    Aircraft Equipment --
    e.g., electronic gear)
6. Award Tail Assembly Subcontract

7. Award Wings Subcontract
8. Complete Manufacture of Fuselage
9. Complete Assembly of Fuselage/Engine
10. Receive Wings from Subcontractor
11. Receive Tail from Subcontractor
12. Receive GFAE
13. Complete Aircraft

a = most optimistic time (least time) required for an activity

m = most likely or realistic time required

b = pessimistic (most) time required (considering adverse contingencies)

$$T_e = \text{Estimated Time Required} = \frac{a + 4m + b}{6}$$

T_1 = Actual Time Taken

T_a = Slack Time = $T_1 - T_e$

also indicate which activities must be completed before others can be started. For example, bench testing must be completed before engineering can begin to fabricate a working model, because the bench test results are necessary inputs to engineering's fabrication of its model.

Gantt charts are best suited to scheduling a series of unrelated activities. They are of limited value when scheduling and controlling large, complex projects wherein activities are highly interdependent (wherein certain activities must be completed before others can begin). PERT and CPM were developed to overcome this limitation.

P.E.R.T. Networks

PERT is the acronym for Program Evaluation and Review Technique.[31] The first PERT network was developed in 1958 by the Navy Special Projects Office, Lockheed Aircraft Corporation, and management consultants, Booz, Allen & Hamilton, in order to schedule and manage the Polaris Ballistic Missile Project. Here we will not discuss CPM (Critical Path Method) networks,[32] which were developed by Dupont Company engineers at virtually the same time. Neither will we discuss any of the other thirty or so planning methods, among which are: Least Cost Estimating and Scheduling; Scheduling, Control, and Automation by Network Systems; and Production Analysis Control Technique. Although different from CPM and other methods in certain respects, PERT utilizes many of the same basic principles. Today, it is the most widely used approach —especially for planning and managing large projects.

Network Basics

PERT networks are essentially time-event analyses that provide a diagramatic representation of work flow and the interdependencies among activities. They draw on Gantt charting, line of balance concepts, milestone reporting systems, and critical path concepts.

A simplified PERT network is shown in **Figure 12**. Note the following aspects and principles involved:

1. An event or "milestone" is a clearly identifiable point in time that marks the beginning of an activity—or— the completion of one or more activities and the beginning of one or more activities. It may be a decision

point (rather than a physical start and/or accomplishment point). An event is indicated on a network with a letter or number inside a circle, box, or hexagon. For example: Event 3 indicates the completion of the activity begun at Event 1. It also indicates the start of the four activities completed at Events 4, 5, 6, and 7.

a. An interface event indicates the start of several "sub-networks." [It is customary to break down very large and complex networks (having hundreds or even thousands of events) into sub-networks. It is also customary to prepare a summarized network (having fewer than fifty major events) for top management review and project oversight. **Figure 12** is a highly summarized network.] For example: Event 1 is an interface event that begins two sub-networks, the first of which begins with Event 2, and the second of which begins with Event 3. Event 3 is also an interface event. It begins several sub-networks: 4-8-9, 7-10, 6-11, and 5-12.

b. A burst event (such as Event 3) indicates the start of several activities.

c. A merge event (such as Event 13) indicates the completion of several activities.

d. An event cannot occur twice—that is, there can be no "looping back."

2. An activity is the task to be performed between two events. It is indicated by a line with an arrow at the right, top, or bottom end.

a. There can be only one activity line between any two events.

b. An activity line does not represent an alternative path. The activity must be performed.

c. An activity cannot begin until the event preceding it has occurred. For example: The activity between Events 9 and 13 cannot occur until Event 9 has occurred.

d. All interdependencies between activities must be shown.

e. An activity usually reflects a change in responsibility (from one person or group to another).

Basic Steps for Constructing a PERT Network

1. Prepare a list of all events that must occur if the project is to be completed.

2. Arrange the list of events in chronological order.

3. Number or letter the events on the list. Each event can have only one number or letter, and no two events can have the same letter or number.

4. Divide the events into sub-project or work package groupings. For example: In Figure 12, there are engine-related events (2 and 9), fuselage-related events (4 and 8), wing-related events (7 and 10), tail-related events (6 and 11), and GFAE-related events (5 and 12). Once events have been grouped in such a manner, they can be more easily placed on a network in appropriate positions.

5. Design a PERT Network based on the (grouped) listing of events. Keep in mind that two or more events can occur at the same point in time, and that a number of activities can be performed concurrently (by different individuals or groups).

   a. Working backwards (from right to left) is advisable. First, indicate the final event on the right side of the network. Next, indicate any events that precede the final event. Next, indicate any events that precede those events. Continue working all the way back to the event at which the project begins.

   b. Show related sub-project or work package events on the same level of the network (as has been done in Figure 12).

   c. Place each event in chronological order.

   d. Connect the events with lines (having arrows at the end) to indicate the proper sequences of activities. Account for the interdependencies that exist among activities and events.

6. For each activity, estimate the activity time—the estimated time that will be required to accomplish the activity (or the time from its "start event" to its "completion event"). Activity times are usually expressed in weeks. As shown in Figure 12, they are written immediately above, below, or beside the activity lines to

which they apply. The following are the formal steps for arriving at each activity's activity time:

   a. Estimate the least (or most optimistic) time required for the activity (if all goes well). This is the "a" value in the formula below Figure 12. As illustrated only once in Figure 12 (beneath the activity line drawn between events 5 and 12), it is the left-hand number of the three numbers shown.

   b. Estimate the most likely (or most reasonable) time required. This is the "m" value in the formula below Figure 12. As illustrated in Figure 12, it is the middle number shown beneath the activity line mentioned above.

   c. Estimate the most (or most pessimistic) time required (if what could go wrong does). This is "b" figure in the formula below Figure 12. As illustrated in Figure 12, it is the right-hand number shown beneath the activity line mentioned above.

   d. Calculate the activity's "estimated time required" using the formula below Figure 12 [the quantity (a + 4m + b), divided by 6]. The resulting figure is a weighted average of the three estimates. It accounts for the probabilities of three possible outcomes.

   Note: Although all activities' estimated "a," "m," and "b" time frames may be written on a working copy of a network in order to perform and keep track of calculations, only their calculated times (ETRs) are shown on a completed network.

7. Calculate the critical path and semi-critical path(s).

   A network path is a chain of sequential events and activities required to move from a project's starting point to its completion. In Figure 12, the paths are: 1-2-9-13; 1-3-4-8-9-13; 1-3-7-10-13; 1-3-6-11-13; and 1-3-5-12-13.

   a. The Critical Path is the sequence of events that takes the longest time and results in the earliest date by which the entire project can be completed. It normally requires the closest monitoring and control in order to keep a project on schedule. (Any events that could significantly affect events along the critical path should also be monitored. A delay in one or more of these may lengthen the

project.) In Figure 12, the critical path includes events 1-3-4-8-9-13. This path takes 131.6 weeks (when the activity times along the path are added).

   b. <u>Semi-critical paths</u> can be calculated, also. One or more of these can become critical during a project (if one or more of the activities involved falls significantly behind schedule). Semi-critical paths can be ranked in order of their criticality and need to be monitored.

   c. <u>Surplus paths</u> are those that take significantly shorter time than critical and semi-critical paths. These paths should be identified, because it is from them that managers may be able to borrow resources (e.g., money and/or personnel) in order to speed up performance along the critical path.

8. Calculate the <u>slack time</u> involved in paths other than the critical path. As indicated below Figure 12, slack time is the difference between the time required for the critical path and the time required for another path. Where a particular path contains some slack time (and is essentially a "surplus path"), there is less pressure to keep it on schedule.

PERT / Time

   A PERT network can be formatted in a manner that enables managers to determine a project's status at the end of every week or month. Basically, this is done by (a) initially constructing the network so that each event is shown as occuring during the week in which it is scheduled to occur, and then (b) updating the network to show the week in which each event actually occurred. Such a format looks like a network of events superimposed on a week-by-week "elapsed time continuum"—such as that on a Gantt chart. The network in Figure 12 is not formatted in this manner.

PERT / Cost

   A PERT network can also be formatted (in much the same manner) so that managers can determine (a) the cost of the project as of the end of a particular week or month, and (b) whether or not the project is proceeding according to budget. Here, planners generally accumulate costs based on work packages, because (a) there may not be a job center account for each activity, and (b) the network is not complete enough to show every activity that incurs a cost.

It should be noted that progress toward the cost budget may not be the same as progress toward the time schedule.
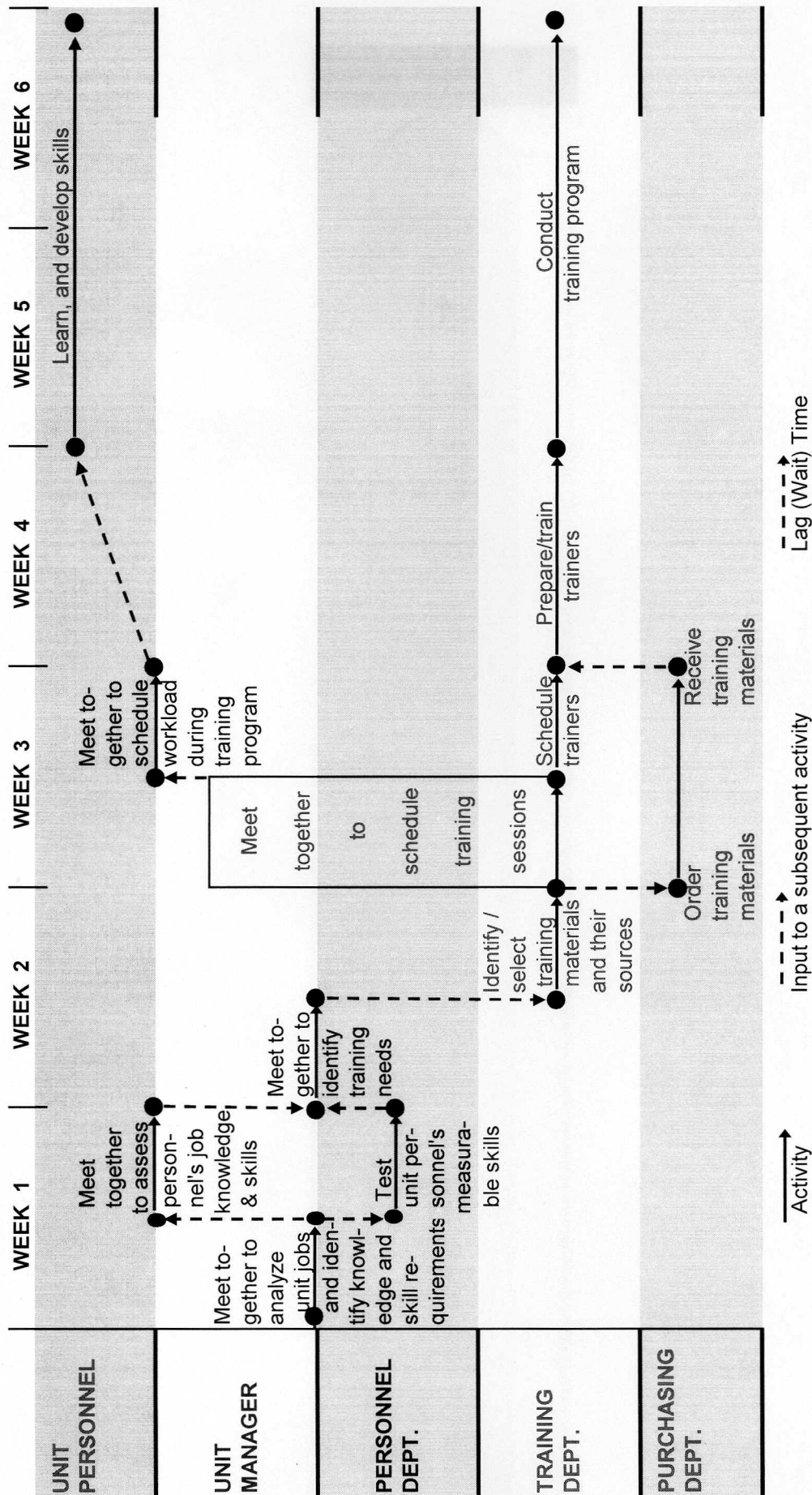
   A PERT approach has these <u>benefits or advantages</u>:

   a. It both forces and helps managers to plan more effectively.

   b. It often stimulates the formulation of alternative plans and schedules.

   c. It provides a basis for evaluating a plan in terms of its ability to meet goals.

   d. It promotes planning "down the line," because subordinates must plan the events for which they are responsible.

   e. It provides a means for planning, discussing, and controlling details of complex projects.

   f. It makes it possible to break down a project into sub-networks applying to any group or individual. This enables all to know what they are to do, when, and how their activities interface with others' activities.

   g. It focuses attention on activities that are most likely to delay a project's completion and should be monitored closely.

   h. It provides a basis for anticipating problems and taking remedial action before they actually occur.

   i. It is a tool for quickly determining a project's current status.

   j. It indicates which activities are falling behind schedule and require expediting.

   k. It provides a basis for taking appropriate actions to save time and money.

   l. It can indicate what action must be taken by which level in the organization.

   m. It improves progress reporting.

   n. It enables more effective resources management. It can (a) call attention to resources that are not being effectively or efficiently utilized, and (b) indicate where they might be better utilized.

   A PERT network also has these <u>limitations/disadvantages</u>:

   a. It is least useful when event times cannot be estimated accurately. This particularly applies to unique projects for which planners have no past experience on which to draw.

   b. Time estimates often prove to be unreliable when outside vendors and subcontractors are involved.

   c. It is impractical for projects involving a repetitive sequence of events (e.g., assembly line routines),

Figure 13: Example of a Hybrid Network or "Planning Diagram" (for a Training Project)

| | WEEK 1 | WEEK 2 | WEEK 3 | WEEK 4 | WEEK 5 | WEEK 6 |

UNIT PERSONNEL

Meet together to assess personnel's job knowledge & skills

Learn, and develop skills

UNIT MANAGER

Meet together to analyze unit jobs and identify knowledge and skill requirements

Test unit personnel's measurable skills

Meet together to identify training needs

Meet together to schedule workload during training program

PERSONNEL DEPT.

Identify / select training materials and their sources

Meet together to schedule training sessions

TRAINING DEPT.

Schedule trainers

Prepare/train trainers

Conduct training program

PURCHASING DEPT.

Order training materials

Receive training materials

Activity

Input to a subsequent activity

Lag (Wait) Time

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because virtually all events fall along a single critical path.

d. It can be more easily understood than applied, especially when a project is very complex.

e. It can be costly to use, especially when there are hundreds to thousands of events involved.

f. It can be mathematicaly unweildy, especially when completion times must be initially calculated and later updated for thousands of events.

g. It can be very difficult to follow. Especially when activity lines are not labeled on a network, individuals must often look up what the event letters or numbers mean in order to determine what should be happening.

h. It does not handle costs as well as some other control methods.

i. The logic behind a network's design can be difficult to validate.

Planning Tools for Smaller, More Everyday Projects

We often use hybrid diagrams when working with organizations to structure projects or solve problems. **Figure 13** is such a tool. It is a cross between a bar chart and a PERT network. Our example outlines a training project that has been designed to help solve problems resulting from a group's lack of technical skills and proficiency. This full-page diagram . . .

a. indicates the activities to be performed by various individuals or groups (the department manager, the manager's subordinates, the personnel department, the training department, and the purchasing department);

b. indicates the names of the tasks/activities (rather than using numbers or letters that must be looked up);

c. indicates who needs to do what, when, and in what (interdependent) sequences;

d. indicates the scheduled time frames for activities; and

e. can be modified rather easily (e.g., when activities take longer than planned)—if, for example, it has been drawn using (a) erasable lines, and (b) activity labels written on stick-on materials that can be moved to another time frame when necessary.

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