PRINCIPLES FROM "HOW TO WIN FRIENDS AND INFLUENCE PEOPLE"

Become a Friendlier Person

1. Don't criticize, condemn or complain.
2. Give honest, sincere appreciation.
3. Arouse in the other person an eager want.
4. Become genuinely interested in other people.
5. Smile.
6. Remember that a person's name is to him or her the sweetest and most important sound in any language.
7. Be a good listener. Encourage others to talk about themselves.
8. Talk in terms of the other person's interests.
9. Make the other person feel important—and do it *sincerely*.

Win People to Your Way of Thinking

10. The only way to get the best of an argument is to avoid it.
11. Show respect for the other person's opinions. Never tell a person he or she is wrong.
12. If you are wrong, admit it quickly and emphatically.
13. Begin in a friendly way.
14. Get the other person saying "yes, yes" immediately.
15. Let the other person do a great deal of the talking.
16. Let the other person feel that the idea is his or hers.
17. Try honestly to see things from the other person's point of view.
18. Be sympathetic with the other person's ideas and desires.
19. Appeal to the nobler motives.
20. Dramatize your ideas.
21. Throw down a challenge.

Be a Leader

- Begin with praise and honest appreciation.
- Call attention to people's mistakes indirectly.
- Talk about your own mistakes before criticizing the other person.
- Ask questions instead of giving direct orders.
- Let the other person save face.
- Praise the slightest improvement and praise every improvement. Be "hearty in your approbation and lavish in your praise."
- Give the other person a fine reputation to live up to.
- Use encouragement. Make the fault seem easy to correct.
- Make the other person happy about doing the thing you suggest.

PRINCIPLES FROM "HOW TO STOP WORRYING AND START LIVING"

Fundamental Principles for Overcoming Worry

1. Live in "day-tight compartments."
2. How to face trouble:
   a. Ask yourself, "What is the worst that can possibly happen?"
   b. Prepare to accept the worst.
   c. Try to improve on the worst.
3. Remind yourself of the exorbitant price you can pay for worry in terms of your health.

Basic Techniques in Analyzing Worry

1. Get all the facts.
2. Weigh all the facts—then come to a decision.
3. Once a decision is reached, act!
4. Write out and answer the following questions:
   a. What is the problem?
   b. What are the causes of the problem?
   c. What are the possible solutions?
   d. What is the best solution?

Break the Worry Habit Before It Breaks You

1. Keep busy.
2. Don't fuss about trifles.
3. Use the law of averages to outlaw your worries.
4. Coöperate with the inevitable.
5. Decide just how much anxiety a thing may be worth and refuse to give it more.
6. Don't worry about the past.

Cultivate a Mental Attitude That Will Bring You Peace and Happiness

1. Fill your mind with thoughts of peace, courage, health and hope.
2. Never try to get even with your enemies.
3. Expect ingratitude.
4. Count your blessings—not your troubles.
5. Do not imitate others.
6. Try to profit from your losses.
7. Create happiness for others.

The Perfect Way to Conquer Worry

1. Pray.

Don't Worry about Criticism

1. Remember that unjust criticism is often a disguised compliment.
2. Do the very best you can.
3. Analyze your own mistakes and criticize yourself.

Prevent Fatigue and Worry and Keep Your Energy and Spirits High

1. Rest before you get tired.
2. Learn to relax at your work.
3. If you run a household, protect your health and appearance by relaxing at home.
4. Apply these four good working habits:
   a. Clear your desk of all papers except those relating to the immediate problem at hand.
   b. Do things in the order of their importance.
   c. When you face a problem, solve it then and there if you have the facts necessary to make a decision.
   d. Learn to organize, deputize and supervise.
5. Put enthusiasm into your work.
6. Don't worry about insomnia.

ROLM®

PHILOSOPHY

ROLM PHILOSOPHY

ROLM Corporation was founded in 1969 with four goals:

To Make a Profit
To Grow
To Offer Quality Products and Customer Support
To Create a Great Place to Work

The four goals are closely interrelated. One cannot exist without the other. In order for ROLM to profit, it must offer quality products and customer support. In order to grow, it must profit. And in order to develop quality products and customer support, ROLM must maintain a work environment conducive to creativity and productivity.

In the course of our history, certain practices have proven successful in achieving the four goals. These practices have become known as the attributes of success at ROLM. The goals and the attributes, taken together, constitute the ROLM philosophy.

ROLM Philosophy provides a bond for this highly decentralized company. We do our best to maintain an entrepreneurial spirit and to avoid bureaucracy through broad decentralization of responsibility and authority. This approach necessarily leads to differences of opinion. However, we believe this is the only environment that provides the individual freedom required for creative thinking and rapid response to the changing needs of the marketplace. We are convinced that a highly structured, bureaucratic organization is much less effective than our organization. Certainly, that form of organization would never attract the excellent people we have at ROLM.

ROLM Philosophy is the basis for most of our decision making. It indicates much of what we are doing at ROLM and where we are headed. This statement of the Philosophy is presented for your consideration and implementation.

[signature]
President

ROLM

To Make a Profit

A primary reason for the existence of most businesses in our economic society is to make a profit. Making a profit is necessary to finance the business intelligently. On a continuous basis we need additional funds for doing research and development, expanding facilities, upgrading equipment, maintaining inventories, and strengthening sales and service channels. ROLM profits, with the exception of those distributed in our employee profit-sharing plan, have always been totally reinvested in the business.

Further, making a profit is necessary to have the flexibility to make the correct long-term decisions for the company. A consistent profit advance provides a secure basis for thoughtful examination of future possibilities. Undue profit pressure forces an environment in which decisions may be made with poor planning and a short-term view.

To Grow

A company can compete successfully with others only if it grows. Further, the ultimate reward for our stockholders investment is profitable growth. At ROLM we recognize two other major reasons for steady, planned growth.

First, there is a strategic reason. ROLM competes against the giants of the computer and telecommunications industries. Success in this competition is marked by gaining market share from companies that are less responsive and creative. We must grow to supply these large markets in which we choose to operate.

Secondly, there is a basic human reason for corporate growth. The environment that we continue to create at ROLM is one of expanding opportunity and challenge for our people. The opportunity for the growth of each individual is dependent upon the healthy growth of ROLM Corporation. Conversely, the growth of ROLM Corporation is dependent upon the growth of each individual.

To Offer Quality Products and Customer Support

ROLM has a single basic reason for being in existence: to provide the finest quality products and customer support. We have been and will continue to be distinguished by our excellent products and our efficient customer support.

The goods that go out our back door — our products, our hardware — are conceived and manufactured to be of the highest possible quality. ROLM customers are led to expect the finest. ROLM people are committed to delivering the finest.

However, our products are only a portion of the total quality ROLM offers. We are also committed to providing the best customer support in the industry. This includes: meeting customer needs quickly, interacting with customers professionally, focusing on uptime, and offering a complete range of services. In this manner, we strive to earn the loyalty of our customers.

To Create a Great Place to Work

The first three goals of ROLM are shared by many companies throughout the world. The fourth, "To Create a Great Place to Work," is rare. We know of no other organization that makes this one of its basic goals.

We do this quite simply because we want to attract and motivate the best and the brightest people that we can. In order to attract and motivate the best and the brightest people ROLM promotes a humane and challenging work environment, a very competitive compensation and benefits plan, and physical surroundings befitting the quality of ROLM people.

The humanity and challenge of the ROLM work environment is predicated on a dual responsibility. ROLM corporation acts to provide equal opportunity to grow and be promoted; fair treatment for each individual; respect for personal privacy; encouragement to succeed; opportunity for creativity; evaluation based on job performance in the context of ROLM Philosophy. ROLM people are expected to respond by being individually accountable; being helpful toward others to enhance teamwork; performing to the best of his/her abilities; and understanding and implementing the ROLM Philosophy.

Attributes of Success for All ROLM People

- Avoid bureaucracy; keep practices simple, but make sure they are communicated, understood, and effective.
- Freely communicate ideas and suggestions.
- Show initiative to assure you understand the performance expectations of your job.
- Avoid "finger-pointing." When you see a stalemate, encourage discussion to get the problem solved.
- Discourage rumors by communicating facts upwards, downwards, and sideways throughout the company.
- Use written communications when it makes sense to do so. Recognize the value of face-to-face communication.
- Focus on substance; it is always more important than form.
- Take a large view of your job; do whatever it takes to make your tasks succeed whether or not it is part of your "job."
- Solve problems; don't make excuses or look for fault in others. Don't act "on the record" to prove someone wrong; help make it right.
- Focus on the important issues; let the inconsequential slip.
- Build teamwork inside and outside your work group; it avoids the need for bureaucracy.
- Fix problems as we grow; don't stop growing to fix problems. Don't fix things that aren't broken; try to anticipate things that may become broken.
- Set personally challenging and difficult goals that support departmental and Corporate objectives.

Additional Attributes of Success for ROLM Managers

- Level with people. Communicate your expectations — encourage honest response.
- Get decisions made as close to the action as possible; don't second-guess them unless you have good reasons which you communicate. Let people plan and control as much of their own work as possible.
- Assure that people understand job performance expectations; then encourage their individual initiative to expand.
- Promote from within whenever feasible; seriously consider ROLM people if they want promotion.
- Identify and create an environment that motivates all ROLM people.
- Maintain equal opportunity and affirmative action practices that meet the spirit as well as the letter of the law. Assist individuals to compete and succeed and reward them on the basis of merit.
- Recognize individual accomplishment in and out of your immediate work sphere. Praise in public; criticize in private. Don't point to third parties to rationalize your failures.
- Help ROLM people build their self-image; treat them as individuals.
- Assure that people are paid fairly considering the labor market, internal equity, and individual worth to the Corporation; then give merit increases only.
- Communicate praise to individuals in the group; buffer them from group criticism; make sure they are aware of any real shortcomings.
- Give salary and performance reviews on time.
- Use written PPGs to document practices, policies, and guidelines for routine tasks critical to the smooth functioning of the organization. If PPGs don't reflect reality, rewrite them.
- Follow important projects and take continual corrective action, if necessary, to keep them on track.
- Manage by walking around. Recognize potential problem areas before they become major.
- Encourage each individual to develop his/her skills for career advancement.

ROLM Corporation

00BREAK00

Marketing Myopia

By THEODORE LEVITT

THEODORE LEVITT, *Lecturer in Business Administration, Harvard Business School, formerly economic consultant in the oil industry, is now concentrating in marketing.*

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▸ Shortsighted managements often fail to recognize that in fact there is no such thing as a growth industry.

MARKETING MYOPIA

By Theodore Levitt

Every major industry was once a growth industry. But some that are now riding a wave of growth enthusiasm are very much in the shadow of decline. Others which are thought of as seasoned growth industries have actually stopped growing. In every case the reason growth is threatened, slowed, or stopped is *not* because the market is saturated. It is because there has been a failure of management.

Fateful Purposes

The failure is at the top. The executives responsible for it, in the last analysis, are those who deal with broad aims and policies. Thus:

◖ The railroads did not stop growing because the need for passenger and freight transportation declined. That grew. The railroads are in trouble today not because the need was filled by others (cars, trucks, airplanes, even telephones), but because it was *not* filled by the railroads themselves. They let others take customers away from them because they assumed themselves to be in the railroad business rather than in the transportation business. The reason they defined their industry wrong was because they were railroad-oriented instead of transportation-oriented; they were product-oriented instead of customer-oriented.

◖ Hollywood barely escaped being totally ravished by television. Actually, all the established film companies went through drastic reorganizations. Some simply disappeared. All of them got into trouble not because of TV's inroads but because of their own myopia. As with the railroads, Hollywood defined its business incorrectly. It thought it was in the movie business when it was actually in the entertainment business. "Movies" implied a specific, limited product. This produced a fatuous contentment which from the beginning led producers to view TV as a threat. Hollywood scorned and rejected TV when it should have welcomed it as an opportunity — an opportunity to expand the entertainment business.

Today TV is a bigger business than the old narrowly defined movie business ever was. Had Hollywood been customer-oriented (providing entertainment), rather than product-oriented (making movies), would it have gone through the fiscal purgatory that it did? I doubt it. What ultimately saved Hollywood and accounted for its recent resurgence was the wave of new young writers, producers, and directors whose previous successes in television had decimated the old movie companies and toppled the big movie moguls.

There are other less obvious examples of industries that have been and are now endangering their futures by improperly defining their purposes. I shall discuss some in detail later and analyze the kind of policies that lead to trouble. Right now it may help to show what a thoroughly customer-oriented management *can* do to keep a growth industry growing, even after the obvious opportunities have been exhausted; and here there are two examples that have been around for a long time. They are nylon and glass — specifically, E. I. duPont de Nemours & Company and Corning Glass Works:

Both companies have great technical competence. Their product orientation is unquestioned. But this alone does not explain their success. After all, who was more pridefully product-oriented and product-conscious than the erstwhile New England textile companies that have been so thoroughly massacred? The DuPonts and the Cornings have succeeded not primarily because of their product or research orientation but because they have been thoroughly customer-oriented also. It is constant watchfulness for opportunities to apply their technical know-how to the creation of customer-satisfying uses which accounts for their prodigious output of successful new products. Without a very sophisticated eye on the customer, most of their new products might have been wrong, their sales methods useless.

Aluminum has also continued to be a growth industry, thanks to the efforts of two wartime-created companies which deliberately set about creating new customer-satisfying uses. Without Kaiser Aluminum & Chemical Corporation and Reynolds Metals Company, the total demand for aluminum today would be vastly less than it is.

Error of Analysis

Some may argue that it is foolish to set the railroads off against aluminum or the movies off against glass. Are not aluminum and glass naturally so versatile that the industries are bound to have more growth opportunities than the railroads and movies? This view commits precisely the error I have been talking about. It defines an industry, or a product, or a cluster of know-how so narrowly as to guarantee its premature senescence. When we mention "railroads," we should make sure we mean "transportation." As transporters, the railroads still have a good chance for very considerable growth. They are not limited to the railroad business as such (though in my opinion rail transportation is potentially a much stronger transportation medium than is generally believed).

What the railroads lack is not opportunity, but some of the same managerial imaginativeness and audacity that made them great. Even an amateur like Jacques Barzun can see what is lacking when he says:

"I grieve to see the most advanced physical and social organization of the last century go down in shabby disgrace for lack of the same comprehensive imagination that built it up. [What is lacking is] the will of the companies to survive and to satisfy the public by inventiveness and skill."[1]

Shadow of Obsolescence

It is impossible to mention a single major industry that did not at one time qualify for the magic appellation of "growth industry." In each case its assumed strength lay in the apparently unchallenged superiority of its product. There appeared to be no effective substitute for it. It was itself a runaway substitute for the product it so triumphantly replaced. Yet one after another of these celebrated industries has come under a shadow. Let us look briefly at a few more of them, this time taking examples that have so far received a little less attention:

¶ *Dry cleaning* — This was once a growth industry with lavish prospects. In an age of wool garments, imagine being finally able to get them safely and easily clean. The boom was on.

Yet here we are 30 years after the boom started and the industry is in trouble. Where has the competition come from? From a better way of cleaning? No. It has come from synthetic fibers and chemical additives that have cut the need for dry cleaning. But this is only the beginning. Lurking in the wings and ready to make chemical dry cleaning totally obsolescent is that powerful magician, ultrasonics.

¶ *Electric utilities* — This is another one of those supposedly "no-substitute" products that has been enthroned on a pedestal of invincible growth. When the incandescent lamp came along, kerosene lights were finished. Later the water wheel and the steam engine were cut to ribbons by the flexibility, reliability, simplicity, and just plain easy availability of electric motors. The prosperity of electric utilities continues to wax extravagant as the home is converted into a museum of electric gadgetry.

[1] Jacques Barzun, "Trains and the Mind of Man," *Holiday*, February 1960, p. 21.

How can anybody miss by investing in utilities, with no competition, nothing but growth ahead?

But a second look is not quite so comforting. A score of nonutility companies are well advanced toward developing a powerful chemical fuel cell which could sit in some hidden closet of every home silently ticking off electric power. The electric lines that vulgarize so many neighborhoods will be eliminated. So will the endless demolition of streets and service interruptions during storms. Also on the horizon is solar energy, again pioneered by nonutility companies.

Who says that the utilities have no competition? They may be natural monopolies now, but tomorrow they may be natural deaths. To avoid this prospect, they too will have to develop fuel cells, solar energy, and other power sources. To survive, they themselves will have to plot the obsolescence of what now produces their livelihood.

¶ *Grocery stores* — Many people find it hard to realize that there ever was a thriving establishment known as the "corner grocery store." The supermarket has taken over with a powerful effectiveness. Yet the big food chains of the 1930's narrowly escaped being completely wiped out by the aggressive expansion of independent supermarkets. The first genuine supermarket was opened in 1930, in Jamaica, Long Island. By 1933 supermarkets were thriving in California, Ohio, Pennsylvania, and elsewhere. Yet the established chains pompously ignored them. When they chose to notice them, it was with such derisive descriptions as "cheapy," "horse-and-buggy," "cracker-barrel storekeeping," and "unethical opportunists."

The executive of one big chain announced at the time that he found it "hard to believe that people will drive for miles to shop for foods and sacrifice the personal service chains have perfected and to which Mrs. Consumer is accustomed." [2] As late as 1936, the National Wholesale Grocers convention and the New Jersey Retail Grocers Association said there was nothing to fear. They said that the supers' narrow appeal to the price buyer limited the size of their market. They had to draw from miles around. When imitators came, there would be wholesale liquidations as volume fell. The current high sales of the supers was said to be partly due to their novelty. Basically people wanted convenient neighborhood grocers. If the neighborhood stores "cooperate with their suppliers, pay attention to their costs, and improve their service," they would be able to weather the competition until it blew over.[3]

It never blew over. The chains discovered that survival required going into the supermarket business. This meant the wholesale destruction of their huge investments in corner store sites and in established distribution and merchandising methods. The companies with "the courage of their convictions" resolutely stuck to the corner store philosophy. They kept their pride but lost their shirts.

Self-Deceiving Cycle

But memories are short. For example, it is hard for people who today confidently hail the twin messiahs of electronics and chemicals to see how things could possibly go wrong with these galloping industries. They probably also cannot see how a reasonably sensible businessman could have been as myopic as the famous Boston millionaire who 50 years ago unintentionally sentenced his heirs to poverty by stipulating that his entire estate be forever invested exclusively in electric streetcar securities. His posthumous declaration, "There will always be a big demand for efficient urban transportation," is no consolation to his heirs who sustain life by pumping gasoline at automobile filling stations.

Yet, in a casual survey I recently took among a group of intelligent business executives, nearly half agreed that it would be hard to hurt their heirs by tying their estates forever to the electronics industry. When I then confronted them with the Boston streetcar example, they chorused unanimously, "That's different!" But is it? Is not the basic situation identical?

In truth, *there is no such thing* as a growth industry, I believe. There are only companies organized and operated to create and capitalize on growth opportunities. Industries that assume themselves to be riding some automatic growth escalator invariably descend into stagnation. The history of every dead and dying "growth" industry shows a self-deceiving cycle of bountiful expansion and undetected decay. There are four conditions which usually guarantee this cycle:

1. The belief that growth is assured by an expanding and more affluent population.
2. The belief that there is no competitive substitute for the industry's major product.
3. Too much faith in mass production and in the advantages of rapidly declining unit costs as output rises.
4. Preoccupation with a product that lends itself to carefully controlled scientific experi-

[2] For more details see M. M. Zimmerman, *The Super Market: A Revolution in Distribution* (New York, McGraw-Hill Book Company, Inc., 1955), p. 48.

[3] Ibid., pp. 45-47.

mentation, improvement, and manufacturing cost reduction.

I should like now to begin examining each of these conditions in some detail. To build my case as boldly as possible, I shall illustrate the points with reference to three industries — petroleum, automobiles, and electronics — particularly petroleum, because it spans more years and more vicissitudes. Not only do these three have excellent reputations with the general public and also enjoy the confidence of sophisticated investors, but their managements have become known for progressive thinking in areas like financial control, product research, and management training. If obsolescence can cripple even these industries, it can happen anywhere.

Population Myth

The belief that profits are assured by an expanding and more affluent population is dear to the heart of every industry. It takes the edge off the apprehensions everybody understandably feels about the future. If consumers are multiplying and also buying more of your product or service, you can face the future with considerably more comfort than if the market is shrinking. An expanding market keeps the manufacturer from having to think very hard or imaginatively. If thinking is an intellectual response to a problem, then the absence of a problem leads to the absence of thinking. If your product has an automatically expanding market, then you will not give much thought to how to expand it.

One of the most interesting examples of this is provided by the petroleum industry. Probably our oldest growth industry, it has an enviable record. While there are some current apprehensions about its growth rate, the industry itself tends to be optimistic. But I believe it can be demonstrated that it is undergoing a fundamental yet typical change. It is not only ceasing to be a growth industry, but may actually be a declining one, relative to other business. Although there is widespread unawareness of it, I believe that within 25 years the oil industry may find itself in much the same position of retrospective glory that the railroads are now in. Despite its pioneering work in developing and applying the present-value method of investment evaluation, in employee relations, and in working with backward countries, the petroleum business is a distressing example of how complacency and wrongheadedness can stubbornly convert opportunity into near disaster.

One of the characteristics of this and other industries that have believed very strongly in the beneficial consequences of an expanding population, while at the same time being industries with a generic product for which there has appeared to be no competitive substitute, is that the individual companies have sought to outdo their competitors by improving on what they are already doing. This makes sense, of course, if one assumes that sales are tied to the country's population strings, because the customer can compare products only on a feature-by-feature basis. I believe it is significant, for example, that not since John D. Rockefeller sent free kerosene lamps to China has the oil industry done anything really outstanding to create a demand for its product. Not even in product improvement has it showered itself with eminence. The greatest single improvement, namely, the development of tetraethyl lead, came from outside the industry, specifically from General Motors and DuPont. The big contributions made by the industry itself are confined to the technology of oil exploration, production, and refining.

Asking for Trouble

In other words, the industry's efforts have focused on improving the *efficiency* of getting and making its product, not really on improving the generic product or its marketing. Moreover, its chief product has continuously been defined in the narrowest possible terms, namely, gasoline, not energy, fuel, or transportation. This attitude has helped assure that:

- Major improvements in gasoline quality tend not to originate in the oil industry. Also, the development of superior alternative fuels comes from outside the oil industry, as will be shown later.

- Major innovations in automobile fuel marketing are originated by small new oil companies that are not primarily preoccupied with production or refining. These are the companies that have been responsible for the rapidly expanding multipump gasoline stations, with their successful emphasis on large and clean layouts, rapid and efficient driveway service, and quality gasoline at low prices.

Thus, the oil industry is asking for trouble from outsiders. Sooner or later, in this land of hungry inventors and entrepreneurs, a threat is sure to come. The possibilities of this will become more apparent when we turn to the next dangerous belief of many managements. For the sake of continuity, because this second belief is tied closely to the first, I shall continue with the same example.

Idea of Indispensability

The petroleum industry is pretty much persuaded that there is no competitive substitute for its major product, gasoline — or if there is, that it will continue to be a derivative of crude oil, such as diesel fuel or kerosene jet fuel.

There is a lot of automatic wishful thinking in this assumption. The trouble is that most refining companies own huge amounts of crude oil reserves. These have value only if there is a market for products into which oil can be converted — hence the tenacious belief in the continuing competitive superiority of automobile fuels made from crude oil.

This idea persists despite all historic evidence against it. The evidence not only shows that oil has never been a superior product for any purpose for very long, but it also shows that the oil industry has never really been a growth industry. It has been a succession of different businesses that have gone through the usual historic cycles of growth, maturity, and decay. Its over-all survival is owed to a series of miraculous escapes from total obsolescence, of last-minute and unexpected reprieves from total disaster reminiscent of the Perils of Pauline.

Perils of Petroleum

I shall sketch in only the main episodes:

¶ First, crude oil was largely a patent medicine. But even before that fad ran out, demand was greatly expanded by the use of oil in kerosene lamps. The prospect of lighting the world's lamps gave rise to an extravagant promise of growth. The prospects were similar to those the industry now holds for gasoline in other parts of the world. It can hardly wait for the underdeveloped nations to get a car in every garage.

In the days of the kerosene lamp, the oil companies competed with each other and against gaslight by trying to improve the illuminating characteristics of kerosene. Then suddenly the impossible happened. Edison invented a light which was totally nondependent on crude oil. Had it not been for the growing use of kerosene in space heaters, the incandescent lamp would have completely finished oil as a growth industry at that time. Oil would have been good for little else than axle grease.

¶ Then disaster and reprieve struck again. Two great innovations occurred, neither originating in the oil industry. The successful development of coal-burning domestic central-heating systems made the space heater obsolescent. While the industry reeled, along came its most magnificent boost yet — the internal combustion engine, also invented by outsiders. Then when the prodigious expansion for gasoline finally began to level off in the 1920's, along came the miraculous escape of a central oil heater. Once again, the escape was provided by an outsider's invention and development. And when that market weakened, wartime demand for aviation fuel came to the rescue. After the war the expansion of civilian aviation, the dieselization of railroads, and the explosive demand for cars and trucks kept the industry's growth in high gear.

¶ Meanwhile centralized oil heating — whose boom potential had only recently been proclaimed — ran into severe competition from natural gas. While the oil companies themselves owned the gas that now competed with their oil, the industry did not originate the natural gas revolution, nor has it to this day greatly profited from its gas ownership. The gas revolution was made by newly formed transmission companies that marketed the product with an aggressive ardor. They started a magnificent new industry, first against the advice and then against the resistance of the oil companies.

By all the logic of the situation, the oil companies themselves should have made the gas revolution. They not only owned the gas; they also were the only people experienced in handling, scrubbing, and using it, the only people experienced in pipeline technology and transmission, and they understood heating problems. But, partly because they knew that natural gas would compete with their own sale of heating oil, the oil companies pooh-poohed the potentials of gas.

The revolution was finally started by oil pipeline executives who, unable to persuade their own companies to go into gas, quit and organized the spectacularly successful gas transmission companies. Even after their success became painfully evident to the oil companies, the latter did not go into gas transmission. The multibillion dollar business which should have been theirs went to others. As in the past, the industry was blinded by its narrow preoccupation with a specific product and the value of its reserves. It paid little or no attention to its customers' basic needs and preferences.

¶ The postwar years have not witnessed any change. Immediately after World War II the oil industry was greatly encouraged about its future by the rapid expansion of demand for its traditional line of products. In 1950 most companies projected annual rates of domestic expansion of around 6% through at least 1975. Though the ratio of crude oil reserves to demand in the Free World was about 20 to 1, with 10 to 1 being usually considered a reasonable working ratio in the

United States, booming demand sent oil men searching for more without sufficient regard to what the future really promised. In 1952 they "hit" in the Middle East; the ratio skyrocketed to 42 to 1. If gross additions to reserves continue at the average rate of the past five years (37 billion barrels annually), then by 1970 the reserve ratio will be up to 45 to 1. This abundance of oil has weakened crude and product prices all over the world.

Uncertain Future

Management cannot find much consolation today in the rapidly expanding petrochemical industry, another oil-using idea that did not originate in the leading firms. The total United States production of petrochemicals is equivalent to about 2% (by volume) of the demand for all petroleum products. Although the petrochemical industry is now expected to grow by about 10% per year, this will not offset other drains on the growth of crude oil consumption. Furthermore, while petrochemical products are many and growing, it is well to remember that there are nonpetroleum sources of the basic raw material, such as coal. Besides, a lot of plastics can be produced with relatively little oil. A 50,000-barrel-per-day oil refinery is now considered the absolute minimum size for efficiency. But a 5,000-barrel-per-day chemical plant is a giant operation.

Oil has never been a continuously strong growth industry. It has grown by fits and starts, always miraculously saved by innovations and developments not of its own making. The reason it has not grown in a smooth progression is that each time it thought it had a superior product safe from the possibility of competitive substitutes, the product turned out to be inferior and notoriously subject to obsolescence. Until now, gasoline (for motor fuel, anyhow) has escaped this fate. But, as we shall see later, it too may be on its last legs.

The point of all this is that there is no guarantee against product obsolescence. If a company's own research does not make it obsolete, another's will. Unless an industry is especially lucky, as oil has been until now, it can easily go down in a sea of red figures — just as the railroads have, as the buggy whip manufacturers have, as the corner grocery chains have, as most of the big movie companies have, and indeed as many other industries have.

The best way for a firm to be lucky is to make its own luck. That requires knowing what makes a business successful. One of the greatest enemies of this knowledge is mass production.

Production Pressures

Mass-production industries are impelled by a great drive to produce all they can. The prospect of steeply declining unit costs as output rises is more than most companies can usually resist. The profit possibilities look spectacular. All effort focuses on production. The result is that marketing gets neglected.

John Kenneth Galbraith contends that just the opposite occurs.[4] Output is so prodigious that all effort concentrates on trying to get rid of it. He says this accounts for singing commercials, desecration of the countryside with advertising signs, and other wasteful and vulgar practices. Galbraith has a finger on something real, but he misses the strategic point. Mass production does indeed generate great pressure to "move" the product. But what usually gets emphasized is selling, not marketing. Marketing, being a more sophisticated and complex process, gets ignored.

The difference between marketing and selling is more than semantic. Selling focuses on the needs of the seller, marketing on the needs of the buyer. Selling is preoccupied with the seller's need to convert his product into cash; marketing with the idea of satisfying the needs of the customer by means of the product and the whole cluster of things associated with creating, delivering, and finally consuming it.

In some industries the enticements of full mass production have been so powerful that for many years top management in effect has told the sales departments, "You get rid of it; we'll worry about profits." By contrast, a truly marketing-minded firm tries to create value-satisfying goods and services that consumers will want to buy. What it offers for sale includes not only the generic product or service, but also how it is made available to the customer, in what form, when, under what conditions, and at what terms of trade. Most important, what it offers for sale is determined not by the seller but by the buyer. The seller takes his cues from the buyer in such a way that the product becomes a consequence of the marketing effort, not vice versa.

Lag in Detroit

This may sound like an elementary rule of business, but that does not keep it from being

[4] *The Affluent Society* (Boston, Houghton Mifflin Company, 1958), pp. 152–160.

oil companies do anything different? Would not chemical fuel cells, batteries, or solar energy kill the present product lines? The answer is that they would indeed, and that is precisely the reason for the oil firms having to develop these power units before their competitors, so they will not be companies without an industry.

Management might be more likely to do what is needed for its own preservation if it thought of itself as being in the energy business. But even that would not be enough if it persists in imprisoning itself in the narrow grip of its tight product orientation. It has to think of itself as taking care of customer needs, not finding, refining, or even selling oil. Once it genuinely thinks of its business as taking care of people's transportation needs, nothing can stop it from creating its own extravagantly profitable growth.

"Creative Destruction"

Since words are cheap and deeds are dear, it may be appropriate to indicate what this kind of thinking involves and leads to. Let us start at the beginning — the customer. It can be shown that motorists strongly dislike the bother, delay, and experience of buying gasoline. People actually do not buy gasoline. They cannot see it, taste it, feel it, appreciate it, or really test it. What they buy is the right to continue driving their cars. The gas station is like a tax collector to whom people are compelled to pay a periodic toll as the price of using their cars. This makes the gas station a basically unpopular institution. It can never be made popular or pleasant, only less unpopular, less unpleasant.

To reduce its unpopularity completely means eliminating it. Nobody likes a tax collector, not even a pleasantly cheerful one. Nobody likes to interrupt a trip to buy a phantom product, not even from a handsome Adonis or a seductive Venus. Hence, companies that are working on exotic fuel substitutes which will eliminate the need for frequent refueling are heading directly into the outstretched arms of the irritated motorist. They are riding a wave of inevitability, not because they are creating something which is technologically superior or more sophisticated, but because they are satisfying a powerful customer need. They are also eliminating noxious odors and air pollution.

Once the petroleum companies recognize the customer-satisfying logic of what another power system can do, they will see that they have no more choice about working on an efficient, long-lasting fuel (or some way of delivering present fuels without bothering the motorist) than the big food chains had a choice about going into the supermarket business, or the vacuum tube companies had a choice about making semiconductors. For their own good the oil firms will have to destroy their own highly profitable assets. No amount of wishful thinking can save them from the necessity of engaging in this form of "creative destruction."

I phrase the need as strongly as this because I think management must make quite an effort to break itself loose from conventional ways. It is all too easy in this day and age for a company or industry to let its sense of purpose become dominated by the economies of full production and to develop a dangerously lopsided product orientation. In short, if management lets itself drift, it invariably drifts in the direction of thinking of itself as producing goods and services, not customer satisfactions. While it probably will not descend to the depths of telling its salesmen, "You get rid of it; we'll worry about profits," it can, without knowing it, be practicing precisely that formula for withering decay. The historic fate of one growth industry after another has been its suicidal product provincialism.

Dangers of R & D

Another big danger to a firm's continued growth arises when top management is wholly transfixed by the profit possibilities of technical research and development. To illustrate I shall turn first to a new industry — electronics — and then return once more to the oil companies. By comparing a fresh example with a familiar one, I hope to emphasize the prevalence and insidiousness of a hazardous way of thinking.

Marketing Shortchanged

In the case of electronics, the greatest danger which faces the glamorous new companies in this field is not that they do not pay enough attention to research and development, but that they pay *too much* attention to it. And the fact that the fastest growing electronics firms owe their eminence to their heavy emphasis on technical research is completely beside the point. They have vaulted to affluence on a sudden crest of unusually strong general receptiveness to new technical ideas. Also, their success has been shaped in the virtually guaranteed market of military subsidies and by military orders that in many cases actually preceded the existence of facilities to make the products. Their expansion has, in other words, been almost totally devoid of marketing effort.

Thus, they are growing up under conditions that come dangerously close to creating the illusion that a superior product will sell itself. Having created a successful company by making a

Executives concerned with increasing marketing effectiveness will be interested in three other important aspects of the problem that are discussed in this issue. See John F. Magee, "The Logistics of Distribution," page 89; Victor P. Buell, "Looking Around: Guides to Marketing Planning," page 37; and Alfred R. Oxenfeldt, "Multi-Stage Approach to Pricing," page 125.

superior product, it is not surprising that management continues to be oriented toward the product rather than the people who consume it. It develops the philosophy that continued growth is a matter of continued product innovation and improvement.

A number of other factors tend to strengthen and sustain this belief:

(1) Because electronic products are highly complex and sophisticated, managements become top-heavy with engineers and scientists. This creates a selective bias in favor of research and production at the expense of marketing. The organization tends to view itself as making things rather than satisfying customer needs. Marketing gets treated as a residual activity, "something else" that must be done once the vital job of product creation and production is completed.

(2) To this bias in favor of product research, development, and production is added the bias in favor of dealing with controllable variables. Engineers and scientists are at home in the world of concrete things like machines, test tubes, production lines, and even balance sheets. The abstractions to which they feel kindly are those which are testable or manipulatable in the laboratory, or, if not testable, then functional, such as Euclid's axioms. In short, the managements of the new glamour-growth companies tend to favor those business activities which lend themselves to careful study, experimentation, and control — the hard, practical, realities of the lab, the shop, the books.

What gets shortchanged are the realities of the *market*. Consumers are unpredictable, varied, fickle, stupid, shortsighted, stubborn, and generally bothersome. This is not what the engineer-managers say, but deep down in their consciousness it is what they believe. And this accounts for their concentrating on what they know and what they can control, namely, product research, engineering, and production. The emphasis on production becomes particularly attractive when the product can be made at declining unit costs. There is no more inviting way of making money than by running the plant full blast.

Today the top-heavy science-engineering-production orientation of so many electronics companies works reasonably well because they are pushing into new frontiers in which the armed services have pioneered virtually assured markets. The companies are in the felicitous position of having to fill, not find markets; of not having to discover what the customer needs and wants, but of having the customer voluntarily come forward with specific new product demands. If a team of consultants had been assigned specifically to design a business situation calculated to prevent the emergence and development of a customer-oriented marketing viewpoint, it could not have produced anything better than the conditions just described.

Stepchild Treatment

The oil industry is a stunning example of how science, technology, and mass production can divert an entire group of companies from their main task. To the extent the consumer is studied at all (which is not much), the focus is forever on getting information which is designed to help the oil companies improve what they are now doing. They try to discover more convincing advertising themes, more effective sales promotional drives, what the market shares of the various companies are, what people like or dislike about service station dealers and oil companies, and so forth. Nobody seems as interested in probing deeply into the basic human needs that the industry might be trying to satisfy as in probing into the basic properties of the raw material that the companies work with in trying to deliver customer satisfactions.

Basic questions about customers and markets seldom get asked. The latter occupy a stepchild status. They are recognized as existing, as having to be taken care of, but not worth very much real thought or dedicated attention. Nobody gets as excited about the customers in his own backyard as about the oil in the Sahara Desert. Nothing illustrates better the neglect of marketing than its treatment in the industry press:

The centennial issue of the *American Petroleum Institute Quarterly*, published in 1959 to celebrate the discovery of oil in Titusville, Pennsylvania, contained 21 feature articles proclaiming the industry's greatness. Only one of these talked about its achievements in marketing, and that was only a pictorial record of how service station architecture has changed. The issue also contained a special section on "New Horizons," which was devoted to showing the magnificent role oil would play in America's future. Every reference was ebulliently optimistic, never implying once that oil might have some hard competition. Even the reference to atomic energy was a cheerful catalogue of how oil would help make atomic energy a success. There was not a single apprehension that the oil industry's affluence might be threatened or a suggestion that one "new horizon" might include new and better ways of serving oil's present customers.

But the most revealing example of the stepchild treatment that marketing gets was still another special series of short articles on "The Revolutionary Potential of Electronics." Under that heading this list of articles appeared in the table of contents:

- "In the Search for Oil"
- "In Production Operations"
- "In Refinery Processes"
- "In Pipeline Operations"

Significantly, every one of the industry's major functional areas is listed, *except* marketing. Why? Either it is believed that electronics holds no revolutionary potential for petroleum marketing (which is palpably wrong), or the editors forgot to discuss marketing (which is more likely, and illustrates its stepchild status).

The order in which the four functional areas are listed also betrays the alienation of the oil industry from the consumer. The industry is implicitly defined as beginning with the search for oil and ending with its distribution from the refinery. But the truth is, it seems to me, that the industry begins with the needs of the customer for its products. From that primal position its definition moves steadily backstream to areas of progressively lesser importance, until it finally comes to rest at the "search for oil."

Beginning & End

The view that an industry is a customer-satisfying process, not a goods-producing process, is vital for all businessmen to understand. An industry begins with the customer and his needs, not with a patent, a raw material, or a selling skill. Given the customer's needs, the industry develops backwards, first concerning itself with the physical *delivery* of customer satisfactions. Then it moves back further to *creating* the things by which these satisfactions are in part achieved. How these materials are created is a matter of indifference to the customer, hence the particular form of manufacturing, processing, or what-have-you cannot be considered as a vital aspect of the industry. Finally, the industry moves back still further to *finding* the raw materials necessary for making its products.

The irony of some industries oriented toward technical research and development is that the scientists who occupy the high executive positions are totally unscientific when it comes to defining their companies' over-all needs and purposes. They violate the first two rules of the scientific method — being aware of and defining their companies' problems, and then developing testable hypotheses about solving them. They are scientific only about the convenient things, such as laboratory and product experiments. The reason that the customer (and the satisfaction of his deepest needs) is not considered as being "the problem" is not because there is any certain belief that no such problem exists, but because an organizational lifetime has conditioned management to look in the opposite direction. Marketing is a stepchild.

I do not mean that selling is ignored. Far from it. But selling, again, is not marketing. As already pointed out, selling concerns itself with the tricks and techniques of getting people to exchange their cash for your product. It is not concerned with the values that the exchange is all about. And it does not, as marketing invariably does, view the entire business process as consisting of a tightly integrated effort to discover, create, arouse, and satisfy customer needs. The customer is somebody "out there" who, with proper cunning, can be separated from his loose change.

Actually, not even selling gets much attention in some technologically minded firms. Because there is a virtually guaranteed market for the abundant flow of their new products, they do not actually know what a real market is. It is as if they lived in a planned economy, moving their products routinely from factory to retail outlet. Their successful concentration on products tends to convince them of the soundness of what they have been doing, and they fail to see the gathering clouds over the market.

Conclusion

Less than 75 years ago American railroads enjoyed a fierce loyalty among astute Wall Streeters. European monarchs invested in them heavily. Eternal wealth was thought to be the benediction for anybody who could scrape a few thousand dollars together to put into rail stocks. No other form of transportation could compete with the railroads in speed, flexibility, durability, economy, and growth potentials. As Jacques Barzun put it, "By the turn of the century it was an institution, an image of man, a tradition, a code of honor, a source of poetry, a nursery of boyhood desires, a sublimest of toys, and the most solemn machine — next to the funeral hearse — that marks the epochs in man's life." [6]

Even after the advent of automobiles, trucks, and airplanes, the railroad tycoons remained imperturbably self-confident. If you had told them 60 years ago that in 30 years they would be flat on their backs, broke, and pleading for government subsidies, they would have thought you totally demented. Such a future was simply not considered possible. It was not even a discussable subject, or an askable question, or a matter which any sane person would consider worth speculating about. The very thought was insane. Yet a lot of insane notions now have matter-of-fact acceptance — for example, the idea of 100-ton tubes of metal moving smoothly through the air 20,000 feet above the earth, loaded with 100 sane and solid citizens casually drinking martinis — and they have dealt cruel blows to the railroads.

What specifically must other companies do to avoid this fate? What does customer orientation involve? These questions have in part been answered by the preceding examples and analysis. It would take another article to show in detail what is required for specific industries. In any case, it should be obvious that building an effective customer-oriented company involves far more than good intentions or promotional tricks; it involves profound matters of human organization and leadership. For the present, let me merely suggest what appear to be some general requirements.

Visceral Feel of Greatness

Obviously the company has to do what survival demands. It has to adapt to the requirements of the market, and it has to do it sooner rather than later. But mere survival is a so-so aspiration. Anybody can survive in some way or other, even the skid-row bum. The trick is to survive gallantly, to feel the surging impulse of commercial mastery; not just to experience the sweet smell of success, but to have the visceral feel of entrepreneurial greatness.

No organization can achieve greatness without a vigorous leader who is driven onward by his own pulsating *will to succeed*. He has to have a vision of grandeur, a vision that can produce eager followers in vast numbers. In business, the followers are the customers. To produce these customers, the entire corporation must be viewed as a customer-creating and customer-satisfying organism. Management must think of itself not as producing products but as providing customer-creating value satisfactions. It must push this idea (and everything it means and requires) into every nook and cranny of the organization. It has to do this continuously and with the kind of flair that excites and stimulates the people in it. Otherwise, the company will be merely a series of pigeonholed parts, with no consolidating sense of purpose or direction.

In short, the organization must learn to think of itself not as producing goods or services but as *buying customers*, as doing the things that will make people *want* to do business with it. And the chief executive himself has the inescapable responsibility for creating this environment, this viewpoint, this attitude, this aspiration. He himself must set the company's style, its direction, and its goals. This means he has to know precisely where he himself wants to go, and to make sure the whole organization is enthusiastically aware of where that is. This is a first requisite of leadership, for *unless he knows where he is going, any road will take him there.*

If any road is okay, the chief executive might as well pack his attaché case and go fishing. If an organization does not know or care where it is going, it does not need to advertise that fact with a ceremonial figurehead. Everybody will notice it soon enough.

[6] Op. cit., p. 20.

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ROLM Information Systems Guide (ISG):

SYSTEM DEVELOPMENT METHODOLOGY

October 1982

CONTENTS

FIGURES

HOW TO USE THIS DOCUMENT

This section describes how this guide can be used to serve various purposes and also explains the organization of the guide.

Applications

This guide may be used in four ways for the following purposes:

- as a reference guide - to provide a checklist of activities and expected results for developing systems
- as training material - for use in orienting and training uninitiated users and systems personnel in systems development methodology
- as a source document - to provide a guideline for correctly interpreting ROLM system development policies (see Reference 1)
- as an audit control document - to assure that both system development process and the resulting system meet audit services requirements

Organization of Content

The main body of this guide begins in Section 4 (Project Organization) in which participants and their roles in a system development project are outlined. Section 5 (System Development Phases) explains the sequence of activities and expected results for each project phase. Section 6 (Project Management) specifies project milestones and checkpoints. The appendices contain general information used in system development.

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2 INTRODUCTION

Purpose

This document provides a practical guide for developing information systems using the methodology specified by the applicable ROLM systems development methodology policies (see Reference 1). The policy document specifies high level systems development requirements and is not intended for use in guiding the activities of a system development project. The purpose of this document, therefore, is to provide guidelines with enough detail in the description of systems development steps to be helpful to systems and user personnel in an actual situation.

Scope

These guidelines apply to the development of all information systems for the internal use of ROLM.

Definition of Terms

System - In this guide, an information system (from this point on referred to as a 'system') is defined as:

- a collection of manual and automated procedures that provide a necessary or useful service.

A 'system' is therefore distinguished from a 'computer system' because a 'computer system' refers only to automated procedures. This differentiation is essential to the proper use of the methodology described here.

Internal controls - refers to all methods and measures adopted to:

- assure separation of duties
- safeguard company information and computer assets
- assure accuracy and reliability of accounting data
- promote operational efficiency
- encourage adherence to prescribed managerial policies

Applicability

This guide has formalized the system development process only to help the reader. This formalization should not imply that this guide applies only to large-scale formal projects for developing new systems. This guide can be equally helpful in developing small enhancements to systems. The only difference is that, in a given small enhancement project, very few of the activities or results will be applicable, whereas in a large formal project most of the activities and results will be relevant. Therefore, in small enhancement projects, using this guide may consist of taking a few minutes to see which, if any, of the activities or results are relevant, i.e, using it as a quick reference checklist. On the other hand, large projects may be planned to follow this guide very closely during the course of project.

References

1. System Development Methodology, 10/12/81 - ROLM POLICY

2. System Documentation Style Guide (Being developed)

3. ROLM Audit Services - audit program

The relation between this document and the above references are shown in Figure 1.

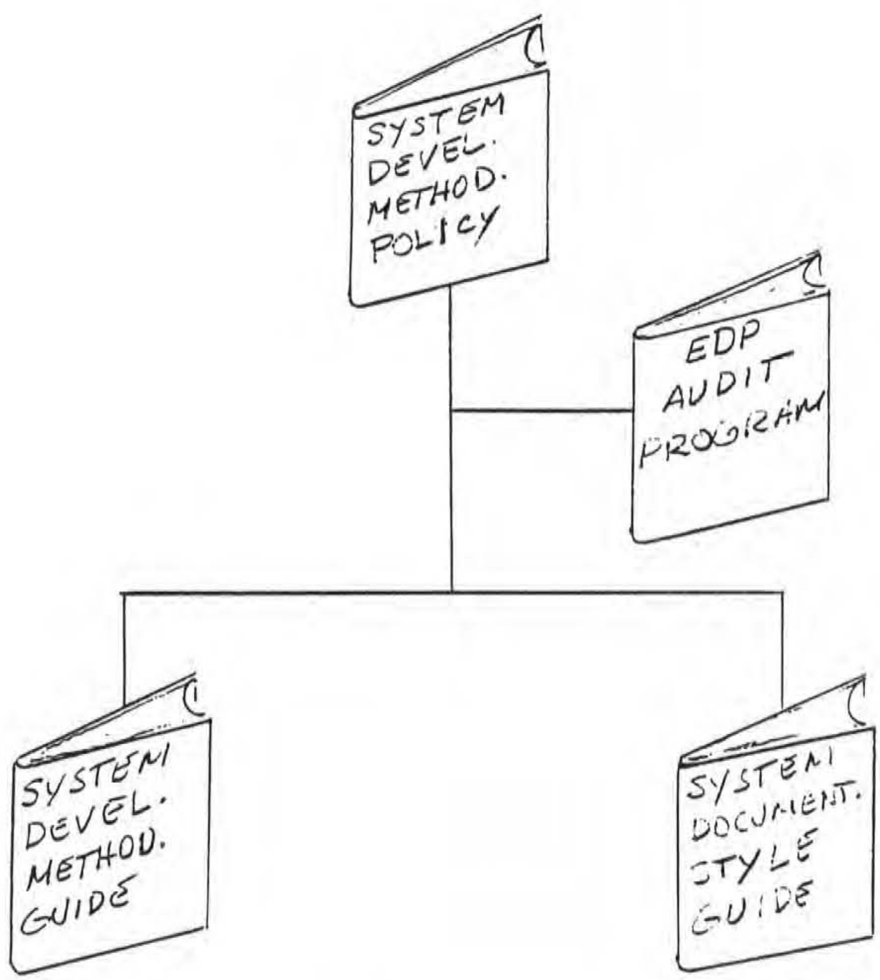

Figure 1. Relationship to Referenced Documents

3 GOVERNING POLICIES

The governing policies for system development are specified in Reference 1. This document is designed to comply with those policies. Therefore, the methodology described here meets ROLM's Information Systems policies and complies with the Audit Services requirements.

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4 PROJECT ORGANIZATION

This section defines the organization and principal participants of each systems development project, and describes the specific responsibilities assigned to each participant.

Project Team

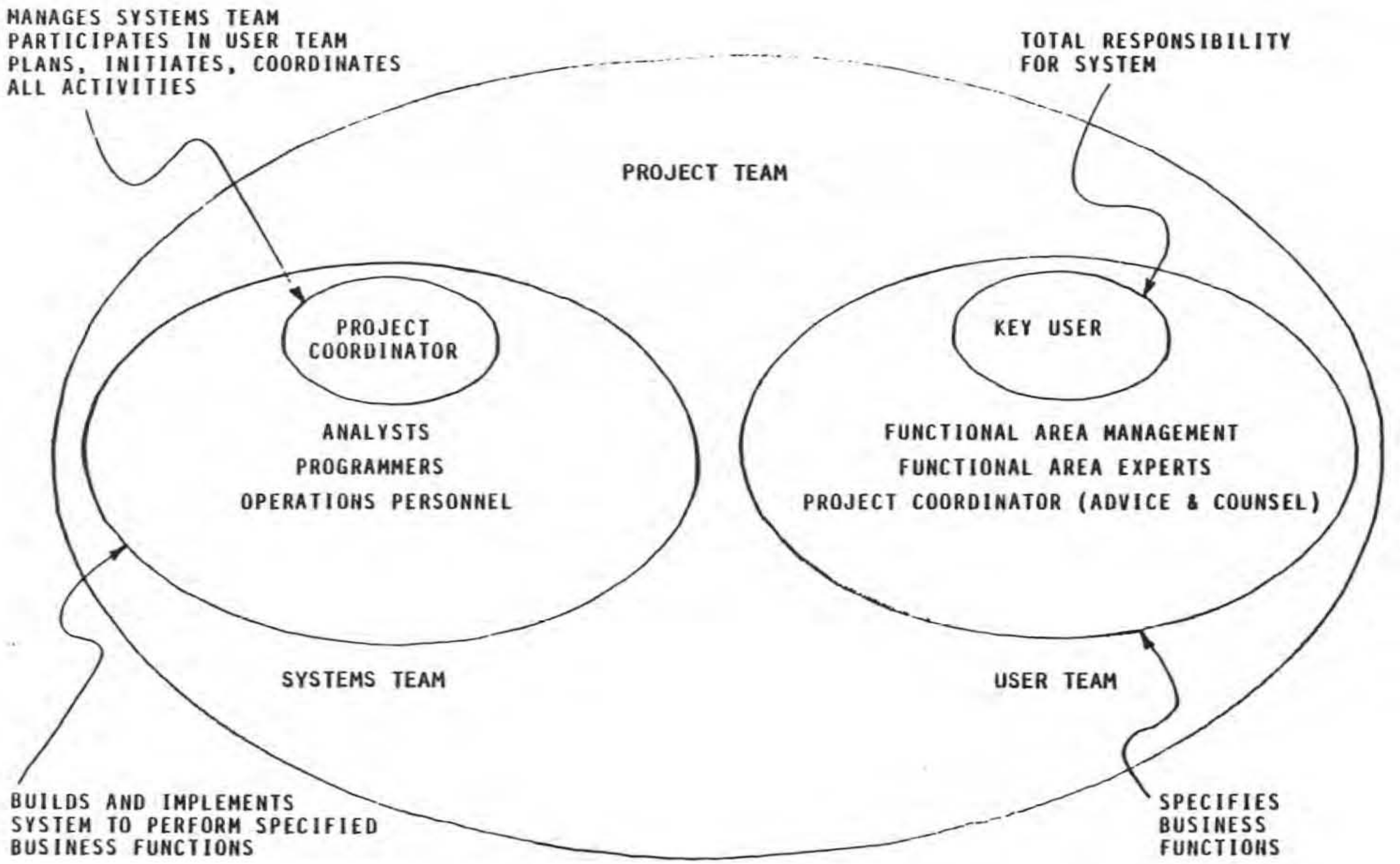
Generally, business information systems cross functional area boundaries; therefore, systems development requires participation by one or more functional areas. To provide for this, business systems are developed as projects and organized to include participants from the various functional groups who will be the eventual end users of the new system. These participants work together as a project team (see Figure 2), in a coordinated effort between two smaller teams: the user team, led by the key user of the system, and the systems team, led by the project coordinator. This subgrouping indicates a differentiation of functions between users and systems designers; in reality, both teams work together toward the single goal of accomplishing project objectives.

Participants

Participants of the project team may vary in number from a single user team member representing one or more functional areas working with a single systems team designer/programmer for small-scale projects, to a large number of persons sharing project tasks. Whatever the number, the primary requisite for membership is that each member must be fully authorized to represent their respective functional areas within the project; i.e., their decisions, as related to the business of the project must be fully supported by their respective functional area. The general categories of project team participants may be summarized as follows:

- user team - includes key functional and management positions from areas within the scope of the system
- key user - a member of the user team who has overall responsibility for the success of the project
- systems team - analysts, programmers, operational staff, assigned by information systems management
- project coordinator - assigned by information systems management at request of key user to coordinate all project activities and manage the systems team

Additionally, participants may be chosen to attend review meetings without participating directly in the project (see Section 5, Project Management). These would include members from:



APPLICATION SYSTEMS DEVELOPMENT
PROJECT ORGANIZATION FRAMEWORK

Figure 2.

- o user departments affected by system
- o department system managers
- o Corporate MIS
- o Rolm Audit Services

Responsibilities

Basically, the systems team builds the system for the eventual use of the user team, so that the relationship between the two teams has in it many elements of a supplier/client relationship. However, both teams work from their respective positions to define and carry out project tasks. The major roles and responsibilities of these participants may be summarized in the following paragraphs.

User team - While some functional requirements of the system are shared by participating areas, each area may also have a unique set of system functions. The timing, priority, and resource requirements of system functions unique to one area may not be in harmony with system functions common to all areas or unique to other areas. Successfully implementing these diverse needs is the primary responsibility of the user team. Fulfilling this requirement requires the user team to formulate a clear set of overall project objectives, define, coordinate, and prioritize functional requirements, and monitor project activity on a continuous and regular basis to insure that all objectives and functional requirements are addressed. Specific functions for which the user team is responsible include the following:

- o defines system objectives
- o specifies high level business requirements
- o specifies project justification criteria
- o establishes and controls project scope
- o assures functional completeness and consistency
- o obtains necessary resource approvals
- o establishes desired time table
- o resolves conflicting requirements
- o reviews progress
- o monitors user team membership
- o signs off at completion of major milestones

Key user - The key user plays a dual role. First, as a member of the user team, the key user is responsible for all the user team functions defined above. Secondly, the key user has total responsibility for the project and for continued operation of the system after project completion. These responsibilities may be summarized as follows:

- o initiates the project
- o assures that user team has appropriate representation

- o assures that user team attends to the project's business in a timely manner

- o assures that user team provides a unified and consistent set of business function specifications for the project

Systems team - The systems team builds the system to perform all business functions and performs all planned project activities.

Project coordinator - The project coordinator plays an important role in system development. This individual must have the ability and the authority to manage the systems team; most importantly, the coordinator must be able to communicate effectively with user team members and with the key user. The project coordinator also participates in the user team in an advisory capacity. Specific functions for which the project coordinator is responsible include the following:

- o plans, initiates, and coordinates all activities necessary to meet project objectives

- o participates in user team as advisor

- o manages system team

- o coordinates all activities outside project with project team

- o assures specifications are met

- o assures development time and cost objectives are met

- o assures that all deliverables and milestones are met

The project coordinator must be trained in using the methodology. Consequently, the project plan should allow sufficient time for project coordination activities.

Audit Services - The Audit Services department reviews the system development projects to see whether or not adequate internal controls are designed into the system. The Audit Services requirements have been incorporated into this guide, therefore, if this guide is followed properly, requirements would be met.

4 SYSTEM DEVELOPMENT PHASES

Overview

Project development methodology - Developing systems requires three basic elements:

- o methodology
- o techniques
- o tools

This document addresses only the methodology. This is primarily because everyone in the project must use the same methodology or the project cannot be effectively planned and controlled. Use of a given system development methodology requires practice and prior experience; therefore, from a productivity point of view it is necessary to use one methodology for all systems and improve it over time. For those reasons this guide only addresses the system development methodology that must be common to all projects. Techniques and tools, on the other hand, should generally be chosen to suit a given task. Therefore, the choice of techniques and tools has been left to the individual project coordinator.

Project phases - The concept of phased methodology described here is commonly used in the industry. It accurately models the natural system development process adopted by most experienced system developers after some trial and error. The approach is to systematically guide the project through the following steps:

- o Decide whether or not the project is worth doing
- o Define the specific needs
- o Define how the system should work
- o Build, test and install it
- o Look back and see how well the job was done and how the system can be improved

These steps directly correspond to five phases of development. Figure 3 shows an overview of major activity categories in each phase and relative timeing. The first three phases consist of specific steps to find out the answers to more detailed lists of questions, document the answers, review them with people who may be affected, and get management approval to proceed to the next phase. The fourth phase consists of steps necessary to build, test, and install the system. The fifth (final) phase consists of evaluating the results achieved, developing a plan for future system improvements, and documenting the plan. These five phases are discussed in the following paragraphs. A high level overview of major steps is shown in Figure 4. To assure proper management reviews and approvals, the results of each phase should be reviewed and approved before substantial work can begin on the follow-on phase(s).

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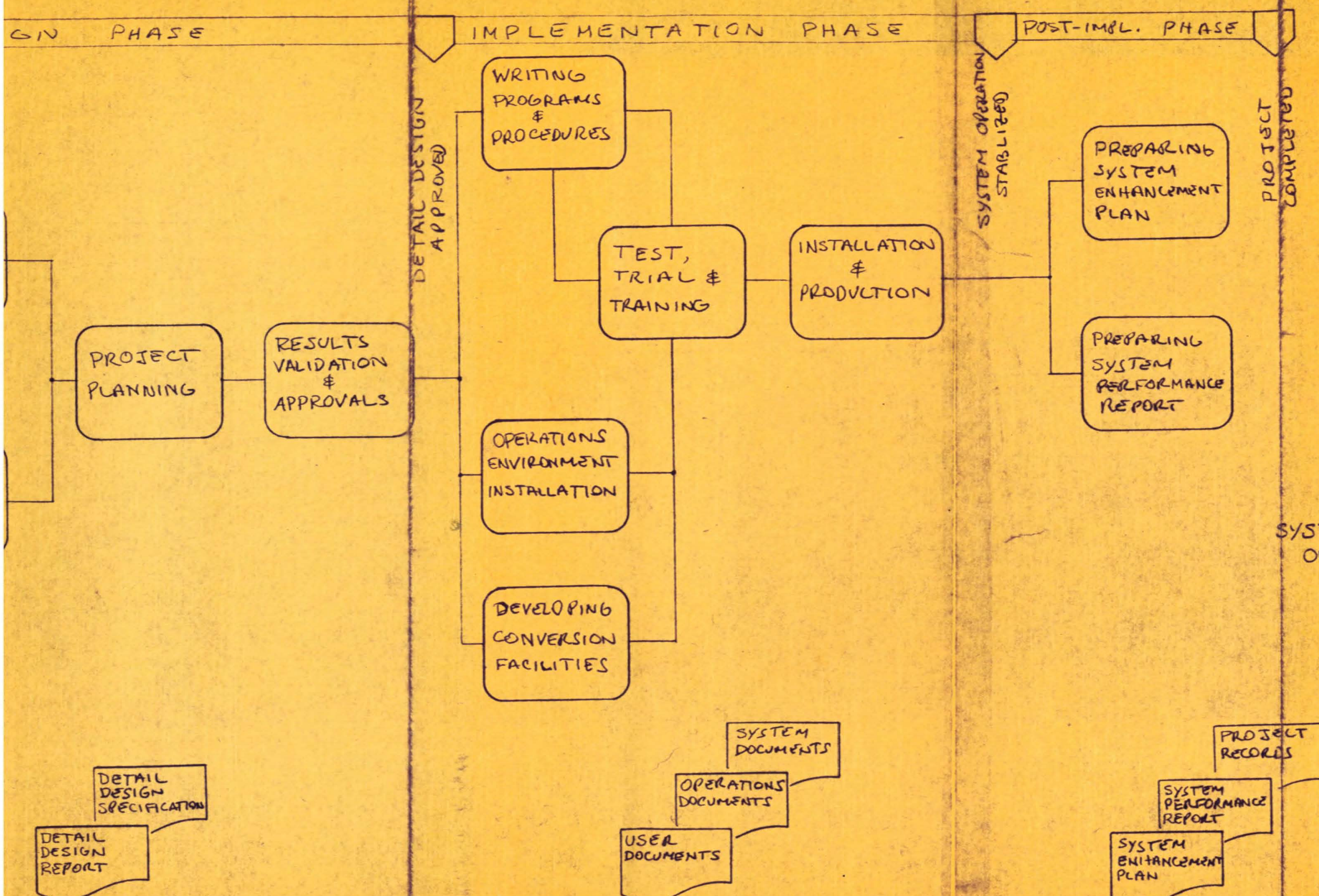
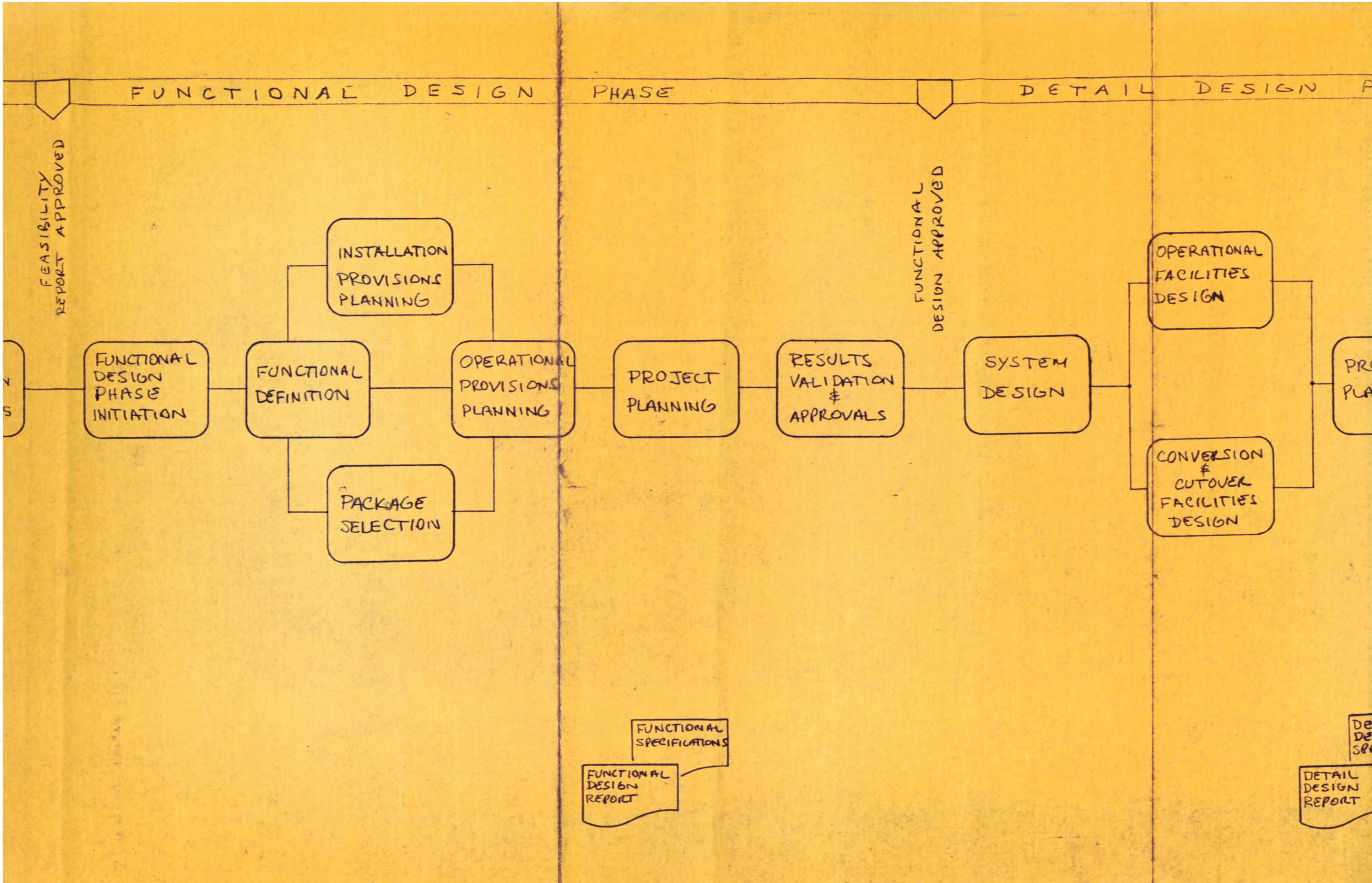
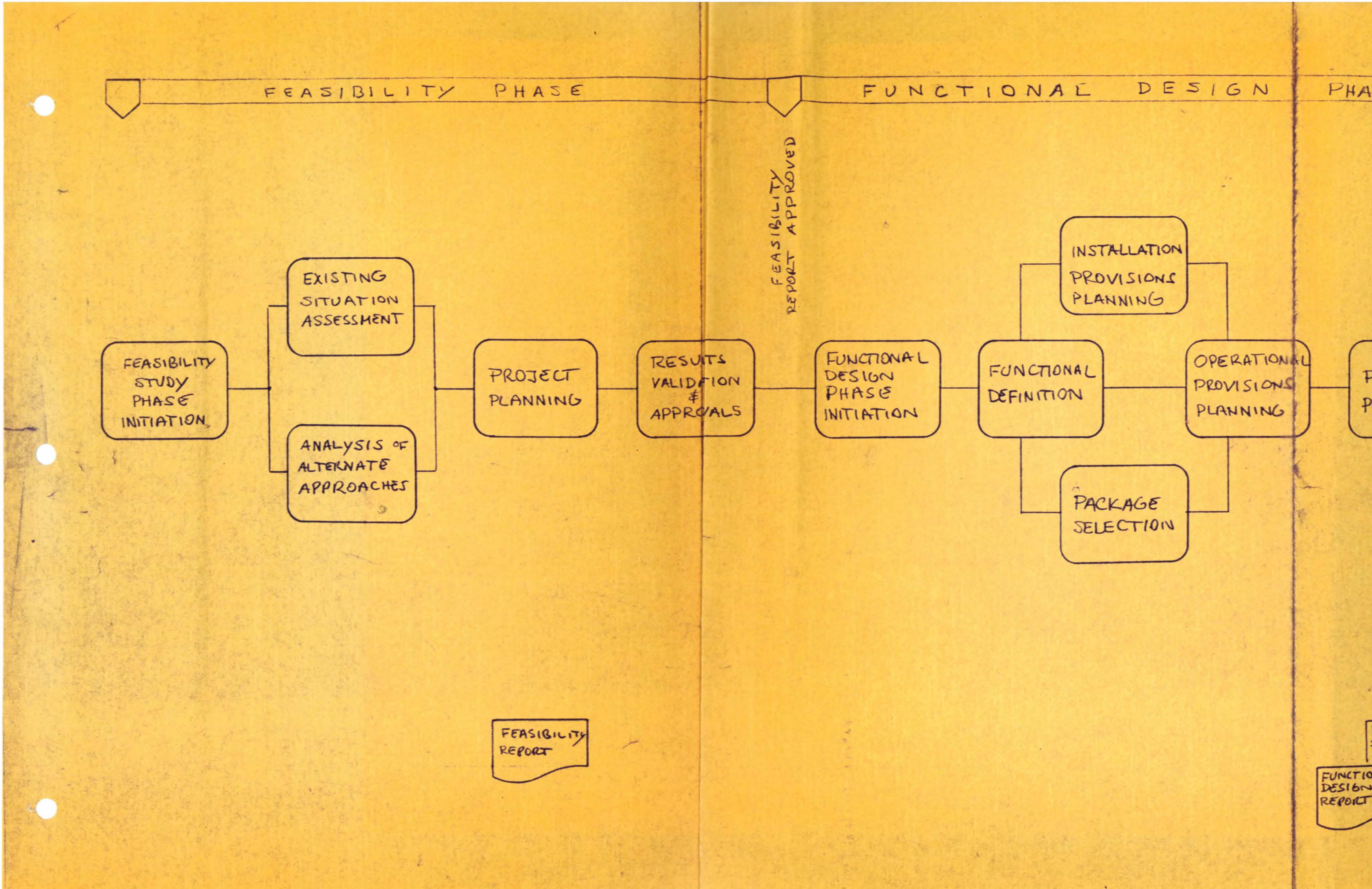


SYSTEM DEVELOPMENT OVERVIEW CHART

FIGURE 3



FUNCTIONAL DESIGN PHASE
DETAIL DESIGN PH
FEASIBILITY REPORT APPROVED
FUNCTIONAL DESIGN APPROVED
FUNCTIONAL DESIGN PHASE INITIATION
FUNCTIONAL DEFINITION
INSTALLATION PROVISIONS PLANNING
PACKAGE SELECTION
OPERATIONAL PROVISIONS PLANNING
PROJECT PLANNING
RESULTS VALIDATION & APPROVALS
SYSTEM DESIGN
OPERATIONAL FACILITIES DESIGN
CONVERSION & CUTOVER FACILITIES DESIGN
PRO PLAN
FUNCTIONAL SPECIFICATIONS
FUNCTIONAL DESIGN REPORT
DETAIL DESIGN REPORT


FEASIBILITY PHASE
FUNCTIONAL DESIGN PHAS
FEASIBILITY REPORT APPROVED
FEASIBILITY STUDY PHASE INITIATION
EXISTING SITUATION ASSESSMENT
ANALYSIS OF ALTERNATE APPROACHES
PROJECT PLANNING
RESULTS VALIDATION & APPROVALS
FUNCTIONAL DESIGN PHASE INITIATION
FUNCTIONAL DEFINITION
INSTALLATION PROVISIONS PLANNING
PACKAGE SELECTION
OPERATIONAL PROVISIONS PLANNING
FEASIBILITY REPORT
FUNCTION DESIGN REPORT

	1	2	3	4	5
System Development Activities	Feasibility	Functional Design	Detail Design	Implementation	Post-implementation Review
Establishing direction (project initiation)	Problem or opportunity description Objectives and primary requirements Exclusions				
Developing business functions	Alternative solutions Recommended solutions Expansion and flexibility considerations	Manual procedure identification Personnel change requirements	Manual procedure definition	User's and operations procedure documentation Training	
Developing computer systems definitions		High level information flow diagram General system characteristics specifications Output specifications Source input specifications System interface definition Data store definition Data element definition Code value descriptions	Detail system information flows System interface design Data base design		
Programming			Program definition and design	Programming and unit testing	
Developing operating facilities		System operational environment characteristics System operational impact	System operational environment specification System operating specifications Capacity analysis Training plan	Hardware/software/TP network installation and testing User's and operations procedure documentation Training	
Developing conversion and cutover facilities		Data conversion specifications System cutover scheme definition	Data conversion facility design System cutover plan	Conversion/parallel/cutover	
System trials		System test and trials scheme definition	System test and trial plan	String and system integration testing Conversion/parallel/cutover	
Project management	Proposed project organization System paybacks Projected schedule, time, and cost	Project schedule, time, and cost Applicable standards and conventions	Project schedule, time, and cost		System enhancement plan Report of system performance Development resource actual to estimate comparison
Milestones	Documents distributed ← two weeks → General review Feasibility checkpoint and functional design go-ahead	Documents distributed ← two weeks → General review Functional design checkpoint detail design go-ahead	Documents distributed ← two weeks → General review Detail design checkpoint and implementation go-ahead	Final cutover plan distributed ← one week → General review	Documents distributed General review System sign-off
Documents produced	Feasibility Analysis Report	Functional Design Report Functional Design Specifications	Detail Design Report Detail Design Specifications	User's Guide: User documentation System documentation Operations documentation Data preparation instruction	Post-Implementation Review Report System Enhancement Plan

Figure 4. System Development Activity Summary

Feasibility Study

Purpose - the purpose of the feasibility study phase is to determine if an opportunity is of sufficient value to justify committing the required resources.

Key Results - The key results expected from the feasibility study phase are:

- o project organization - identification of the key user and project team
- o project definition - definition of system objectives and primary requirements
- o recommended approach - ranking of alternative solutions and expected benefits
- o project plan - estimation of schedule, time, and costs for the overall project .

Startup - This phase begins when a key user is assigned to investigate an information-system related need or opportunity.

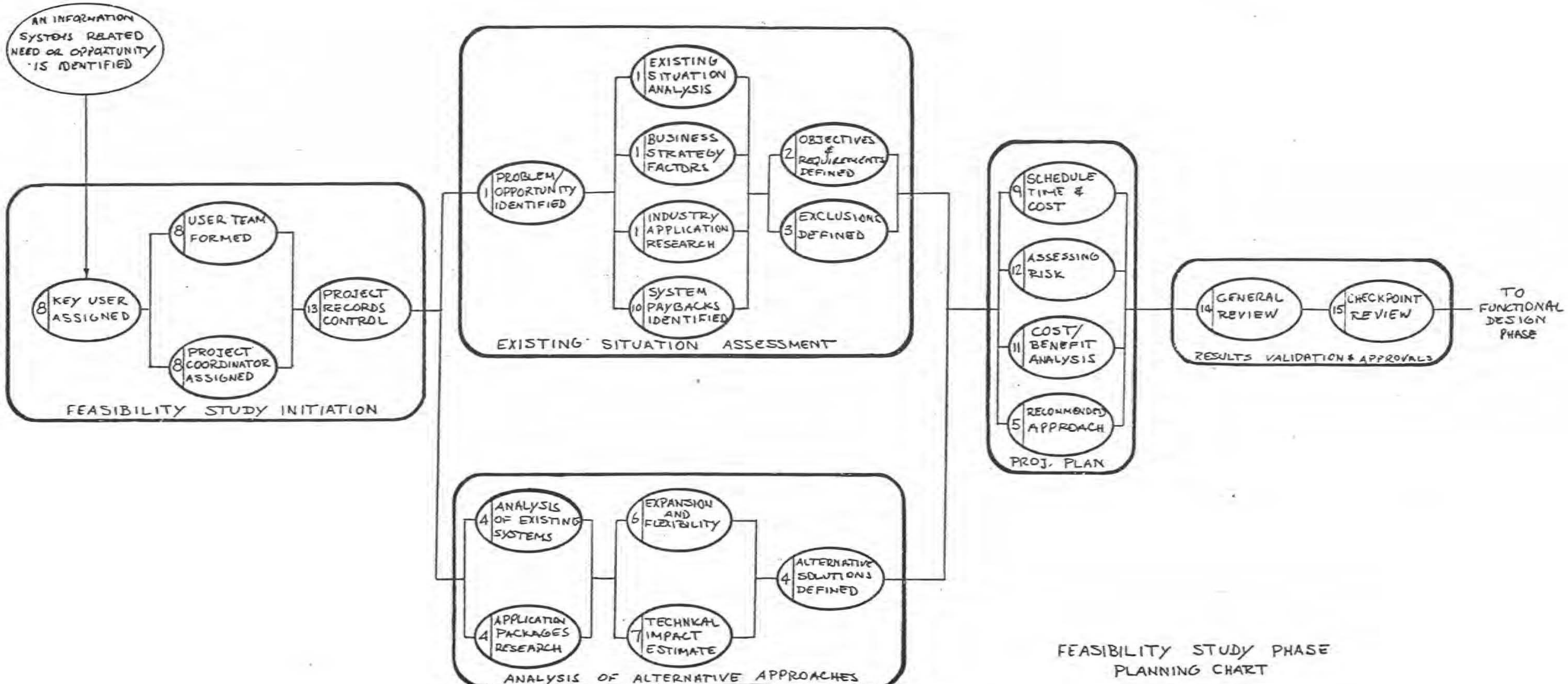
Approach - Specific questions guiding the feasibility study include the following:

- o What is the perceived problem or opportunity?
- o What are the desired end objectives and requirements?
- o What general solutions should be considered and what is the most feasible solution?
- o What are the potential benefits?
- o Who are the participants?
- o What is the total estimated schedule, time, and cost of providing a solution?
- o Should the project continue to the next phase of development, i.e., functional design and what are the schedule, time, and cost of the next phases?

Ideally, these questions should be asked in the sequence shown above, but in general this is not the most practical approach. As in any investigation or exploration process, work proceeds by iterating through these questions several times. The knowledge gained in each pass through these questions provides a better insight into the next pass. This iterative process continues until the understanding of the problem or opportunity and the related solutions are clear enough to be present to the management.

Feasibility Study

The phase planning chart (Figure 5) shows the sequence of tasks for one pass through the process. In reality, two or more passes through this set of tasks may be necessary to achieve the desired results.



FEASIBILITY STUDY PHASE
PLANNING CHART
FIGURE 5

Tasks - The time sequence of the feasibility phase tasks to answer the above questions and achieve the desired results is diagrammed in the phase planning chart shown in Figure 5. For convenient reference, the task descriptions are listed below in logical sequence rather than time sequence as follows:

o project definition

(1) defining the problem
(2) defining objectives for solution
(3) defining exclusions to objectives

o project analysis

(4) evaluating alternative solutions
(5) selecting recommended solution
(6) defining expansion and flexibility considerations
(7) evaluating technical impact

o project plan development

(8) forming the project team
(9) estimating the schedule, time, and cost
(10) estimating system paybacks
(11) analyzing costs and benefits
(12) assessing risk
(13) controlling project records
(14) conducting general review
(15) conducting checkpoint review

For an overall view of tasks versus phases, refer to Figure 4. Each of these tasks is described more fully in the following paragraphs.

Task 1 - Defining the problem - Define the problem so that it can be clearly understood as it is perceived by :

o management
o functional areas
o information systems

To ensure that the definition will accurately portray all aspects of the situation, the following activities can be carried out as part of the feasibility study:

o research - investigate existing practices and business processes to identify the specific problems or opportunities

o analysis - study the subject area thoroughly enough to accurately identify the causes of the problem or the source of the opportunity

- evaluation - identify the effect of these problems or opportunities

The subject area should be studied so that the existing situation can be accurately assessed. This study usually includes reviewing and documenting the existing business processes and identifying the particular areas that the problem or opportunity addresses. Then, the existing situation will be assessed in the context of the identified problem or opportunity.

Do not directly or indirectly suggest a solution to the problem in this step. Instead, it is important to comprehend the problem or opportunity in a way that allows easy evaluation of candidate solutions.

Task 2 - Defining objectives for solution - Based on the understanding of the problem or opportunity define the following:

- set of end objectives (end results to be achieved)
- set of requirements to meet those objectives

This step will then concisely describe the list of desired end results in a few, brief, clear, and easily understood statements. Note that an existing situation will often impose requirements for achieving the desired end results. For example, the objective may be to reduce clerical errors. Because of circumstances, the following requirements may be imposed: Processing will be in batch mode, the problem should be solved in 90 days or less. The objectives and requirements are distinguished from solution alternatives in that they are not intended to describe how the problem should be solved. Instead, they narrow the field of possible solutions, and provide the criteria for evaluating the effectiveness of candidate solutions. At the completion of the project, they will be used for judging the effectiveness of the final results.

Task 3 - Defining exclusions to objectives - Define and describe any areas that are intentionally excluded from further consideration. The intent is not to develop an exhaustive list of exclusions. Therefore, describe only items or subjects that naturally fall within the context of the objectives, but in this case are intentionally excluded. Also describe the reasons or considerations for excluding each subject.

Task 4 - Evaluating alternative solutions - Identify, describe, and analyze general solutions for achieving the objectives by studying each applicable solution in sufficient detail to limit the solutions to a few serious candidates. To arrive at an accurate description for each solution, analyze each possible solution with regard to the following considerations:

- functional
- technical
- financial
- strategic

The results of this analysis will provide answers to the following questions:

- o Which basic business functions does the solution address and to what degree?
- o How does the solution fit into the division's or the ROLM business plan?
- o How does the solution fit into the hardware and software environment?
- o How does the solution fit into the information systems plan?
- o What are the one-time and ongoing costs?
- o What is the value of paybacks (benefits)?
- o What is the return on investment?
- o What risk factors are associated with this solution?

The alternative solutions then should be ranked based on the answers to these questions. Appendix C provides a more detailed checklist of questions for this purpose. The result of this task will be sufficient information for management, users, and systems people to jointly decide which solution, if any, should be pursued further.

Task 5 - Selecting a recommended solution - Select one of the solutions for further consideration and develop a rationale for recommending this particular solution. Document the rationale to relate the analysis of the solutions to the project objectives and requirements.

Task 6 - Defining expansion and flexibility considerations - Consider the candidate solution in relation to possible future requirements, with sufficient information to develop a feel for how effective the solution would be if any one of the probable future business or technical scenarios were to materialize. These scenarios could include:

- o changes in the line of business
- o organizational changes
- o changes in the way business is done
- o changes in the volume of business
- o changes in the hardware and or software environment
- o changes in geographic distribution of work

Usually, future considerations consists of a range of possibilities rather than specific requirements. Therefore, the expansion and flexibility considerations provide criteria for analysis of the solution alternatives.

Task 7 - Evaluating the technical impact - The impact of the recommended solution on major technical elements such as hardware, software, and communication facilities should be evaluated at a high level of consideration.

Task 8 - Forming the project team - Based on the project objectives and requirements, identify the proposed project participants in the following categories:

- o key user
- o user team
- o project coordinator
- o systems team

See Section 3 (Project Organization) for a description of functions for each of these participants. Identify participants in the first three categories for the duration of the project. For the systems team, identify only those members who will be active in the feasibility phase. Since the recommended solution may not require a project, or may not be specific enough to identify the final project organization at this point. Propose the project team as completely as possible based on the available information. The key-user, however, must be identified as a prerequisite to beginning any activity in the feasibility phase (see Figure 5).

Task 9 - Estimating schedule, time, and costs - Prepare a schedule for each of the solutions, with estimates for project time and costs. Prepare estimates for the following two categories:

- o functional design phase only
- o total project

The functional design phase estimates use firm numbers to provide detailed enough data about the next phase to commit resources. Estimates for the total project may be rough projections based on limited information. (See Appendix B for an estimating technique.)

Task 10 - Estimating system paybacks - Estimate the value of the benefits to be gained by implementation of the recommended solution. Generally, paybacks are in the following two categories:

- o costs - reduced, eliminated, or prevented
- o value - increased or enhanced

Since these benefits will be contrasted to project costs, they should be in dollar units and be as accurate as the project cost estimates. It is important to estimate both categories as accurately as possible. While it is difficult to predict the value-related benefits, these usually represent the greatest paybacks.

Task 11 - Analyzing costs and benefits - Compare the project costs to paychecks/benefits. For most projects a simple listing of costs, expected benefits and risk factors on one sheet of paper should be sufficient, and formal financial analysis is not required. On very rare occasions, a project may require substantial investment and a simple financial analysis may be warranted.

Task 12 - Assessing risk - Risk in this context refers to degree of exposure to factors that may prevent the project from meeting its objectives. The task is to assess the likelyhood of occurence of one or more of the following situations:

- o missing implementation deadlines
- o failing to fulfill required performance standards
- o failing to realize some or all of the anticipated benefits
- o exceeding planned cost or resource levels

A large number of factors could influence the outcome of a project. A list of factors to examine in determining the size of the risk are listed in Appendix A5 (Risk Assessment Checklist). Risk factors for each solution should be assessed as part of its characteristics.

Task 13 - Controlling project records - Establish a project file to maintain sufficient project correspondence, work papers, and documentation to show that the project has performed to the functional requirements and to record key decisions and assumptions.

Task 14 - Conducting general review - Refer to Project Management section.

Task 15 - Conducting checkpoint - Refer to Project Management section.

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Functional Design Phase

Purpose - The purpose of functional design phase is to find out the specific business needs and to define, in users language, the functional system elements and internal control requirements in sufficient detail so that during the next phases specific manual procedures and computer programs can be designed to perform the business functions.

Key Results - The key results expected from the functional design phase are:

- o definition of functions - a complete and accurate definition of business functions, a description of individual functional elements, and a high level description of the proposed system elements in relationship to the business functions and to each other.
- o operational considerations - description of major operational elements
- o installation considerations - description of major conversion and cutover considerations
- o project plan - revised estimation of the project schedule, time, and cost for project completion

Startup - This is the second phase of the system development process. It begins when management approves the feasibility report and authorizes project resources for functional design.

Approach - The feasibility study phase outlined the problem or opportunity and recommended a feasible general solution. The functional design phase defines the major business functions within the context of the selected general solution. Two categories of questions guide the functional desgin effort:

- o general - questions that are answered in general terms to achieve functional descriptions and high level system diagrams
- o specific - questions that are answered in specific terms to prepare functional specifications

The two levels of questions can be summarized in the following paragraphs.

General questions - To desgin the functional system with enough detail and enough accuracy to aviod the possibility of substantial revision during subsequent project phases, high level overviews of related system elements must be defined, charted, and described by answering the following questions in general terms:

- o How are the major system components related to each other, to data stores, and to inputs and outputs?
- o What is the high level process flow between computerized and manual procedures?
- o What is the basic organization of each data store?
- o What are the system characteristics relating to audit and controls, performance, security and reliability, and processing volume?
- o What are the elements of the new operational environment (software, hardware, user site equipment, telecommunications network, etc.)?
- o How will the current operating mode be converted to the new environment?
- o What qualitative and quantitative personnel changes will be required?
- o What are the schedule, time, cost, and resource requirements for the total project?

Since the questions are answered in general terms during this phase, the answers may undergo change in the course of the detail design. It is important to remember that the functional design phase describes what functions will be performed by the system, rather that how these functions should be automated. Since subsequent phases will address how the system should be automated, the functional design specifications should be written in user language. Within this framework, answers to the specific set of questions listed below may be defined to provide the foundation upon which the system will be built. Although some of these specifications may also change during the remaining phases, it is essential at this point to finalize a set of complete and consistent answers to serve as a complete and consistent set of functional design specifications.

Specific questions - Usually a system addresses a set of related business functions. While there is an interplay between these functions, each function generally has its own unique input, processing, and output requirements. The interplay between functions is accomplished through interfaces (i.e., the output of one function is used as and input to another function) or through the sharing of stored data. For these reasons, it is helpful, at the onset, to identify and define with a brief narrative each of the individual functions. Once the narrative definitions of all functions are in place, the following questions must be answered in detail for each function:

- o What are the outputs?
- o What are the inputs?

- o What are the information flows within the function?
- o What interfaces are there between functions?
- o What are the data stores (i.e., files and data bases) and what is the data content of each?
- o What specific processes will be performed?
- o What specific manual processes will be required?
- o What are the schedule, time, cost, and resource requirements for the detail design phase?

Similar to the Feasibility study, work proceeds in an iterative manner. Generally, it is impractical to answer each of these questions completely in one pass. As in any design process, however, work proceeds iteratively between higher level design and detail design, with development of each providing validation for the other. This iterative refinement process continues just enough to define a clear, consistent and compatible set of functional elements, so that both the users and systems people are at ease with how the business functions will be conducted.

Figure 6 shows the time sequence of activities and their relationships for one pass through the process. In reality, two or more passes through these set of tasks may be necessary to achieve an effective functional design.

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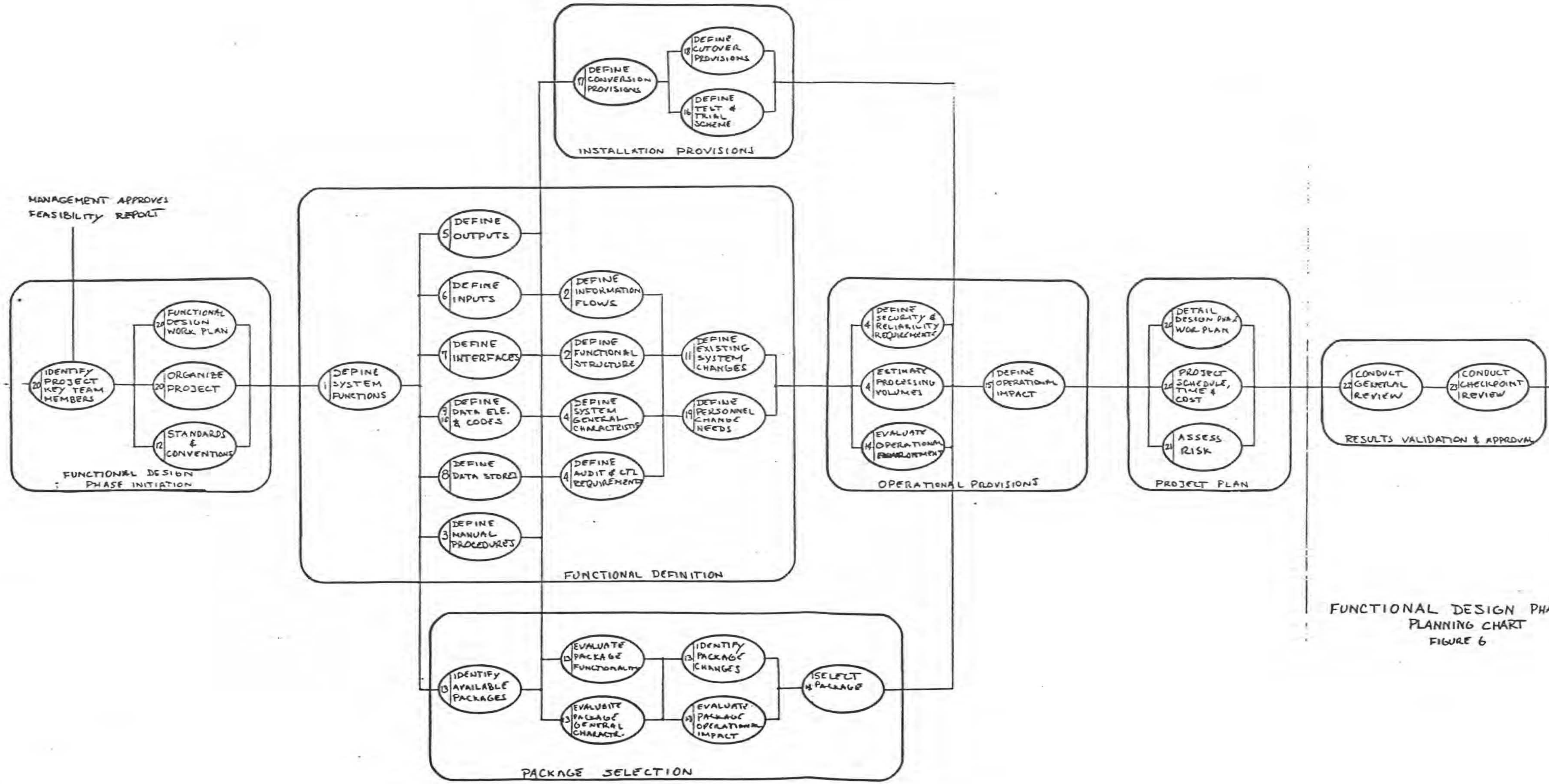

FUNCTIONAL DESIGN PHASE
PLANNING CHART
FIGURE 6

Functional Design Phase

Tasks - The time sequence of analysis and definition tasks to create a detailed set of specifications is shown in Figure 6. For convenient reference, the task descriptions are listed below in logical sequence rather than time sequence as follows:

- o definition of functions - Create a conceptual framework of all major elements required for performing the business functions, by means of the following tasks:

  (1) defining business functions
  (2) defining high level information flow
  (3) identifying manual procedures

- o functional specification preparation - Define all system elements required to meet functional requirements by performing the following tasks:

  (4) defining system general characteristics
  (5) defining output specifications
  (6) defining input specifications
  (7) defining system interface
  (8) defining databases
  (9) defining data elements
  (10) defining code values
  (11) defining changes to the existing systems
  (12) defining applicable standards
  (13) selecting a package

- o preliminary installation plan preparation - Propose the scheme for installation and explain its ramifications, by performing the following tasks:

  (14) defining the operational environment
  (15) defining system operational impact
  (16) defining test and trial scheme
  (17) defining data conversion provisions
  (18) defining cutover provisions
  (19) defining personnel change requirements

- o project plan revision

  (20) revising estimates for project schedule, time, and cost estimates
  (21) assessing risk
  (22) conducting general review
  (23) conducting checkpoint reviews

For an overall view of tasks versus phases, refer to Figure 4. Each of these tasks is described more fully in the following paragraphs.

Task 1 - Defining business functions - A system usually deals with a sub set of business functions. These functions should be clearly identified based on the objectives that were decidied upon in the feasibility study phase. Each function must be narratively described in a few consise sentences. The definition should only include enough details to convey what is done rather than how it is done. When complex elaborate functions are involved, it is helpful to break them down to their sub functions and define the sub function. The relationship between these sub functions can usually be shown by a hierarchy chart.

Task 2 - Defining high level information flow - Identify and describe the automated and manual processes performed by the system to process the inputs and data bases to produce the outputs. Identify and describe the computer system elements (programs, sorts, etc.) at a high level suitable for planning the scope of required programming. The intent here is to break down system functions to logical processing blocks with each element described in enough detail to enable program designers to define and design the necessary programs during the next phase (detail design). The specific items addressed are:

- system functional structure - Develop diagrams and appropriate narratives to show the relationship between computer processing elements and manual processes.
- computer processing elements - Identify major high level computer processing elements (on-line processing programs, sorts, utility programs, batch programs, etc.) and identify inputs, data stores, outputs, controls, and timing for each element.
- information flow - Show the flow of information from one system element to the next.

Task 3 - Identifying manual procedures - Identify and define the manual procedures associated with the manual processes shown in the high level information flow diagrams described above. These descriptions are the foundation of the user procedures to be prepared in subsequent phases. At this point these descriptions will specify what needs to be done without necessarily being specific about who does it or how it is done. The specifics of who and how will be addressed in the detail design phase.

Task 4 - Defining system general characteristics - Describe the following general characteristics for the system:

- performance characteristics - Specify the general performance characteristics required to meet both user and operational needs. (See Appendix A for a general performance items list.)
- audit and control requirements - Describe general requirements for easily relating processing results to inputs and files, in order to provide a

trace mechanism for observing causes and effects (see Appendix A1)

- security requirements - Describe the general requirements for establishing controlled access for various levels of authority.

- processing volume estimates - Estimate processing volumes in the following categories for the planned life of the system: input transactions, on-line transactions, data storage volume, data storage accesses rates, volume of outputs, and data preparation volume. The estimated volumes should, if significant, specify the timing requirements associated with the volumes related to processing, with any peak periods or critical time windows identified.

Task 5 - Defining output specifications - Define the major system hardcopy reports (manual or automated), screens, and microform outputs in detail and provide the following information for each output:

- identification
- purpose (who uses it, for what, when)
- format and data content
- sort sequence and control breaks
- frequency
- distribution and availability
- security
- retention
- volume and expected growth
- balancing controls
- audit trails

Final design and ordering of preprinted forms should be deferred to the implementation phase.

Task 6 - Defining input specifications - Define the major hard-copy inputs and screens in detail, and provide the following information for each input:

- identification
- purpose (who prepares it, for what, when)
- format and data element content
- edits and validation criteria and default values
- security
- retention (if hard copy)
- volume, expected growth
- source/origination mechanism
- frequency and timing
- controls

Final design and ordering of preprinted forms should be deferred to the implementation phase.

Task 7 - Defining system interface - Define both the inputs received from other systems and the outputs produced as input to other systems, and provide the following information for each system interface:

- o identification
- o purpose (when produced or received, what information, for or from which system)
- o data element content
- o general structure
- o frequency and timing (produced or received)
- o source or destination
- o media (tape, disk, transmission, etc.)
- o controls
- o security
- o retention

Task 8 - Defining databases- Define the major databases (files, data stores or manual records) used in the system, and describe the following characteristics in specific terms:

- o identification
- o data element content

Define the following characteristics in general terms:

- o access type (random, sequential, etc.)
- o access key
- o organization or structure
- o access method or technique
- o size or data volume and expected growth
- o controls (integrity, security, backup, and recovery)

Task 9 - Defining data elements - Define each data element referenced in the outputs, inputs, and data stores, and provide the following information for each data element:

- o identification
- o description
- o value characteristics
- o where used (outputs, inputs, interfaces, and data stores)

Task 10 - Defining code values - Define the specific meaning of values for all data elements having predefined discrete values that affect the processing logic (codes). For each code, provide the following information:

- o data element identification
- o external code values
- o code description

Task 11 - Defining changes to existing systems - Usually, creating a system requires some changes in the existing systems. The section on interfaces discusses the exchange of data between the systems. In addition to defining interfaces during this phase, it is essential to specify the changes that should be made to the existing systems. These changes may be viewed as a development process themselves and, therefore, may require some or all the steps specified here. In other words, the functional design of changes to the existing system must be addressed in the same level of detail as the system being developed.

Task 12 - Defining applicable standards - Identify all standards and conventions that will be used in the system in either of the following two categories:

- o global or division/department standards
- o conventions and standards specific to the system

For global or division/department standards and conventions, state only those standards and conventions that will not apply to this system. For standards and conventions that apply to the specific system, define and categorize as shown by the following examples:

- o common algorithms (modules), such as data convert routines, rounding, hash coding, currency conversion, etc.
- o screen or report headings and footings
- o internal controls, such as record level or field level controls
- o error detection and reporting
- o abnormal ending handling, etc.

The standards and conventions must be clearly specified in this phase and updated throughout the life of the system.

Task 13 - Selecting a package - For some systems, parts or all of the functional needs can be satisfied by an off-the-shelf application software package. The decision to use a package or not as well as selecting a specific package depends on the system functions. Therefore, package selection activities parallel functional definition activities. Usually work proceeds in an iterative between functional definition and package calculation, each providing input to the other. In each step some of the candidate packages are eliminated. This process continues until all functional needs are identified and either package is selected or all candidates are eliminated. Package selection includes the following sub-tasks:

- o identifying candidate packages
- o evaluating package functional capability
- o evaluating package technical characteristics
- o evaluating technical environment necessary to run the package

o defining the package modifications required
o evaluating the vendor

Task 14 - Defining system operational environment - Identify the major operational environment characteristics relating to:

o operating system software
o programming aids
o data storage management aides
o host hardware characteristics
o user site equipment and facilities
o telecommunications network and equipment
o internal controls

At this point, identify and describe the general characteristics of only those elements that are known requirements. Specific technical requirements and hardware/software selection criteria will be addressed as the system design takes shape in the follow-on phases.

Task 15 - Defining system operational impact - Summarize, at a high level for advanced planning purposes, the computer operational requirements during development and conversion and the production needs after implementation. The estimates may be at gross levels but should identify the best and worst case. The following items should be addressed:

o storage capacity
o CPU load
o telecommunications traffic and line load
o wall clock run/processing times (elapsed time)
o printer load and elapsed time
o data preparation load
o decolating, bursting, and paper handling load

Task 16 - Developing test and trial scheme - Define the general high level scheme for testing the overall system and providing user practice sessions. The usual test elements are:

o string and system integration testing
o user practice sessions
o parallel period
o acceptance testing and sign off criteria

At a high level, specify what types of tests will be required and the general sequence of events for performing tests. At this point it is not necessary to develop specific test scenarios and specifications for the test data preparation. This is done in the subsequent phases.

Task 17 - Defining data conversion provisions - Define the following elements in general terms:

o conversion scheme - Specify the process for converting both manual and automated practices from the current environment to the new system environment. If any of the existing policies are effected or a new policy is implemented, they must be defined.

- data purification - Identify all manual and computer files to be reviewed for data complete ness, accuracy, compatibility, and consistency for the new system to function properly. For each file, establish its approximate data volume, define the criteria it must meet, and then define the general process that it must go through to satisfy the new system needs.

- file conversion - Identify and define in general terms all manual or computer files to be converted, define the process for transforming the existing files to the data stores defined earlier, and estimate the data volume of each file as accurately as possible.

- conversion audit and control - Specify the internal control procedures and audit requirements for each file to be converted.

Task 18 - Defining cutover provisions - Specify the general cutover steps and sequences of events for starting the operation of the new system in the production environment and terminating the use of the old system. One element of cutover is data conversion (Task 14). Cutover usually includes the following elements:

- user transition to new system - general sequence of events for using new manual procedures, forms, facilities, etc. and wrapping up the old ones

- file conversion - the general timing and sequence of events for converting files

- operational transition - the general computer operational procedures and a plan for initiating the new system

- contingency plan - the general contingency procedures for backoff

- old system wrap up - general procedures for preserving old system data, programs, and procedures

Frequently, the cutover scheme influences the way files are converted. Occasionally it requires changes to the old system as well as imposing requirements on the new system. For these reasons, the cutover scheme must be specified in as much detail as possible. The general description given here will be used in subsequent phases to develop specific and detail plans for system cutover. This information also provides the general requirements and constraints for preparing conversion programs and procedures.

Task 19 - Defining personnel change requirements - Define the personnel changes in both user and systems areas in terms of the following:

- o organizational changes
- o skill requirements
- o headcount requirements

Task 20 - Revising estimates for project schedule, time, and cost - Revise project estimates for schedule, time, and cost for two levels of detail:

- o detail design phase - Prepare a plan for the upcoming detail design phase with firm estimates of required resources.

- o total project - Revise the estimate for the remaining phases of the project with ballpark estimates.

See Appendix B for an estimating technique. Cost estimate should include costs for development, conversion, and operation.

Task 21 - Assessing risk - The risk involved in not meeting the project objectives were initially assessed in the feasibility study phases (refer to Feasibility Study Phase discussion). A similar risk assessment is necessary at this time. More specifics are known about the project, therefore a more realistic risk measurement is possible. Refer to Appendix A5 for risk assessment checklist.

Task 22 - Conducting general review - Refer to the Project Management section.

Task 23 - Conducting checkpoint review - Refer to the Project Management section.

Detail Design Phase

Purpose - The purpose of the detail design phase is to design the computer system as well as the operational procedures and the manual procedures required to perform the business functions specified during the functional design phase. The emphasis during this phase is on how the computer programs and the manual procedures will work individually and together in a total business system.

Key results - The key results expected from the detail design phase are:

- o system design - design of all system elements in detail
- o software overview - identification of all software elements
- o system operation - detailed definition of major operational elements
- o installation - detailed definition of major conversion and cutover elements
- o system testing - definition of system test and training requirements in detail
- o project plan - revised estimation of project schedule, time, and cost for project completion

Startup - This third phase of system development begins when the user has approved the functional design specifications and management has approved the functional design report and authorized project resources for detail design.

Approach - The previous phase, functional design, defined major system functions by describing specific system outputs, inputs, processes, and data stores. This phase (detail design) describes how those functions will be performed as both computer-assisted functions and manual functions. The following two categories of questions will guide the detail design effort:

- o old questions - questions previously answered only generally or identified with no attempt to provide answers
- o new questions - questions to be addressed and answered for the first time

The questions requiring answers under each of these two catagories can be summarized as follows:

Old questions

- o How are system inputs generated (ie, what are the manual processes leading to system inputs)?
- o How are system outputs used (ie, what are the manual processes using the system outputs)?
- o How are the inputs, input interfaces, and data stores processed to produce new data stores, outputs, and output interfaces?
- o How are data stores organized and accessed?
- o What are specific operational environment elements (hardware, software, user site equipment, telecommunications network, etc.)?
- o What specific manual procedures and/or programs are needed?
- o What is the plan for going from the current environment to the new systems environment?
- o What are the test scenarios and how will testing be carried out?
- o What plan will be used for training users and operational personnel?
- o What are the schedule, time, cost, and resource requirements for the implementation phase?

New questions:

- o What are the processing functions of each program in the system and how does each program fit into the system?
- o What are the procedures for operating the system?

This is the last phase in the development cycle that deals with defining what is to be done, and how it will work. The implementation phase will use these definitions to actually build the set of specific manual procedures, programs, files, and operating procedures required for the final installed operating system. Therefore, all specifications developed during this phase must be explicit and clearly documented to accommodate the building process.

As in the first two phases, the detail design proceeds with interactive interaction between high level and detail design, with each effecting and validating the other. Therefore, an effective design is obtained with two or more passes through the above questions, with each pass providing additional design insight to the next pass. Figure 7 shows the time sequence of tasks for one pass through those questions. In reality two or more passes may be necessary to design the system.

Detail Design Phase

Revision of prior steps - During detail design, some specifications developed during functional design may change or may be further refined. although these changes may have been reflected in the detail design, all previous documents must be revised to reflect the latest specifications. Routine revisions can be expected in the following areas:

- o data elements (programming characteristics added)
- o input/output specifications
- o code values (internal values added)
- o system general characteristics specifications

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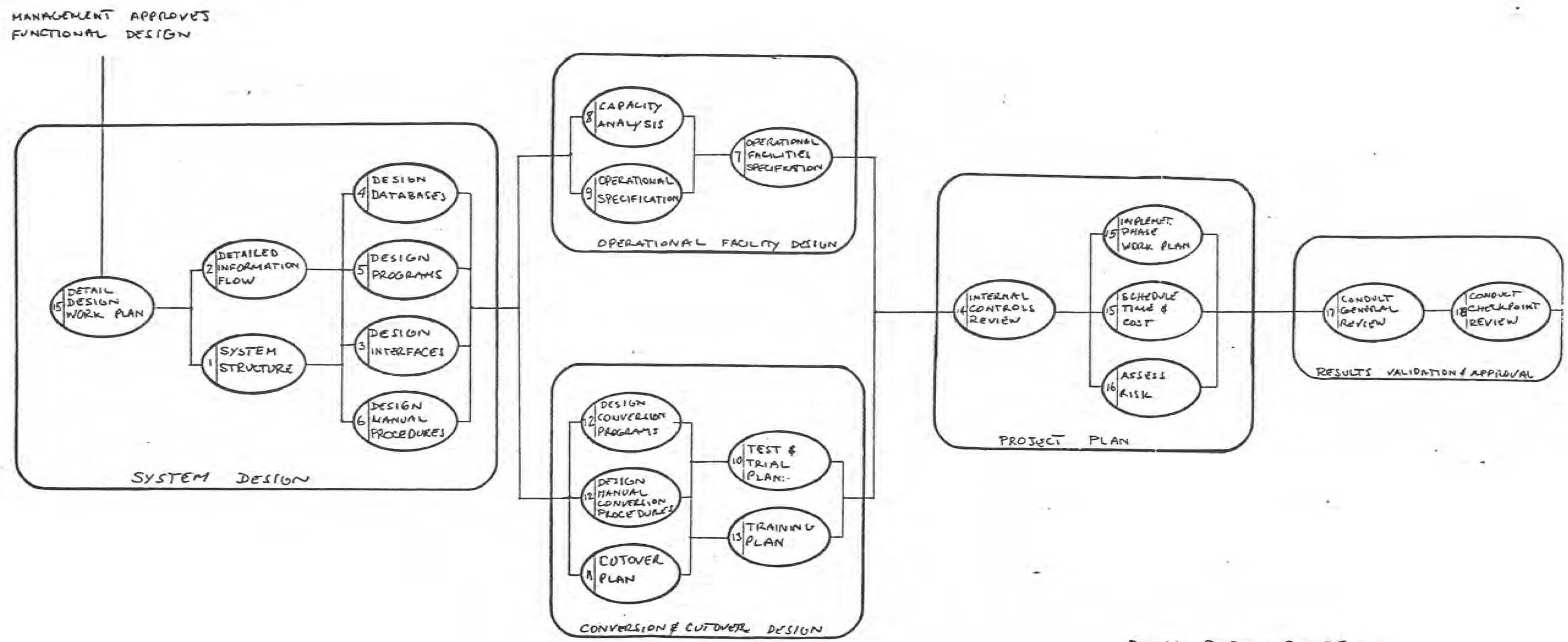

DETAIL DESIGN PHASE
PLANNING CHART
FIGURE 7

Detail Design Phase

Tasks - For an overall view of phases versus tasks refer to Figure 4. For convenient reference the tasks descriptions are listed below in logical sequence as follows:

- EDP system structure design - Define and chart all detailed interaction between all major elements of the proposed system by performing the following tasks:

  (1) defining computer system structure
  (2) defining detailed system information flow

- detailed design development - Create detailed design for all functional elements and define their interrelationship and interaction with the following tasks:

  (3) designing system interface
  (4) designing data bases
  (5) defining and designing specific computer programs
  (6) designing all required manual procedures
  (7) creating system operational facilities specifications
  (8) performing the capacity analysis

- implementation plan development - Continue to develop and refine plans for implementation, to be carried out in the upcoming implementation phase, by performing the following tasks:

  (9) developing system operating specifications
  (10) developing a system test and trial plan
  (11) developing system cutover plan
  (12) developing a data conversion facility
  (13) developing a training plan
  (14) reviewing audit and control requirements

- project plan revision

  (15) updating project schedule, time, and cost estimates
  (16) assessing risk
  (17) conducting general review
  (18) conducting checkpoint review

Task 1 - Defining computer system structure - To develop a high level view of the computer system functions, prepare a chart showing all major modules and programs and their relationships.

Task 2 - Defining detailed system information flows - Prepare a set of detailed diagrams and associated narratives to show the information flows through all the system components. Include inputs, programs, files and data bases, outputs, interfaces, manual processes, and the relationships among those elements. Identify all major internal control points. These diagrams, which are the detail exploded view of the high level information flowcharts prepared during the functional design phase, should provide both a user's and technical view of the system.

Task 3 - Designing system interface - Specify the source or destination, media (tape, disk, etc.) to be used, and required controls for all system interfaces defined during functional design. The functional design phase defined the interfaces and their data content primarily from the user's view. This task augments that definition with the following technical details:

- access type (random, sequential, etc.)
- access key or keys
- detailed data record and set layouts
- edit and validation requirements
- detailed data store organization and structure
- specific access methods or techniques
- specific controls (integrity, security, backup, and recovery)
- estimated storage size and access frequency

Usually, creating a system requires some changes in the existing systems. In addition to defining the interfaces, it is essential during this phase to design whatever changes should be made to the existing systems. These changes may be viewed as a development process of their own and, therefore, may require some or all the steps specified below. That is, the detail design of changes to the existing system must be addressed in the same detail as the system being developed.

Task 4 - Designing data bases - The functional design identified the data bases and described their data content, access type, and general organization. For this task, design specific files, data stores and manual records (files) by specifying for each data store the following technical details:

- access type (random, sequential, etc.)
- access key or keys
- detailed data record and set layouts
- detailed data store organization and structure
- specific access methods or techniques
- specific controls (integrity, security, backup, and recovery)
- estimated storage size and access frequency

Task 5 - Defining and designing specific computer programs - Define and design the specific programs (modules) for performing the computer processing functions. Include applicable items from the following elements:

- identification
- function or purpose

- o input files and data bases
- o output files and data bases
- o transactions processed (batch and screen handling)
- o tables used
- o calculations performed
- o console message or operator interventions
- o abnormal endings
- o edits performed
- o calling programs
- o called programs or subroutines
- o reports produced
- o special performance or technical requirements
- o exception handling (error messages and conditions)
- o security and other controls

If a program consists of two or more smaller modules, provide the same information for each module and describe how the modules are to be combined to make up the program. Note that good design techniques will simplify program definition. If programs are properly designed, only a few of the above elements will apply to each module. Usually the description of these elements for a given program or module requires only one 8½ x 11-inch sheet of paper.

Task 6 - Designing all required manual procedures - For each manual procedure identified and described during the functional design phase, define each procedural step in terms of the following elements:

- o What is the purpose of each step?
- o What are the inputs and outputs of each step?
- o When is each step done or what other steps led to this step?
- o Which department, function, or area is responsible for each step?
- o What are the sequence of steps for each procedure?

Task 7 - Creating system operational facilities specifications - Determine all hardware and software requirements for the operating environment elements identified in general terms during the functional design phase. Also develop a detailed plan for installing and testing the hardware, software, and telecommunications network. Certain elements, such as programming tools, languages compilers, and data store management aids, are needed in the beginning of the implementation phase; consequently, they must be installed and tested during detail design.

Task 8 - Performing the capacity analysis - For each system element, specify the estimated volume and frequency of each element (eg, inputs, outputs, files, etc.). Conduct a detailed analysis of the volume of activity, processing load, and storage needs to determine the ability of the operational environment to accommodate the required production volumes. Include the following items:

- o storage capacity
- o CPU load

- o telecommunications traffic and line load
- o wall clock run with processing times (elapsed time)
- o printer load and elapsed time
- o data preparation load
- o decolating, bursting, and paper handling load

The analysis should account for peak periods and future load changes.

Task 9 - Developing system operating specifications - Specify the elements required to operate the computer system in the production environment, including the following:

- o input control
- o output control
- o backup and recovery
- o security
- o sequence of jobs to be run and their input/output
- o run and recovery procedures
- o operator interactions
- o run to run controls
- o timing and schedules

These specifications will be used during the implementation phase to document specific operating instructions and procedures.

Task 10 - Developing a system test and trial plan - Describe and plan the tests and test procedures to be used to verify that the system functions correctly and according to specifications. Usually a period of operation is planned when both the old system and the new system are operated in parallel. If such parallel testing is foreseen, develop a general set of plans and controls during detail design. These plans are made specific during the implementation phase as part of the cutover plan. For each type of test, specify the following items:

- o test purpose
- o test criteria
- o how the test will be conducted
- o by whom the test will be conducted
- o when the test will begin and end
- o what type of data will be used for testing
- o what preparation is required for testing
- o signoff criteria

Task 11 - Developing a system cutover plan - To develop a specific plan to phase in the new system and phase out the old system, begin with the general scheme for bringing up the new system environment developed in the functional design phase. Plan the specific details for the following activities:

- o cutover provisions - time and date for cutting over each specific transaction, procedure, etc.

- o file conversion - timing and specific procedures for converting files
- o startup procedure - specific computer operational procedures and plans for initiating the new computer system
- o contingency - specific contingency procedures for backoff
- o storage - specific procedures for preserving old system elements

Task 12 - Developing a data conversion facility - Define and design specific programs and detailed manual procedures to purify and convert files and data as specified during the functional design phase. Frequently, conversion requires building a small system to be used only once. Therefore, defining and designing a data conversion facility may require activities similar to those for defining and designing the main system, except that these activities will be on a smaller scale and without long term usage considerations. The conversion design specifications should include:

- o inputs
- o outputs
- o files
- o data bases
- o programs
- o manual procedures
- o internal controls

Task 13 - Developing a training plan - Develop a high level plan for training the system users and operators. This plan, after refinement, will be used during the implementation phase to actually train the users and operational staff.

Task 14 - Reviewing audit and control requirements - Audit and control requirements are designed into all individual elements of the system as part of tasks 3, 4, 5, 6 and 9. To verify that system internal controls are adequate, an overall review should be conducted. This review will insure that:

- o adequate controls are designed into each system element
- o overall controls across system elements are complete and consistent

This review should be conducted as often as necessary during the detail design phase to assure that reasonable internal controls have been planned.

Task 15 - Updating project schedule, time, and cost estimates - The project schedule, time, and cost were estimated during the feasibility phase and later refined during the functional design phase. This is the last time that the project schedule, time, and cost will be revised.

Task 16 - Assessing risk - During the first two phases the risk of not meeting the project is assessed. Similarly during the detail design phase potential risk factors should be reviewed and their impact (if any) should be assessed. Refer to Appendix A5 for a list of risk factors.

Task 17 - Conducting general review - Refer to the Project Management section.

Task 18 - Conducting checkpoint review - Refer to the Project Management section.

Implementation

Purpose - The purpose of the implementation phase is to program and test the computer system, write the manual procedures, train the users, demonstrate that the system can perform the specified business functions, and install the system in a production environment.

Key results - The key results expected from the implementation phase are:

- o fully functional tested computer system and associated documentation
- o documented procedures for manual processes, computer operation, and use of computer system
- o trained user and operational personnel
- o complete and consistent set of startup computer files and manual records
- o installed and tested user location equipment, facilities, and telecommunications network

Startup - This fourth phase of the system development process begins when management approves the detail design results and authorizes resources for implementation.

Approach - The work that needs to be done during this phase has been defined and documented in the past three phases with a complete, consistent set of functional specifications describing all proposed manual and automated procedures and a set of detailed technical design specifications required for computer programming. The implementation phase will use these completed specifications to write and test all computer programs and all interactions between automated and manual procedures. The emphasis during this phase is on getting a large number of highly interrelated tasks done. Usually, additional people join the project in this phase who may not be familiar with the project. Frequent detailed reviews, tests, and walkthroughs are necessary to assure that the specifications are being interpreted correctly and the individual tasks are being coordinated. The time sequence of tasks and their relationships are shown in Figure 8.

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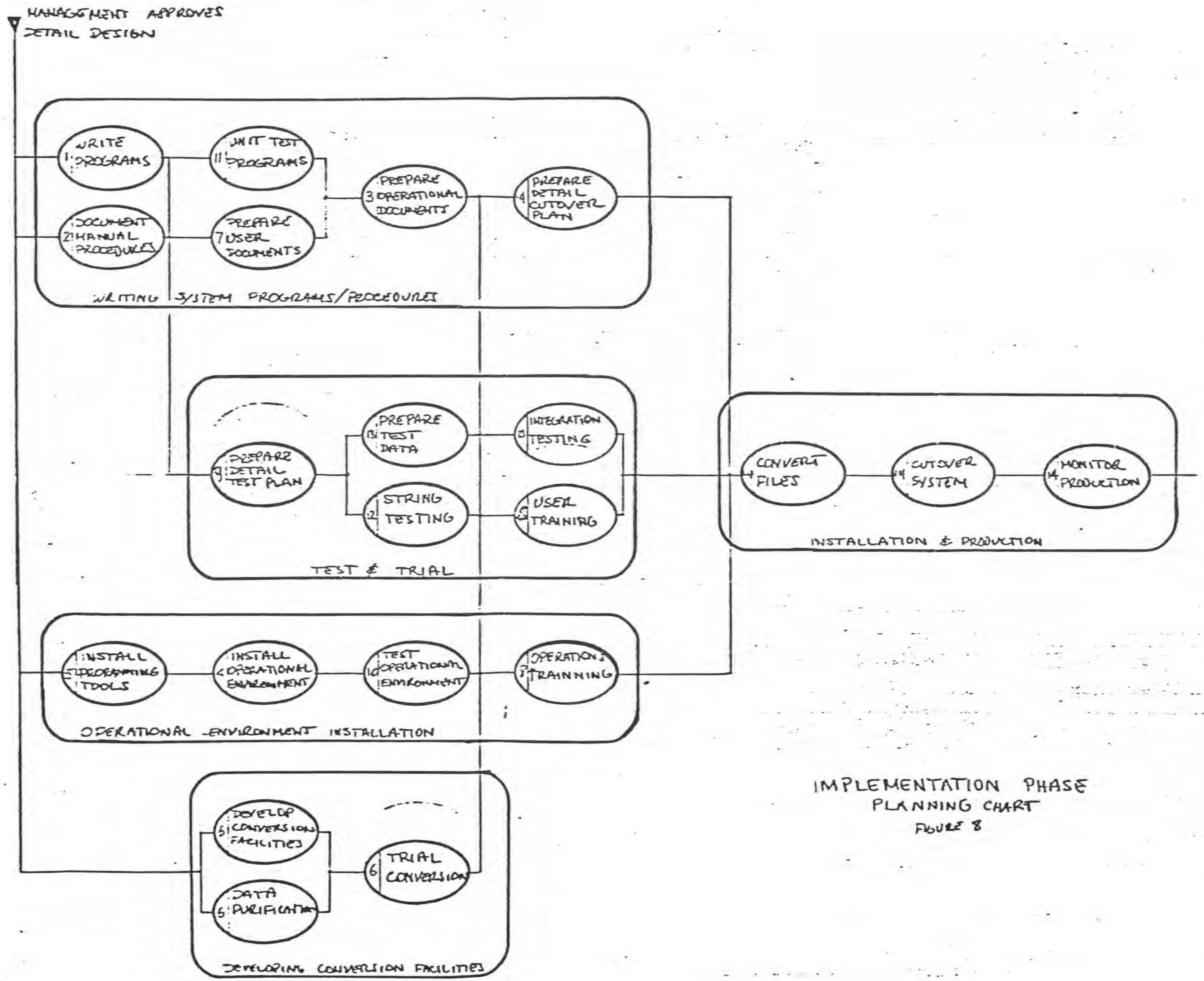

IMPLEMENTATION PHASE
PLANNING CHART
FIGURE 8

Implementation Phase

Tasks - Figure 4 shows the phases versus tasks. For convenient reference, the tasks are listed in logical order as follows:

- system design and documentation
  - (1) developing computer programs
  - (2) documenting manual procedures
  - (3) preparing operational documentation
- system implementation and documentation
  - (4) installing the operational environment
  - (5) installing programming tools
  - (6) developing conversion facilities
  - (7) preparing user documentation
  - (8) training user personnel
- system testing and documentation
  - (9) preparing a detailed test plan
  - (10) testing system operational environment
  - (11) unit testing computer programs
  - (12) performing string testing
  - (13) performing integration testing
  - (14) installing the system

Task 1 - Developing computer programs - Develop all computer programs specified during detail design.

Task 2 - Documenting manual procedures - Document all the manual procedures specified during detail design in a form that will clearly guide personnel in performing their functions in a production environment. These will be included in the final user documentation (see Task 7).

Task 3 - Preparing operational documentation - Document all procedures for operating the computer system, including the following operational elements:

- control of inputs and outputs
- run procedures for batch jobs
- startup and shutdown procedures for on-line applications
- data store backup and recovery
- special handling
- exception handling
- data preparation procedures
- run-to-run controls

Task 4 - Installing the operational environment - Install the specific hardware, software, telecommunications network, and user site equipment specified during detail design.

Task 5 - Installing programming tools - Install and test all programming tools or data management tools.

Implementation Phase

Task 6 - Developing conversion facilities - Develop all programs and manual procedures necessary for a conversion according to the conversion plan specified during detail design.

Task 7 - Preparing user documentation - Prepare all user documentation for inclusion in the following documents:

- o user's guide
- o training manual
- o training materials package

Task 8 - Training user and operations personnel - Train user personnel in the use of the system to perform business functions. Train operations personnel in production environment operation of the system. The following tasks are required to complete this training:

- o Identify trainees

- o Refine the training plan initially prepared during detail design

- o Develop training materials and methods for hands-on practice sessions

Test user's and operations performance during training and revise the procedures and system as necessary. As much as possible, training should use actual production procedures and facilities. Although training is more effective with a totally tested system, frequently this is not practical. Since training in a non-tested system usually uncovers procedural and computer system dysfunctions or problems, the training plan should allow for troubleshooting. Usually, system parallel testing (if planned) provides good opportunities for hands-on practice sessions.

Task 9 - Preparing a detailed test plan - Detail test plans were developed during detail design phase as the system test and trial plan. During implementation, the following activities will be required:

- o Develop specific test sequences

- o Develop test data

- o Develop a detailed test plan identifying sequences of events, timing, and responsibilities

Task 10 - Testing the operational environment - Test the hardware, software, telecommunications network, and user site equipment of the system operational environment (see Task 4).

Task 11 - Unit testing computer programs - Test all individual programs. as they are developed.

Task 12 - Performing string testing - Perform string testing to ensure that individually tested programs will work together in sequence to perform system functions.

Task 13 - Performing integration testing - Perform integrated systems testing according to the test plan (Task 9) to ensure that all programs can work together as a total computer system and that the system is capable of interfacing with all other relevant systems.

Task 14 - Installing the system - Final system installation consists of three major activities as follows:

- o conversion of all files needed for new system startup and initialization of new system files
- o beginning to use the system in production and ceasing to use the old system
- o monitoring production operation of the new system until it has stabilized both from users viewpoint and from technical viewpoint.

Usually system installation requires a very large number of tasks that must be accomplished in a short period of time. The relative sequence of these tasks and their timing is important to successful installation and operation of the system. Because of this, it is necessary to develop a detail plan for these activities. This plan should spell out every task, responsible person, timing, verification of results, and a backup contingency.

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Post-Implementation Review

Purpose - The purpose of the post-implementation review phase is to develop a plan for implementing future system enhancements, review and assess system operation in relation to objectives and requirements, and evaluate the effectiveness of the development approach.

Key results - The key results expected from the post-implementation review phase are:

- o evaluation of system performance relative to objectives and primary requirements from users perspective
- o evaluation of development process relative to the project plan
- o fully developed plan for system enhancements

Startup - This fifth and final phase of the system development process begins when the system operation stabilizes in its production environment and terminates when the key user signs off the project as completed.

Approach - During this phase, system performance is reviewed from both the users and the computer operations point of view in relation to the initially defined project objectives and requirements. Additionally, any desired enhancements to the system are also evaluated and decided upon. Frequently, during the earlier development process and continuing into the first few weeks of operation (ie, the shakedown period), certain features or improvements are intentionally or unintentionally deferred for future implementation. Deferment usually results in a list of unprioritized enhancements composed of end-user functional features, operations features, and technical improvements. The focus of this post-implementation review is, consequently, to determine and document the answers to the following questions:

- o How can future projects benefit from what was learned during this project?
- o What future enhancements are needed?

This review is usually more effective when done after the shakedown period is completed, ie, after the system has been operating in a stable condition for a period of time. This time may vary from a few weeks to a few months, depending upon the complexity of the system environment.

Tasks - Post-implementation usually proceeds as two parallel efforts, focusing first on the development of an enhancement program and secondly on project review. A third effort is involved in gathering together and completing any uncompleted project documentation for inclusion in the project history manual. As shown in Figure 9, these efforts are treated separately as the following tasks:

(1) preparing the system enhancement plan
(2) preparing the system performance report
(3) signing off project

The specific tasks for the post-implementation review are described in the following paragraphs.

Task 1 - Preparing the system enhancement plan - Develop and document a general plan with which to implement the items appearing on the deferred enhancements list. Include the following items in the plan:

- a documented definition of each enhancement
- prioritization of all enhancements
- an estimated schedule, time, and cost for each enhancement
- a time-phased plan for implementing all enhancements

This plan is used as the governing document for any system improvement; consequently, all desired changes, if possible, should be incorporated into this plan during the post-implementation period.

Task 2 - Preparing the system performance report - Prepare the system performance report to include an evaluation of system performance, an evaluation of the effectiveness of the system development process, and a summary of conclusions and recommendations for use in future projects. System performance should be evaluated in terms of the following questions:

- How well does the system meet the user functional needs?
- Are the results timely?
- Does the user understand the system and use it effectively?
- To what degree have anticipated benefits and paybacks been realized?
- How well does the system fit into its operational environment?
- How well and to what degree does the system meet each objective or requirement?

The system development process should be evaluated in terms of the following questions:

- o How did the estimated project schedule, time, and cost for each phase compare with the actuals for each phase?
- o How valid or applicable were the standards, conventions, or methods used in the course of the project?
- o How effective were the project team, user team, system team, and project participants in fulfilling their assigned responsibilities?
- o How adequate were the resources (systems and user personnel, computer time, facilities, etc.) allocated for project use?

Any conclusions and recommended actions should be included as a brief statement in the Conclusions section of the report.

Task 3 - Signing off project - Obtain signoff from the key user and user teams for completion of the project.

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6 PROJECT MANAGEMENT

Requirements for managing a systems development project are numerous and their discussion is outside the scope of this guide. The three aspects of project management discussed are:

- o reviews conducted at project milestones
- o control of project records
- o control of system elements
- o progress reporting

Project Milestones

System development is managed by conducting periodic reviews and preparing progress reports throughout the project to verify the project status and the results of development in terms of the established project milestones summarized in Table 1. The three management mechanisms are:

- o general review meetings
- o checkpoint meetings
- o progress reports

Each of these are described in the following paragraphs.

General Review Meetings

General reviews provide a mechanism for presenting project information to, as well as inviting comments from, all personnel who may be affected by the project. In these sessions, all users and information systems departments formally review the system elements in detail to ensure that the system meets the needs and is consistent and compatible with existing and planned systems, as well as with the total information system environment.

Purpose - The general reviews are guided by the following basic purposes:

- o to assure that key system information has been adequately communicated to all who need to know

- o to allow important issues to be raised, documented, and addressed in a timely manner

The user team is responsible for resolving all important issues raised in the general review. Any issues that cannot be resolved by the user team should be documented in the phase documents and addressed as the next checkpoint meeting.

Participants - Selecting participants for the general reviews is an important responsibility. Primary participants are those who may not have been intimately involved in the project, since those who are closely involved with the project are expected to get their information in other ways. Participants are generally selected from the following areas:

- o user departments affected by the system
- o information systems departments
- o Corporate MIS
- o Internal Audit Departments
- o key project team members
- o Communication Services Department

Frequency and timing - Each of the five system development phases will conduct at least one general review (see Table 1). This is a minimum requirement and may not be adequate. The project should plan additional general reviews during the development process, if required. The timing and frequency of these reviews are usually decided by the project team and depends on the type of project activity being reviewed. Any of the following groups can also request a general review:

- o user departments affected
- o department system managers
- o Corporate MIS
- o Internal Audit

Meeting format - The format of the review meeting should be tailored to a specific case and audience. Usually the review consists of a presentation followed by a discussion period. The discussions should only be used to stimulate comments and raise important issues. They should not be used for resolving issues or solving problems. Therefore, as soon as an issue/problem is clearly understood, the discussion should continue to the next subject. Problems and issues should be resolved outside these reviews.

Feedback - Participants may provide verbal or written feedback during the review or shortly afterwards. The project team must confirm feedback information with the appropriate people when necessary. Major issues must be clearly documented. The responsibility for documenting these issues should be assigned in the review meeting.

Checkpoint Reviews

Checkpoint meetings allow the management to review major projects at the conclusion of each major phase of development (see Table 1).

Purpose - The four basic purposes for this checkpoint review are:

- o to inform management of project status
- o to resolve issues that require management direction
- o to obtain additional management direction
- o to obtain formal management approval

Phase	Required Milestones	Timing	Prerequisites	Signoffs
Feasibility Analysis	o General review	End of phase	Two weeks after required documents are distributed	Users, Audit services review
	o Feasibility checkpoint	After general review	Two weeks after required documents are distributed	
Functional Design	o General review	End of phase	Two weeks after required documents are distributed	Users, Audit services review
	o Functional design checkpoint	After general review	Two weeks after required documents are distributed	
Detail Design	o General review	End of phase	Two weeks after required documents are distributed	Users, EDP, Audit services review
	o Detail design checkpoint	After general review	Two weeks after required documents are distributed	
Implementation	o Conversion cutover general review	Any time during the phase	One week after cutover plan is distributed	Users, EDP, Audit services review
Post-Implementation Review	o General review	End of phase	One week after required documents are distributed	Users, Audit services review
	o Sign-off	After general review		

Table 1. System Development Milestones

The information purpose of the checkpoint is always there, but other purposes may or may not be predetermined. In other words, the project team cannot always detect issues or see the need for a mid-course direction realignment without management involvement and input. Therefore, the checkpoint may be problem revealing as well as problem solving. In attempting to resolve perceived issues and setting new directions, it may instead raise new issues and point out the need for alternative redirection.

Participants - The primary participants of the checkpoint meetings are:

- o appropriate level managers
- o user team members
- o project coordinator
- o department systems managers
- o Corporate M.I.S.

Other participants may be specifically invited by one of the primary participants.

Frequency and timing - Three checkpoints are planned to be held at the end of the first three phases of the development process (see Table 1). Some projects may require additional checkpoints. These will be planned at the discretion of the key user or the department systems managers.

Meeting format - The checkpoint meetings include a presentation and discussion. The general agenda is:

- o purpose of checkpoint
- o presentation of information
- o discussion and questions
- o actions requested from management
- o recap of action items and decisions

Feedback - The primary feedback from checkpoint reviews is management approval or disapproval provided by means of the checkpoint completion forms specified in Appendix A4. The approvals represent agreement between all participating functional areas on all major and important matters relating to the project. No other feedback is required unless specifically requested on a specific item. The project team should confirm the relevant information from the checkpoint feedback with the appropriate people, if necessary. Major issues must be documented.

Unresolved issues - The checkpoints and resulting approvals are the most important milestones in the project. If important and significant changes are required after the checkpoint approval, the project team should attempt to reach an agreement on whether to include the changes or not. If the project team decides to make changes to approved specifications, the key user will inform the management and determine if another checkpoint is needed to obtain approvals. On rare occasions when the project cannot reach an agreement in a timely manner, the key user will use existing management channels to escalate the matter to the appropriate levels (including division management if necessary) for clear resolution.

Project development will continue to proceed according to the agreements of the last checkpoint until changes to these agreements are approved through the existing management channels. Timely resolution of issues is essential to the success of the project. Everyone involved must make every effort to resolve all unresolved issues as quickly as possible.

Project Records Control

Sufficient project correspondence, work papers, and deliverables are to be maintained to show that the objectives of the project have been met and to document key decisions affecting the project development. A designated project file (in the possession of ROLM if an outside contractor is involved) should include the following:

- o a record of all project correspondence
- o a record of the project and user organizations and changes to these organizations
- o a copy of the original feasibility analysis, functional design, and detail design deliverables
- o a record of the changes made to the feasibility, functional design and detail design deliverables
- o a record of project development and conversion plans and major changes to these plans
- o a record of all signoffs, along with a walk-through foils and handouts of checkpoint reviews.

System Elements Control

The project coordinator must establish, maintain, and assure adherence to good procedures for:

- o control the project documents, work papers, correspondence, etc.
- o control of programs
- o control of specifications, and manual procedure changes
- o control of test facilities and test data
- o separation of test environment from production environment.

Progress Reports

The formal documents specified for each phase are the primary tools for communicating the results of development. In addition to these end-result oriented documents, each project needs to inform all project participants as well as those outside of the project who have a need to know but are not direct participants. This communication is accomplished by means of regularly published progress reports, prepared by the project coordinator or the key user and addressed to the user team, with copies to systems team members and to all those with a need-to-know who are outside the project.

Purpose - The progress report serves the following purposes:

- o informs the project team of progress being made by the various participants
- o provides the agenda for user team meetings
- o provides a chronological record of key considerations and decisions that have guided the direction of the project (essential for the continuity of the project)
- o serves as an information bulletin of major project activities for key members of divisions who are not direct participants in the project
- o triggers the project coordinator and key user to regularly review the project at an overall level
- o assures the project team that important issues are being addressed at the proper responsibility levels

Content - The progress report will contain the following information:

- o key accomplishments for the period ending
- o remaining problems or unresolved issues affecting the project's progress
- o planned key activities for the coming period
- o anticipated problems requiring user team attention
- o recommendations for resolving unresolved issues
- o brief description of key decisions that can set or alter the direction of the project

Frequency and timing - The frequency of this report is determined by the degree of project activity. A regularly published biweekly report is desirable.

APPENDICES

Appendix

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Appendix A1

GENERAL SYSTEM CHARACTERISTICS

Introduction

Certain system elements are so general in nature that they apply to many of the system functions and features. These elements, referred to as "general characteristics", fall into the following four basic categories:

- o audit and control
- o performance
- o security and reliability
- o processing capacity

Of these, the requirements relating to the two categories of audit and control characteristics and performance characteristics are specified in the functional design phase. During the detail design phase, these characteristics can be designed into each element of the system. The following paragraphs provide brief discussions of each of these two categories.

Audit and Control Characteristics

Internal controls for each of the system elements have been specified in the main body of this document. Audit, as used here, refers to the "seethrough" qualities of the system, that enable the programmers and/or users to:

- o trace inputs - positively identify all the effects of inputs (add, update, deletes, and inquiries) and trace them to their origins
- o trace file changes - observe the cause and effect relationships between inputs, files and data bases, and outputs
- o verify validity - observe certain intermediate results of data manipulation or calculation in order to verify the validity of the algorithms used

These characteristics are usually implemented with a set of logging mechanisms and reports designed to give users and systems personnel the ability to easily see through the system, research problems, and trace all changes in the system data to their origin.

Note - Financial and accounting audits may be considered a specific system function and should be explicitly defined with whatever audit characteristics are required in addition to these general characteristics.

Reference 3 specifies the internal controls required by the Audit Services department.

Performance Characteristics

System design requires that consideration be given to a large number of performance related factors. While it is desirable to meet all these requirements, doing so is not practical in most cases. Designing performance into a system requires a large amount of resources and time. Therefore, the characteristics outlined below must be specified judiciously and realistically. Typical performance factors are listed in the following paragraphs:

User related - User related performance characteristics include the following:

- o ease of use
- o convenience
- o ease of training and learning effort
- o functional flexibility and enhanceability
- o user level controllability
- o on-line response time
- o batch turnaround time
- o recoverability from various errors
- o invulnerability to user errors
- o consistency with other systems
- o compatibility with other systems
- o data security and reliability
- o self checking capability
- o data and transaction capacity

Computer operations related - Computer operations related performance characteristics include the following:

- o ease of operation
- o operational reliability
- o automatic operational recovery
- o operational controllability
- o invulnerability to operational errors
- o computer resource usage efficiency
- o degree of manual operator intervention required

Programming and maintenance related - Programming and maintenance related performance characteristics include the following:

- o level of program self documentation
- o maintainability of program source
- o vulnerability to programming errors
- o maintainability of file structure
- o adherence to standards and conventions

Appendix A2

A METHODOLOGY FOR ESTIMATING MANPOWER SIZE

Introduction

What is the scope of effort required to make the proposed system operational? This basic question is always asked of the Information Systems Department whenever a major system development effort is being considered. The question asks for:

- o How many man-months will be required?
- o How long will it take?

The body of this appendix addresses only the man-time estimate.

Validity - The estimating guidelines and percentages used to arrive at this estimate are based on broad and varied experience. Still, they should not be taken as hard rules. Their use must be modified, whenever possible, with the knowledge and application of pertinent specifics. With repeated use, they should be refined to better fit each given system development environment. When possible, a comparison should be made between estimates prepared by this method and actual figures collected from any previous similar development effort. In analyzing this comparative data, the methodology should be used as a checklist to help determine what is and is not included in the figures.

Staffing considerations - Though the methodology addresses the staffing requirements of both EDP and user representatives who will have specific system development responsibilities, the following five groups of personnel are not included in the resultant estimates:

- o conversion transcription personnel
- o machine operators
- o maintenance group programmers
- o interface programmers
- o user personnel not contributing to the development effort

Reasonably low rates of personnel turnover, sick leave, personal business, and vacation time are already accounted for.

Gross Estimate Calculation

To make a gross estimate of the total effort, first make a rough estimate of the man-time required to execute the functional design phase. Once this is available, the approximate size of each of the other development phases can be derived using the percentages shown in Table 1.

This methodology is based on a more detailed document entitled "A METHODOLOGY FOR SIZING THE SYSTEM DEVELOPMENT EFFORT". The full text of this document is available from the Corporate MIS staff.

Development Phase	Percentage
Feasibility Phase	7%
Functional Design Phase	16%
Detail Design Phase	18%
Implementation Phase	52%
Post-Implementation Review Phase*	7%

* The post-implementation review phase includes shakedown and production monitoring after implementation but before signoff.

Table 1. Apportionment of Man Time

To develop the gross estimate, you must provide an answer to each of the following three questions:

- o Which other systems will be affected?
- o Which departments will be affected?
- o What application processes are to be addressed?

For each system directly affected by the new system, allocate one man-month during the functional design phase. For each department affected by the system, allocate two man-months during the functional design phase. In making the gross estimate it is also necessary to identify the application processes to be addressed by the system. Each application process may be identified as having its own set of functional procedures, which may or may not be in writing. An inventory of the source documents and input screens in current use often provides a good first cut at identifying the basic processes involved. These will eventually result in specific transactions, each with a set of related action codes and procedural instructions for their use. Allocate three man-months of functional design phase time to each process identified. To summarize the estimation of the functional design phase:

1 x (The number of systems involved)
2 x (The number of departments involved)
3 x (The number of processes involved)

= The total number of man-months

Once this man-month figure is calculated, every other development phase can be estimated using the percentages contained in Table 1. The sum of all phases equals the gross estimate of the total system development effort. These estimated man-months show total EDP and user staff time required. Using the percentages shown in Table 2, the time required from each group can be estimated.

Other Factors

The gross estimate is calculated by applying man-time multipliers to a list of application elements, which together outline the proposed system. It quantifies the minimum level of effort necessary to develop a system -- including both EDP and user effort. It assumes that development effort is strictly technical in nature, occurring under ideal conditions. The effect of the following conditions affecting system development have not been factored in:

- staff knowledge
- staff experience
- staff motivation
- staff authority
- staff availability
- project management
- steering mechanism
- development philosophy
- predefined dates
- operations support
- team proximity
- interim measures
- operating familiarity
- conversion requirements

The possible impact of each of the above-listed conditions should be taken into account for any specific project. When possible, however, the effect of these conditions should be used merely to check estimates based on known, pertinent specifics.

Phases	EDP Emphasis		User Emphasis	
	EDP	User	EDP	User
Feasibility	65%	35%	35%	65%
Functional Design	75%	25%	60%	40%
Detail Design	80%	20%	75%	25%
Implementation	75%	25%	70%	30%
Post-Implementation Review	85%	15%	80%	20%

Table 2. Total Estimated Man-Months for EDP and User Staff Effort

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Appendix A3

A CHECKLIST FOR COMPARING ALTERNATIVE SOLUTIONS

Introduction

During the feasibility phase of system development, candidate solutions are identified and evaluated. To facilitate the selection process, the advantages and disadvantages of each alternative are examined. Since the analysis of alternatives is carried out as a process of matching the solutions to project objectives and primary requirements, it is usually unique for each system. The following paragraphs suggest general factors that may be applicable in varying degrees to any specific case.

Hierarchy of Options

First, the following basic hierarchy of options are considered:

- MANUAL/PROCEDURAL APPROACH - or
- COMPUTER ASSISTED APPROACH
  - MODIFY/ENHANCE EXISTING SYSTEMS - or
  - DEVELOP A NEW SYSTEM
    - MAKE - or
    - BUY

Factors

After considering the alternatives in the context of the above hierarchy, the following set of factors should be considered:

- o To what degree does it meet the functional needs?
- o To what degree will it be adaptable to further needs?
- o To what degree can it be integrated with the existing and planned future systems?
- o What would it take to convert to it?
- o How well does it fit into the hardware and operating software environment?
- o To what degree can it handle current and future business volume?

- o How well does it fit into the computer operating environment?

- o To what degree does it meet the implementation timing needs?

- o What level of cost and other resources does it require?

- o To what degree does it meet the required conventions and standards?

- o How well does it work with the existing programming tools, facilities, and utilities?

- o How demanding is it technically?

- o What support is available?

- o How qualified is the vendor to support and enhance the product?

- o What is the quality of implementation and documentation?

These factors are general in nature and are not to be considered an exhaustive list of the elements to be evaluated when comparing alternative solutions. Their use must be modified, whenever possible, to fit the specific case. They are provided here only as an aide to the evaluation process.

Appendix A4

CHECKPOINT COMPLETION FORMS

The primary feedback from checkpoint reviews is management approval or disapproval provided by means of the checkpoint completion forms specified in this appendix. The approvals represent agreement between all participating functional areas on all major and important matters relating to the project.

CHECKPOINT COMPLETION FORM

FOR

APPLICATION SYSTEM DEVELOPMENT

FEASIBILITY PHASE

Please sign and return to ______________________________ before __/__/__. If no response is received by this date the project will assume that the phase is approved.

PROJECT NAME ____

BRIEF DESCRIPTION ____

____

____

APPROVAL

___	___	___
APPROVED	NOT APPROVED	CONDITIONAL APPROVAL

______________________________ SIGNATURE ______ DATE

COMMENTS

	REQUIRES ATTENTION
OBJECTIVES & PRIMARY REQUIREMENTS	___
PROPOSED SOLUTION	___
PROJECT PARTICIPANTS	___
BENEFITS/PAYBACKS	___
TIMING/SCHEDULE & RESOURCES	___
OTHER ______________________	___

____

____

CHECKPOINT COMPLETION FORM

FOR

APPLICATION SYSTEM DEVELOPMENT

DETAIL DESIGN PHASE

Please sign and return to ______________________ before __/__/__. If no response is received by this date the project will assume that the phase is approved.

PROJECT NAME ____

BRIEF DESCRIPTION ____

____

____

APPROVAL

___	___	___
APPROVED	NOT APPROVED	CONDITIONAL APPROVAL

________________________________ SIGNATURE ____________ DATE

COMMENTS

	REQUIRES ATTENTION
FUNCTIONALITY	___
OPERATING ENVIRONMENT	___
TESTING & TRAINING	___
CONVERSION & CUTOVER	___
OTHER ____________________	___

____

____

CHECKPOINT COMPLETION FORM

FOR

APPLICATION SYSTEM DEVELOPMENT

FUNCTIONAL DESIGN PHASE

Please sign and return to ______________________________ before __/__/__. If no response is received by this date the project will assume that the phase is approved.

PROJECT NAME ____

BRIEF DESCRIPTION ____

____

____

APPROVAL

___	___	___
APPROVED	NOT APPROVED	CONDITIONAL APPROVAL

______________________________ ________

SIGNATURE DATE

COMMENTS

	REQUIRES ATTENTION
SCOPE	___
	___
FUNCTIONALITY	___
	___
EFFECT ON OTHER SYSTEMS	___
	___
PERSONNEL CHANGES	___
	___
TIMING/SCHEDULE & RESOURCES	___
	___
OTHER ______________________	___
______________________	___
______________________	

Appendix A5

RISK ASSESSMENT CHECKLIST

Introduction

Any system development project faces some degree of uncertainty whether or not it will meet its objectives, but for a given situation, some approaches are more likely to succeed than others. Therefore risk factors play a major role in choosing an alternative solution. The following checklist could be used to identify the risk areas (if any). If this checklist is to be used for comparing two approaches, it is advisable to use the "score card" technique to estimate the size of the risk for each approach. To do this, assign a weight factor (1 to 5) to each question and assign a severity (1 to 3) to each of the answers and compute the weighted risk factor.

1. Total development man-hours for system*

100 to 3,000	low
3,000 to 15,000	medium
15,000 to 30,000	medium
More than 30,000	high

2. What is estimated project implementation time?

8 months or less	low
9 months to 24 months	medium
More than 24 months	high

3. Number of departments (other than IS) involved with system

One	low
Two	medium
Three or more	high

4. If replacement system is proposed, what percentage of existing functions are replaced on a one-to-one basis?

0% to 25%	high
25% to 50%	medium
50% to 100%	low

* Time to develop includes systems design, programming, testing, and installation.

5. What is severity of procedural changes in user department caused by proposed system?

Low
Medium
High

6. Does user organization have to change structurally to meet requirements of new system?

No	
Minimal	low
Somewhat	medium
Major	high

7. What is general attitude of users?

Poor - anti data-processing solution	high
Fair - some reluctance	medium
Good - understands value of DP solution	

8. How committed is upper-level user management to system?

Somewhat reluctant or unknown	high
Adequate	medium
Extremely enthusiastic	low

9. Has a joint data processing/user team been established?

No	high
Part-time user representative appointed	low
Full-time user representative appointed	

10 Which of the hardware is new to the company?

None	
CPU	high
Peripheral and/or additional storage	high
Terminals	high
Mini or micro	high

11. Is the system software (nonoperating system) new to IS project team?

No	
Programming language	high
Data base	high
Data communications	high
Other - specify	high

12. How knowledgeable is user in area of IS?

First exposure	high
Previous exposure but limited knowledge	medium
High degree of capability	low

13. How knowledgeable is user representative in proposed application area?

Limited	high
Understands concept but no experience	medium
Has been involved in prior implementation efforts	low

14. How knowledgeable is IS team in proposed application area?

Limited	high
Understands concept but no experience	medium
Has been involved in prior implementation efforts	low