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ENGINEERING ORIENTATION MANUAL

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PREFACE

As a new employee at Digital, you will feel quickly at home if you have a clear statement of the philosophy and values we believe have made Digital not only an outstanding success in the computer industry, but also a good place to work. Our philosophy has shaped our "style" and the environment in which you will work.

We want the *highest quality products* in the industry. When you ask current or potential computer users, "Who makes the best computer systems?" we want the answer to be "Digital!"

We want *leadership products* in every Digital market – products that do the job for the user better than those available from any other supplier.

The foundation of our success is our knowledge of computer technology; we must always strive to increase that knowledge.

We turn our technology into products through people. We have, and want to continue to have, the *best people* in the industry. We hire the best and we work hard to maintain an environment that allows them to contribute to their fullest potential. The key elements of this environment are:

- **Individual responsibility:** We depend upon our people to use their heads, to reach out for responsibility, to make decisions.

- **Open communication:** There are no barriers to effective communication between people at Digital. Organizational boundaries and titles are, as far as communication is concerned, irrelevant. We believe in total openness on all issues, that issues are best resolved by direct interaction between people, regardless of different organizations or different levels of responsibility.

- **Good ideas:** They come from everywhere. We believe that our managers should encourage and promote the creative ideas that bubble up from people in the organization.

In the last several years, Digital has scored number one as the most *ethical* computer company in the industry. This is no accident. We want to be completely honest and open with our customers. We want them to get their money's worth when they buy from us; we expect to meet all our commitments.

In short, having hired the best people in the industry and provided a rich environment for them, we expect extraordinary performance. Work hard, produce good products, reach beyond the normal requirements of your job, and above all, *use your head*, and both you and Digital will grow and prosper.

We are happy to have you with us. We hope you, too, will enjoy working at Digital.

Larry Portner
Vice President,
Associate Head of Engineering

FOREWORD

The following text is reprinted with permission from "The Unwritten Laws of Engineering" by W.J. King, originally appearing in the May, June, and July 1944 issues of *Mechanical Engineering*. That the article has been reprinted several times during the last 36 years should bear witness to its usefulness. It offers much wisdom to young engineers starting their careers, and to older engineers who know these things perfectly well but who all too often fail to apply them in practice.

IN RELATION TO YOUR WORK

However menial and trivial your early assignments may appear give them your best efforts. Many young engineers feel that the minor chores of a technical project are beneath their dignity and unworthy of their college training. They expect to prove their true worth in some major enterprise. Actually, the spirit and effectiveness with which you tackle your first humble tasks will very likely be carefully watched and may affect your entire career.

Occasionally you will worry unduly about where your job is going to get you – whether it is sufficiently strategic or significant. Of course these are pertinent considerations and you would do well to take stock of them, but by and large it is fundamentally true that if you take care of your present job well, the future will take care of itself. This is particularly so in the case of a large corporation, where executives are constantly searching for competent people to move up into more responsible positions. Success depends so largely upon personality, native ability, and vigorous, intelligent prosecution of any job that it is no exaggeration to say that your ultimate chances are much better if you do a good job on some minor detail than if you do a mediocre job as section head. Furthermore, it is also true that if you do not at first make a good showing on your present job you are not likely to be given the opportunity of trying something else more to your liking.

There is always a premium upon the ability to get things done. This is a quality which may be achieved by various means under different circumstances. Specific aspects will be elaborated in some of the succeeding items. It can probably be reduced, however, to a combination of three basic characteristics:

(a) Energy, which is expressed in initiative to start things and aggressiveness to keep them moving briskly.

(b) Resourcefulness or ingenuity, i.e., the faculty for finding ways to accomplish the desired result, and

(c) Persistence (tenacity), which is the disposition to persevere in spite of difficulties, discouragement, or indifference.

This last quality is sometimes lacking in the make-up of brilliant engineers, to such an extent that their effectiveness is greatly reduced. Such dilettantes are known as "good starters but poor finishers." Or else it will be said of a man (or a woman): "You can't take him too seriously; he'll be all steamed up over an idea today but tomorrow he will have dropped it and started chasing some other rainbow." Bear in mind, therefore, that it may be worth while finishing a job, if it has any merit, just for the sake of finishing it.

In carrying out a project, do not wait for managers, vendors, and others to deliver the goods; go after them and keep after them. This is one of the first things a new engineer has to learn in entering a manufacturing organization. Many novices assume that it is sufficient to place the order and sit back and wait until the goods are delivered. The fact is that most jobs move in direct proportion to the amount of follow-up and expediting that is applied to them. Expediting means planning, investigating,

promoting, and facilitating every step of the process. Cultivate the habit of looking immediately for some way around each obstacle encountered, some other recourse or expedient to keep the job rolling without losing momentum. There are ten-to-one differences between individuals in respect to what it takes to stop their drive when they set out to get something done.

On the other hand, the matter is occasionally overdone by overzealous individuals who make themselves obnoxious and antagonize everyone by their offensive browbeating tactics. Be careful about demanding action from another department. Too much insistence and agitation may result in more damage to your personal interests than could ever result from the miscarriage of the technical point involved.

Confirm your instructions and the other person's commitments in writing. Do not assume that the job will be done or bargain kept just because the other person agreed to it. Many people have poor memories, others are too busy, and almost everyone will take the matter a great deal more seriously if he or she sees it in writing. Of course there are exceptions, but at times it pays to mark a third party for a copy of the memo, as a witness.

When sent out on any complaint or other assignment stick with it and see it through to a successful finish. All too often a young engineer from the home office will leave a job half done or poorly done in order to catch a train or keep some other engagement. Wire the boss that you've got to stay over to clean up the job. Neither the boss nor the customer will like it if another person has to be sent out later to finish it up.

Avoid the very appearance of vacillation. One of the gravest indictments of an engineer is to say: "His or her opinion at any time depends merely upon the last person with whom he or she has talked." Refrain from stating an opinion or promoting an undertaking until you have had a reasonable opportunity to obtain and study the facts. Thereafter see it through if at all possible, until fresh evidence makes it folly to persist. Obviously the extremes of bullheadedness and dogmatism should be avoided, but remember that reversed decisions will be held against you.

Don't be timid – speak up – express yourself and promote your ideas. Every young engineer should read Emerson's essay on "Self Reliance." Too many new people seem to think that their job is simply to do what they're told to do, along the lines laid down by the boss. Of course there are times when it is very wise and prudent to keep your mouth shut, but, as a rule, it pays to express your point of view whenever you can contribute something. The quiet mousey individual who says nothing is usually credited with having nothing to say.

It frequently happens in any sort of undertaking that nobody is sure of just how the matter ought to be handled; it's a question of selecting some kind of program with a reasonable chance of success. This is commonly to be observed in engineering meetings. The first person to speak up with a definite and plausible proposal has better than an even chance of carrying the floor, provided only that the scheme is definite and plausible. (The "best" scheme usually cannot be recognized as such in advance.) It also happens that the person who talks most knowingly and confidently about the matter will very often end up with the assignment to carry out the project. If you do not want the job, keep your mouth shut and you'll be overlooked, but you'll also be overlooked when it comes time to assign larger responsibilities.

Before asking for approval of any major action, have a definite plan and program worked out to support it. Executives very generally and very properly will refuse to approve any proposed undertaking that is not well planned and thought through as regards the practical details of its execution. Quite often a young person will propose a project without having worked out the means of accomplishing it, or weighing the actual advantages against the difficulties and costs. This is the difference between a "well-considered" and a "half-baked" scheme.

Strive for conciseness and clarity in oral and written reports. If there is one bane of an executive's existence, it is the person who takes a half hour of rambling discourse to tell what could be said in a sentence of twenty words. There is a curious and widespread tendency among engineers to surround the

answer to a simple question with so many preliminaries and commentaries that the answer itself can hardly be discerned. It is so difficult to get a direct answer out of some people that their usefulness is greatly diminished. The tendency is to explain the answer before answering the question. To be sure, very few questions admit of simple answers without qualifications, but the important thing is to state the crux of the matter as succinctly as possible first. On the other hand, there are times when it is very important to add the pertinent background or other relevant facts to illuminate a simple statement. The trick is to convey the maximum of significant information in the minimum time, a valuable asset to anyone.

An excellent guide in this respect may be found in the standard practice of newspapers in printing the news. The headlines give you 90% of the basic facts. If you have the time and interest to read further, the first paragraph will give you most of the important particulars. Succeeding paragraphs simply give details of progressively diminishing significance. To fit an article into available space, the editor simply lops off paragraphs at the rear end, knowing that relatively little of importance will be lost. You can hardly do better than to adopt this method in your own reports, presenting your facts in the order of importance, as if you might be cut off any minute.

Be extremely careful of the accuracy of your statements. This seems almost trite, and yet many engineers lose the confidence of their superiors and associates by habitually guessing when they do not know the answer to a direct question. It is certainly important to be able to answer questions concerning your responsibilities, but a wrong answer is worse than no answer. If you do not know, say so, but also say, "I'll find out right away." If you are not certain, indicate the exact degree of certainty or approximation upon which your answer is based. A reputation for dependability and reliability can be one of your most valuable assets.

This applies, of course, to written matter, calculations, etc., as well as to oral reports. It is definitely bad business to submit a report to the boss for approval without first carefully checking it yourself, and yet formal reports are sometimes turned in full of glaring errors and omissions.

IN RELATION TO THE BOSS

Every manager must know what's going on in his or her bailiwick. This principle is so elementary and fundamental as to be axiomatic. It follows from the very obvious fact that a person cannot possibly manage his or her business successfully unless he or she knows what's going on in it. It applies to minor managers and other individuals charged with specific responsibilities as well as to department heads. No one in his or her right mind will deny the soundness of the principle and yet it is very commonly violated or overlooked. It is cited here because several of the rules which follow are concerned with specific violations of this cardinal requirement.

Do not overlook the fact that you're working for your boss. This sounds simple enough, but some engineers never get it. By all means, you're working for society, the company, the department, your family, and yourself, but primarily you should be working for and through your boss. And your boss is your immediate superior, to whom you report directly. It is not uncommon for young engineers, in their impatient zeal to get things done, to ignore the boss, or attempt to go over or around the boss. Sometimes they move a little faster that way, for a while, but sooner or later they find that such tactics cannot be tolerated in a large organization. Generally speaking, you cannot get by the boss; he or she determines your rating and rates you on your ability to cooperate, among other things. Besides, most of us get more satisfaction out of our jobs when we're able to give the boss our personal loyalty, with the feeling that we're helping him or her to get the main job done.

Be as particular as you can in the selection of your boss. In its effect upon your engineering career, this is second in importance only to the selection of proper parents. In most engineering organizations the influence of the senior engineer, or even the section head, is a major factor in molding the professional character of younger engineers. Long before the days of universities and textbooks, master craftsmen in

all the arts absorbed their skills by apprenticeship to master craftsmen. It is very much as in the game of golf; a beginner who constantly plays in company with "duds" is very apt to remain a "dud," too, no matter how faithfully the rules are studied. Whereas even a few rounds with a "pro" will usually improve a novice's game.

But of course, it is not always possible to choose your boss advisedly. What if he or she turns out to be somewhat less than half the person he or she ought to be? There are only two proper alternatives open to you; (a) accept the boss as a representative of a higher authority and execute his or her policies and directives as effectively as possible, or (b) transfer to some other outfit at the first opportunity. A great deal of mischief can be done to the interests of all concerned (including the company) if some other alternative is elected, particularly in the case of younger persons. Consider the damage to the efficiency of a military unit when the privates, disliking the leader, ignore or modify orders to suit their individual notions. To be sure, a business organization is not a military machine, but it is not a mob either.

One of the first things your owe your boss is to keep him or her informed of all significant developments. This is a corollary of the preceeding rules: A manager must know what's going on. The main question is: How much must he or she know – how many of the details? This is always a difficult matter for the new engineer to get straight. Many novices hesitate to bother the boss with too many reports, and it is certainly true that it can be overdone in this direction, but in by far the majority of cases the executive's problem is to extract enough information to be kept adequately posted. For every time the boss has to say, "Don't bother me with so many details," there will be three times he or she will say, "Why doesn't someone tell me these things?" Bear in mind that the boss is constantly called upon to account for, defend, and explain your activities to the "higher-ups," as well as to coordinate these activities into a larger plan. In a nutshell, the rule is therefore to give him or her all the information needed for these two purposes.

Whatever the boss wants done takes top priority. You may think you have more important things to do first, but unless you obtain permission it is usually unwise to put any other project ahead of a specific assignment from your own boss. As a rule, he or she has good reasons for wanting his or her job done *now*, and it is apt to have a great deal more bearing upon your rating than less conspicuous projects which may appear more urgent.

Also, make note of this: If you are instructed to do something and you subsequently decide it isn't worth doing (in view of the data or events) do not just let it die, but inform the boss of your intentions and reasons. Neglect of this point has caused trouble on more than one occasion.

Do not be too anxious to follow the boss's lead. This is another side of the matter covered by the preceding rule. An undue subservience or deference to the department head's wishes is fairly common among young engineers. A person with this kind of psychology may:

1. Plague the boss incessantly for minute directions and approvals.

2. Surrender all initiative and depend upon the boss to do all of his or her basic thinking.

3. Persist in carrying through a design or a program even after new evidence has proved the original plan to be wrong.

This is where an engineering organization differs from an army. In general, the program laid down by the department or section head is tentative, rather than sacred, and is intended to serve only until a better program is proposed and approved.

The rule therefore is to tell your boss what you have done, at reasonable intervals, and ask for approval of any well-considered and properly planned deviations or new projects that you may have conceived.

REGARDING RELATIONS WITH ASSOCIATES AND OUTSIDERS

In all transactions be careful to "deal in" everyone who has a right to be in. It is extremely easy, in a large organization, to overlook the interests of some division or individual who does not happen to be represented, or in mind, when a significant step is taken. Very often the result is that the step has to be retracted or else considerable damage is done. Even when it does no apparent harm, most people do not like to be left out when they have a stake in the matter, and the effect upon morale may be serious.

Of course there will be times when you cannot wait to stand on ceremony and you'll have to go ahead and "damn the torpedoes." But you cannot do it with impunity too often.

Note particularly that in this and the preceding item the chief offense lies in the invasion of the other person's territory without his or her knowledge and consent. You may find it expedient on occasions to do the other person's job in order to get your own work done, but you should first give the other person a fair chance to deliver the goods or else agree to have you take over. If you must offend in this respect, at least you should realize that you are being offensive.

Be careful about whom you mark for copies of letters, memos, etc., when the interests of other departments are involved. A lot of mischief has been caused by young people broadcasting memoranda containing damaging or embarrassing statements. Of course it is sometimes difficult for a novice to recognize the "dynamite" in such a document but, in general, it is apt to cause trouble if it steps too heavily upon someone's toes or reveals a serious shortcoming on anybody's part. If it has wide distribution or if it concerns manufacturing or customer difficulties, you'd better get the boss to approve it before it goes out unless you're very sure of your ground.

Promises, schedules, and estimates are necessary and important instruments in a well-ordered business. Many engineers fail to realize this, or habitually try to dodge the irksome responsibility for making commitments. You must make promises based upon your own estimates for the part of the job for which you are responsible, together with estimates obtained from contributing departments for their parts. No one should be allowed to avoid the issue by the old formula, "I can't give a promise because it depends upon so many uncertain factors." Consider the "uncertain factors" confronting a department head who must make up a budget for an entire engineering department for a year in advance! Even the most uncertain case can be narrowed down by first asking, "Will it be done in a matter of a few hours or a few months – a few days or a few weeks?" It usually turns out that it cannot be done in less than three weeks and surely will not require more than five, in which case you'd better say four weeks. This allows one week for contingencies and sets you a reasonable bogie under the comfortable figure of five weeks. Both extremes are bad; a good engineer will set schedules which can be met by energetic effort at a pace commensurate with the significance of the job.

As a corollary of the following, you have a right to insist upon having estimates from responsible representatives of other departments. But in accepting promises, or statements of facts, it is frequently important to make sure you are dealing with a qualified representative of the other section. Also bear in mind that when you ignore or discount another person's promises you impugn his or her responsibility and incur the extra liability yourself. Of course this is sometimes necessary, but be sure that you do it advisedly. Ideally, another person's promises should be negotiable instruments, like a personal check, in compiling estimates.

When you are dissatisfied with the services of another section, make your complaint to the individual most directly responsible for the function involved. Complaints made to a person's superiors, over the person's head, engender strong resentments and should be resorted to only when direct appeal fails. In many cases such complaints are made without giving the person a fair chance to correct the grievance, or even before he or she is aware of any dissatisfaction.

This applies particularly to individuals with whom you are accustomed to dealing directly or at close range, or in cases where you know the person to whom the function has been assigned. It is more formal and in some instances possibly more correct to file a complaint with the head of the section or depart-

ment, and it will no doubt tend to secure prompt results. But there are more than a few individuals who would never forgive you for complaining to their boss without giving them a fair chance to take care of the matter.

In dealing with customers and outsiders remember that you represent the company, ostensibly with full responsibility and authority. You may be only a few months out of college but most outsiders will regard you as a legal, financial, and technical agent of your company in all transactions, so be careful of your commitments.

PURELY PERSONAL CONSIDERATIONS FOR ENGINEERS

About 99% of the emphasis in the training of engineers is placed upon purely technical or formal education. In recent years, however, there has been a rapidly growing appreciation of the importance of "human engineering," not only in respect to relations between management and employees but also as regards the personal effectiveness of the individual worker, technical or otherwise. It should be obvious enough that a highly trained technological expert with a good character and personality is necessarily a better engineer and a great deal more valuable to his or her company than a sociological freak or misfit with the same technical training. This is largely a consequence of the elementary fact that in a normal organization no individual can get very far in accomplishing any worthwhile objectives without the voluntary cooperation of his or her associates. And the quantity and quality of such cooperation is determined by the "personality factor" more than anything else.

This subject of personality and character is, of course, very broad and much has been written and preached about it from social, ethical, and religious points of view. The following "laws" are drawn from the purely practical point of view based upon well-established principles of good engineering practice, or upon consistently repeated experience. As in the preceding sections, the selections are limited to rules which are frequently violated, with unfortunate results, however obvious or bromidic they may appear.

"LAWS" OF CHARACTER AND PERSONALITY

One of the most important personal traits is the ability to get along with all kinds of people. This is rather a comprehensive quality but it defines the prime requisite of personality in any type of industrial organization. No doubt this ability can be achieved by various formulas, although it is probably based mostly upon general, good-natured friendliness, together with fairly consistent observance of the "Golden Rule." The following "do's and don'ts" are more specific elements of such a formula:

1. Cultivate the tendency to appreciate the good qualities, rather than the shortcomings of each individual.

2. Do not give vent to impatience or annoyance on slight provocation. Some offensive individuals seem to develop a striking capacity for becoming annoyed, which they indulge with little or no restraint.

3. Do not harbor grudges after disagreements involving honest differences of opinion. Keep your arguments on an objective basis and leave personalities out as much as possible.

4. Form the habit of considering the feelings and habits of others.

5. Do not become unduly preoccupied with your own selfish interests. It may be natural enough to "look out for Number One first," but when you do your associates will leave the matter entirely in your hands, whereas they will be much readier to defend your interests for you if you characteristically neglect them for unselfish reasons.

This applies particularly to the matter of credit for accomplishments. It is much wiser to give your principal attention to the matter of getting the job done, or to building up your people, than to spend too much time pushing your personal interests ahead of everything else. You need have no fear of being overlooked; about the only way to lose credit for a creditable job is to grab for it too avidly.

6. Make it a rule to help the other fellow when the opportunity rises. Even if you're mean-spirited enough to derive no satisfaction from accommodating others it's a good investment. The business world demands and expects cooperation and teamwork among the members of an organization. It's smarter and pleasanter to give it freely and ungrudgingly, up to the point of unduly neglecting your responsibilities.

7. Be particularly careful to be fair on all occasions. This means a good deal more than just being fair, upon demand. All of us are frequently unfair, unintentionally, simply because we do not habitually view the matter from the other person's point of view, to be sure that his or her interests are fairly protected. For example, when a person fails to carry out an assignment, he or she is sometimes unjustly criticized when the real fault lies with the manager who failed to give him or her the tools to do the job. Whenever you enjoy some natural advantage, or whenever you are in a position to injure someone seriously, it is especially incumbent upon you to "lean over backwards" to be fair and square.

8. Do not take yourself or your work too seriously. A normal healthy sense of humor, under reasonable control, is much more becoming, even to an executive, than a chronically soured dead pan, a perpetually unrelieved air of deadly seriousness, or the pompous solemn dignity of a stuffed owl. It is much better for your blood pressure, and for the morale of the office, to laugh off an awkward situation now and then than to maintain a tense tragic atmosphere of stark disaster whenever matters take an embarrassing turn. To be sure, a serious matter should be taken seriously, and a person should maintain a quiet dignity as a rule, but it does more harm than good to preserve an oppressively heavy and funereal atmosphere around you.

9. Put yourself out just a little to be genuinely cordial in meeting people. True cordiality is, of course, spontaneous and should never be affected, but neither should it be inhibited. We all know people who invariably pass us in the hall or encounter us elsewhere without a shadow of recognition. Whether this be due to inhibition or preoccupation we cannot help feeling that such unsociable chumps would not be missed much if we never saw them again. On the other hand it is difficult to think of anyone who is too cordial, although it can doubtless be overdone like anything else. It appears that most people tend naturally to be sufficiently reserved or else overreserved in this respect.

10. Give other people the benefit of the doubt if you are inclined to suspect their motives, especially when you can afford to do so. Mutual distrust and suspicion breed a great deal of absolutely unnecessary friction and trouble, frequently of a very serious nature. This is a very common phenomenon that can be observed among all classes and types of people, in international as well as local affairs. It is derived chiefly from misunderstandings, pure ignorance, or from an ungenerous tendency to assume that a person is guilty until proved innocent. No doubt the latter assumption is the "safer" bet, but it is also true that if you treat others as depraved scoundrels, they will usually treat you likewise, and they will probably try to live down to what is expected of them.

Regard your personal integrity as one of your most important assets. In the long pull there is hardly anything more important to you than your own self-respect and this alone should provide ample incentive to maintain the highest standard of ethics of which you are capable. But, apart from all considerations of ethics and morals, there are perfectly sound hardheaded business reasons for conscientiously guarding the integrity of your character.

One of the most striking phenomena of an engineering office is the transparency of character among the members of any group who have been associated for any length of time. In a surprisingly short period each individual is recognized, appraised, and catalogued for exactly what he or she is, with far greater accuracy than that individual usually realizes. This is true to such a degree that it makes people appear downright ludicrous when they assume a pose or otherwise try to convince us that they are something better than they are. As Emerson puts it: "What you are speaks so loud I cannot hear what you say." In fact, it frequently happens that people are much better known and understood by their associates, collectively, than they know and understand themselves.

Therefore, it behooves you as an engineer to let your personal conduct, overtly and covertly, represent your conception of the very best practical standard of professional ethics, by which you are willing to let the world judge and rate you.

Moreover, it is morally healthy and tends to create a better atmosphere, if you will credit the other fellow with similar ethical standards, even though you may be imposed upon occassionally. The obsessing and overpowering fear of being cheated is the common charactersitic of second- and third-rate personalities. This sort of psychology sometimes leads a person to assume an extremely "cagey" sophisticated attitude crediting him or herself with being impressively clever when he or she is simply taking advantage of his or her more considerate and fairminded associates. On the other hand a substantial majority of top-flight executives are scrupulously fair, square, and straightforward in their dealings with all parties. In fact most of them are where they are largely because of this characteristic, which is one of the prime requisites of first-rate leadership.

The priceless and inevitable reward for uncompromising integrity is confidence, the confidence of associates, subordinates, and "outsiders." Confidence is such an invaluable business asset that even a moderate amount of it will easily outweigh any temporary advantage that might be gained by sharp practices.

Integrity of character is closely associated with sincerity, which is another extremely important quality. Obvious and marked sincerity is frequently a source of exceptional strength and influence in certain individuals, particularly in the case of speakers. Abraham Lincoln is a classic example. In any individual, sincerity is always appreciated, and insincerity is quickly detected and discounted.

In order to avoid any misunderstanding, it should be granted here that the average person, and certainly the average engineer, is by no means a low dishonest scoundrel. In fact, the average person would violently protest any questioning of his or her essential honesty and decency, perhaps fairly enough. But there is no premium upon this kind of common garden variety of honesty, which is always ready to compromise in a pinch. The average person will go off the gold standard or compromise with any sort of expediency whenever it becomes moderately uncomfortable to live up to his or her obligations. This is hardly what is meant by "integrity," and it is certainly difficult to base even a moderate degree of confidence upon the guarantee that you will not be cheated unless the going gets rough.

Finally, it should be observed that the various principles which have been expounded, like those of the arts and sciences, must be assiduously applied and developed in practice if they are to become really effective assets. It is much easier to recognize the validity of these "laws" than it is to apply them consistently. The important thing here is to select, in so far as possible, a favorable atmosphere for the development of these professional skills. This is undoubtedly one of the major advantages of employment in a large engineering organization. Perhaps, even more important, as previously mentioned, is the selection of your boss, particularly during those first few years that constitute your engineering apprenticeship. No amount of precept is as effective as the proper kind of example. Unfortunately, there is not nearly enough of this kind of example to go around, and in any event it will behoove you to study the "rules of the game" to develop your own set of principles to guide you in your professional practice.

CHAPTER 1

CORPORATE OVERVIEW

1 SCOPE

Orientation means to familiarize with or adjust to a new situation; it also means to align or position with respect to a specific direction or reference system. Chapter 1 helps you become familiar with Digital Equipment Corporation in four ways. First, Ken Olsen, founder and president of Digital, relates Digital's own brand of philosophic autonomy in the areas of communication, compromise, and cooperation. Second, a short history of the company's achievements is provided. Next, "Digital Philosophy" provides you with positive, growth-producing values inherent to the operation of the company. Finally, Digital's management style and structure are broadly outlined. These topics in Chapter 1 provide you with a perspective with which you may meld your personal goals with those of the corporation to grow and prosper.

Note

All domestic telephone numbers in this manual are on the Digital Telephone Network (DTN), accessible only from inside a Digital facility. See your Digital Telephone Directory or local operator for external exchange codes.

2 INTRODUCTION - KEN OLSEN

Before you select specific sections to read that may be of immediate interest to you, take a few minutes to read the following excerpts from a speech given by Ken Olsen to an engineering group.

> "Don't communicate with neighbors in your community about company matters; there is just too much information about what we do at Digital that reaches people outside the corporation. Sometimes we don't fully appreciate the importance of keeping our mouth shut because any one thing doesn't look all that significant. But altogether, things are really important. Any time we, as a company are so open and talk about company matters, we invest heavily in communication.

"Everything is a compromise and we ought to consider every decision we make as a meaningful compromise. The whole art of engineering is compromise. Therefore, engineers of all people should be best at compromising. Often, however, they have the worst time in making compromises. You can't build a bridge, or an airplane, or a computer that's absolutely safe in every alternative. It would take forever, cost an infinite amount of money, and there wouldn't be enough weight left for cars on the bridge, you couldn't get off the ground in the airplane, and you couldn't meet your schedule.

"There is no absolute safety. We're professionals, we can't get away with saying 'I will go all the way, one way and be safe.' We must find the best compromise and then live with the ensuing criticisms. We just learn by our mistakes and do better. That's what we're paid for in our profession. There is a list of things in which we must compromise and identifying them, I think, will help us face the issue.

"The first area of compromise is in new technology. The only time we claim that we've ever been ahead of technology is the day we opened our doors and we've been behind ever since. There are a number of reasons for this. When we started, we had a handful of technology. After that we had to live with our previous product and with our customers who dictated what they wanted. In general, they didn't care about technology. They wanted the products to continue, they had problems to solve and that is what they were interested in. Compromises come because in the long run they use technology that gives the best product, the best solution to problems, the lowest price, and the best reliability. We must always face that.

"A few years ago, the world was promising great things in integrated circuits. The professors at MIT were promising then what we can just do today and the world hated us because we said it wasn't ready yet. We were the last ones to use integrated circuits, and then we were 6 months early! The argument that showed we were right said that we paid 60 cents per unit while others paid 4 dollars per unit because they started earlier than we did and their product was therefore that much more expensive.

"A few years ago, one of our development managers was very excited about magnetic bubbles. 'You can't lose,' he said. 'We must jump on the bandwagon; we must be a leader or we'll lose out.' Even Gordon Bell said it was coming soon. We were reluctant to offend that development manager because he was so enthusiastic, but we said no. Well, five years later, it doesn't look like we've lost all that much. Waiting until we're sure has been a good policy. On the other hand, you can't survive by saying no to all new technology.

"The second area of compromise is merely red tape which includes scheduling and budgeting. Our engineering departments terrify me because I think we're training hundreds of people to be budgeters and schedulers and after awhile they'll all forget how to be engineers. Budgets and schedules are tools; they are not used instead of engineering. We've got to use them but that's all they are, just tools. We are engineers, and we are only useful as long as we're doing engineering.

"A third area of compromise is safety. There are many things that fail for which there is no excuse. We just really work to cover all the alternatives. Products shouldn't fail. In some areas there is no excuse for failure; the compromise comes in because you can't make everything absolutely safe.

"In engineering there are no excuses. It has to work. I sat at IBM for a year, which was the worst year of my life. I didn't have much to do, but I learned a lot there. I was representing MIT and the Air Force and I had to make certain the products were done right. I could nail them because they didn't have technical analyses on the steel racks, but I couldn't tell them to start at the joints because that wasn't in the requirements. I decided that all the people there were really making a list of reasons that if any failures occurred it wasn't their fault.

"We can't do that! We have to get the job done, make sure it succeeds and realize there is always some chance of failure. We mustn't make a list of reasons to show that if something goes wrong it wasn't our fault. When we schedule projects, the normal tendency of an engineer is to schedule the test point two years away; postpone the day of failure for two years. That's just not healthy. I have often thought I wouldn't hire my son at Digital. I think if I did I would have him go into our Computer Special Systems organization because they succeed or fail every month and learn from it. We should make all our mistakes easy ones, our failures small and have them come early, so we can learn.

"The fourth area of compromise that I worry about in modern engineering is the amount of time that people spend preparing presentations for marketeers (when they're not budgeting or scheduling). Let me tell you how it looks to an outsider. A group of engineers studies something, they think about it for months and they look at it from every angle. They know as much as can be known. They know exactly which way to go. But, either because they are cowardly and want someone else to take the responsibility for their decision, or for some mysterious reason I can't explain, they make massive presentations to marketing people and lay the question before them. Now the marketeers have never thought about the subject before. When engineers ask them for a point of view they get back from 100 people 100 points of view that become 1,000 points of view before the meeting is over. Because engineers have a project on which they don't want to do engineering, they'll work two years budgeting and scheduling, they won't do any work, won't read a magazine, won't look at a book, nor a catalogue and won't draw up our diagrams; because they won't do any real work until they have this 'buy-in' from marketeers.

"Another area of compromise comes in discipline. We follow sort of the New England tradition of revolutionary soldiers. We look and behave like rebels. We think we won the Revolution because the British soldiers marched in straight rows, fired their muskets in unison and never aimed, while the smart Americans fired at random from behind trees and stone walls. The real story is that whenever the British started shooting back, the Americans just ran. The whole fight that we're so proud of in Concord was one big mistake. The Americans were so undisciplined and disorganized they got the whole thing started by mistake. The Colonial rebels really didn't win until they hired some European officers who taught them how to march in straight rows, shoot on command, and stand their ground when the other side shot back. When they finally got discipline, they won the war.

"You can take all these great stories on discipline with a grain of salt. Complete discipline would be too much of course. It's a compromise. No discipline whatsoever and there's never any production at all. We have to have discipline in our organization, our lives, our way of doing things. Compromise comes in because too much, by definition, is too much.

"Another area of compromise is in management. Managers must always compromise. They can go to extremes. One extreme is to do it all themselves. The problem with this is that we can't get them to do anything right, because the projects have to stay small so they can do everything themselves. It frustrates the people working for them. It frustrates the boss. Nothing happens until he gets around to it. He's not a manager at all. The other kind of manager who maybe is even worse, abandons everything. Between these extremes comes the compromise. Managing is playing that compromise. The manager must realize this and always face it. There are all kinds of tricks you can use to help. One is to require people to schedule all their work and then submit reports. The preparation of these reports will, in fact, force people to comply and review the information they need to do their job. When something falls apart, you know it and can talk to the people who are in trouble. Engineering sometimes takes forever, but it always comes out. Those things we watch get done, and those we don't watch never get done. It's one of the tricks. Another trick to managing is to threaten people that you might do the job better than they.

"I had lunch with the editor of one of Boston's big newpapers and had been critical of him. As we were walking out he asked, 'Do you ever have trouble motivating these 30 to 35 year old people?' I said, 'Our trouble is we can't get them to go home!' My frustration with that newspaper is that the reporters don't know what they are doing. They report freely but don't know what they are writing about. I figured out what that editor should do. If he would say, 'Let it be known that every month I am going to become an expert on a new subject' but not tell anybody what those things were, it would change the whole organization.

"We used to work for Jay Forrester, one of the real pioneers in computers. We called his style pulse management. He would come in with one pulse. Pulse management can keep people on their toes because they can't ever tell when you're going to come down and pulse them and know more than they do. It keeps the whole outfit sharp! They had better be awake!

"The other area in working out this compromise is to delegate. Of course you can't abandon a project either or nothing happens. One technique is to read a little about warfare. If you are an officer charged with defending a position, you go by every hour and check every single machine gun and the troops manning them. You make sure your men are not dead, that they're not sleeping, or sick; that they haven't run away. You make sure they're ready every hour. There is no such thing as losing the position and then saying, 'Well, things seemed okay when I checked yesterday.' When you're a manager, you have to manage so that you know everything that is going on. There is no such thing as, 'I trusted so and so and he let me down.

"What happens to middle-aged people? In general, they want to get into management. Engineers want to retire from engineering. I think maybe society has forced us into doing that, and engineers ought to fight it. It's okay to be a manager; the company depends upon the availability of good managers. But we should never become managers because we want to 'retire' and get an easy job. There are no easy jobs. You ought to fight the temptation to retire and always take the hard jobs. Always work hard at it and when you become 40 or 50 you'll be in demand. During the last recession, many people in Massachusetts who were 45 and 50 were looking for jobs. They thought they couldn't find work because they were too old. I interviewed a number of them and consistently they said that they used to be engineers, or draftsmen, or machinists. But they got promoted into some administrative work for which they were paid very well. But now they couldn't find work. The secret of it, I think, is always to be something. Don't be a nothing. Be in demand. The interesting thing is that our society wants us to be promoted into a do-nothing administrative job. Be someone who's been something for 45 years and work hard at being *good* at what you do."

3 FACTS ABOUT DIGITAL

Digital Equipment Corporation, headquartered in Maynard, Massachusetts, is the world's leading manufacturer of interactive computers and a leader in distributed data processing. Its products include small, medium, and large-scale computer systems. Digital also manufactures a complete range of peripheral devices and interfacing equipment and provides comprehensive customer support services. Digital employs more than 63,000 people worldwide and has shipped more than 235,00 computers. For its fiscal year ended 24 June 1981, the company reported sales of $3.2 billion.

Since the company began in 1957, the commitment has been good for Digital and good for its customers. Digital's first computer, the PDP-1, broke the million dollar barrier in 1960, providing interactive computing capability for about $125,000. Digital's first minicomputer, the PDP-5, lowered the cost of interactive computing to about $25,000. (Its current equivalent costs less than $2000!)

Digital's computer systems revolve around four central processor families:

- The PDP-8 12-bit computer family was first used as laboratory tools. Today, it functions in machine control, real-time monitoring applications, process control, and a host of business and commercial applications.

- The PDP-11 16-bit computer family brought new technological advances to small computers. Compatible with processors from the LSI-11 to the PDP-11/70, it encompasses the broadest range of peripherals and software ever offered. These systems are used for everything from running a lathe to running a railroad.

- The DECsystem-10, a 36-bit architecture system, was the first commercially available time-sharing system designed to simultaneously handle timesharing, batch, remote job entry, and real-time tasks. DECsystem-10s are used by more data service companies to provide time-sharing services than any other system. The DECSYSTEM 20, a smaller version of our large computer capability, bridges the gap between the DECsystem-10 and the PDP-11.

- The VAX-11/780 is a multiuser, multilanguage, multiprogramming, high-performance computer system. It combines a 32-bit architecture, a virtual memory operating system, and efficient memory management to provide essentially unlimited program space.

To support this line of processors, Digital manufactures a full line of peripheral equipment including disk and tape systems, input/output devices, hard copy and video terminals, and communication interfaces. This large selection of peripheral equipment allows Digital's customers to tailor systems to meet their specific needs, with the assurance of expansion capability for future requirements.

Complementing the hardware offering, Digital offers software products such as application packages, operating systems, higher level languages, and utilities. These products provide the full capability to meet its commitment of increased performance at a lower price.

Possibly more important, Digital provides resources and services to support all of its products:

- Software support services which range from getting a specialized system up and running to writing a customized application program.

- A Field Service organization of more than 6,000 engineers worldwide who are available to service and perform preventive maintenance on all Digital computer systems.

- Sales, Software Support, and Field Service representatives provide sales and service from more than 400 locations in the US and 35 foreign countries.

- Over 300 computer-related courses are available to all Digital customers at worldwide training centers.

- DECUS, the Digital Equipment Computer Users Society, the largest such group in the world, sponsors symposia, publishes newsletters, and administers a program library for its members.

4 DIGITAL PHILOSOPHY

Digital philosophy as represented by the following statements reflects the kind of company Digital strives to be, to its employees and to the outside world.

HONESTY

We want to be not only technically honest, but also to make sure that the implication of what we say and the impressions we leave are correct. When we make a commitment to customers or to employees, we are obligated to see that it happens.

PROFIT

We are a public corporation. Stockholders invest in our corporation for profit. Success is measured by profit. With success comes the opportunity to grow, the ability to hire good people, and the satisfaction that comes with meeting your goals. We feel that profit is in no way inconsistent with social goals.

QUALITY

Growth is not our primary goal. Our goal is to be a quality organization and do a quality job, which means that we will be proud of our product and our work for years to come. As we achieve quality, we achieve growth.

RESPONSIBILITY

Plans are proposed by managers or teams. These plans may be rejected until they fit corporate goals or until the Operations Committee is confident of those plans. But when they are accepted, they are the responsibility of those who proposed them. The impetus for a plan may come from outside the group making the proposal, but once accepted, the proposal is the responsibility of the one who proposed it.

LINE MANAGEMENT

We particularly want to be sure that line management jobs are clear and well-defined. Because so many people are dependent on the plans of line managers, it is very important that the plans have regular automatic measurements built into them. Meeting financial results is only one measure of a plan; other measures are satisfied customers, development of people, meeting Digital's long range needs, development of new products, and the opening of new markets. We believe that our commitment to planning ensures our freedom to act.

SOCIETY

We are committed as a corporation to take affirmative action in providing equal opportunity for employment and promotion for all persons regardless of race, color, creed, or sex. We encourage all employees to take responsibility in community, social, and government activities. We are always open for proposals as to what the corporation or an individual on corporation time may want to do in these areas. However, activities done on company time or with company funds should have a formal proposal including ways of regularly measuring success toward goals.

ENVIRONMENT

As good citizens we have a responsibility to keep our environment free of pollution, and to set an example by these activities.

CUSTOMERS

We must be honest and straightforward with our customers. Not only must they be told the facts, but we must be sure they understand the facts.

To the best of our ability, we want to be sure that the products we sell answer the needs of the customer, even when that customer does not understand these needs exactly. When we sell a product to a customer, we want to be sure the corporation fulfills the obligations we took on with the sale. We sell our corporation, not a single individual, to our customers and we must be sure all Digital commitments are met.

COMPETITORS

We never criticize the competition publicly. We sell by presenting the positive features of our own products. We want to be respectful of all competition, and collect and analyze all public information about competitors. When we hire people from competitors, we should neither press them for confidential, competitive information, nor should we use confidential literature they may have taken with them.

SIMPLICITY AND CLARITY

We want all aspects of Digital to be clear and simple and we want simple products, proposals, organization, literature that is easy to read and understand, and advertisements that have a simple, obvious message. We have thousands of employees and many thousands of customers. We have to keep things simple to be sure that we all work together. Our decisions must always consider the impact on the people who are affected by them.

ORIGINAL EQUIPMENT MANUFACTURERS

Standard products are the basis of our business. At times we will invest in software and hardware specifically for special markets. But we should never lose sight that the base of our business is our standard products. We are very dependent on selling to OEMs. There are more applications for our products than we could ever develop. In addition, there are many risks to be taken in developing new fields which we cannot afford. Therefore we are very dependent on OEMs, and when they take the risks and they are clever enough to be successful, we should be most respectful of their risks. When our OEMs are in trouble with a customer, we should tell them.

PERSONNEL DEVELOPMENT

We encourage people to develop technical skills, breadth of knowledge, and expertise in a specific area. We also encourage people to develop supervisory and management skills. We believe that individual discipline should be self-generated.

PROMOTION

We promote people according to their performance, not only their technical ability but also their ability to get the job done and to take the responsibility that goes with the job. Ability is measured not only by past results, but also by attitude and desire to succeed. Performance results are also used to decide if a person should remain in his or her current job.

HIRING FROM CUSTOMERS

We should be exceedingly careful when hiring employees from customers. Sometimes this is reasonable and desirable; but we should do it with all caution and by being sure that the employee first tells the customer and allows the customer the chance to compete against us.

FIRST RULE

When dealing with a customer, a vendor, or an employee, do what is "right" in each situation.

5 DIGITAL STRUCTURE

Digital operates on a matrix structure which is not used by many companies. Therefore, most people are not familiar with how it works. Briefly, a matrix organization is one in which many members are responsible to more than one person. It enables people from all areas of the corporation to communicate, work together, and see one another's viewpoints. This way, people feel responsible for more than one primary aspect of the business.

A matrix organization is designed to provide checks and balances in decision-making as well as to ensure that major proposals receive full exploration from all interested parties. The matrix organization is one of Digital's greatest strengths, making it possible to view the overall business from a variety of perspectives. For example, it is possible to look at a single product across product lines from an Engineering or Manufacturing perspective. Sales may be viewed worldwide by product line. A single country, region, or district may be examined across functions and product lines. Product lines can develop and market products using the resources of Engineering, Manufacturing, and Customer Services organizations.

Engineering is the backbone and lifeblood of Digital, continually providing innovative products with greater capabilities. Engineering performs product development according to the plans agreed upon with product line Marketing. Engineering also performs advanced development and research, providing a high degree of technical specialization in Printer, Computer Systems, Software Engineering, and major corporate processes to maintain Digital as a major competitor in the marketplace. Engineering Services, Documentation Control, and Specification Control Systems are provided in support of Engineering.

Product Lines have most of the functions you would expect to find in a small company. Digital's three major product line groups are Commercial Products, Technical Products and Computer Products. The focal point for profit and loss measurement at Digital is the product lines. Product line managers are responsible for profits accrued by their market areas. One or more product lines within a market segment may be aimed at very specific markets, with resident Engineering groups established to meet the needs of those market areas.

Manufacturing's function is to produce Digital's products at the product's specified quality level, at a manufacturing cost that maintains a competitive position in the market, and to a schedule that meets our commitments to our customers. Manufacturing operations include approximately 32 facilities. United States locations are in New England, the Southwest, and the West Coast. International locations are in Puerto Rico, Canada, Great Britain, Germany, Hong Kong, Taiwan, and Singapore.

Manufacturing is composed of seven line organizations: Systems Manufacturing, Mass Storage Manufacturing, Terminals Manufacturing, CPU Manufacturing, Process Manufacturing, Component and Memory Manufacturing, and Far East Operations. Plant reporting is within these groups.

Sales have field offices in the United States, Canada, Europe, and General International Area locations to provide promotional and sales services. In order to serve the needs of the marketplace more efficiently, Digital's sales force is specialized; sales persons are trained to serve one or more specific market segments. For instance, there are sales representatives dealing with commercial markets, industrial markets, and educational institutions. Sales training is made available to the entire sales force.

Customer Services comprises many functions, three of which are Customer Service Systems Engineering, Software Services, and Educational Services. Customer Service Systems Engineering groups develop Field Service maintenance and business plans, hardware documents, training requirements, product safety requirements, reliability and maintainability programs, and evaluation of these functions during new product development. Software Services provides services to satisfy Digital's software needs in the field in the areas of warranty support, sales support, and consulting services. Educational Services provides training to anyone, customer or employee, interested in Digital hardware, software, or a variety of other computer-related topics. This group also designs and teaches custom-tailored courses to meet the special needs of a customer. They have extensive facilities in Massachusetts and in major cities around the world.

CHAPTER 2

PERSONNEL

Manager: John Meyer (ML3-4/A11, 223-2633)

Personnel works to enable all groups within Central Engineering to meet the following objectives:

- Attract, develop, and retain a competent, innovative workforce;
- Link business and organizational requirements with individual employee needs;
- Understand and manage the impact of corporate decisions and conditions on organizational effectiveness and employee morale;
- Develop programs and processes to facilitate communication among employees;
- Ensure that employees are treated fairly, and in a manner consistent with Digital policies and legal requirements;
- Develop, support, and manage related administrative and personnel programs, systems, and tools;
- Influence, participate in, and ensure the integration of group objectives and Corporate Personnel goals.

Personnel meets these goals through work in these and other areas of functional support:

- *Employee Relations*: Interpreting policy, solving problems, and providing counseling
- *Compensation and Benefits*: Salary planning and review administration; benefits configuration and administration
- *Staffing and Placement*: Recruiting, interviewing, and assimilating new employees
- *Organization and Employee Planning and Development*: Workforce planning, training, career and performance management, organizational diagnosis and consulting
- *Equal Employment Opportunity (EEO)/Affirmative Action*: Setting goals, reporting, developing awareness strategies
- *Administrative Systems*: Maintaining personnel data base, employee profiles and records

Every employee has the following individuals available to assist him or her with personnel issues:

The *Personnel Services Administrator* (PSA) keeps employee records. The Personnel Services Administrator also processes paperwork for tuition refunds, disability benefits, U.S. savings bonds, leaves of absence, taxes, increase letters (notice of salary increase), and automatic deposit agreements. They handle employee transfers, orient new hires, and help with retirements. The Personnel Services Administrator is the best source of information on benefits at Digital.

Your Personnel Services Administrator is responsible for keeping your personnel file up to date. You can help by supplying your PSA with changes to your address, home phone number, emergency contact, and other essential information. Your department has your Employee Profile, which enables you to keep these records correct.

The *Personnel Representative* advises employees in areas including career development and training, job performance, reclassification and transfers, and leaves of absence. Personnel Representatives work with management on issues of workforce planning, job descriptions, salary planning, Equal Employment Opportunity/Affirmative Action, and organization design and development. They sign personnel requisitions, salary reviews, relocation advances, vouchers, and exceptions, as well as training requests, tuition refund forms, and transfer and termination forms. They also conduct exit interviews.

Personnel Representatives make an effort to meet all new employees, either at an orientation or in an individual meeting, to answer any questions and address any concerns they may have.

Each group has a *Personnel Manager*, responsible for the overall management of the functions listed above. Personnel Managers ensure a productive balance between individual and organizational needs. They consult with group management and other senior-level group members on all aspects of Engineering's business that affect people, and provide strategic and long-range perspective on workforce planning issues.

CHAPTER 3

FUNDING FOR PLANNED AND UNPLANNED PROJECTS

1 PLANNED PROJECTS

The preparation of Engineering budgets is a year-round activity. Engineering is continually involved in the refinement of product development tactics and the evaluation of product development issues and opportunities which arise during the year. These activities dictate a need for flexible budget modifications.

The Engineering budget is determined by the Operations Committee at a formal review in March each year. The Committee approves a budget for the next three fiscal years. The budget for the next fiscal year is very detailed and has little reserve for "new ideas". The remaining years have progressively larger reserves, since our understanding of needs and opportunities is less clear the further we are from the time of actual implementation.

At the Operations Committee review, the major engineering programs present their current plans and status, followed by proposals for new projects. The following programs made presentations at the last Operations Committee review:

16-Bit Systems

32-Bit Systems

36-Bit Systems

Computing Terminals

Office Information Systems

Distributed Systems

Storage Programs

Semiconductor Engineering

Software Engineering Program

Process Technology Program

General Technology Programs

Before the Operations Committee review, each program must analyze the market and technology opportunities in its area. They must consult with all other appropriate organizations within Digital to ensure that their proposals will meet the overall interest of the Corporation. Specifically, this requires formal interaction with Manufacturing, Customer Services, and the marketing Product Groups. Some Program Offices establish special committees as the basis for this interaction. Marketing task forces (MTFs), strategic planning units (SPUs), and product steering groups are examples.

Since it is essential that our engineering investments meet the business needs and respond to the opportunities defined by our marketing Product Groups, the marketing groups must receive special attention from Engineering. One or more times a year the engineering program offices make presentations and obtain feedback at staff meetings of the marketing Group Vice Presidents.

Engineers seeking funding for a product idea should follow the process and procedures defined by their engineering organization. Their group's management will decide whether to incorporate their suggestion into the formal proposals to the Operations Committee.

2 UNPLANNED PROJECTS

There are three sources to which engineers may turn for funding of unplanned projects. Unplanned projects may be funded by product lines, by receiving cross-funding from another engineering group, and by the Research and Advanced Development (RAD) Committee (see section 3.5 of Chapter 5 for a description of this committee).

Product Line Funding

If the project that the development or project manager proposes to undertake has application to a single product line, he or she can request direct funding by that product line. Each product line sets aside a certain percent of its net operating revenue to be used for product line engineering. The engineering group within the product line can finance a proposed project, or Engineering can fund the project directly. A project manager or development manager has access to these funds.

Cross-Funding

In those cases where an engineering manager is supplying services, he or she may receive cross-funding from another engineering manager. A typical example would be the services of the packaging group being used by a CPU development group.

Research and Advanced Development Funding

Occasionally, projects evolve from such alternative avenues as informal discussions, reviewing the current technical literature, and changing market demands. An engineer's personal interest in a particular idea may result in a "lunchroom" project, one which may ultimately benefit the company. To encourage and support such projects, Engineering allocates 1% of its research and advanced development budget each fiscal year for the research and development of unplanned projects. The total research and advanced development fund is 13% to 15% of the Central Engineering fund.

If you have a product that you believe will make a significant contribution to the future of Digital, submit your project to the Research and Advanced Development (RAD) Committee in the form of a preliminary project proposal. RAD will consider potential projects and permit you to sidestep regular management approval.

Your proposal should be submitted to a RAD Committee member or the technical coordinator of the RAD Committee, Nick Johnson (ML2-2/H33, 223-9223). It should briefly describe the nature of your effort, the resources required, the anticipated technical rewards, and the project's relationship to the organizational strategy.

The Research and Advanced Development Committee will review your proposal to determine if money should be spent to test the technical soundness of your project, and then hold a follow-up review by qualified engineers. RAD may also allocate funds to articulate your project to other levels within Digital (for example, Marketing, Manufacturing).

Because RAD receives more project ideas than it can finance, money is allocated only to those projects which demonstrate promise. Roughly half of all project proposals receive funding for further research.

CHAPTER 4

THE PHASE REVIEW PROCESS

PART 1: DEFINITION OF THE PHASE REVIEW PROCESS

PURPOSE OF THE PHASE REVIEW PROCESS IN CENTRAL ENGINEERING

Hundreds of projects are being developed within Central Engineering throughout the year. Most of these projects are products or components of products that are destined to be produced and sold by Digital within the next year or two. Many people outside a particular engineering organization urgently need to know what is being developed within: for example, they may need to plan promotion, allocate resources, schedule manufacturing or software distribution facilities, prepare handbooks or training manuals. It was in this context, the need to communicate project status to groups outside the development engineering group, that the already widespread use of the Phase Review Process model was made official throughout Central Engineering during 1980.

The Phase Review Process is both a model, using the concept of a product life cycle, which spans the functions of the total corporation (Engineering and Manufacturing, Marketing and Sales, and Customer Services), and a management tool used by Product Management. To understand the model, we will describe the idea of a Phase. To understand the tool, we will briefly explain the Review Process.

WHAT IS A PHASE?

Each phase of a product life cycle constitutes a "manageable chunk" of a different type of policy and operational effort. Central Engineering has developed a set of criteria, a checklist of minimum requirements to be met, to indicate that each market-destined product has been addressed by each organization that must act or react in the creation or support of that product. These criteria, within the 6 phases of the product life cycle, are given in the Central Engineering *Phase Review Process Guide*, available from your Operations Manager, or Central Engineering Operations (223-8776). (These phases are outlined in the next two parts of this chapter, on hardware and software projects, but these parts address engineering concerns only: the Phase Review Process is a policy and operational guide to Product Management and non-engineering issues as well.)

In addition, most Engineering Groups have added criteria specific to their own organization, and each product's detailed Phase Planner, listing the milestones that a given product team has agreed to produce within each phase, has added criteria. Apart from these minimum requirements, each product plan is unique.

The purpose of breaking down the total product effort into these phases is to create an event-triggered model of review. This is in addition to a "periodic" model of review: the monthly status reviews, the annual write-up in an operating plan, etc.

The events triggered by the end of one phase and the beginning of another are almost always a shift in resources allocated to a project: a commitment of funding, of lab resources, of human resources, of testing resources, of manufacturing plant resources. At these resource transfer points, engineering and non-engineering groups must collaborate to establish readiness, changes in plans, and so forth.

WHAT IS THE REVIEW PROCESS?

The Review Process is the planning and execution of the phases and phase transitions of a product life cycle. Typically a project team has primary responsibility for coordinating the engineering development work with the business and support functions of the corporation.

This manager is responsible for defining and scheduling the overall phase activities (as described in the *Phase Review Process Guide*, above in *What is a Phase?*) and managing the Phase Transition Review Meetings. The manager will send out an announcement of this meeting time and location, and distribute the required phase transition documentation for review. At the meeting, representatives of each group in the corporation involved in this or the next phase of the product life cycle review and approve documentation, raise and discuss issues, and conclude with either transiting the phase, transiting with conditions, or rescheduling the meeting. In concluding the Review Process, the manager publishes a memo with the minutes of the meeting, indicating the status of the attempted transition.

WHICH DEVELOPMENT EFFORTS ARE REQUIRED TO USE THE PHASE REVIEW PROCESS?

Basically, all products destined for the market place use the process. The following criteria are usually cited for development efforts that may be required to use the process regardless of the end-user.

- Product is to be developed within Central Engineering.
- Product is to be routed through the Corporate Pricing/ Policies Committee (P/PC) for Product Announcement and First Customer Ship.
- Project is to report in the monthly Central Engineering Project Status Report (Yellow Book).

These Pricing/Policy Committee product classifications would each use the Phase Review Process. A modified version of the Review Process may be used in low-impact development efforts (see H3 and S3 below, and the Phase Review Process document for allowable modification).

1. Systems: New CPUs, new Operating Systems, and others as designated by Product Management.
2. Hardware 1 (H1): New products expected to generate revenue in the high bracket (over $16M at this writing, see P/PC Policies for latest bracket value). Examples: COMET, HSC50, VT100, RX04, 11/23, MINC.
3. Hardware 2 (H2): New or modified products expected to generate revenue in the lower bracket (under $16M at this writing, see above). Examples: HIGH IMPACT CHANGES, PCL11-B, CMS11-K, ICS11, IP300.

4. Hardware 3 (H3): Minor enhancements to an existing product or add-on. Example: DUP11 on VAX.

5. Software 1 (S1): New high-impact product or major enhancement to an operating system. Examples: TRAX, SCS, RSTS, VMS, TOPS-20, PDT, MINC.

6. Software 2 (S2): New version of existing product or low impact product. Examples: BASIC, MUMPS, third party applications.

7. Software 3 (S3): Maintenance release.

Note

Contact Digital Standards Administration (ML3-2/E56, 223-9475) for copies of Standards and Specifications listed below.

PART 2: THE LIFE OF A HARDWARE PRODUCT

SCOPE

From product inception, through steady-state production, to product retirement, a hardware product passes through 6 phases:

PHASE 0: STRATEGY AND REQUIREMENTS
PHASE 1: PLANNING
PHASE 2: IMPLEMENTATION
PHASE 3: QUALIFICATION
PHASE 4: PRODUCTION AND SUPPORT
PHASE 5: RETIREMENT

This is an overview of the life of a hardware project, from the perspective of the engineering function, in the sequence of the 6 phases. Information pertinent to Engineering Development has been extracted from the "Policies and Procedures" references listed at the end of each phase and restated here. For full detail of the other functions (for example, Customer Services, Manufacturing, Product Management) involved in the life of a hardware product, and for more detail on policies for Engineering, refer to the sources listed.

This presentation is intended only as a general orientation: to help development engineers determine their responsibilities, understand their roles, and learn about groups they will potentially contact and work with during the product life cycle.

ENGINEERING'S GENERAL PRODUCT DEVELOPMENT RESPONSIBILITIES FOR MARKET-ORIENTED PRODUCTS

At Digital we have a saying about how to make decisions: "Do it right". For the Development Engineer, "doing it right" hinges upon clear communication to and from engineering groups.

1. The "right" thing to do is defined by the joint effort of marketing, product management, customer service, manufacturing and engineering. Keeping in mind that malfunctions in application are often expensive and costly, that a product must be marketable to be worth the

development effort, and that manufacturability is an essential in the design of the product, the development engineer must be receptive to the needs of the representatives of these organizations and allow the necessary adjustments in the technical design to assure quality and safety.

2. "Doing it right" is also a reminder that, as the development effort evolves, the key to success lies in the clear and precise communication of engineering ideas. Although the working model, or engineering "prototype", is the most tangible form of engineering communication, non-engineering groups working on the product will require information in the form of clear, unambiguous documentation directed to the needs of their particular expertise. *How well the Engineering team forges the crucial link between technical knowledge and the other areas of knowledge that will ensure the product's success as it evolves through the product life cycle:* this is the true measure of Engineering's contribution to the product.

THE PHASE REVIEW PROCESS FOR HARDWARE PROJECTS

The following pages identify:

- the objectives of each phase, including non-engineering as well as engineering goals;
- the groups involved, other than the engineering team;
- the Development Engineering group's responsibilities, including Central Engineering's documentation phase transition exit criteria, and other criteria that have been established for all market-destined products;
- and tools: policies, procedures, background research, and groups to consult for further orientation.

PHASE 0: STRATEGIES AND REQUIREMENTS

The Development Engineer's Role in Phase 0

The purpose of Phase 0 is to assess the risks of a go/no decision on product development. It might appear that the engineer's role in Phase 0 is to adopt a "wait and see" attitude until lab and human resources are fully allocated and the project team is ready to start the specifications and prototype. But this is not true. A core of engineers become active in Phase 0 for technical contributions, the two below are minimum:

DOCUMENTATION REQUIRED OF ENGINEERING FOR PHASE 0 TRANSITION

- Write and publish the Alternatives and Feasibility Document. This document is a summary of the engineer's research and understanding of any technical risks involved with solving the problem. It assesses the relevant states of the art of technology in general, in our industry, and within Digital. If there are no technical risks, this is clarified. Alternative solutions are outlined, and the most promising solution, from the perspective of current or evolving technology, is justified.
- Provide information and review and comment prior to publication of the Business Plan, Market Requirements, and Product Requirements documents. These three documents are written and published by the product manager, with the support of engineers, Marketing, Manufacturing, Customer Services, and other functional groups. Part of your job as a consultant on these documents is to participate in the scoping and planning of the project. Part of it is to

provide the product manager with specific information on request, particularly for the Product Requirements document. This cursory document includes clarification of functionality, operating environment, and special requirements which will be detailed later by the development engineering staff during Phase 1 in the Functional Specification.

Tools

Policies and Procedures

- *Phase Review Process*, Phase 0 requirements, Appendix B
- *General New Product Startup Manual* (Manufacturing)
- *Design Review Process* (DEC STD 007)
- *Design and Certification of Hardware* (DEC STD 060)
- *Environmental Standard for Computers and Peripherals* (DEC STD 102)
- *System Business Plans* (DEC STD 130)

Background Research and Consultation

- Corporate Library, Technical Information Center (ML4-3/A20, 223-7963)
- Market Data Center for competitive product research (PK3-1/S52, 223-2504)
- Central Engineering Data Center: product documentation archives (ML12, 223-8776)
- Environmental Engineering Laboratory
- FCC Program Office

PHASE 1: PLANNING

Objectives

- To categorize the hardware product into one of the 4 P/PC categories (see explanation in PART 1: PHASE REVIEW PROCESS)
- To generate a master schedule of the development effort and product support throughout the product life cycle
- To identify all resources required in the development effort
- To generate cost estimates of the total development effort
- to provide detailed description of the product in its operating environment, from which a design description may be created
- To create a commitment within the Corporation to implementing this master plan in the remaining phases of the product life cycle

The groups listed below have developed special expertise in their own areas. The assistance they offer is presented in detail in other sections of this manual. In Phase 1, this list may be used as a resource checklist for determining which groups to contact.

- Manufacturing Representative for New Products
- Software Engineering
  Defines software user documentation; helps to define schedules to relate to major operating system releases; helps to define software interface; creates drivers and defines intelligent tests and standards; helps define engineering specifications for compatibility, migration, and new functionality
- Component Engineering
  Helps research and specify component needs

- Purchasing
  Helps with vendor selection, sourcing, and problem solving
- Engineering Services
  Provides manual and automated design drafting/printed circuit layout; acts as a communication link for all Engineering Services
- Standards and Methods Control
  Provides copies of Digital Standards
- Technical Systems and Services
  Provides resources for optimizing the manufacturability of printed wiring boards, modules, and backplanes
- Diagnostic Engineering
  Assists in hardware/software tradeoffs and logic partitioning decisions; generates diagnostics for your product
- Model Shop
  Supplies fabrication in metal, wood plastic, clay and foam; assembles prototype modules, small assemblies, and cable harnesses; provides PC board modules, hand testers, low volume blasting of PROMs and ROMs
- Educational Services Development and Publishing
  Provides technical documentation planning, technical writing services, publication services, printing and distribution services
- Mechanical Engineering
  Designs packaging, evaluates materials, measures heat transfer and flow, tests connectors; designs castings and molded parts
- Industrial Design and Industrial Packaging
  Performs industrial design, formulates appearance, packaging, and product design concepts (panels, colors)
- Customer Service Systems Engineering
  Helps design support features and plans for field support (the Support Plan introduces the product to all Field Service offices)
- Reliability Engineering
  Provides early Mean-Time-Between-Failure (MTBF) predictions
- Appropriate Process Engineering Group
  Consult with your Manufacturing contact about Digital's way of manufacturing and testing of a new product; if necessary, Manufacturing can design fixtures and tools to facilitate the manufacture and testing of a new product
- Manufacturing Test Applications
  Assists in Hardware/Software decisions to generate diagnostics for Manufacturing applications

Development Engineering's Role in Phase 1

In this phase, Engineering team members focus on refining the technical goals of the product, and specifying what actions must be undertaken in order to achieve the technical goals. For completing Phase 1, the engineering staff has the design, and schedule for implementing the design, defined to a level of detail such that a prototype may be begun in Phase 2. This information will be captured in the Functional Specification and the Design Specification.

You may have noticed that the Design Specification is not listed as a specific phase exit criteria for Phase 1; it is usually started during Phase 1 as soon as the Functional Specification has been drafted, and may be completed during Phase 1 or 2 (the Design Specification is frozen as Phase 2 exit criteria).

As part of the design stage of development, projects involving a higher level of complexity of design or evolving technology may require the formation of a Design Review Committee. This process has been a standard procedure at Digital for many years, and constituted the early version of a process not unlike

the current phase review process (the major difference being the extension of "event-triggered" rather than periodically scheduled reviews to cover the whole product life cycle, rather than just the design cycle). A Design Review process may be integrated within the overall product life cycle phase review structure: the Design Review Committee meeting is used to focus more on technical issues than on planning and major business issues. The bulk of the Design Review Committee effort takes place in the product life cycle Phases 1, 2, and 3. To find out more about the Design Review Process, see Background Research and Consultation for this section.

DOCUMENTATION REQUIRED OF ENGINEERING FOR PHASE 1 TRANSITION:

- Write and publish the Functional Specification. This document is the engineering blueprint for guiding all subsequent technical development required for the product. More concrete and specific than the Product Requirements document in Phase 0, but more general than the detailed Design Specification, the Functional Specification identifies, in technical terms, what the end product must do to meet user and environmental requirements. It will serve as a cross-reference check for subsequent effort.

- Provide information and review for the *Business Plan Phase 1 Revision*, and the *Project Plan.* As in Phase 0, development engineers consult, advise, and provide specific information on request of the authors of these documents.

- Development Management approval of each of these documents at the Phase 1 transition review constitutes Engineering's commitment to the schedule and cost for the remainder of the development effort.

Tools

Policies and Procedures

- *Phase Review Process*, Phase 1 requirements, Appendix B
- *General New Product Start-up Manual* (Manufacturing)
- *Module Manufacturing Standard* with PDG Questionnaire (DEC STD 030)
- *Field Maintenance Print Sets* (DEC STD 117)

Background Research and Consultation

- *Design Review Process* (DEC STD 007)
- Contact the Office of Chief Engineer (ML3-3/H14, 223-6208) for forms and procedures concerning the Design Review Process.

PHASE 2: IMPLEMENTATION

Objectives

- To resolve the last design problems by finalizing and testing base-level prototype(s)
- To freeze the design (formal ECO control of the design, the parts list, and the part descriptions at the end of Phase 2)
- To select facilities and schedule Verification Testing required to qualify the product for the target market(s)
- To finalize Manufacturing, Marketing, and Customer Service commitments for the planned activities of Phase 3

Groups Involved

- Engineering Services: Component, Design, Drafting, and Diagnostics Groups
- Engineering Quality Groups: Environmental, Product Safety, and Reliability Engineering
- Manufacturing Test Applications, Design Maturity Testing
- Model Shop
- Product Lines
- New Product Marketing
- Sales
- Finance
- Customer Services

Development Engineering's Role in Phase 2

Phase 2 is the turning point of product development within the 6 phases of the life cycle. In Phase 2, we begin to pivot away from development within Engineering to readiness for the manufacturing plant and marketplace. Engineering has three goals in this phase.

The first goal is to implement the engineering design concepts developed in strategic and planning phases. The implementation task culminates in a final prototype, created by Engineering, with the help of such services as the Model Shop, Drafting, and Industrial Design. The focus here is on marketability: the prototype must conform as closely as possible to the needs of the market as defined in the documentation produced during Phases 0 and 1. A Design Review Committee, if formed, will help with technical issues of applied engineering for this task.

The second goal is insure that any "bugs" discovered in the design or prototype have been ironed out, that engineering has internally reviewed and approved the work prior to prototype release to Test, Manufacturing, and Service organizations. Both manufacturability and maintainability are essential in the engineer's definition of "design approval". If a Design Review Committee has been formed, they will meet for a Final Specification Design Review to help the development engineers establish that specification to design has been achieved.

The final prototype, accompanied by a design specification, engineering drawings and other pertinent documentation, will be used for the verification and maturity testing performed throughout the remainder of Phase 2 and Phase 3. When design maturity has been verified, the team will freeze the design, placing the design specifications under Engineering Change Order (ECO) control. This means that no new functionality or changes in design (architecture) may be generated without a formal approval process since these kinds of changes usually have a significant impact on the product content, delivery schedule, and development cost. Changes to the prototype that do not alter design or functionality are incorporated during the base-level and verification testing.

The third goal is to plan and schedule the verification and maturity testing that will occur through Phase 3. These plans take into account the intended market (including international), manufacturing process, and scope of service to be provided. Component Engineering, Diagnostics and Reliability Engineering are groups that can aid in the planning of the Verification Testing and Analysis. Digital has environmental test chambers that test for heat, humidity, supply voltage, frequency, and other factors that affect product safety and performance. External test facilities may also be required.

DOCUMENTATION REQUIRED OF ENGINEERING FOR PHASE 2 TRANSITION:

- Write and publish the Final Base-Level Prototype Test Results Report, a prerequisite for verification/field test ring; and the Verification Test Plans, which specify the role of each in-house and external (if required) testing groups in the next phase.

- Provide information and review for the Phase 2 Business Plan, the updated revision of the Phase 1 Business Plan.

Tools

Policies and Procedures

- *Phase Review Process*, Phase 2 requirements, Appendix B
- *Parts Lists* (DEC STD 025)
- *Module Manufacturing Standard* (DEC STD 030)
- *International Certification Standards* (DEC STD 060)
- *Environmental Standard for Computers and Peripherals* (DEC STD 102)
- *Digital Product Safety* (DEC STD 119)
- *Etch Board and Module Release Verification Requirements and Procedures* (DEC STD 142)
- *Wirewrap Backplane and Wirewrap Module Release Process* (DEC STD 181)
- *Process Maturity Test Specification* (A-SP-7665268-00-0001)

Background Research and Consultation

- *DEC Field Service Philosophy*
- *ECO Handbook* (A-MN-ELENECO-0-0) (Available from Digital Standards Administration)

PHASE 3: QUALIFICATION

Objectives

- To measure compliance to all existing Corporate, Industry, and Government Agency standards applicable to the product's target markets

- To plan and schedule the introduction of the product into the manufacturing process of the specified manufacturing plant(s)

- To plan and schedule the introduction of the product in the marketplace (including advertising, selling, servicing)

Groups Involved

- Product Management
- Engineering: Drafting, Environmental, Software, Diagnostics, Component, Reliability, Process
- Manufacturing: Test Applications, Plant Management, Plant Materials
- Customer Services: Systems Engineering, Field Services
- Purchasing
- Finance
- Sales
- Product Lines, Product Line Marketing
- Corporate Pricing/Policies Committee (P/PC)

Development Engineering's Role in Phase 3

Phase 3 focuses on ensuring smooth product introduction, both into the manufacturing start-up process and through the Corporate criteria for introduction into the public marketplace. In Phase 3, product management, manufacturing, marketing, sales and service groups are mobilized, according to the documentation and planning created in the earlier development phases.

To qualify the product for the designated target markets, Engineering and Quality Groups usually put a number of prototypes through rigorous tests. The Product Manager attends to the P/PC checklist for Product Announcement and First Customer Ship (FCS). The Engineering tasks on this checklist are extracted below. See your Product Manager for the complete checklist, including criteria of Manufacturing, Customer Services, and other groups.

ENGINEERING TASKS REQUIRED BY PRICING/POLICIES COMMITTEE FOR PRODUCT ANNOUNCEMENT AND FIRST CUSTOMER SHIP (FCS) OF HARDWARE PRODUCTS

- Implementation complete (note, base-level done at phase 2 transition for H1 and H2; this item is implicit for H3)
- Qualification Phase complete (for H1 and H2)
- Demonstration of DEC STD 102 Compliance
- Demonstration of Product Safety Compliance
- Demonstration of FCC Compliance
- System Environment/Evaluation Test Phase 2 and Design Maturity Test (DMT) complete (for H1); or, Reliability Evaluation Results (for H2, if planned) (with Manufacturing)
- Run Time and Coverage goals demonstrated (for H1 and H2); or, "Diagnostics Available" (for H3) (with Diagnostic Engineering)
- FCS Diagnostics signed off (for H1 and H2) (with Diagnostic Engineering)

If product is designated as a "system", add (with Product Management):

- Statement on System Performance
- Statement on Digital Product Positioning
- Statement on Competitive Product Positioning

Note

Hardware categories (H1, H2, H3) are defined in PART 1 of this chapter.

OTHER DOCUMENTATION REQUIRED OF ENGINEERING FOR PHASE 3 TRANSITION

In addition to the documentation required by P/PC criteria, the project team requirements from development engineering are:

- Edit and publish the Final Report of Verification Testing Results: each test area writes its own evaluation report and submits it to the Development Manager for compilation and final report publication.
- Provide information and review for the Phase 3 Revision of the Business Plan.

Additional Tools

Policies and Procedures

- *Phase Review Process*, Phase 3, Appendix B
- *Hardware Field Test Policy and Procedures* (contact P/PC)
- *Purchase Specifications* (Component Engineering)
- *Design and Certification of Hardware Products* (DEC STD 060)
- *Digital Product Safety* (DEC STD 119)
- *Etch Board and Module Release Verification Requirements and Procedures* (DEC STD 142)
- *Wirewrap Backplane and Wirewrap Module Release Process* (DEC STD 181)

Background Research and Consultation

- Component Engineering, for testing and incoming inspection
- Manufacturing Training Services, for in-plant training
- Diagnostic Engineering, for tester software and in-plant support
- Manufacturing Tool Generation, for templates
- Process Engineering for volume production test requirements
- New Product Reference Library
- *General New Product Start-Up Manual*

PHASE 4: PRODUCTION AND SUPPORT

Objectives

- To transfer ECO control from Engineering (Phase 4A) to Manufacturing (Phase 4B)
- To evaluate the product development effort
- To evaluate the manufacturing process for Quality Certification
- To manufacture and market the planned volume of the product
- To evaluate the market performance of the product
- To generate strategy for the orderly phasing out of the product, from the point of peak (or steady-state) volume manufacturing through retirement

Groups Involved

- Product Management
- Development Teams
- Engineering Support Management (Product Assurance Groups)
- Manufacturing Plant Management
- Plant Manufacturing Support Management
- Product Lines
- Customer Services
- Sales
- Finance
- Corporate Pricing/Policies Committee

Development Engineering's Role in Phase 4

The Engineering focus in phase 4 is to establish how and when engineering support for the product will occur as the product is transferred into Manufacturing. These problems include determining who performs the engineering required for ECOs, which group controls the project accounting, etc. There is no universally applicable rule of thumb for this transfer, since complexity of design, projected volume, projected life of the product, and many other factors are considered in developing the support required.

Once the transfer is agreed upon and occurs, the product completes phase 4A. Further Engineering contribution depends upon this agreement.

DOCUMENTATION REQUIRED OF ENGINEERING FOR PHASE 4 TRANSITION

- Contribute to and review the Post Partum Review, with Product Managment, after volume production and field data exist.

- Contribute to and review the Retirement Business Plan, with Product Management, upon maturity of product life cycle.

Tools

Policies and Procedures

- *Phase Review Process,* Phase 4, Appendix B
- *Engineering Change Orders* (DEC STD 100)

Background Research and Consultation

- *Product Certification Policy* (A-SP-7665327-00-0000)
- *System Business Plans* (DEC STD 130)

PHASE 5: PRODUCT RETIREMENT

Objectives

- To generate and carry out operational plan of scheduled activities for the phasing out of the product.

Groups Involved

- Product Management
- Manufacturing
- Product Lines
- Customer Services
- Sales
- Finance

Development Engineering's Role in Phase 5

As a product's life cycle continues, and as new products are developed and introduced in its wake, volume of sales and volume of manufacturing begin to level off. When the product is no longer anticipated to contribute to customer needs, and as it becomes more expensive to support, the decision to phase out the product will come. Many groups must be coordinated in the effort to phase the product out of their lists, accounting, and support activities. Engineering may have a role in this phase. Refer to the Retirement Business Plan, and other criteria in your area regarding phase-out.

Tools

- *System Business Plans* (DEC STD 130)

PART 3: LIFE OF A SOFTWARE PROJECT

SCOPE

This section contains general information for software engineers regarding computer facilities, quality methodologies, the software development process, and the Phase Review process. This section addresses:

a. who is involved

b. what documents/activities are required

c. when the documents/activities are required

This section is not intended as a substitute for the more detailed *Software Development Policies and Procedures Manual.* It is intended only as a pointer to that manual by providing an introductory overview of the software development process (contact Gladys Pannell, ML3-5/B39, 223-5860, for a copy of the *Software Development Policies and Procedures Manual*).

GENERAL INFORMATION

How to Develop Quality Software Products

Software Development uses certain processes and tools to ensure the quality of software products. For example, *code inspections* carried out periodically in the development of software attempt to spot problems before they become expensive problems. The more bugs found early in the development process, the easier it is to maintain the product later. In the published literature on this topic, one study has shown that an error that might cost $50 to fix in the requirements stage costs $1800 to fix in the integration and systems test stage.

One method of spotting problems early is the process of using *base levels*. Base levels are stepping stones in the development of software. The Project Leader plans and controls what goes into each base level. These are functional stages (that is, each base level is a testable unit that can run alone) which build on one another until code is developed which has many functions. Because many people must work on code beside yourself, the practice of using base levels allows others to integrate their base level functions with yours at various stages of coding.

Tests are performed after base levels are reached to build confidence that the code does what it is supposed to do as it continues to evolve. A clear advantage in using base levels is that as each level is tested and finalized, later debugging of the complete code can be kept to a minimum.

To further ensure the highest quality in software products, Software Development uses a standard high-level language for software projects. For this purpose, BLISS is the preferred implementation language. BLISS implementations are normally cheaper and easier to maintain than assembly language implementations. They also offer opportunity for reasonable portability for part or all of the program under development. For more information about Software Development's policy on BLISS usage, see the *Software Development Policies and Procedures Manual*, Section 7A3-2.A.

Another method of ensuring the quality of software products is the process known as *DECnet certification.* Certification is a method of validating a product's ability to carry out its DECnet functions with all other DECnet products. The purpose of this method is to establish a single set of standards to maintain general interconnectability among DECnet products. It is also used to ensure the compatibility of products at the user level. As Digital grows, certification will be used for most software products.

Ensuring quality software products also includes meeting the *minimum ship criteria.* The minimum ship criteria must be met prior to the submission of a software product to the Software Distribution Center (SDC) for shipment to customers. Before submission to the SDC, there is a 30-day "code freeze" period during which a product is installed, verified, and tested. Minimum ship criteria which must be met during this period include installing and verifying the code and publications, checking size, performance, and compatibility, and testing the product in intended market environments. Be sure to allow enough time during the development process for these criteria to be met. Consult the *Software Development Policies and Procedures Manual*, Section 7A3-1.A, for full particulars regarding the minimum ship criteria.

Software product quality extends far beyond developing programs with few bugs. Quality represents a multitude of factors often overlooked by people developing programs. Ultimately, it is how our products are perceived in the marketplace by the user. To this end, Digital is working toward improving user perceptions of installability, ease of use, human engineering, performance, maintainability, compatibility, and reliability.

SOFTWARE DEVELOPMENT PROCESS

The Software Development organization has developed its own processes for orderly and effective development and support of our software products.

The six successive development phases are:

PHASE 0: STRATEGY AND REQUIREMENTS
PHASE 1: PRODUCT PLANNING
PHASE 2: IMPLEMENTATION (including internal testing)
PHASE 3: PRODUCT QUALIFICATION (field testing) AND RELEASE
PHASE 4: PRODUCT PRODUCTION AND SUPPORT
PHASE 5: PRODUCT RETIREMENT

The Product Manager is the chief coordinator of the development of a software product. He or she is responsible for coordinating the actual development (design and programming) with other activities that impact the product, for example, Marketing, Sales, Training, Documentation, and Software Services. In general, the Product Manager ensures that all affected groups have an identified contact person for the project, and that those people are kept apprised of important information relating to the project and product.

Note that not all projects have a Product Manager, but every project has a Project Leader. If there is no Product Manager, the Project Leader must establish communication with other support groups (Marketing, Sales, Training, Documentation, and Software Services).

The actual design and development of the product are the responsibility of the Software Engineers on the development team. These engineers are responsible for the success of the product as measured by the quality of the design and the success of the implementation.

In the development of a software project, the activities of various groups are concurrent. Greatly simplified, these activities are:

Group	*Activities*
Development	Plan, develop, test, package, release, and maintain a software product
Software Quality Management	Represent user in-house by establishing quality goals, monitoring development activity, and assessing risk in shipping a software product
Software Documentation	Write manuals for use by customers
Software Distribution Center	Reproduce, stock, and distribute software and accompanying manuals
Product Management	Manage the business aspects of a product throughout its life
Software Services	Support customers in using a software product
Educational Services, Software Services Training, Sales Training	Provide training courses for customers, employees, sales people, and development personnel

The software development process requires detailed documents at specified times. Consult the *Software Development Policies and Procedures Manual* for a complete list and description of all required documents. Four key documents are described below:

The *Project Plan* provides a conceptual overview of design objectives, an overview of required features both internal and external. It identifies interfaces with other projects and products, and it identifies all subsequent documentation requirements. It includes budgets, schedules, and staffing requirements. The Project Plan either contains the related plans or explicitly points to them. This document represents the commitments of the project.

The *Functional Specification* describes in detail the external characteristics of the software product. External characteristics are those observable to or under the control of the user of the product. All features of the system actively under the control of the user are defined. Those items that are only passively under user control, for example, listing formats or diagnostic messages, are described in sufficient detail to determine their applicability.

The *Functional Specification* is a design-to document and, as such, describes the product sufficiently for detailed design to commence. All hardware and software compatibilities, standards compliances, dependencies, macro calls, interfaces, and files are identified as well as size and performance objectives. Furthermore, all known limitations or functional capabilities not implemented should be specified. This information should be sufficient for all support groups to proceed.

The *Design Specification* defines the internal design of a software product and becomes part of the Internal Maintenance Specification. It pinpoints the software technology involved and defines the internal structure and tables. It specifies intrasystem calls, delineates all interdependencies, and describes the method to be used for the implementation of the Functional Specification.

The Software Product *Business Plan* identifies and describes the software product to be developed, the goals and non-goals of the project, its assumptions and constraints, and the target markets and applications for the product. It also includes an analysis of the competition, technological considerations and implementations.

CHAPTER 5

ENGINEERING DEVELOPMENT GROUPS

As an engineer, you will often need to contact Engineering groups outside your local domain for assistance and services. The following pages describe the functions of various Engineering groups. Information is provided to help you determine when to contact a group and whom to contact.

These organizations make up the core of Engineering at Digital:

1 16-Bit Systems

2 Software Engineering

3 Systems, Architecture, and Technology

4 LSI Manufacturing and Engineering

5 Storage Systems Development

6 Distributed Systems

7 32-Bit Systems

8 Large Systems Product Development

9 Terminals

10 Computing Terminal (CT) Program

11 European Engineering

1 16-BIT SYSTEMS
Manager: Mike Gutman

The 16-Bit Systems Program has three major functions:

- Line management for all 16-bit hardware development and support activities, except those associated with terminal products
- Software program management for all 16-bit systems
- Line management of advanced development of $10,000-30,000 systems

1.1 16-BIT SYSTEMS HARDWARE DEVELOPMENT
Manager: Herb Shanzer (ML1-2/E60, 223-5159)

16-Bit Hardware Systems Development is responsible for Digital's traditional 16-bit systems products (both Q-bus and Unibus), and all PDP-8-based products. Responsibilities include not only designing the specific CPU hardware, but also integrating complete systems offerings, including software, peripherals, and packaging.

1.1.1 Advanced Development
Manager: Donald Gaubatz (ML1-2/E60, 223-4858)

Advanced Development is responsible for investigation and predesign studies on those systems issues that are crucial to our next generation of products. Areas of activity include working with Software Engineering's CPU chip development group, bus structures and implementation, self-installability and ease of use, packaging, and manufacturing issues.

1.1.2 16-Bit Product Support and Assurance
Manager: Dan Casaletto (ML21-4/E10, 223-3618)

This group supports ongoing 16-bit systems. They work with Manufacturing, Marketing, and Customer Services to resolve production and customer problems, and to improve product quality and yields. Their product assurance function ensures that new 16-bit systems meet all of Digital's product standards. New systems must be compatible with other PDP-11 family products, and have a known level of performance as measured against established product requirements.

1.1.3 J-11 Development
Manager: Gerry Goodrich (ML1-2/E60, 223-3085)

This group develops new systems using the J-11 chip set. They work closely with the J-11 Development group of Semiconductor Engineering (see 4.1 of this chapter), and are developing the 11/24J system.

1.1.4 F-11 Development
Manager: Paul Gardner (ML1-2/E60, 223-5937)

This group develops traditional PDP-8-based systems, such as the VT278 and RL278, and traditional PDP-11-based systems, such as the 11/23B. They support existing and PDP-8 products, as well as those under development in the product lines.

2 SOFTWARE ENGINEERING

Manager: Bill (B.J.) Johnson (ML12-3/A62, 223-3982)

2.1 BASE SYSTEMS SOFTWARE

Manager: Bill Heffner (ZK1-3/J35, 264-8348)

The Base Systems Software group (BSSG) develops competitive real-time and general purpose software products. They provide other Digital groups with base-level software systems on which these groups can build products. The BSSG organization includes product development groups that design, implement, maintain, and enhance software products. Also included are product and quality management groups, and a publications group that develops user documentation.

Descriptions of these groups follow. Contact the appropriate group when you need information about products being planned or developed. Additionally, contact them when you identify future requirements that can be met by this organization's expertise.

2.1.1 Base Systems Quality Management

Manager: Brad Glass (ZK1-1/D19, 264-8400)

This group is responsible for software quality program definition and implementation for base systems software. Group activities include quality management, all software field tests, product assurance, test systems development, and performance measurement for all VAX/VMS and RSX software.

The group's emphasis is on providing a user-oriented quality perspective on software development activities.

2.1.2 Base Systems Software Product Management

Manager: Kurt Friedrich (ZK1-3/J33, 264-8328)

Base Systems Software Product Management manages software products built at Spitbrook. These products include VMS, RSX, RMS-11, RMS-32, DECnet VAX, FORTRAN, PL/1, C, PASCAL, APL, and Ada.

Software product managers are the primary interface among Engineering, other groups within Digital, and the customer base. They manage the Phase Review Process (see Chapter 4), define product requirements, generate business plans, introduce new products, and manage DECUS activities.

2.1.3 VAX/VMS Systems Development

Manager: Joe Carchidi (ZK1-1/D42, 264-8426)

This group develops and maintains operating system software for the VAX-11 family of computer systems, VAX/VMS. VAX/VMS also provides a base system for a broad and growing range of languages and applications software.

The group is also responsible for ensuring that all VAX-11 software products are perceived by customers as part of one, high-quality product offering. To ensure this, all corporate VAX-11 products must be approved by this group before their release.

2.1.4 RSX/RMS-11 Systems Development

Manager: Eric Baatz (ZK1-3/H21, 264-8217)

The RSX/RMS-11 Development group develops, produces, and maintains certain base systems upon which Digital products can be built. In addition to building two real-time products, RSX-11M/S and RSX-11M-PLUS, upon two of those bases, the group ensures a total product set of the highest quality. Real-time products in combination with languages, networks, file systems, and so forth, must constitute a high quality, competitive offering.

The RSX/RMS-11 Development group also develops, produces, and maintains RMS-11 (Record Management Services). This product is in the unique position of being a base system to a number of languages and a layered product to a half-dozen PDP-11 operating systems.

In addition to developing drivers, executives, file systems, and utilities for our own products, the group contributes key components to other products, for example:

- Mass storage drivers, file system, and many utilities for IAS (Interactive Applications System)
- Several any-compatibility mode utilities for VMS
- Support and maintenance of several VMS components (for example, the MCR and AME interfaces)
- Operating system software for the CT (Computing Terminal) Program (see Section 10 of this chapter)

2.1.5 VMS-RMS

Manager: Frank Hassett (ZK1-2/E16, 264-8610)

The VMS-RMS group develops software for specific VMS functions relating to record management, data integrity, and availability. They provide RMS-32, the Record Management System shipped as a part of VMS. The group also provides the portion of VMS responsible for the integrity and availability of data and processes.

RMS-32 Activity: RMS-32, an integral part of the VMS product, provides sequential, relative, and indexed file operations for programs written in any supported language. The RMS-32 group produces continued releases of RMS-32 in response to growing customer needs, as well as the needs of Digital's layered products. A release may have as many as 100 requests for added functionality.

A typical release cycle is 18 months, and, in addition to design, includes performance measurement, documentation, and extensive field testing. The quality of the product is top priority, and all designers are responsible for fixing "bugs" for periodic maintenance updates betweeen major releases.

System Availability and Integrity: This group develops VMS software enabling execution of high-availability applications on VAX/VMS systems. They also help define how the nucleus of VMS and RMS needs to support these applications.

The major area of RMS functionality needed for high-availability systems is a journalling capability. This and other RMS needs are so closely tied to other system availability requirements that this specific RMS work will be done within the System Availability group.

2.2 CENTRAL COMMERCIAL ENGINEERING

Manager: Bob Daley (MK1-1/E06, 264-6183)

The Central Commercial Engineering Group (CCEG) develops and supports technology- and market-based products. CCEG's technology-based role involves Data Base, Transaction Processing, and Information Management products for the general data processing market. This engineering effort includes products such as Datatrieve, DBMS, CATS, TPSS, and the Common Data Dictionary (CDD). CCEG's market-oriented role is to enhance and engineer for Digital's commercial marketplace. Market-oriented engineering includes the development and support of products such as RSTS/E, the DEC DATASYSTEM series of packaged systems, TYPESET-11, and VAX-11 DECset.

2.2.1 CCEG Architecture and Technology

Manager: Bruce E. Parker (MK1-2/C02, 264-6956)

This department consists of three major areas of responsibility: Architecture and Technology, Commercial Systems Evaluation, and the Engineering Network group.

Architecture and Technology ensures an integrated architecture and advanced development effort across the CCEG development organization. The program's thrust is to ensure that all CCEG technology, advanced development, and architecture efforts are properly focused to support related activities within Software Engineering, and to ensure consistency with the overall Central Engineering product development strategy.

Commercial Systems Evaluation (CSE) provides all levels of systems evaluation to the CCEG and Office Systems Engineering groups, including performance measurement and analysis, product assurance, and cross-project studies. CSE acts as the CCEG representative to the other performance groups, and is responsible for CCEG and general commercial product positioning, workload standardization, and special tool development. Consulting support is also provided to Marketing, Product Management, and to those product lines involved with CCEG products.

The *Engineering Network* group maintains the links in the Digital Engineering Network. The Engineering Network ties Digital's engineering groups together by computer, to provide rapid transmission of data. The Network group provides topology planning, problem resolution, and emergency assistance to the many facilities tied into the Network. Contact them to get your computer into the Network.

2.2.2 CCEG Project Management

Manager: John T. Morgan (MK1-2/AO8, 264-5672)

CCEG Project Management has three major sections:

Project Management supports CCEG's commitments made for functionality, schedule, and cost of products. They support Bill Johnson's goal of Digital's worldwide recognition as the leader in software quality by FY85.

Commercial Systems Evaluation evaluates the system performance of CCEG products in support of development projects, supplies product assurance for CCEG systems and layered products, and performs product positioning studies for Engineering groups.

Resource Development and Project Services provides support services and management tools for project management and CCEG resource planning and tracking. Services include capital planning and acquisition and CCEG project reporting (Beige and Yellow Books) to Engineering. Management tools include: administrative tools for decentralized management decision-making and project control; employee skills and resource skills development related to project management; risk management; and quality implementation.

2.2.3 CCEG Product Management

Manager: John Anderson (MK1-2/D03, 264-7783)

The Commercial Product Management group defines the requirements of commercial software products throughout Digital. They introduce these products to the market, and coordinate the products throughout their life cycles. Product requirement issues include service, support, promotion, distribution pricing, and other market-sensitive parameters, as well as functional capabilities. Group responsibilities include RSTS/E, CATS/TPSS, Information Management, and Commercial Languages.

CCEG Product Management offers the engineer a central place to come for information and support for product development.

2.2.4 CCEG Publications and Services

Manager: Gerry Broyles (MK1-2/H03, 264-8790)

This group provides support functions for the Commercial Engineering Groups at Merrimack. These functions include documentation, typesetting, publishing, computer operations, library, space and facilities, and other necessary areas of support.

2.2.4.1 Commercial Engineering Documentation

Managers: Bill James (MK1-2/H03, 264-6772)
Sandy Kaplan (MK1-2/H03, 264-6919)

Commercial Engineering Documentation (CED) plans and writes user documentation for CCEG, Commercial Languages, and commercial product lines. Contact their writers and editors with your documentation questions about these product areas:

- Information Management (DBMS, DATATRIEVE, CDD, RDMS)
- CATS and TPSS
- RSTS/E
- Commercial Languages and Utilities (BASIC, COBOL, RTL, SORT, EDT)
- DECset (In-house typesetting system)

CED also does ongoing research into customer and market requirements, competitive literature, and user reaction to documentation.

2.2.4.2 Office Products Documentation

Manager: Fran Ladd (MK1-2/E06, 264-5834)

This group provides high-quality documentation sets to accompany small office computers. Their writers work with development program teams, which include project engineers and managers, product managers from the Product Lines and Engineering, CSSE, SDC, and others.

Currently, the group writes for Word Processing (WPS-8/Diskette and Disk: 78, 80, 200 Series and DECmate) and OFIS (OFIS/Word Processing; DECmail; OFIS Base Machine, Message Router, Digicalc). In addition, the group takes on writing projects for other product lines with similar products.

This group is concerned with providing manuals for the office end-user environment. In this environment, the customer may be responsible for installing the equipment and learning how to run and maintain it. This represents a new challenge for training, reference, and support documentation.

2.2.4.3 Creative Typeset and Publishing

Manager: Ginger Landry (MK1-1/H08, 264-6873)

The only full-service in-house publishing group in Merrimack, Creative Typeset and Publication (CTP) can handle virtually any typesetting and design need, from microfiche headers, posters, newsletters, and promotional brochures to multi-volume technical manuals. The group can convert various source files (WPS, RNO, or DOC) to typeset copy, using Digital's TMS-11 system and a Mergenthaler Linotron 202. CTP also offers proofreading, production editing, and complete art services, including layout, pasteup, graphic design, technical illustration, photography and photostat services (halftones, screened shots, reversals, transparencies, overheads, and slides). In addition, CTP handles all printing arrangements.

2.2.4.4. Computer Services and Facilities

Manager: John Shoudel (MK1-1/K09, 264-5685)

Computer Services and Facilities (CS&F) provides several service functions for Software and Hardware Engineering in Merrimack. These services include Computer Operations, Operating Systems Support, Order Processing, and Office and Lab Space Administration. CS&F also provides Merrimack with an Engineering Network focus, as well as Data Communications support and Corporate Stockroom 393 services.

2.2.5 Commercial Systems Engineering

Manager: Brian Fitzgerald (MK1-1/B07, 264-5553)

Commercial Systems Engineering develops hardware products for CCEG and the Merrimack product lines. They design computer systems and related equipment for general purpose commercial, word processing, and office applications. Commercial Systems Engineering also provides diagnostic engineering, drafting, and printed circuit design services for all hardware engineering departments in Merrimack, and can provide similar support for other organizations in southern New Hampshire.

Commercial Systems Engineering consists of four departments:

2.2.5.1 Datasystem Hardware Engineering

Manager: Jim Milton (MK1-2/H32, 264-6117)

Datasystem Hardware Engineering designs, develops and supports PDP-11 and VAX-11 hardware computer systems, and related commercial products. They develop common hardware subsystem configurations around standard corporate products, and integrate them with appropriate software packages to produce complete systems suitable for commercial data processing operations. They presently emphasize novice-installable systems, humanized diagnostics, and installation and repair manuals to reduce the costs of ownership.

Datasystem Hardware Engineering is also a Central Engineering resource for electrical or mechanical design and development work at Digital's southern New Hampshire locations.

2.2.5.2 Office Systems Hardware Engineering

Manager: Bob Gray (MK1-1/J14, 264-5874)

Office Systems Hardware Engineering designs, develops, and supports total computer systems for word processing and office system applications. These market-specific products may be developed by modifying standard corporate products or by buying suitable products from outside vendors.

Office Systems Hardware Engineering also provides system product assurance for office products, to ensure installability and maintainability.

2.2.5.3 Diagnostic Engineering

Manager: Bob Misner (MK1-1/L38, 264-5949)

Diagnostic Engineering develops diagnostic programs for Merrimack hardware design groups. Their primary efforts support Communication Engineering's options and network testing. Diagnostic Engineering also supports the Word Processing, Graphic Arts, Telecommunications, Traditional, and Government Systems product lines.

Diagnostic Engineering provides design and implementation assistance on all Reliability, Availability, and Maintainability (RAMP) aspects of systems and units. They work with software and hardware groups to help set and meet RAMP goals in the commercial environment. This work requires the department to provide a system-oriented overview and to be concerned with the human engineering of components critical to meeting RAMP objectives.

2.2.5.4 Merrimack Engineering Services

Manager: Robert Tremblay (MK1-1/B07, 264-5442)

Merrimack Engineering Services provides drafting, printed circuit design, engineering change orders (ECOs), engineering document service, CAD (computer-aided design) and computer services for Merrimack and other southern New Hampshire engineering groups. For more discussion of these services, see Section 1.3.4 of Chapter 6 on Engineering Services.

2.2.6 Information Management

Manager: Fred Howell (MK1/J12, 264-6023)

This group is responsible for information management and transaction processing systems, and related products that support commercial applications. They develop software products and aid other engineering groups with strategy and program management.

The group's two major programs are:

- Corporate Information Management Strategy and related products
- Transaction and interactive information management processing systems for medium-large business systems

The Information Management group is responsible for such specific products as:

- CDD (Common Data Dictionary)
- DBMS (CODASYL Data Base Management System)
- TPSS (Transaction Processing Subsystem)
- RDMS (Relational Data Management System)
- CATS (Commercial Applications Terminal Support)

Contact the group on any of the following topics:

- Current or planned capabilities of the products listed above
- Commercial data processing capabilities of VAX and VAX/VMS systems
- Corporate Information Management Strategy
- Corporate transaction and interactive Information Management systems

The Information Management group can provide you with project plans, functional specifications, technical strategy documents, and related materials.

2.2.7 Text and Media Systems

Manager: Bob Mitchell (MK1-2/C8, 264-6168)

Text and Media Systems develops systems and applications for interactive text management processing and media systems.

DECset Software Engineering develops future product software for the DECset publishing system, and builds a capability to perform current customer software engineering for DECset.

Media Industries Current Products Engineering promotes and maintains customer satisfaction for TMS-11 systems, by providing post-sales software support and product enhancements.

Media Industries New Products Engineering develops new software products for media industries on the PDP-11 and the VAX family of hardware, and ensures that quality is an integral part of each new product.

2.2.8 RSTS/E Systems Development

Manager: Pam Saloky (MK1-2/L2, 264-7776)

RSTS/E Systems Development engineers and maintains RSTS/E, a timesharing system for general commercial application, and DECnet/E, a software package enabling RSTS/E systems to communicate with other Digital systems.

Contact RSTS/E Systems Development to discuss the products listed above, hardware support for RSTS/E, and engineering and business strategies for the small business marketplace. They can provide you with project plans, functional specifications, system plans, and related materials.

2.3 10/20 AND SMALL SYSTEMS AND CORPORATE LANGUAGES

Manager: Dom LaCava (MR1-2/L8, 231-5062)

This organization consists 10/20 Systems, Small Systems Software, and Corporate Languages.

The *10/20 Systems* group develops all software for the DECsystem-10 and DECSYSTEM 20, with the exception of network software. They also have a major advanced development program in profession-based systems. The 10/20 Systems group is divided into Operating Systems, Languages, Publications, Data Management, and Program/Quality Management.

The *Small Systems Software* group develops the RT-11 operating system, which is Digital's low-end PDP-11 operating system and its highest volume software product. They produce the Forms Management System's layered forms filling software, which runs on most of Digital's operating systems. They also work on chip and board software development systems, graphics, and human factors advanced development.

The *Corporate Languages* group develops virtually all languages for Digital's computers, from the PDP-11 up through the largest DECsystem-10s and DECSYSTEM 20s. The Corporate Languages group is divided into Technical Languages and Commercial Languages.

2.3.1 Technical Languages

Manager: Norma Abel (ZK1-3/D40, 264-8138)

The Technical Languages group develops technical language compilers for the PDP-11, VAX, and DECSYSTEM 20; these languages include FORTRAN, APL, and PL/1. The group is also responsible for the VAX debugger and for language-related object-time systems for PDP-11 technical languages. They handle the set maintenance of those products on the PDP-11 and VAX.

2.3.2 Commercial Languages

Manager: Jeffrey Rudy (MK1-2/J5, 264-6680)

This group develops and maintains language processors and utilities for PDP-11 and VAX-11 systems. The languages have industry-wide appeal for commercial applications, although they are not limited to that area. Such languages include COBOL and the extended DEC BASIC products.

Commercial Languages also develops key system utilities, including SORT packages, language translators, the DEC Standard Editor, and the VAX/VMS Common Run Time Library. Members of the group hold positions on numerous national and company standard committees, and participate in software architecture activities.

Contact this group on questions or issues related to the products listed above. Commercial Languages can provide additional information on VAX Language Environment Standards, CODASYL COBOL, ANSI COBOL and BASIC or Command Language committees, and DEC Standards for Editors, BASIC, or COBOL.

2.3.3 10/20 Systems Software

Manager: Ron Criss (MR1-2/L8, 231-5243)

The 10/20 Software Systems group consists of the Operating Systems Group and the Data and Systems Management Group.

The Operating Systems Group, managed by Peter Hurley (MR1-2/L10, 231-6183), includes the following organizations:

- The *Monitor Group*, supervised by Sumner Blount (MR1/L10, 231-6328), is responsible for TOPS-10 and TOPS-20 monitors.
- The *Suvax Group*, supervised by Larry Samberg (MR1-2/110, 231-6338), is responsible for SUVAX software advanced development.
- The *Coexistence Group*, supervised by Fred Engel (MR1-2/L10, 231-6871), is directing the 32/36 coexistence work.

The Data and Systems Management Group is managed by Dave Braithwaite (MR1-2/L14, 231-4400). It consists of these teams:

- The *Data Management Group*, supervised by Bill Harrelson (MR1-2/L14, 231-5180), is responsible for the software development of DBMS-10/20, RMS, FORTRAN and COBOL.
- The *GALAXY team*, supervised by Sue Godsell (MR1-2/L14, 231-6338), is responsible for the BATCH, spooling, and network utilities for DECsystem-10 and DECSYSTEM 20 products.
- The *Release Engineering* team, supervised by Magee Symonds (MR1-2/L14, 231-4498), prepares DECsystem-10 and DECSYSTEM 20 software for release to the Software Distribution Center (SDC). The team also ensures that components for 10/20 software products are complete and consistent for general release.

2.3.4 Small Base Systems Software

Manager: Gil Steil (ML5-5/E76, 223-5150)

The Small Base Systems Software group specifies, designs, implements, tests, and supports small real-time operating systems, personal computer software, intelligent terminal software, chip and board software, BASIC and PASCAL language implementations, and special, directly-funded software products.

2.4 SOFTWARE PUBLICATIONS

Managers: Armen Varteressian (ZK1-3/J35, 264-8344)
Norm Brimhall (TW/E07, 264-2275)
Gerry Broyles (MK1-2/H03, 264-8970)
Kathy Richer (MR1-2/E37, 231-6581)

Software Publications is located in Tewksbury (Distributed and Mid-Range Systems), Marlboro (10/20 Systems), Merrimack (Commercial Engineering), and Nashua (Base Systems).

These writers, editors, and production people generate and maintain software manuals for customers at all levels of experience. Collectively their responsibilities include the planning, organization, completeness, accuracy, appropriateness, user orientation, and appearance of software publications.

To effectively design a software manual, groups gather information from software and hardware engineering, the product lines, software quality management, Software Services training, DECUS, and visits to customer sites.

These groups maintain a close professional relationship with other document-producing groups within Digital to promote compatibility, consistency, and uniformity in software and hardware manuals.

2.5 APPLICATION SYSTEMS GROUP
Manager: Ollie Stone (ML21-3/E87, 223-6617)

The Application Systems group is responsible for application systems development and strategy within Central Engineering. In addition, they will provide contract hardware and software engineering and technical writing for any group within Digital.

Application Systems is composed of Application Systems Development and Application Technology.

2.5.1 Application Systems Development
Manager: Ollie Stone (ML21-3/E87, 223-6617)

Application Systems Development (ASD) designs and implements hardware and software systems for internal Digital organizations and product line groups. Application Systems is a systems engineering resource that provides software and hardware engineering, technical writing, "bug" fixing, consultation, and other related services.

The group's systems represent major investments in hardware and software development, requiring high availability and reliability. To ensure the necessary predictability of costs and schedules, Application Systems follows a written agreement on project functionality.

Group projects are usually based on VMS, RSTS, or RSX, but many projects use other operating systems and a wide variety of languages.

In addition to Technical Systems (2.5.1.1), three other teams provide services for Digital organizations:

Group	*Manager*
ASD North	S.S. Bajwa (ZK1-2/D13, 264-8578)
VAX Technical Systems	Steve Hargrave (ML21-3/E87, 223-4438)
ASD Technical Writing	Martha Dufresne (MK1-1/A6, 264-7488)

2.5.1.1 Technical Systems
Manager: Don Wilson (ML21-3/E87, 223-5806)

This group combines hardware and software engineering expertise to develop technical application systems, real-time applications, custom hardware, and system consulting.

The systems and products developed by this group are done at the request of internal organizations, including Central Engineering, Field Service, Manufacturing, and Product Lines.

Software Engineering capabilities and expertise include all PDP-11 operating systems, VAX/VMS, most languages, and firmware development. Hardware Engineering capabilities and expertise include digital and analog development, and system design and qualification.

Contact this group at the concept stage of your project if you need their assistance.

2.5.1.2 Internal Special Systems
Manager: Ollie Stone (ML21-3/E87, 223-6617)

Internal Special Systems (ISS) provides services to organizations throughout Digital in consulting on and developing customized application systems. These applications are on-line and real-time, ranging from engineering to business, industrial, financial, and medical. Data base systems developed include

order processing, material tracking, bill of material/product price merging, corporate switch, and contract administration systems. Real-time systems include 1981 Digital Network Control and FCC (Federal Communications Commission) Measurement Control.

To achieve high quality results, ISS uses a written and orderly development process for its projects. These processes include:

- Project Plan
- Functional Specification Outline
- Design Specification Outline
- Coding Conventions
- Software Quality Assurance Release Procedures
- Project Monitoring Tools
- Software Installation, Customer Training, and Support

Contact this group for assistance in consulting and developing application systems software to handle your business needs.

2.5.2 Application Technology

Manager: Cliff Neer (MK1-2/K32, 264-7634)

This group develops commercial application systems based on a flexible application architecture.

2.6 SOFTWARE ARCHITECTURE AND TOOLS

Manager: Bill Keating (ZK1-3/J10, 264-8315)

This group is responsible for the management and coordination of Software Architecture. They help administer architectural processes and provide technical leadership to resolve key strategic and implementation issues within Software Development. They also coordinate various software advanced development activities.

Contact the group for solutions to major software architectural problems. The group will also help you understand the process in place, and take suggestions relative to software advanced development. Contact them with questions or suggestions about tools and methods available at Digital.

2.6.1 Hardware/Software Coordination

Manager: Jim Kapadia (ZK1-3/J10, 264-8319)

The Hardware/Software Coordination group is primarily responsible for coordination and planning between hardware and software groups. They try to minimize disjointed efforts between the two by facilitating and influencing compatibility among plans, technology, strategies, and processes. They also help resolve issues common to both hardware and software and, over the long range, help provide needed decisions for smooth and efficient cooperation between the two.

The group publishes the *Hardware-Software Planning Matrix* on a regular basis. The *Matrix* helps the planning process between the hardware products and software systems.

Contact this group when there is an inconsistency between hardware and software plans (for example, release dates, funding, support), products (for example, design, architecture), and strategies. The group will help resolve the issues by providing proper visibility and by directing work to appropriate functions (like Software Planning, Systems Architecture, Product Management). An engineer should contact this group when hardware-software issues are detected that relate to his or her specific efforts, but are broader in impact and hence need a continuing overall focus.

2.6.2 Software Methods And Tools
Manager: Bill Segal (ZK1-3/B21, 264-8049)

This group develops and supports tools for software engineers with a primary focus on increasing productivity and software quality and decreasing software life-cycle costs. They also promote the use of state-of-the-art software engineering methods where applicable within Digital.

The Methods and Tools group will provide specific software tools along with documentation, training, and support as needed. The group is interested in consulting on any area within their expertise such as implementation languages, debuggers, text processors, library control systems, intelligent workstations, and software methodology. They also publish the Software Tools Newsletter.

Contact the group for information or support on any of the following:

- BLISS Compilers and Utilities
- DEC Standard RUNOFF
- Debuggers for VAX and PDP-11
- DIAMOND (Performance Measurement System)
- Electronic Mail System (DEC MAIL)
- Magnetic Tape Interchange
- Microfiche Utilities
- Documentation Tools
- Source Library Manager (STEP)
- Transportable Software
- Software Methodology
- BLISS and MACRO-11/780 Coding Conventions
- Test Library and Verification System (TSV)

2.6.3 Software and Systems Architectural Management
Manager: Alex Conn (ZK1-3/J10, 264-8320)

This group assists in the integration of architectures within Software Engineering and helps coordinate the development of key strategies, interfaces, and functionality for these architectures. The group is particularly concerned with the establishment of effective processes for managing these architectures.

Contact this group if there are major discrepancies or unclear strategies within or between architectures, or whenever there appears to be insufficient coordination between groups. They help to resolve issues on a global level, and do not deal with specific problems within a product that do not affect other groups or products. This group will also assist in bringing significant complex cross-component architectural issues before SARA (Systems Architecture Review and Approval Group) for resolution. (See 3.5 of this chapter for a description of SARA.)

2.7 OFFICE SYSTEMS PROGRAM
Manager: Bruce Stewart (MK1-2/E6, 264-7510)

The Office Systems Program develops office information systems products. Their products include word processing systems, electronic mail, letter-quality printers, intelligent copiers, file servers, administrative subsystems, voice subsystems, and graphics. Through buy-outs and in-house development, they add hardware and software to existing Digital products to create these capabilities. They also provide systems integration for Office Systems products.

3 SYSTEMS, ARCHITECTURE, AND TECHNOLOGY

Manager: Sam Fuller (ML2-2/H33, 223-4562)

Systems, Architecture, and Technology (SA&T) provides leadership in the basic technical areas and processes necessary for the development of Digital's future products. In particular, SA&T is responsible for those functions that require a central focus: research, architecture, standards, the positioning of present and future products, and technology strategies. They also manage those technical activities that, because of their cross-product or cross-organizational implications, unusual technical expertise requirements, or newness to Digital, are best handled by a central group.

3.1 Corporate Research

Manager: Richard Eckhouse, acting (HL2-3/N04, 225-5800)

Corporate Research is responsible for providing Digital with the knowledge and expertise needed to develop new products, technologies, processes or businesses that we believe will be critical 5 to 10 years from now, by performing industrial research work in areas of high risk and leverage. The group focuses on a few high-priority technical areas, and does not do research in all the technologies associated with our business. Corporate Research also provides information services through Corporate Information and Library Services. Ongoing dialogues and joint projects ensure that Corporate Research learns the needs of and exchanges ideas with other groups.

The following sections describe the programs, skill centers, and information services functions of Corporate Research.

3.1.1 Manufacturing Automation

Manager: Tom Williams (HL2-3/N04, 225-5804)

The Manufacturing Automation program, in conjunction with Manufacturing, explores technologies for improving Digital's manufacturing capabilities. The Design/Manufacturing Automation Steering group coordinates the program.

The program is currently investigating robotics and computer vision, with emphasis on materials handling, assembly, test, and inspection. They are also researching the problems of distributing information in the manufacturing environment.

The Manufacturing Automation Laboratory on ML3-5 supports this program.

3.1.2 Exploratory Research

Manager: Steve Lipner (HL2-3/M08, 225-5805)

The Exploratory Research program examines fundamental technical issues that may have high technical risk, but also show high potential market value to Digital. Current projects include image processing, systems security, visual fatigue, high-performance computation, numerical analysis, and a microcoded math library.

The results of these projects may be used by current development groups. Once there is a basic understanding of the technical issues and potential pay-off, Exploratory Research projects may become the basis of new programs.

3.1.3 Integrated Systems and Terminals

Manager: Steve Lipner (HL2-3/M08, 225-5805)

This skill center explores architectural and implementation issues primarily relevant to low-end systems. They attempt to exploit Digital's proprietary LSI components, as well as utilizing industry-stored and LSI/VLSI devices. Current research includes:

- Integrated System Architecture
- Component VAX systems
- Generalized Image Architecture
- Low-end disk controller architectures

The group also maintains a growing reference library on internal and external systems and module designs.

3.1.4 Multiprocessing and Local Area Networks

Manager: Fernando C. Colon Osorio (HL1-2/E47, 225-4738)

This skill center researches multiprocessing, area network design and methodology, and distributed processing. They believe that, by the late 1980s, multiprocessing systems will replace single processor systems in all major areas of computing. For this reason, they concentrate their research in the following areas:

- *Local Area Networks*: Designing cost-effective local area networks for the low-end user. Alternative medium-size technologies for the local area networks of the late 1980s.
- *Interconnect Architectures*: Designing and implementing architectures to support distributed processing applications. Providing a network services interface to applications running on the local area network.
- *Multiprocessing*: Designing and implementing operating systems that support distributed functions in a multiple processor environment.

In addition, this skill center is researching numerical analysis, such as high accuracy microcoded mathematical and floating point computation (including Digital's standardization effort).

3.1.5 Distributed Software Architecture Research

Manager: Frank Germano, Jr. (ML3-4/T50, 223-7581)

This skill center researches the design and implementation of distributed software systems. Demonstrating concepts by using prototypes is a major focus. Projects are underway or planned on the technical problems of profession-based systems and distributed transaction systems. Major current projects include constructing a distributed concurrency control algorithms test bed, studying alternative distributed data base system architectures, prototype construction of a network operating environment for profession-based systems, and the evaluation of directory architectures.

3.1.6 Languages and Applications

Manager: Ike Nassi (ML3-4/T50, 223-4487)

This skill center is conducting research in languages and applications. They believe that applications software will play an important role in Digital's future. For this reason, the group's goal is to develop expertise and provide tools in this field. Currently, the group's projects are divided into four areas:

- Software Methodology (SEER, STEP-software maintenance tool)
- Languages (Ada, translator tools such as PAT)
- Data Bases (semantic models, data base machines, interfaces QBF, data base languages)
- Professional workstations

The group's current strengths are in the areas of languages, tools, and systems. They would be happy to provide consultation, tutorials, or other forms of assistance in these areas.

3.1.7 Integrated Profession-Based Systems Program

Manager: Rick Peebles (HL3-2/M08, 225-5802)

This research program is developing a prototype personal computer network for the professional. They are building an experimental system, called the Liberty Net, that they plan to use for their own daily work. This lets them tackle both design for future computing styles and evolution to that future from today's world. The Liberty Net will include a variety of computers including:

- Ada machines running on VAX processors. (Ada machines are computers where the lowest available interface is the Ada programming language.)
- VAX/VMS group machines that provide access to VMS software tools, the Engineering Network, dial-up phone lines, and historical files.
- Smalltalk machines (Xerox Smalltalk-80) running on 11/23B processors.
- Data servers for archiving, and printer servers for hardcopy output from personal computers.

This program is one of the principal efforts in Digital to understand the personal computer network environment of the future, including the roles of VLSI central processors in the PDP-11 and the VAX. For further information, contact Rick Peebles (ML3-2/E41, 223-8817).

3.1.8 External Research

Manager: Dieter Huttenberger (HL3-2/N04, 225-5805)

This group identifies critical corporate research needs and develops these research projects for Digital in cooperation with universities and research institutions. There is a mutually beneficial transfer of technology and processes, and the outside institutions also benefit from access to Digital equipment.

Each project has a Digital sponsor. The sponsor submits and describes, estimates, and justifies the cost of the proposed research. All projects must be evaluated and approved by the Research Review Board. Approved projects are reviewed annually.

3.1.9 Planning Research and Operations
Manager: Jan Jaferian (HL2-3/N04, 225-5801)

This group is divided into two major functions:

Planning facilitates Corporate Research's planning and allocation of human and fiscal resources. The output of the Planning group includes the Beige and Yellow books, internal program and project plans, and various market analyses and technical reports.

- *Market Research* analyzes the potential business success of research projects, provides functional product specifications, and maintains a competitive data base.
- *Technology Tracking* evaluates specific technologies and processes in view of make/buy decisions and competitive strategies.
- *Human Factors* provides aid in the design and specification of user-oriented products.

Operations is responsible for the general administration of Corporate Research, and maintains the various laboratories that support its research and computing needs.

3.1.10 Corporate Information and Library Services
Manager: Ralph Coffman (ML4-3/A20, 223-6465)

Corporate Information and Library Services (CILS) is an information processing center located in the Corporate Library, Maynard. It works cooperatively with the 11 information centers on the Digital Library Network. For more information on CILS, see the description of the Digital Library Network, Chapter 10, Section 1.

3.2 VAX-11 AND PDP-11 SYSTEMS ARCHITECTURE
Manager: Bill Strecker (TW/B05, 247-2130)

This group is responsible for the management of key Digital architectures. Management includes the functions of architecture definition, specification, maintenance, and evolution. The key architectures currently managed include the PDP-11 and the VAX-11 hardware architectures, the emerging I/O architecture, and the emerging high-availability architecture.

The group resolves ambiguities or errors in architecture specifications (for example, the PDP-11 Processor Handbook, the VAX-11 Architecture Handbook, and the VAX-11 SRM). The group handles requests for changes to existing architectures. Additionally, it assesses the architectural impact of new hardware structures (for example, bus structures).

Contact the group when you need architecture changes, clarifications, or architecture usage data (instruction statistics) or when you think new architectures should be brought under formal architecture management.

3.3 SOFTWARE AND ARCHITECTURE STANDARDS

Manager: Gary Robinson (ML12-3/E51, 223-4094)

Software and Architecture Standards (SAS) manages Digital's representation on standards committees outside of the corporation. The Standards manager defines guidelines for delegates and budgets for travel costs and dues to standards organizations. Delegates are usually chosen from development organizations by the Standards manager and the appropriate engineering manager.

Contact SAS for information about the standards process, or to join one of the committees. You can also join review lists to contribute Digital's comments and votes. Organizations covered include:

ANSI	American National Standards Institute
CODASYL	Conference on Data Systems Languages
CCITT	International Telecommunications Organization
ECMA	European Computer Manufacturer's Association
EIA	Electronic Industries Association
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Standards Organization
JEDEC	Joint Electronic Devices Engineering Council
NBS	National Bureau of Standards

SAS does not manage participation in standards committees concerned with environmental and safety issues (acoustics, electrical safety, EMI, RFI). These committees are generally sponsored by CBEMA (Computer and Business Equipment Manufacturers Association) or ECMA. Participation is managed by Hardware Design Assurance. Likewise, standards committees on micrographics issues are the responsibility of Engineering Services.

A second major function of SAS is sponsoring development and maintenance of Digital Standards in the areas of software, I/O architecture, networks, media, office systems, keyboards, and user interface to Digital products.

The following standing committees are maintained to develop standards and review product specifications: BASIC, COBOL, PASCAL, Keyboard Arrangements, VAX Languages, and DECnet Architecture.

SAS can supply you with these documents and services:

- *The World of EDP Standards*: a non-technical description of the activities and relationships of the many organizations involved in national, regional, and international standards for computers and information processing.

- *Computer Industry Standards Summary*: abstracts of all computer-related standards published by ANSI, FIPS Federal Information Processing Standards), CCITT, IEEE, ECMA, and ISO.

- *Standards Libraries*: a large library of computer-related standards based in Maynard. Collections of ANSI, FIPS, and ECMA standards are located in the corporate libraries of Marlboro, Tewksbury, Merrimack, Spitbrook Road, and Reading, England.

- *Interest Lists*: list of Digital employees qualified and interested in commenting on standards subjects. Can be used as a source of names for Design Reviews.

- *Consultation Service*: Consultation on interpretation of industry standards, standards processes, and politics. Assistance in developing text to describe standards conformance in user manuals or Software Product Descriptions (SPDs).

Contact Software and Architecture Standards during the earliest phases of your project to determine what Digital and external standards are applicable. They would like to review all Project Plans and any functional specifications where conformance to Standards is an important part of product definition. SAS can tell you about proposed standards that may become mandatory before your product is shipped.

Contact SAS for review of the exact text of Software Product Description (SPDs) or user manuals that describe standards conformance. Because of the legal impact of standards conformance it is important that the text be accurate. Phrases like "conform", "compatible with", "based on", or "subject to" can have very different legal meanings.

Contact SAS if you feel a project is not following applicable Digital or industry standards. They do not enforce standards or grant waivers, but they can make sure your issue gets the proper visibility.

Software and Architecture Standards would like to be notified if you hear of new standards committees that Digital should join.

3.4 SYSTEMS PERFORMANCE ANALYSIS

Manager: Terry Potter (HL2-3/N11, 225-6061)

This group provides performance analysis for the Technical Director (manager of Systems Architecture and Technology), and for other organizations within Digital, on a charge-back basis (primarily Engineering development groups). Engineering support focuses on analyzing architectural/design alternatives, to determine their impact on the system's performance, and product positioning, to determine the cost performance of the system.

They also develop methodologies and tools for loading systems and for analyzing, measuring, and predicting system performance.

The group's performance analysts are skilled in modeling, measurement, tool development, and analysis. Contact them whenever you need these skills applied to problems in the above areas.

3.4.1 16/32/36-Bit Systems

Manager: Paul Nelson (HL2-3/C09, 225-5905)

This group will provide systems positioning, analysis, studies, and information for 16-, 32-, and 36-bit systems, and intelligent terminals and competitive systems.

They can assist you in design support, system CPU modeling, engineering evaluation of prototypes, and product positioning.

They can perform analytical and simulation modeling and system measurement including hardware monitoring and single- and multi-user system benchmarks.

Contact them if you have a performance/design related problem that their techniques and skills can help you solve. Requests for special studies require funding, but current information is available at no charge.

3.4.2 Architectures, Networks, and Storage
Manager: Linda Wright (HL2-3/C09, 225-5940)

Architecture, Networks, and Storage provides performance analysis support, primarily to architecture, advanced development, and development groups. They work in the following areas:

- Future system architectures (for example, object-based architectures)
- Local area networks
- Network interconnects
- Network protocols
- Communications subsystems
- Storage subsystems (including data base machines)
- Human interfaces

Contact this group if you want to predict the performance impact of design alternatives in these areas.

3.4.3 Loads, Drivers, and Models
Manager: Rick Fadden (HL2-3/C90, 225-5970)

This group develops methods and tools for representing system workloads, applying workloads to systems (for example, Remote Terminal Emulation such as SIM11), and modeling system behavior under varying load conditions.

Modeling tools can provide the basis for system design analysis, predictive product positioning, and system performance management, including sizing new systems and planning for the growth of current ones. This group develops the SIM11 remote terminal emulator, the SORT (System Organization Review Tool) and SPAM (System Performance Analysis Model) modeling tools, and workload analysis and performance management tools.

3.4.4 Performance Laboratory
Manager: Dave Arnold (HL2-3/C09, 225-5980)

The Performance Laboratory is a hardware/software environment for the completion of performance work. There are two sections of the Performance Laboratory. The Computer Systems Laboratory supports and maintains current Digital products; the Competitive Analysis Laboratory supports and maintains a selection of competitive systems.

The Performance Laboratory group aims to be a cost-effective resource for the Digital performance community. All computer systems in all Systems Performance Analysis labs can be scheduled for use. Time can be scheduled for users outside the performance community as well. Please contact this group if they can help in making stand-alone systems available to you.

3.5 PLANS AND OPERATIONS
Manager: Bill Svirsky (HL2-3/N11, 225-6073)

Plans and Operations is responsible for developing planning and asset management processes used by other Systems, Architecture, and Technology (SA&T) groups. They manage SA&T's facility and space planning and the SA&T business calendar, and interface with other planning groups within Engineering. They also provide functional management for SA&T laboratories.

Plans and Operations provides adminstrative support to these standing committees:

- Research and Advanced Development Committee (RAD)

This committee consists of key senior technical contributors representing all aspects of engineering. They review advanced development plans and projects on a regular basis. They encourage specific advanced development activities by soliciting proposals and funding those that meet their criteria, based on merit, long-term corporate strategy, and innovation.

- Technology Management Committee (TMC)

This committee consists of advanced development managers. They primarily focus on long-range strategic planning, and the integration of plans with the corporate product development strategy.

- Systems Architecture Review and Approval Group (SARA)

The Systems Architecture Review and Approval group (SARA) is an umbrella organization composed of architects representing major component groups (of products) within Central Engineering. Its fundamental purpose is to recognize, study, and resolve major cross-component architectural issues, by establishing appropriate processes and task groups. In addition, SARA serves as a forum for architectural issues of major corporate impact for which an alternate architectural forum is not available. SARA is not intended to centralize the architectural function. Rather, it ensures and determines that adequate mechanisms are in place to achieve timely resolution of issues, whether within the component architecture or in the interfacing with other components.

Contact SARA through Alex Conn (ZK1-3/J10, 264-8320) with your comments and questions about major architectural issues that cannot or will not otherwise be adequately addressed by existing cross-component architectural groups.

4 LSI (LARGE SCALE INTEGRATION) MANUFACTURING AND ENGINEERING

Manager: Jim Cudmore (ML1-5/E30, 223-2393)

4.1 SEMICONDUCTOR ENGINEERING GROUP

Manager: Steve Teicher (HL1-1/R08, 225-4900)

The Semiconductor Engineering group (SEG) drives the use of semiconductor technology in Digital products, because the ability to develop and produce silicon-based systems is critical to the Corporation's long-range plans. To do this, SEG offers a variety of services that insure the development, implementation and support of product-specific and standard LSI/VLSI chips. The following groups comprise Semiconductor Engineering. Contact them when you have a question about their area of expertise.

4.1.1 Architecturally-Focused Product Development

Manager: Duane Dickhut (HL1-1/S08, 225-4941)

This group develops the chips and subsystems that are most closely related to Corporate-maintained computer architectures. Their products include microprocessors and their subsystems, to be used in a range of product applications.

4.1.2 Program-Specific Product Development
Manager: Mark Menezes (HL1-1/R11, 225-7907)

This group designs MOS and bipolar LSI chips that are not commercially available, but are required for use in Digital products. Contact them when you need custom-designed LSI devices and technology.

4.1.2.1 Mass Storage and Peripherals Circuit Design
Manager: Art Cappon (HL1-2/Q10, 225-4897)

Mass Storage and Peripherals Circuit Design (MS&P) supports Digital's custom integrated circuit needs from system conception through circuit implementation. They apply appropriate process technologies to find total system solutions. MS&P is expert in process, circuit, and system design, in MOS and bipolar technologies, and in knowledge of industry capabilities in these areas. Contact MS&P in the concept stage of your project, to maximize their ability to balance tradeoffs between the needs and difficulties of systems and of integrated circuits. Cost, performance, and schedule can all benefit from early contact with MS&P. They can act as driver of a project or as technical consultant, and are ready to perform feasibility studies on current and future concepts.

4.1.2.2 Medium/High-End Circuit Design
Manager: Mark Menezes, acting (HL1-1/R11, 225-4097)

This group performs circuit/chip LSI development for Mid-Range Systems, Large Systems, and the Interconnect groups. They have expertise in both MOS and bipolar chips. In addition to providing internal LSI chip development, they provide consulting support and evaluation of external vendor proposals. Medium/High-End Circuit Design has been the driving force behind development and characterization of state-of-the-art bipolar gate arrays at Digital. Contact them when you have questions about development of new custom LSI components, or need clarification of the trade-offs between different semiconductor technologies.

4.1.2.3 Systems and Logic
Manager: Rony Elia-Shaoul (HL1-1/S04, 225-4913)

Systems and Logic provides user support for Digital's LSI group, and performs a variety of technical functions. They make feasibility studies, generate project plans and proposals, design logic, and run the SAGE2 simulation for custom LSI designs. They primarily focus on bipolar (ECL, TTL) and NMOS technologies. Technical members of Systems and Logic are assigned to specific user groups to support their information needs. In addition, the group provides the following documents: the Custom LSI User's Handbook, the bi-monthly newsletter *MicroEclectic News*, the SEG User's Handbook (available Q4 1982), and the DEC LSI Data Book (available Q3 1982). Contact the Systems and Logic group in the preliminary product definition stage of your project. Block diagrams, performance requirements, and functionality descriptions will help them to assist you in your custom LSI needs.

4.1.3 Advanced Development
Manager: Bob Supnik (HL1-1/S08, 225-4947)

SEG/Advanced Development investigates, selects, and prototypes semiconductor-based technologies. These include semiconductor processes, design methodology, and silicon-directed architecture.

The following are Advanced Development's principal subgroups:

Process Development, managed by Ruth Rawa (HL1-1/H04, 225-4535), performs process specification development and characterization.

Design Methodology, managed by Alain Hanover (HL1-1, 225-4072), is responsible for design philosophy and tools.

VLSI Architecture (Bob Supnik, acting manager, HL1-1/S08, 225-4947) investigates VLSI architecture at the structure, component, and system levels.

VLSI Training, managed by Lee Williams (Hl1-1/S02, 225-4802), develops programs for in-house semiconductor engineering education.

University Programs, directed by Del Thorndike (HL1-1, 225-4911), is Digital's liaison to university VLSI programs.

Microware, managed by Maurice Marks (HL1-1/S06, 225-5022), is responsible for silicon-specific applications.

4.1.4 Computer-Aided Design

Manager: Joe Zeh, acting (HL1-1/R02, 225-4040)

SEG's Computer-Aided Design (CAD) group develops and supports computer-based tools used in the engineering design process. These tools are used for the physical design of LSI/VLSI chips, and for logic design at all product levels (IC, hybrid, PC, backplane, and system).

Such tools include:

- Logic Design Entry (DECDRAW)
- Logic/Fault Simulation and Microcode Development (DECSIM/TUMS/SAGE 2)
- Test Pattern Generation (DECSIM, SAGE 2)
- Circuit/Device/Process Simulation (SLIC, SPACE/SUPREM/ GEMINI)
- Automatic Layout for Gate Arrays (FINCUT/CHARIOT)
- Interactive IC Layout (CALMA)
- Design Rules, Electrical Rules, and Interconnect Verifications (DRC/ERC/IV)
- Data Base Manager (CHAS)

Four groups make up SEG CAD:

CHAS Development, headed by Carol Peters (HL1-1/O08, 225-4076), is responsible for CHAS and overall CAD architecture.

VLSI CAD Development, headed by Ed McGrath (HL1-1/Q05, 225-4086), is responsible for DECDRAW, SLIC, SPICE, SUPREM, GEMINI, new IV for VLSI, and CALMA-to-VAX hard-wired link.

LSI CAD Development, headed by Val Patel (HL1-1/Q05, 225-4842), is responsible for DECSIM, TUMS, SAGE 2, FINCUT, CHARIOT, DRC, ERC, AND IV.

CAD/Graphic Operations, headed by Bob Bureau (HL1-1/Q05, 225-4842), is responsible for providing time-sharing computers and data communications resources, CALMA and SUDS design services, and overall computer resource management.

CAD tools are no longer a luxury, but rather an absolute necessity. The tools are an integral and significant part of the engineering design process. It is important to recognize that CAD is both a great benefit and a potential limitation to the design process, especially since the technology is constantly changing. If you are an old, new, or potential user of CAD tools and have requests, concerns, or simply want to find out more, please contact appropriate people in the SEG CAD organization.

4.2 LSI TEST ENGINEERING

Manager: Prakash Bhalerad (WZ2/238-3303)

This group is broken down into Bipolar, MOS, Memories, and Computer-Aided Test Tools engineering groups. The first three groups bring new LSI devices into the corporation. They establish contacts with vendors, generate test programs, and provide overall support for LSI Manufacturing and Engineering. The fourth group, Computer-Aided Test Tool (CAT), generates test vectors for all LSI Chips and brings in test tools.

Contact the group responsible for the class of devices you are considering bringing into the company. They can supply you with information on what is available, what is qualified, and what is a problem. The groups need to know what part you plan to buy and its application.

Bipolar Engineering:	Sunil Murgai (WZ2, 238-3556)
MOS Engineering:	Ed Terrenzi (WZ2, 238-3311)
Memories Engineering:	Mike Misiaszek (WZ2, 238-3402)
CAT Tools Engineering:	Omur Tasar (WZ2, 238-3372)

5 STORAGE SYSTEMS DEVELOPMENT

Manager: Grant Saviers (ML3-6/E94, 223-9765)

Storage Systems Development is responsible for the development, strategy, and business planning for Digital's storage products. These products include semiconductor and other solid-state memory devices, arrays, subsystems, flexible disks (floppies), cartridge and cassette tape drives, 1/2-inch industry-compatible tape drives, and removable and fixed media hard disk drives of all sizes. The organization supplies these products to the corporation by both developing and purchasing them.

In addition to large product development activities in Maynard and Colorado Springs, there are Product Management, Planning, and Advanced Technology groups that support the mission of the organization. Storage products are manufactured in Colorado Springs, Colorado, in Massachusetts (Westfield, Springfield, and Natick), and in Mountain View, California. Products and subassemblies are also manufactured in Hong Kong, Taiwan, and Singapore. European requirements are partially met by facilities in Galway, Ireland.

5.1 TAPE DEVELOPMENT

Manager: David W. Brown (ML1-3/E58, 223-1923)

This group is responsible for strategy, business planning, product development, and support of tape storage products. These products are used on all systems and sold by all product lines.

Products include magnetic tape drives, formatters, and controllers, including low-cost, non-IBM-compatible devices as well as more expensive high-speed units. Examples: the TU78, TM78, TS11, and TU58. Tape Development provides its products for Digital by developing and by purchasing them.

Tape Development supports products manufactured at the Springfield, Massachusetts plant, including the TE16, TS11, TU77, and TU78. Product Support solves technical problems involving the manufacture, maintainance, and application of disk and tape products still in production or common use. They serve as the focal point for the design and implementation of Engineering Change Orders (ECOs) for tape products.

They interact with Customer Services, Manufacturing, and Systems Engineering groups during the planning, design, and testing phases of new product develoment, to ensure that total systems meet their performance and competitive requirements.

5.2 ELECTRONIC STORAGE DEVELOPMENT

Manager: Richard Morris (ML21-2/E64, 223-3094)

This group develops most of Digital's electronic storage products. They acquire and maintain applicable device technologies, along with the technical skills and product understanding needed to apply these technologies to storage systems.

Selecting the appropriate technology and systems configuration, the group designs systems, builds prototypes, and performs extensive testing before releasing the product to Manufacturing, complete with documentation and test tools.

Contact this group if your needs involve electronic storage (for example, bipolar/MOS devices or bubbles). To best satisfy your needs, the organization needs to know schedule and budget constraints, reliability and performance goals, and be allowed to participate in the conceptual phase in assessing various alternatives.

The group is organized as two distinct departments, Electronic Storage Technology (described in Section 5.2.1 of this chapter), and Electronic Storage Systems Development, organized as follows:

Small Systems Applications (supervisor: Bill Coates, ML21-2/E64, 223-3410), focuses on Q-bus development and the application of electronic storage technology to terminals.

Medium Systems Applications (supervisor: Tony Zacconi, ML21-2/E64, 223-5318) focuses on Unibus developments and the small/medium VAX systems (Tewksbury support).

Large Systems Applications (manager: Dave Ellis, ML21-2/E64, 223-3028) focuses on DECsystem-10 and DECSYSTEM 20 applications, Venus, and various special complex storage issues.

5.2.1 Electronic Storage Technology

Supervisor: Dave Dutton (ML21-2/E32, 223-6020)

This department selects, characterizes, and qualifies electronic devices and technologies that have significant potential for product application.

The group works with the electronic device vendor community. They do extensive analytical and empirical evaluation of devices to reveal failure modes, operating margins, functional issues and technology trends, as well as developing suitable test tools and specifications.

They have substantial expertise in device analysis and testing, reliability issues pertaining to semiconductors and magnetic bubbles, and the selection of test equipment and life test facilities.

Contact Electronic Storage Technology if you need data on current and future electronic storage devices, or help in selecting the appropriate device for your application.

5.3 STORAGE ADVANCED DEVELOPMENT

Manager: Mike Riggle (ML1-3/E58, 223-5316)

The Storage Advanced Development group is responsible for acquiring a technology base sufficient to allow Digital's storage products to be competitive. The group's efforts are a mix of technology acquisition and development. Advanced Development generally develops or trades critical, fast-moving technology, since it is hard to acquire it otherwise.

The group works with digital and analog circuits, magnetic recording, servos, memory subsystems, large scale integration, mechanical systems, recording and error correcting codes, component development, solid state memories, and optical memories.

They provide technology and, sometimes, product breadboards to product development groups. Consultation on a variety of storage issues is also available.

Storage Advanced Development includes four subgroups:

- Heads and Components Development, Maynard
- Storage Systems and Memories Advanced Development, Maynard
- Media Development, Colorado
- Advanced Disk Technology, Colorado

5.4 NEW ENGLAND STORAGE SITE TECHNICAL OPERATIONS

Manager: James Lacey (ML3-6/E42, 223-3730)

This group provides a variety of support services for the Storage Systems Development organization. They participate in all phases of product development by designing diagnostic and test strategies, providing design and documentation support, computer services, and capital equipment management. These and other services are discussed in the following sections.

5.4.1 Storage Systems Diagnostics-Maynard

Manager: Dan Deknis (ML21-4/E10, 223-4163)

This group designs and develops diagnostics for Digital's disk, memory, and tape products. They provide products and services to Engineering, Manufacturing, and Field Service. They also play a key role in the selection of vendor hardware. The group provides consultation and assistance in the early stages of product development to improve product diagnosis.

Storage Systems Diagnostics develops software for Engineering to verify that hardware is in compliance with hardware specifications. They provide software to aid in breadboard and prototype debugging. Additionally, the group provides software to evaluate vendor hardware and to aid in Design Maturity Testing (DMT).

The group develops software for use in Manufacturing during Process Maturity Testing (PMT), unit production, and Final Assembly and Test (FA&T). Module test programs for standard testers are also developed here.

Finally, the group provides software to Field Service to verify complete system installation, to effect a high degree of fault detection and isolation (to speed up the Mean-Time-to-Repair), and to complement other tools in providing preventive maintenance services.

5.4.2 Design Services-Maynard

Manager: Richard Cook (ML3-6/E42, 223-2984)

This Engineering Services group provides hardware-oriented services to New England Storage Systems as described in Chapter 6, Section 1.4.3 on Engineering Services.

5.4.3 Engineering Systems and Tools-Maynard

Manager: Bob Barnes (ML3-6/E42, 223-3854)

This group manages the operation of New England Storage Systems computer services and facilities. Multi-user and timesharing services are provided on PDP-11/70, VAX, and DECSYSTEM 20 systems, with emphasis in site software support (DEC20-RSX-11M+) and operator services. Facilities planning, consulting, and implementation are additional services. Computer-aided design (CAD) timesharing support is planned for Q2 FY82.

Engineering Systems and Tools provides functional management of capital planning for all computers, systems, add-ons, and software, including hardware test equipment. They coordinate Storage Systems Development's office automation, networking, and communications efforts with Digital's overall efforts.

5.4.4 Technical Administration Support-Maynard

Administrator: Susan Goff (ML3-6/E42, 223-3285)

This group provides technical administration support to Storage Systems Development.

Technical Administration Support can supply you with information about audio/video (slow scan) teleconferencing, and space management policies and procedures within Storage Systems Development.

They also maintain Engineering Stockroom 132. Contact them for acquisition assistance and for information about components used in Storage Systems devices.

5.5 COLORADO STORAGE SYSTEMS ENGINEERING

Manager: Demetrios Lignos (CX, 522-2100)

This group is responsible for strategy, business planning, and development of medium and large disk drives and attachments (controllers) for storage products. Selecting the appropriate technologies, the group designs, builds prototypes for, and tests entire disk subsystems. Products are released to Manufacturing complete with documentation and test tools.

Contact this group if you need information on mid-range and large disks and controllers for storage devices. They are knowledgeable in disk recording, servo-current technologies, and LSI and VLSI technology. They work to define disk subsystem architectures and interface protocols. They also monitor and understand the competition, and develop the strategy and make business recommendations for medium and large disk and disk subsystems development.

The group is organized as follows:

5.5.1 Fixed Disk Products
Manager: Paul Esling (CX, 522-2228)

This group is responsible for the development of Winchester-type products, such as the RM80 and later drive families. Head-to-disk assemblies (HDAs) containing data are not removable on these products.

5.5.2 Removable Disk Products
Manager: Bill Glover (CX, 522-2222)

This group develops and supports all removable cartridge and disk pack drive products. In addition, they support all removable products purchased from outside vendors (for example, RMs and RPs).

5.5.3 Subsystems Engineering
Manager: Phil Arnold (CX, 522-2229)

This group develops attachments (intelligent controllers) for disk and tape storage devices. The following functions are included:

- Controller hardware and software development activities
- LSI/VLSI development group
- Colorado diagnostics
- Subsystems packaging group (cabinets, configurations, FCC compliance)

5.5.4 Colorado Operations
Manager: Wes Brown (CX, 522-2001)

This group provides engineering design support for Colorado (drafting, layout, documentation). They are also responsible for Colorado engineering facilities management, the Library, Model Shop, and CAD/CAM tools and systems.

5.5.5 Site Management
Manager: Demetrios Lignos (CX, 522-2100)

Site Management for Colorado Storage Systems Engineering is administratively responsible for interfacing with and assisting various engineering support groups located in Colorado. The support groups include Customer Services, Component Engineering and Technical Publications.

5.6 SMALL DISK PRODUCT DEVELOPMENT
Manager: Paul Bauer (ML1-3/E58, 223-6581)

This group is responsible for strategy, development, release to manufacturing, and support of small disks, both floppy and hard. These storage subsystems include:

- Floppy disk devices, controllers, and systems interfaces (RX01, RX02, and RX50)
- Small removable and fixed head disk devices, controllers, and system interfaces (RD50, RD52, AZTEC)

Small Disk Product Development works with most of Digital's engineering and product line groups.

5.7 STORAGE SYSTEMS PRODUCT MANAGEMENT

Manager: Mike Gutman (ML3-6/E94, 223-5285)

This group is responsible for managing all products developed in Storage Systems Development. The group facilitates communication between technology and marketing, enabling Storage Systems Development to view the marketplace and Marketing to assess the current technology. The organization is involved with a product from cradle to grave, from conception and development through first-customership and product phase-out.

The group integrates the marketing and development plans of several organizations, develops long-term product strategy, generates and obtains approval of business plans consistent with long-term strategy, and coordinates activities necessary for the successful introduction of sales and service of Storage Systems Development products. It also reviews and analyzes products against corporate profit and market objectives, and continually conducts analyses of Digital's competition.

Products	*Product Managers*	*Mail Stops/DTNs*
RM02/03/80	Paul Ferester	ML3-6/E94, 223-4962
RP06/07, RM05	John Forde	ML3-6/E94, 223-3516
RL01/02	Dan Dillon	ML3-6/E94, 223-7871
Floppy Disks	Dick Leslie	ML3-6/E94, 223-6964
RK05/06/07	John Woelbern	ML3-6/E94, 223-5015
Cartridge Tape TU58	Dick Leslie	ML3-6/E94, 223-6964
Memory	Pete Durant Celeste LaRock	ML3-6/E94, 223-2147 ML3-6/E94, 223-8897
1/2" Tape	Sergio Kogan	ML3-6/E94, 223-8260
HSC, UDA	Tom Rarich	ML3-6/E94, 223-6809
AZTEC	Larry Tashbook	ML3-6/E94, 223-5297
R81, RA60	Kevin Smith	ML3-6/E94, 223-5880

6 DISTRIBUTED SYSTEMS

Manager: Bernie Lacroute (TW/A08, 247-2113)

This organization is responsible for the architecture, development, and implementation for the following distributed system products: network products for DEC-to-DEC communication (DECnet), Digital-to-IBM communication (Internet), the connection of Digital equipment to Public Packet Networks such as X.25 (Packenet), hardware communication products for 16-, 32-, and 36-bit computers, and the development of local area network structures and communication subsystems.

6.1 DEC INTERCONNECT

Manager: John Gilbert (TW/E07, 247-2673)

This group is responsible for the development of any DECnet product implementing Distributed Network Architecture (DNA). The group develops funding and product implementation strategies. These strategies are aligned with the overall long-term strategy for all software DECnet products.

The group is basically engaged in product development, product support and maintenance, program support, and advanced development.

Contact the group if you have questions concerning DECnet performance criteria and performance measurements. The group develops DECnet-11M/S, DECnet-11M+, and DECnet-RT products, and is responsible for DECnet 10/20, DECnet-E(RSTS/E), and DECnet-VMS strategy.

6.2 DISTRIBUTED SYSTEMS HARDWARE DEVELOPMENT

Manager: Bob Savell (TW/E05, 247-2604)

Distributed Systems Hardware Development consists of three subgroups:

6.2.1 Network Engineering

Manager: Tom Ermolovich (TW/C04, 247-2388)

Network Engineering develops all systems communications products for Ethernet networks. These include network adapters to interface Digital's computers to the Ethernet cable, transceivers, wire selection, and repeaters, and production of the Ethernet specification in collaboration with Xerox and Intel. Network Engineering also ensures that systems of computers interconnected by these devices operate properly.

6.2.2 Communications Subsystem Engineering

Manager: Jim O'Loughlin (TW/E07, 247-2110)

Communications Subsystem Engineering develops communications products that connect to the Ethernet. Their major current development project is PLUTO, an 11/24-based communications system. PLUTO will perform routing and gateway functions for the Ethernet, allowing different networks to communicate, and will also enable terminals to switch among many systems connected to the Ethernet.

6.2.3 Communications Engineering

Manager: Dick Brewer (MK1-1/M37, 264-5825)

Communications Engineering develops non-Ethernet communications products, which generally fall into the lower-speed RS232 category. These include modem products, used to interface Digital products to telephone communications lines. Other products are processor bus options, used to interface Digital computers to terminals and other computers at speeds of up to 1 MHz, both point-to-point and multidrop.

6.3 DISTRIBUTED SYSTEMS ARCHITECTURE
Manager: Tony Lauck (TW/C11, 247-2137)

This group provides a technical focus for the Distributed Systems program, defines the overall Digital Network Architecture (DNA), and defines and maintains the specifications of key interfaces and protocols that make up the architecture.

In addition to developing and maintaining specifications, Distributed Systems Architecture provides consulting services and operates the DECnet Review Group (DRG), a forum for product implementors to review and approve architectural specifications.

If you are developing a hardware or software product that will be a component of a distributed system, contact this group to receive assistance in understanding or interpreting a DNA interface or protocol. The group can also help you resolve incompatibilities among products that are supposed to adhere to the architecture. The group can also modify the architecture to satisfy the needs of new product development.

6.4 LOCAL AREA NETWORK SERVERS-IBM AND X.25 PRODUCTS
Manager: Dave Rodgers (TW/C04, 247-2369)

This group develops strategies for IBM and X.25 communication products, and the software for local area network communication services, such as terminal concentrators and gateways.

6.5 PRODUCT ASSURANCE
Manager: Doug MacKenzie (TW/C11, 247-2381)

This group ensures that Distributed Systems' network products are compatible with each other, and have known levels of performance against which customer requirements can be matched. They also develop the software tools used to design and properly configure networks.

6.6 CROSS-PRODUCT ENGINEERING
Manager: Kami Ajgaonkar (TW, 247-2249)

This group maintains released products and manages the Distributed System group computer resources.

7 32-BIT SYSTEMS PROGRAM
Manager: Bill Demmer (TW/D19, 247-2111)

The 32-Bit Systems Program has 3 major functions:

- Program Management for all 32-Bit Systems activities.
- Line Management for Small and Mid-Range 32-Bit Systems.
- Line Management for the Shared and Advanced Development functions supporting these programs.

7.1 TEWKSBURY SITE MANAGEMENT AND SHARED RESOURCES

Manager: Jim Marshall (TW/A03, 247-2201)

This organization is made up of these functional groups: Advanced Systems Development, System Certification, Shared Resources, and the Configuration Program.

7.1.1 Advanced Systems Development

Manager: Jim Marshall, acting (TW/A03, 247-2201)

This group is responsible for all 32-bit mid-range advanced development. They are currently involved in base technology requirements, architecture studies, system studies including hardware breadboard evaluation, and design process evaluation and developments such as CAD tools.

7.1.2 System Certification

Manager: Mike Powell (TW/C02, 247-2856)

This group provides test planning and management services for the 32-bit program. Their primary responsibility is to plan, coordinate, and drive the testing of products prior to release. Test issues include architectural verification, functional operation, environmental specifications, electromagnetic interference, safety, performance, reliability, and others. Adherence to Digital Standards, international regulatory standards, and various other specifications is also included.

VAX System Certification administers the VAX New Products Committee (VNPC). The VNPC consists of representatives from Engineering, Manufacturing, Customer Services, and other groups concerned with the supportability of new products on VAX systems. Acting as an agent of the VAX system product managers, the VNPC provides them with detailed information about Digital's readiness to support announcement and shipment of new products.

7.1.2.1 Base System Diagnostic Engineering

Manager: Don Wunschel (TW/F17, 247-2210)

This group provides diagnostic engineering for VAX-based system products and Distributed Systems hardware products.

They work closely with Engineering, Manufacturing, and Field Service to establish product test requirements, define diagnostic strategies, perform product testability analysis, and implement methods and diagnostic tools.

The group provides diagnostic end users with breadboard and prototype debug tools, hardware design verification tools, manufacturing test software tools, and Field Service installation and corrective maintenance software tools.

The group administers and implements Engineering Change Orders (ECOs) to VAX-based system diagnostic products.

Base System Diagnostic Engineering also releases all VAX diagnostic software.

7.1.3 Shared Resources
Manager: Fred Lund (TW/D17, 247-2694)

This group consists of four different design support organizations: Power and Packaging Development, Design Services, Computer Resources, and Material Control. Each of these groups provides a support service to the Tewksbury product development function.

7.1.3.1 Power and Packaging Development
Manager: Nelson Velez (TW/C17, 247-2435)

This group designs and documents power supply systems and product packaging for products under development in Tewksbury.

7.1.3.2 Design Services
Manager: John Carter (TW/D17, 247-2560)

This group provides all of the design support services required by the Tewksbury Development Functions. These include drafting, printed circuit layout, gate array layout, Engineering Change Orders (ECOs), reproduction, and documentation control. See Chapter 6, Section 1.4.3, for more information on Engineering Services.

7.1.3.3 Computer Resources
Manager: Tony Baublis (TW/C14, 247-2453)

This group provides the computer resources required by the Tewksbury Development and tenant operations. This includes support of the CAD5 and CAD6 systems and of other general purpose timesharing systems.

7.1.3.4 Material Control
Manager: Bill McMahon (TW/D17, 247-2869)

This function provides stockroom, shipping and receiving, and prototype kitting services for the Tewksbury Development group.

7.1.4 Configuration Program
Manager: Arnold Kraft (TW/A03, 247-2974)

This group is developing software tools and supporting knowledge acquisition procedures to assist in configuring customer's quotes and orders. The tools will be employed by all major functional groups at Digital, including Manufacturing, Sales, Customer Services, Order Administration, and Engineering.

7.2 ADVANCED VAX SYSTEMS
Manager: Demetrios Lignos (TW/C04, 247-2416)

This organization develops future VAX systems, technologies, and tools, to be utilized across the VAX family of products. Contact these groups on any issue concerning future VAX products.

7.2.1 Low Mid-Range VAX Development
Manager: Demetrios Lignos, acting (TW/C04, 247-2416)

This group defines system products in the lower mid-range VAX price band. They use advanced technology studies to design and develop new CPUs incorporating custom VLSI into the product design. Included is the specification of these systems with communications and mass storage products developed in other groups.

7.2.2 Technology
Manager: Geoff Potter (TW/B02, 247-2181)

This group develops new technologies for the mid-range VAX systems. The group focuses on semiconductors, CAD tools, power and packaging, cooling, printed wiring board interconnect and connector requirements, and microprogramming tools.

7.3 MID-RANGE VAX SYSTEMS
Manager: Brian Croxon (TW/C04, 247-2416)

This organization is responsible for the complete product development of the VAX family of systems. They implement the Central Engineering VAX product strategy, from initial product development to the release of the product to Manufacturing.

VAX Systems is made up of these systems management groups:

7.3.1 Systems Management-VAX 11/780
Manager: John Holz (TW/C04, 247-2265)

This group has the overall systems responsibility for strategy and activities for VAX 11/780-based products. This includes Marketing and Product Management, Engineering, System Test, and System Support as well as Customer Services and Manufacturing.

Contact this group on any issue concerning products that may interface with or attach to the VAX 11/780 system.

7.3.2 Systems Management-VAX 11/750
Manager: Charlie Smith (TW/D06, 247-2304)

This group provides system management for the VAX 11/750. They are responsible for the development and enhancement of the VAX 11/750 product.

Contact this group if you are working on a product that might be interfaced or attached to the 11/750 system. They can provide knowledge and expertise on how a product should be designed to ensure production of a reliable, integrated system.

7.3.3 Systems Management-NEBULA
Manager: Mary Breslin (TW/E07, 247-2600)

This group has overall systems development and product coordination responsibility for the NEBULA project. NEBULA is a new, low-cost implementation of the VAX architecture, aimed at the low-end 32-bit marketplace. Contact them if you are developing products which might interface or attach to the NEBULA system.

7.3.4 High Mid-Range VAX Development
Manager: Don McInnis (TW/C04, 247-2118)

This group defines system products in the upper mid-range VAX price band. Advanced technology studies are used to design and develop new CPUs. Included is the specification of these systems with communications and mass storage products developed in other groups.

7.4 32-BIT SYSTEMS PROGRAM OFFICE
Manager: John O'Keefe (TW/A08, 247-2724)

The 32-Bit Program Office creates and publishes the product strategy for all 32-bit systems. In conjunction with engineering, system, and product managers, the 32-Bit Program Office recommends a new product investment plan that can be supported by the Product Lines, Manufacturing, Field Service, and other functions. In addition, they develop the marketing implementation plan for all 32-bit systems. The overall goal of the Program Office is to produce, document, and communicate a superior long-range plan for 32-bit systems.

7.4.1 32-Bit Systems Product Planning
Manager: Steve Rothman (TW/A08, 247-2013)

This group defines the 5- to 10-year product strategy for 32-bit systems. They define priorities and make recommendations for allocation of funds for submission to the Operations Committee.

7.4.2 32-Bit Systems Business Planning
Manager: Ken Nisbet (TW/A08, 247-2470)

This group plans strategic investment in the 32-bit product area.

Product Planning generates a "menu" of products that 32-Bit Systems Business Planning treats as potential business investments. They work closely with 32-Bit System Product Management and Business Analysis to develop and monitor quality business plans. They also create a Systems Pricing Model for 32-Bit Systems.

7.4.3 32-Bit Systems Product Marketing
Manager: Dave Chanoux (TW/A08, 247-2580)

This group develops and implements strategic marketing plans for 32-bit products. They work with System Product Managers and Component Product Managers on new product introduction strategies, including advertising, sales promotion, communication with the field, and sales training. This group is responsible for insuring that strategies are consistent across the 32-bit product space.

8 LARGE SYSTEMS PRODUCT DEVELOPMENT
Manager: Ulf Fagerquist (MR1-2/E78, 231-6408)

The primary goal of the Large Systems Product Development organization is to develop and implement the high-end portion of the corporate product strategy for VAX architecture-based systems and all DECSYSTEM 10/20 products.

8.1 LARGE VAX SYSTEMS TECHNOLOGY AND ADVANCED DEVELOPMENT
Manager: George Hoff (MR1-2/E78, 231-6524)

This group is responsible for 32-bit System Programs.

8.1.1 Large VAX Engineering
Manager: Alan Kotok (MR1-2/E47, 231-7381)

This project group is currently developing VAX-11 processor units to be marketed in the $150-300,000 price range. Group engineers have experience in these technical disciplines: VAX architecture, high performance CPU design, floating point processor design, console design, cache/memory subsystem design, and microprogramming.

The group makes extensive use of SUDS (Stanford University Design System), IDEA (Interactive Design and Engineering Analysis), SAGE (Simulation of Asychronous Gate Elements), microcode simulation, and systems performance evaluation tools. The group is involved in the application of sub-nanosecond technology and high-density components (LSI) to achieve high-performance processor structures.

Contact the group if you wish to investigate advanced implementations of the VAX-11 architecture, the application of high-performance technology to CPU structures, and advanced approaches in applying RAMP (Reliability and Maintainability Program) techniques to improve system availability. Although the group is focused on a specific project and not available to assume additional development tasks, they will provide consultation and assistance to any group requiring their expertise.

8.2 TECHNOLOGY AND ADVANCED DEVELOPMENT
Manager: Sultan Zia (MR1-2/E47, 231-6277)

This group provides engineering resources to assist in technology development for Large Systems products, both in the VAX-11 series and the DECSYSTEM 10/20 series. The group includes engineers experienced in these areas: ECL (Emitter Coupled Logic) technology (10k and 100k), high-density gate arrays, complex multi-layer modules, circuit simulation (propagation delay and noise margin), LSI packaging and cooling, system level packaging, clock design and distribution, UL/CSA/VDE compliance requirements for large systems and power distribution.

Contact the group for information about high-performance technology. The group has extensive experience in the development of KL10- and KS10-based systems. As a functional group, they are chartered to provide support to development groups throughout Digital, resources permitting.

8.3 DECSYSTEM 10/20 DEVELOPMENT
Manager: Bill McBride (MR1-2/E85, 231-6906)

This group is responsible for all 36-bit system programs, current products, and Large System peripheral integration.

8.3.1 New 36-Bit Hardware Development
Manager: Len Kreidermacher (MR1-2/E85, 231-6617)

New 36-Bit Hardware Development for DECsystem-10 and DECSYSTEM 20 is concerned with all the engineering aspects of DECsystem-10 and DECSYSTEM 20 development. These include logic design and implementation, mechanical implementation, packaging, and power supply.

The group's goal is to satisfy the product requirements of performance, cost, and time-to-market. To meet this goal, they use available technologies and aids, and when required, sponsor the development of new methods and techniques (for example, multiwire, CAD tools, simulations).

Contact the group if you need to make a physical interconnection to a DECsystem-10 and DECSYSTEM 20 under development, or if interested in performance specification issues relating to the group's products.

8.4 LARGE SYSTEMS GROUP ADVANCED DEVELOPMENT
Manager: Ron Melanson (MR1-2/E85, 231-6419)

This group is developing Large Systems Group's future CAD system for the development of new products. This system, called CHROMA, is an interactive schematic and physical editor that supports hierarchy, connection verification between schematic and physical layouts, design rule checking, and simulation. CHROMA is currently being used experimentally in the design of LSI bipolar intergrated circuits. It is scheduled for release to LSG engineers in December of 1982.

8.5 MARLBORO SITE ENGINEERING
Manager: Dave Copeland (MR1-2/E78, 231-4012)

Marlboro Site Engineering provides design layout and documentation services, computer services, CAD tools, and engineering processes for Large Systems and other Marlboro groups.

8.5.1 Computer Systems Technical Support
Manager: Bob Hickcox (MR1-2/E69, 231-6227)

Computer Systems Technical Support provides a wide range of computer and network support services to the Large Systems group.

8.5.2 Marlboro Engineering Services
Manager: Nick Cappello (MR1-2/E18, 231-6261)

Marlboro Engineering Services provides design layout and documentation services to Large Systems Group Engineering and other Marlboro development engineering groups. Services provided include:

- Mechanical drafting and documentation
- Printed circuit board layout
- Logic design drafting and documentation
- Document and reproduction control

They also provide process planning and support to Large Systems Engineering projects. See Chapter 6, Section 1.4.3 for more information on Engineering Services.

8.5.3 Large Systems CAD
Manager: Vehbi Tasar (MR1-2/E18, 231-5565)

This group is responsible for developing Computer-Aided Design (CAD) tools needed for Large Systems hardware engineering. Their areas of involvement include logic schematics systems, gate and register-transfer level simulation tools, automatic design verification programs, and placement and routing tools.

8.6 LOGICAL DESIGN CAD SYSTEMS
Manager: Roy Rezac (MR1-2/E18, 231-4140)

This group is responsible for Corporate tools for Logical Design CAD, as well as overall CAD system architecture. These are tools such as Schematics, SUDS, Simulation, and Microcode. This group has program management responsibility, while some aspects of development and support work are contracted out to other organizations within Digital. They also do work and planning in the areas of Design Methodology and Engineering Process.

8.7 OPERATIONS
Manager: Steve Sur (MR1-2/E78, 231-6462)

Digital develops individual products which must be integrated into plans. The Operations Group provides system integration and linkage of Large Systems plans, and assesses progress made towards these stated goals.

The group works to ensure that development groups use the tools available to them during the product development process. Examples of these tools are the Product Business Plan Standard (DEC STD 130) and the Phase Review Process Standard (DEC STD 028). They coordinate the interpretation of these tools within Large Systems, to ensure that development efforts are monitored on all major programs, predictability levels are achieved and measured, and that plans are fully integrated across Large Systems.

9 TERMINALS
Manager: Bill Picott (ML1-2/H26, 223-8076)

This group designs and develops high-volume video and hard copy terminal products. They focus on advanced development, product development, product support, product design services, and planning terminals strategy. The group's products require some of the highest volume electromechanical and plastics tooling in Digital. They furnish many product services to other engineering groups, through their mechanical engineering and product design group, printed circuit design group, power supply engineering group, and 16-bit diagnostics group. Terminals regularly supplies a customer-level product design to Manufacturing. They also design basic terminal components to which other groups add some function or specific application.

Contact the group for solutions to problems associated with designing, manufacturing, or using high-volume terminal products.

9.1 TERMINALS TECHNICAL DIRECTOR
Manager: Walt Tetschner (ML5-3/E12, 223-6788)

This group provides technical leadership and management for common terminal components and architectures. Problems or requirements for keyboards, terminal communication features, or standards associated with high-volume terminal products are handled by this group.

9.2 HARD COPY TERMINALS

Manager: John Ring (ML1-3/E62, 223-6840)

This group designs impact dot-matrix printer terminals, including keyboards, printheads, mechanisms, and packaging, and is responsible for high-volume buyout line printers.

Contact Hard Copy Terminals when you want advice about selecting specialized products, or if you need help in modifying a terminal. Group members can also evaluate vendor terminals (for example, printers and card readers) that you may be planning to acquire.

Other groups within Hard Copy Terminals Engineering include:

Group	*Manager*
Line printer products/ Advanced Development	Tom Dundon (ML5-3/E12, 223-8305)
Matrix printer products/ Advanced Development	Frank Digilio (ML1-3/E62, 223-33778)
LA200 printer products	Paul Nelson (ML5-3/E12, 223-3528)
Support (Phoenix)	Dave Gretton (PN, 602-869-5273)

Printer Engineering Advanced Development does research in support of printer product development. Some examples of the concepts explored by this team include new keyboard technology, alternate printing technologies (thermal, electrosensitive, and electrophotographic), and extensions of impact matrix printing. Advanced Development is also performed within Frank Digilio's printhead group.

9.3 VIDEO DEVELOPMENT

Manager: Don Haney (ML1-2/H26, 223-9243)

This group designs and develops video products that can either serve as entry-level devices or be upgraded to more sophisticated systems. The group concentrates on three areas: video display terminals, advanced terminals, and graphics. Contact the team leaders or the group manager when you are building or modifying a video terminal, or when you need general information on video or graphic architectural techniques.

The *Base Video* team, headed by Jerry Bourque (ML1-2/H26, 223-3295), is responsible for the design and development of interactive video display terminals.

The *Advanced Terminals* team, headed by Don Haney (ML1-2/H26, 223-9243), is responsible for developing new techniques, architectures, and applications of technology for future video terminal products.

The *Graphics Terminals* team, headed by John Elsbree (ML1-2/H26, 231-6939), is responsible for video-based graphics devices that include graphic terminals, graphic architecture, and ancillary devices.

The *Video Support* group, headed by Jerry Bourque (ML1-2/H26, 223-3295), supports the VK100 and corporate terminals, including the VT100, VT100 derivatives, and PDT11-110/130. They help Manufacturing, Marketing, and Customer Services resolve production and customer problems, improve quality and yields, and reduce costs.

9.4 PRODUCT ASSURANCE

Manager: Joe DeMarinis (ML1-2/H26, 223-5687)

This group supports development projects and some terminals in production. They provide technical assistance, engineering change order (ECO) coordination, engineering documentation, design services, and engineering pre-release product testing.

Product Assurance, headed by Joe Bitto (ML1-2/H26, 223-5521), provides technical assistance and product testing for all Terminals Engineering product development projects, to verify function, reliability, and compliance with product specifications, Digital standards, and external regulatory requirements.

Power Supply Engineering, headed by Art Parker (ML8-4/E86, 223-2146), designs and tests power supplies for Terminals Engineering, Computing Terminals, and Small Systems Engineering.

9.5 FIRMWARE DEVELOPMENT

Manager: John Wagner (ML1-2/H26, 223-7274)

This group designs, implements, documents and validates the firmware used in the products developed by Terminals Engineering. They specialize in firmware application and development skills, particularly in the areas of video devices, keyboards, and hard copy terminals.

They are also responsible for 16-bit diagnostic assistance, special tools, diagnostic release, PDP/LSI-11 tools, and DECX maintenance.

9.6 MECHANICAL DESIGN/DESIGN SERVICES

Manager: Dick Gonzales (ML6B-2/E66, 223-4832)

This group provides mechanical engineering support in the development of 16-bit and terminal products. They also provide printed circuit design services for these products and offer their services for non-standard product development throughout Digital.

Group members stay abreast of new design techniques that may facilitate new product development. They engage in advanced development of electromechanical devices, packaging techniques, and plastics technology and application.

10 COMPUTING TERMINAL (CT) PROGRAM

Manager: Avram Miller (ML5-2/T53, 223-9441)

The Computing Terminal (CT) Program is responsible for managing all aspects of the planning, development, manufacturing, and service of Digital's tabletop computer products. The managers responsible for the various elements of the program are listed below.

Hardware Development	Art Williams (ML5-2/T53, 223-3954)
Software Development	Ron Ham (ML12-3/A62, 223-3740)
Manufacturing	Vah Erdekian (ML5-2/T53, 223-1393)
Product Management	Ed Lazar (ML4-3/T64, 223-8927)
Customer Services	Darrel Bates (ML5-2/T53, 223-2763)
Product Assurance	Al Shimer (ML5-2/T53, 223-1394)
Operations and Control	Bob Sanfacon (ML4-3/T64, 223-8662)

11 EUROPEAN ENGINEERING

Manager: Jim Wade (Geneva, Switzerland: GE, E3102, [41]-(22)-933311)

European Engineering consists of the Central Engineering activities that take place in the European area. The group is responsible for product development and planning.

11.1 PRODUCT DEVELOPMENT

Basing Central Engineering product development activities in Europe helps Digital to design and implement products specific to European area needs, to draw on a pool of engineering talent that is not otherwise available to us, and to demonstrate a full local "presence". That capability is sustained by allocating mainstream corporate (worldwide) projects to European Engineering's Product Development groups.

11.1.1 European Software Engineering

Manager: Dick Davies(Reading, UK: RY, [44]-(734)-868711)

European Software Engineering (ESE) develops a variety of software products. They focus on commercial applications and distributed systems. In addition to software engineers, the group has full support services from technical writers, quality engineers, and a hardware administration group.

Contact ESE when you need information about products they are developing or planning.

11.1.2 European Distributed Systems Hardware Engineering

Manager: Bob Suarez (Reading, UK: RY, [44]-(734)-868711)

European Distributed Systems Hardware Engineering extends the Distributed Systems software capability in Reading to provide a total comms/nets product development center. Initial products include terminal modem options and a Q-bus 8-line multiplexer.

11.2 PRODUCT PLANNING

Product Planning is concerned with planning future products that take into account specific European requirements. The group is involved in any product area that demands special European considerations, regardless of where the product is developed. Emphasis is placed on their need to be involved early in product development cycles. Engineers should bear this in mind when contacting the appropriate Product Planning group. Product Planning includes the following organizations:

11.2.1 Safety/Environmental Regulations

Manager: Jan Scherpenhuizen (Geneva, Switzerland: GE, D3304, [41]-(22)-933311)

European area products are affected by a variety of special technical requirements. Some are legislative; some are driven, for example, by trade union pressures. The Safety/Environmental Regulations group ensures that these requirements are clearly documented and available as early as possible to engineers and product managers. Wherever possible, they make information available through established engineering channels, like Standards and Hardware Design Assurance (see Chapter 6 on Engineering Support Groups).

This group is also responsible for European implementation of the Corporate Product Safety program, involving coordination of all field, manufacturing, and engineering activities.

11.2.2 Telecommunications Regulations

Manager: Robert Boers (Geneva, Switzerland:GE, E3310, [41]-(22)-933311)

Like Safety/Environmental Regulations, the Telecommunications Regulations group ensures that clear and up-to-date information on European technical requirements is available to engineers and product managers. They specialize in the requirements imposed by the telecommunications facilities and organizations in Europe.

11.2.3 Commercial Product Planning

Manager: Ron Schuler (Geneva, Switzerland: GE, E3312, [41]-(22)-933311)

Commercial Product Planning ensures that the market needs of the European area are part of the long-range product planning activities of the Commercial Engineering Group. Working closely with the European representatives of the Commercial Product Lines, the group prepares market and product requirements statements, including appropriate business impact figures.

11.2.4 Distributed Systems Product Planning

Manager: Franco Malerba (Geneva, Switzerland:GE, E3104, [41]-(22)-933311)

Like Commercial Product Planning, this group ensures that corporate strategies take European market needs into account. Distributed Systems Product Planning specializes in the application of Digital's future communications and networks products to Europe.

11.3 US COORDINATION

Manager: Bryan Fifield (ML11-3/H19, 223-9620)

European Engineering maintains a permanent representative in the Mill. US Coordination plays a key role, enabling engineers and product managers to interact on a day-to-day basis on international product matters.

CHAPTER 6

ENGINEERING SUPPORT GROUPS

1 TECHNICAL OPERATIONS
Manager: John Holman (ML12-2/T36, 223-5533)

1.1 PRODUCT DESIGN ASSURANCE
Manager: Bruce Smith (ML3-4/E67, 223-6740)

1.1.1 Systems Evaluation Engineering
Manager: John Larkin (ML3-4/E67, 223-5230)

Systems Evaluation Engineering (SEE) provides specialized testing, tools, and consultation services for Digital's product lines, engineering and manufacturing groups, and Field Service organizations. SEE's testing relates to the operation of computer systems, their components and interaction. Hardware and software tools enable the performance of tests that provide the metrics for systems analysis. SEE's consultation services provide system-level expertise and facilities for system test and validation throughout all phases of product life.

Systems Evaluation Engineering's test plans, tools, and reports provide verification and validation information for various approval bodies within Digital. This data is used for risk assessment analysis for the overall improvement of our products.

Systems Evaluation Engineering has all the computer laboratory facilities, tools, and staff needed to provide you with test plans, tools, test configurations, and reports. Contact them early in the development cycle, to ensure that plans and personnel will be available. For a complete information package, contact SEE at 223-2139.

1.1.2 System Parameter Testing
Manager: Bruce Smith (ML3-4/E67, 223-6740)

This specialized team of test engineers works on improving the Engineering release testing process to reduce integration problems and new product start-up costs in System Manfacturing. Team members develop models to analyze, evaluate and resolve test process problems. They support selected product-

specific efforts that serve as "test beds" for process improvements. In addition, they modify existing and proposed specifications and standards to more accurately reflect test requirements. The team also provides testing consultation for Engineering and Manufacturing groups.

1.1.3 Hardware Design Assurance

Manager: Dick Amann (ML11-3/H19, 223-9837)

This group's primary function is to ensure that there exists within Digital the necessary tools, standards, and organizational processes to enable Digital's products to fit into the marketplace relative to hardware-oriented regulations, standards, and compatibility.

The group's strategy includes driving functions which are necessary for adequate Hardware Design Assurance. These functions are organized either within or external to the group, or depending on the most sensible strategy. The group presently has the nucleus of EMI, International Regulations, and hardware standards. These activities will gradually be decentralized to groups in which they can be more effective.

Most of the group's activities are provided on a a pay-as-you-go basis. Some of the services previously provided at no cost will be charged for where appropriate. Central funding will be limited to corporate cross-product activities, and seed money to start new activities. All central funding is spent in the group's cost center with the exception of Product Safety funding. This funding is allocated to the Corporate Product Safety group for safety service to Central Engineering.

The group provides consultation on design problems in the EMC area. They integrate Engineering, Marketing, Manufacturing, and Field Service efforts relative to EMC, and determine what quality assurance programs are needed in manufacturing to guarantee consistent EMC characteristics in Digital's products. EMC testing services are also provided. They place special emphasis on identifying the radiated emission characteristics of Digital's products and ensuring compliance to FCC and VDE regulations.

1.1.3.1 International Regulations

Manager: Dick Amann (ML11-3/H19, 223-9837)

The primary function of this group is to ensure that Digital's products comply with general international regulations. The group monitors regulations, developing and guiding corporate strategy for compliance. They coordinate the efforts of Engineering, Manufacturing, Marketing, and Field Service in meeting regulatory requirements.

This group also provides Digital with an overview of international marketing needs relative to product design and testing. They assess risk and return-on-investment results, making recommendations on issues that concern hardware conformance to these marketing requirements.

You may consult with group members to help you identify reasonable goals in your product design. They can also help you with the implementation of DEC STD 060, *Design and Certification of Hardware Products to National and International Regulations and Standards*, for which the group is responsible. They can help with implementation of DEC STD 062, *Submittal of Hardware Products to National and International Agencies*, which describes all the external agencies to which Digital's products must be submitted.

1.2 INDUSTRIAL DESIGN

Manager: Dick Schneider (HL2-3/J11, 225-6050)

The Industrial Design group develops and maintains product aesthetic designs that have broad applications. Services of this group encompass related aspects of aesthetics, human factors, product recognition, and product-related graphics.

Group Objectives

Aesthetic

- To develop a distinctive and attractive appearance that denotes a high-quality product appropriate to the end-user environment
- To establish and maintain a strong physical resemblance among products throughout the product lines

Human Factors

- To ensure that products for the user are easy to understand
- To ensure that products are convenient, comfortable, and safe to use
- To ensure that the user-product relationship is efficient

Product Recognition

- To ensure that the basic configuration of a product relates well to other products in structure, materials, finish, and physical and mechanical attributes

Product-Related Graphics

- To design and develop product identification graphics such as logos, labels, nameplates, control graphics, and packaging graphics, with attention to the selection and control of color

Industrial Design can furnish you with human factor analyses. They can also help you develop instructional material for non-technical users. Members of the group generate mock-ups, models, and prototypes. They design artwork, documentation, and specifications for all forms of purchased labels, including Class 36 labels.

Contact Industrial Design during the concept phase of user-visible products. They need enough time to study and understand your needs and to relate your product to other Digital products.

1.3 TECHNICAL INFORMATION MANAGEMENT

Manager: Warren Moncsko (ML4-4/T40, 223-4080)

Technical Information Management is the technical controller of engineering information about product and process description and performance. They maintain the quality and security of this information, and develop new methods to provide it to Engineering. The goal of Information Management is for an engineer or other user to be able to access this information so as to speed and ease the making of good technical and business decisions.

1.3.1 Technical Information Process
Manager: Diane Stewart (ML4-2/E90, 223-3025)

This group works on improving the technical information available to engineers through measurement and analysis of technical information needs and of the engineering process.

1.3.1.1 Engineering Metrics
Supervisor: Bill Sutherland, acting (ML4-2/E90, 223-2051)

Engineering Metrics develops and operates the internal Digital systems that measure aspects of engineering design. They work with users to develop, report, and analyze design data. Another focus is design process scheduling, forecasting, and simulation.

Contact these project leaders for more information in their areas:

Metrics development:	Bill Sutherland, 223-2051
Metrics analysis:	Maria Ziminsky, 223-7481
Metrics simulation:	Cynthia Staszko, 223-9504

1.3.1.2 Engineering Information Process Management
Supervisor: Nancy Moore Surrette (ML4-2/E90, 223-3171)

Engineering Information Process Management includes these four major projects:

Engineering Change Order (ECO) Process (Pat Walton, 223-7610) This project's focus is to analyse, define, maintain, and develop Digital's ECO processes, with the ultimate aim of automating them.

Document Control File/Paperless Engineering Documentation System (DCF/PEDS) (Susan McElroy, 223-8082) This project is enhancing the Document Control File (DCF) to shift the current emphasis on document status to a focus on descriptive part information. Information can be correlated, referenced, and linked to other systems, which will facilitate decision making and pave the way towards the Paperless Engineering Documentation System (PEDS) of the future.

Revision Management (Bill Buck, 223-9053) DEC STD 012, *Unified Numbering Code: Policy on Part and Document Identification Conventions*, establishes guidelines for revision control within Digital. The Revision Management project involves the adoption of DEC STD 012, Section 0, and assistance in its implementation. The Revision Management project specifies tools needed to integrate the policies of DEC STD 012, Section 0, into the required information systems.

CAD Library Development (Don Call, 223-5871) This project deals with short-term CAD (computer-aided design) library issues, plans strategy for meeting future CAD tool needs, and researches how CAD tool data may be transported between sites with consistency.

1.3.1.3 Engineering Design Information Process
Supervisor: Dick Bubnel (ML4-2/E90, 223-8081)

Engineering Design Information Process defines, documents, and analyzes printed circuit board and mechanical design process and related issues. They aim to speed design development by documenting process flow, establishing release criteria, gathering metrics information, and analyzing processes from a business viewpoint.

Printed Circuit Process Issues (Dick Bubnel, 223-8081) This project seeks to standardize the printed circuit prototyping process and the producibility checklist. They examine processes including silk-screen, logic design, and release coordination, and analyze supporting documentation.

MECAD Process (Jim Travers, 223-3346) Some of this group's issues are the mechanical design release process, the MECAD (mechanical CAD) release process, the Unigraphics user listing, the Unigraphics-to-COM and KPL process, and file naming conventions.

1.3.1.4 Technical Information Operations
Supervisor: John Holt (ML4-2/E90, 223-2455)

The major tasks of Technical Information Operations are the Unit Charge Administration and the CAD Library Operations.

Unit Charge Administration maintains the Unit Charge system, a financial billing system used by project managers and others to track spending by specific projects and tasks. Unit Charge is a powerful financial forecasting tool for understanding present and future business requirements. Contact Susan Hale, 223-5742, for additional information and requests for system use.

CAD Library Operations maintains and supports the various libraries associated with CAD systems used by Engineering and Engineering Services. They receive, generate, check, and distribute library data on new product design, while ensuring that data is consistent and transportable.

Physical Shape Library	Tom Witowski, 223-4242
Assembly Library	Brad Chapin, 223-4185
Schematic Symbol Library	Tom Witowski, 223-4242
Special Features Library	Jerry Best, 223-6604

Technical Information Operations also assigns blocks of part numbers and updates part number data on the Master Parts File. They support metrics development of data input and report generation.

1.3.2 Technical Systems Management
Manager: Carolyn Rodriguez (ML3-6/H27, 223-9087)

Technical Systems Management manages the operational systems required by Engineering to satisfy their technical information needs. One of the most important of these systems is the Engineering Product Library System (EPLS). EPLS is a central source of information about Digital's products. Using a computerized data base, EPLS collects, stores, and retrieves information.

EPLS contains more information on more part numbers than any other data base in the company. The EPLS Master Parts File has nearly all of the part numbers assigned anywhere in the company, with the deliberate exception of those numbers assigned and used exclusively within a single Manufacturing plant. More than 40 specific pieces of data are available for each part number, using on-line data retrieval and batch services.

EPLS also stores information on structured relationships for all parts. For any part number, EPLS can list all of the parts that go into it (the Bill of Materials) and all of the parts it goes into (the Used-On Listing), through various on-line commands and appropriate batch reports. Both Engineering and Manufacturing Bills of Material are included in EPLS.

Management of information for EPLS is illustrated by the flowchart in Figure 6-1. EPLS collects data from such groups as Engineering Services, Specification Control Systems, manufacturing plants, and the Office of the Chief Engineer. The data consists of such items as the Master Parts File (MPF), engineering parts lists, option module lists, the DEC Standard price list, Bills of Material (BOM), and Mean-Time-Between-Failure (MTBF) rate predictions. The data is then supplied to any group requesting information about Digital's products. Such groups include Engineering, Field Service, Sales, Revenue Accounting, Corporate Planning, Manufacturing, and others.

The EPLS Hotline, 223-6430, provides a communications channel for everything from casual inquiries to emergencies. Analysts are available to either respond to user needs immediately, or to pass along comments to the appropriate person. Please use the Hotline to find out more about EPLS.

1.3.3 Technical Systems Development

Manager: Len Beyersdorfer (ML3-6/H27, 223-2542)

This group provides system analyses and design, applications software develoment, and consultation to help make product information available throughout Digital. This information is disseminated primarily through the Engineering Product Library System (EPLS). See 1.3.2 of this chapter for more information on EPLS.

1.3.4 Diagnostic Operations

Manager: Warren Moncsko, acting (ML21-3/T40, 223-4080)

Diagnostic Operations has a dual role. The first role is the functional management of diagnostic engineering, through chairing the Diagnostic Engineering Managers Committee (DEMC). DEMC includes representatives from Central and Product Line Engineering, Marketing, Customer Services, and Manufacturing. The committee is a forum for the discussion and approval of architectual, strategic, and operational diagnostic issues from a systems point of view.

Diagnostic Operations also manages the development of PDP-11 and VAX-11 diagnostics as a system product, in response to the demand from our customers. Our customers have defined the issues as packaging, documentation, and the feedback mechanism. Diagnostic Operations measures its success in the degree of cooperative work toward the implementation of responsive diagnostic products by other organizations.

1.3.5 Office of the Chief Engineer

Managers: Dick Best (ML3-3/H14, 223-2273)
Carl Noelcke (ML3-3/H14, 223-6208)

The Chief Engineer's primary functions are controlling the option module numbering system, processing MTBF (Mean-Time-Between- Failure) data, furnishing specialized or historical data about options and modules, and administering Design Reviews.

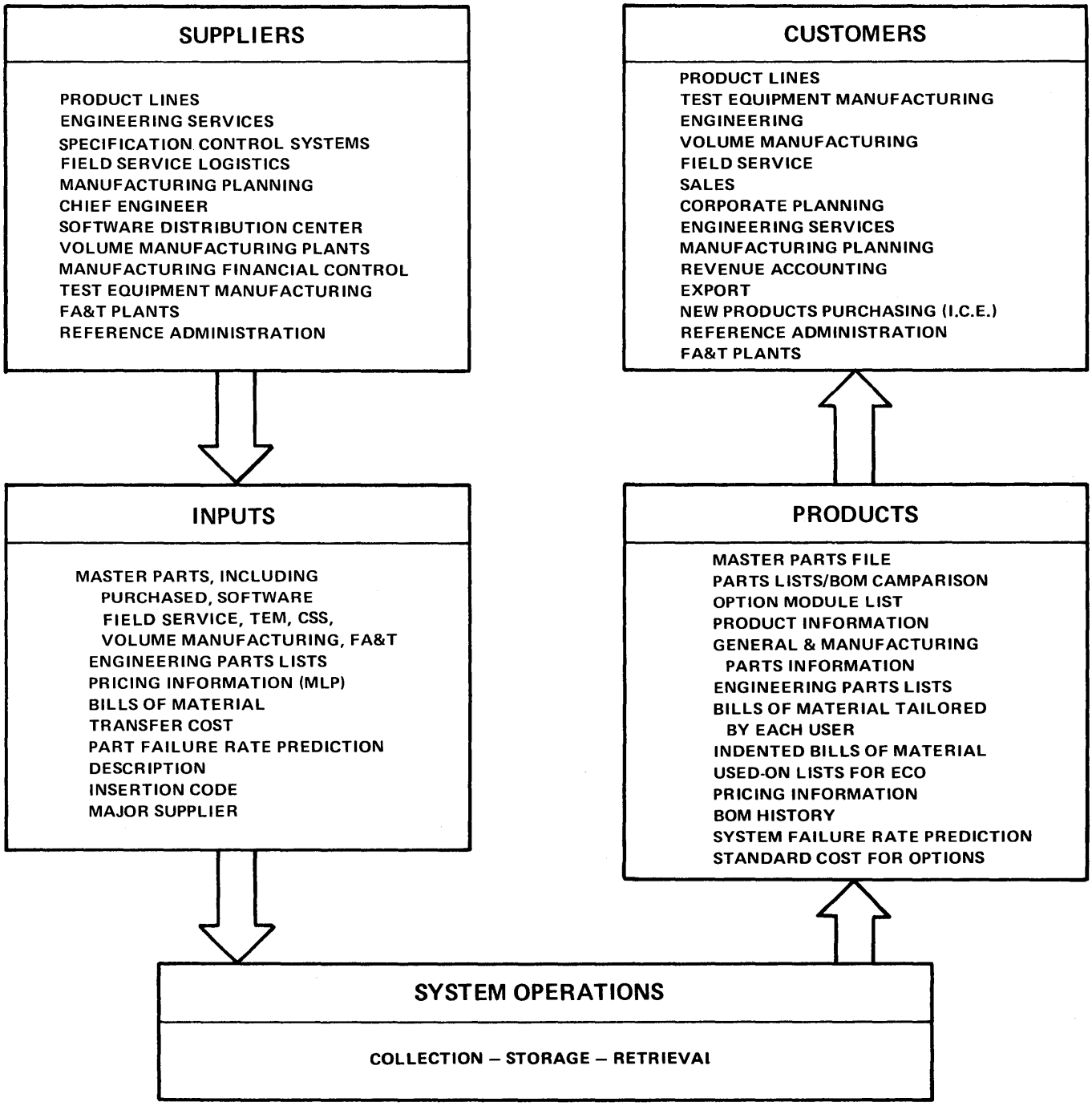

Figure 6-1. EPLS Operations

Responsibilities of the Chief Engineer, Dick Best

- Assigns model numbers and adds them to the Option Module File in EPLS (Engineering Product Library System) along with a description, what it is used on, product category code, voltage code, status, and responsible people

- Maintains integrity of Option Module File by publishing owners' reports for each responsible person (Engineering Manager, Design Engineer, Product Manager, Field Service Manager, Manufacturing Representative, Major Supplier Stockroom Manager) shown on the Option Module File on a quarterly basis and resolving discrepancies in the data

- Provides data to the Master Part File, Corporate Price File, Manufacturing Hi-BOM File, Product Forecasting System, ECO Control, and Drafting

- Approves Printed Circuit Work Requests

- Approves nomenclature and assigns government code for exporting on DEC Standard Price List Maintenance Forms

- Publishes Option Module List (monthly and quarterly)

- Publishes monthly Engineering Newsletter containing technical data and systems and procedures that affect Engineering and Manufacturing personnel

- Provides technical and engineering consultation

- Member of Engineering Review Board, Engineering Committee, and Patent Committee

Responsibilities of Carl Noelcke

- Administers Design Reviews

  (Each product development project that has been assigned a Discrete Project Number and has a well defined completion point is subject to the Design Review Process)

- Receives Design Review plans from Project Engineer and arranges to have Project Engineer present plan to Engineering Committee for approval

- Acts as Secretary of Engineering Committee

  - arranges agenda
  - writes and distributes minutes
  - signs off Digital Standards

- Maintains Reliability Prediction System

- Represents Engineering on Product Safety Committee

Referenced Material

Digital Standards:

DEC STD 007 - *Design Review Process*

DEC STD 008 - *Project Scheduling System*

DEC STD 012 - *Unified Numbering Code*

DEC STD 139 - *Reliability Prediction*

1.4 ENGINEERING SUPPORT OPERATIONS

Manager: Dick Reilly (ML4-4/E99, 223-2982)

Engineering Support Operations has systems and procedures for the creation, control, maintenance, and distribution of part and option information. The organization operates some of these systems and procedures, and monitors most. Groups include Engineering Technical Training, Standards and Methods Control, and Engineering Computer Services. Engineering Information is also responsible for the functional management of all Engineering Services sites.

1.4.1 Standards and Methods Control

Manager: Joe Kurta (ML4-4/E99, 223-8895)

Standards and Methods Control writes and publishes Digital Standards. They administer and support the creation and dissemination of engineering, manufacturing, and other corporate information. Such information includes Digital Standards, A-SP-7665XXX manufacturing specifications, various in-house manuals, and test methods.

Digital Standards are corporate standards. Simply defined, a Digital Standard is a documented agreement among those in the company who have substantial interest in a topic as to how they will handle that topic when it comes up frequently enought to be bothersome. Digital Standards lay out a preplanned course of action to prevent troubles and waste. They reduce costs, reduce development time, promote safety, increase productivity, and foster communication among many organizations. Some Digital Standards establish policy, others state requirements; some describe procedures for performing a task, while others simply provide guidelines.

Areas covered by Digital Standards include Design, Drafting, Hardware Design Assurance, Software and Architecture, Product and Program Management, Manufacturing (workmanship), and others.

Manufacturing-related specifications (7665 series) define internal policies and procedures needed for establishing and maintaining quality control in the manufacturing environment. These specifications cover a variety of topics, from incoming inspection to vendor evaluation, from unit testing and acceptance to automatic component insertion.

Standards and Methods Control also writes and publishes a variety of in-house manuals. Some recently released manuals include *Electrical Design Guide for Printed Circuits*, *Applicon Hybrid Design Manual*, *SUDS Training Manual*, and the *EPLS (Engineering Product Library System) User's Manual.*

Where do you look to see if there are Digital Standards that apply to your area of work? The first place to look is the *EL & 7665 Index*. This index lists, in alphabetical order, over 2,500 entries on subjects ranging from acoustic noise to Zehntel testers. In addition to references to over 200 Digital Standards, the Index also lists the names and order numbers of available manuals. Finally, the Index references over 300 manufacturing specifications (7665 series). One immediate goal is to put the Index on-line so that it can be accessed by computer. In the meantime, you can obtain a copy of the *EL & 7665 Index* by contacting Digital Standards Administration, ML3-2/E56, 223-9475. All of the documents listed in the index are available from Digital Standards Administration.

There is a slight charge for all hardcopy documents. The Index, Digital Standards and 7665-series specifications on microfiche, as well as copies of standards under review, are free.

If your group has established or is establishing policy, requirements, guidelines, or procedures, and you are considering turning these documents into standards, contact Joe Kurta of Standards and Methods Control. The group can help your documents gain the visibility they need through their distribution network. Not only does the group offer writing, editing, and publishing services, they also provide illustrating, administration, and distribution services.

1.4.2 Maynard Engineering Computer Services

Manager: Jim Merksamer (ML1-1/E24, 223-9552)

Maynard Engineering Computer Services provides medium and large system data processing support for Digital's engineering organizations in Maynard. They manage the computer-related assets for Maynard CAD (Computer-aided design) systems and general timesharing systems. Engineering Computer Services has four functional subgroups: CADnet Operations, General Timesharing Operations, System Software Support, and Order Processing.

1.4.2.1 CADnet Operations

Manager: Bob Conlon (ML1-1/E24, 223-3630)

This group provides resource management for Maynard Mill computing systems, primarily involved with computer-aided design (CAD). These systems are also used for general applications in a timesharing environment. Equipment in the CADnet Operations laboratory on ML1-1 includes three KL10 mainframes and a VAX-11/780. The group provides full operations support 24 hours a day, five days a week, as well as weekend on-call coverage.

1.4.2.2 General Timesharing Operations

Manager: Jose Colon (ML4-4/H30, 223-7747)
Operations Supervisor: John Donahue (ML4-4/H30, 223-2880)

This group provides general-purpose timesharing support to Maynard engineering groups, and the Engineering Product Library System (EPLS). The group uses a DECsystem-10 running TOPS-10 and a DECSYSTEM-2060 running TOPS-20. They can provide you with access to the Engineering, Manufacturing, and CAD networks.

You can arrange to use these resources by contacting the people listed above, or your manager can direct you to the appropriate Engineering computer facility for your use. There are many located at various sites throughout Digital. The contact person at each site can give you access to the equipment. He or she can also give you an account number, tell you how to schedule machine time, how to report a machine malfunction, and how to get it repaired.

1.4.2.3 Systems Software Support
Manager: Bob Conlon (ML1-1/E24, 223-3630)

This group provides operation system and network software support for Engineering Computer Services. Kinds of support include analysis of resource performance and consumption metrics, software planning, commodity billing, and general user support. They also provide applications development for Technical Operations.

1.4.2.4 Order Processing/Capital Administration
Supervisor: Barbara Donahue (ML4-4/H30, 223-9375)

This group provides services to assist in the planning, forecasting, budgeting and ordering of capital equipment for many of the different organizations located in the Maynard Mill.

1.4.3 Engineering Services
Functional Manager: Dick Reilly (ML4-4/E99, 223-2982)

Engineering Services provides tools and procedures to convert conceptual and logical engineering data into physical designs. The designs are then turned over to Manufacturing. They provide both computer-aided design and manual design services, including development, documentation, and release support.

The *Engineering Data Services* group provides design data protection and preservation. They maintain the document control file (DCF), document enhancement, archives, reprographics, micrographics (source filming and computer output microfilm), and distribution of media.

The *Engineering Design Library* is a central information source for the protection, preservation, archiving, and transportation of engineering drawings.

Engineering Reprographics provides engineering data reproduction services. This includes hard copy regeneration, microfilm blow-back, and document enhancements. They also provide volume printing of engineering documentation to the Software Distribution Center and mail-in orders.

Engineering Micrographics microfilms new and revised Engineering drawings using 35mm film, which is then mounted onto aperture cards. Duplicate diazo aperture cards are produced from silver negative cards and distributed to over 30 Digital facilities to create and update Engineering documentation aperture card files. To support the field maintenance print set business, photographic enlargements made from silver negative aperture cards are available upon request.

Engineering Services' sites are located throughout the world. However, not all sites presently offer a complete range of services. For a complete listing of all Engineering sites, see Engineering Services in the Digital Telephone Directory.

1.4.4 Model Shop Services (Maynard)

Manager: George Gerelds (ML5-3/E22, 223-2309)

Four groups provide a range of Model Shop services for any one who needs them. The *Stockroom* supplies component parts for your design. The *Mechanical Prototype Shop* fabricates metal, plastic, and wood units. The *Prototype Assembly Shop* assembles prototype modules and subassemblies. The *Production Model Shop* is concerned with model assembly. The specific functions of these groups are outlined in the paragraphs which follow.

Engineering Stockrooms

The various stockrooms stock company-preferred components to avoid the incorporation of obsolete or non-preferred parts into new designs.

Component requirements for a project should be submitted to the appropriate stockroom early enough so that a vendor's delivery schedule will not delay your project. You must supply the stockroom with a parts list showing Digital part numbers (see DEC STD 012, Section 2, *Inventory Class Codes*). You must also supply an engineering charge number and fill out a work order form. Stockrooms will purchase components from vendors, and assemble kits in reasonable quantities. A good rule of thumb is to submit your parts lists just before submitting your new design to the Design Services group.

The Maynard Stockroom (#63) stocks components for prototypes and production models. It also expedites components and software supplies from other stockrooms. Stockroom #63 does not expedite LSI (Large Scale Integration) parts.

Table 6-1 Engineering Stockrooms

Location	*Number*	*Contact/DTN*
ML5-3	#63	Barbara Savoy, 223-3775
MR1-2	#13	Sharon Lindsay, 231-6763
TW	#348	Bill McMahon, 247-2869
ML1-3	#132	Sue Goff, 223-3285
MK1-1	#393	Ben Pakus, 264-7273

Mechanical Prototype Shop: Supervisor: Ed Mayall (ML1-1/E22, 223-2583)

This group fabricates sheet metal, machined plastic, and wood. It also provides machine shop services such as milling, grinding, lathe work, and heat treatments.

The group usually requires two to three days to provide you with a finished prototype, depending on complexity of your design and on the current work load. You must supply the group with sketches or blueprints. You may give verbal instructions, too, but written instructions are better. Because the prototype process often requires several passes, do not order more prototype units than you need.

Prototype Assembly Shop: Supervisor: Helen Grimes (ML5-3/E22, 223-3022)

This group assembles prototype modules, small subassemblies, wirewrap assemblies, printed circuit boards, cable harnesses, and other equipment. Not limited to providing prototypes, the group provides assistance in small-lot production jobs which cannot be handled cost-effectively in Manufacturing. The group will also do breadboarding for you, check for errors in documentation, and advise you on the volume producibility of your prototype.

The group's assembly charges are based on the number of module components and are competitive with outside vendors. You may contact the Prototype Assembly Shop on an informal basis, that is, you may walk in and describe what you want without having to submit formal documentation. Contact the group in the planning stage of your project.

Production Model Shop: Supervisor: Brad Sparkes (ML5-3/E22, 223-3255)

The Production Model Shop builds printed circuit board models and subassembly models (for example, power supplies, power controls, cable assemblies) on request for Manufacturing to compare with production units. The group also generates hand testers for low-volume items, or for items that are not tested on automated module test (AMT), computerized module test (CMT), or standard test equipment.

In addition to building models, the Production Model Shop performs odd jobs that range from building wirewrap boards and cable harnesses to assembling show mock-ups and filling low-volume customer orders. Group members will perform a quality control check on any item upon request.

If you want to use the group's services, you must provide some kind of documentation from which group members can work. Jobs for Digital customers require formal documentation. For other jobs, any documentation will suffice provided it is legible and easy to understand.

When you want ROMs or PROMs blasted, you must supply them, as well as a punched tape or programmed ROM/PROM.

1.4.5 Engineering Technical Training

Manager: Al Pepper (ML4-4/99, 223-8083)

The Engineering Technical Training group provides information, training, and services that will result in a more effective hardware development and design process. They provide state-of-the-art CAD (computer-aided design) tool training in the IDEA and SUDS programs, to meet product development design needs. Acting as a clearinghouse, they identify, develop, and deliver the resources needed to meet a wide range of Engineering's needs in relation to current and future Digital goals.

Computer-Aided Design Training Courses: Engineering Technical Training offers training courses and consulting in SUDS (Stanford University Design Systems) and in IDEA (Interactive Design Engineering and Automation). Norm Rheault (ML4-2/E90, 223-8789) is the SUDS trainer, and Pat Barry (ML4-2/E90, 223-6167) is the IDEA Trainer. Moe Marchand (ML4-2/E90, 223-5235) is trainer for both IDEA and SUDS.

Process Course Development: This function, headed by Don DiMatteo (ML4-2/E90, 223-2438), aids in enhancing the CAD Tool Training program. They develop CAD-related courses, such as the Printed Circuit Design Course and the TOPS-20 User Course.

Training Coordinator (Joy Tucker, ML4-2/E90, 223-9710): The Training Coordinator administers such aspects of the training programs as course enrollment and scheduling, and acts as a resource for internal and external training information.

For more information on CAD training courses, contact Joy Tucker, 223-9710.

1.5 FCC COMPLIANCE PROGRAM

Manager: Dave Brown (ML11-3/T13, 223-2270)

By June 1980, the Federal Communications Commission (FCC) had established requirements for allowable limits on conducted and radiated radio-frequency emission levels for computing equiment, along with dates by which such products must comply. Most of Digital's products are affected by the rulings. The FCC Compliance Program was established to enable Digital to meet these emission requirements.

The FCC set three implementation dates for their rulings:

- By 1 January 1981, all non-exempt products must be labeled with their compliance status.
- By 1 October 1981, products first introduced into production must comply with emission standards.
- By 1 October 1983, all products being manufactured must comply with emission standards.

The FCC Compliance Program has established a labeling process for all equipment, test facilities and scheduling management, and coordinates the FCC program to enable a minimum disruption of engineering and other activities. DEC STD 103, *Electromagnetic Compatibility Hardware Design Requirements*, currently under development, is an important engineering resource. The following are some specific program tasks:

- Construct and operate test sites needed to support FCC conducted and radiated verification tests
- Construct and maintain schedules to ensure efficient use of test facilities
- Develop testing procedures, guidelines, and requirements to ensure rigorous product testing and data collection
- Publish policy memoranda and interpretations of regulations; disseminate technical solutions to avoid redundant design efforts
- Direct the FCC program team, including representatives from throughout Digital; establish task forces as needed to address specific issues
- Provide project management for centralized re-engineering tasks (cables, cabinets) and software to support compliance

Product managers must ensure product compliance at all levels. Each product development group and product line is responsible for its own products. The FCC team is *only* a resource to assist in achieving compliance.

FCC Program Organization

Dave Brown ML11-3/T13, 223-2270	Program Manager; EMC Domain Manager
Mike Cox ML11-3/T13, 223-8005	Test Scheduling Manager: Manages test scheduling for FCC Program-operated test sites. Generates and manages product test logistics.
John Pratt ML11-3/T13, 223-8261	Operations/Project Manager: Operates test sites, brings new sites on line. Project manager for program-funded engineering tasks.
Peter Boers ML11-3/H19, 223-5452	Electromagnetic Compatability Engineering (see Section 1.5.1 of this chapter)
Les Grodberg MS/F19, 223-5740	Corporate Legal Department

1.5.1 Corporate EMI/RFI

Manager: Peter Boers (ML11-3/H19, 223-5452)

This group provides technical expertise for the FCC Compliance Program. They ensure that Digital's products meet international requirements for electromagnetic compatibility (EMC). To do this, the group monitors EMC regulations and tries to influence them through membership in industrial organizations that deal with EMC. Members develop guidelines and standards to guide corporate strategy in complying with EMC regulations.

The group provides consultation on design problems in the EMC area. They integrate Engineering, Marketing, Manufacturing, and Field Service efforts relative to EMC, and determine what quality assurance programs are needed in manufacturing to guarantee consistent EMC characteristics in Digital's products. EMC testing services are also provided. They place special emphasis on identifying the radiated emission characteristics of Digital's products and ensuring compliance to FCC and VDE regulations.

1.6 CORPORATE PRODUCT SAFETY

Manager: Carlton Davenport (PK3-2/H10, 223-7628)

Corporate Product Safety ensures that all hardware products meet the requirements of DEC STD 119, *Digital Product Safety*, and DEC STD 060, *Design and Certification of Hardware Products to National and International Regulations and Standards.*

All applicable products must be UL Listed or Recognized, be Product or Category certified by the Canadian Standards Association (CSA), and comply with International Electrotechnical Commission (IEC) 435. Furthermore, for products marketed in Germany, the appropriate VDE requirements must be met.

Listing, Recognition, and Certifications are always obtained through the Product Safety Group. You should subject your product to Product Safety Reviews at the conceptual (Phase 0), breadboard, and prototype stages, to establish applicability. The group will consult with the engineer on Product Safety design requirements, review and test the product for compliance with Digital Standards, and obtain all UL Listings, CSA Certifications and similar test house approvals. You will be required to supply Product Safety with product specifications, documentation, and samples for testing.

The Product Safety Group also investigates all potential product safety problems. You are required to support all such investigations regarding your product until all problems are solved.

Corporate Product Safety also supports Manufacturing over the life of a product, to ensure that a product continues to be safe, to meet applicable regulations, and to maintain test house certification.

2 EXTERNAL RESOURCES

Manager: Henry Crouse (ML1-5/B98, 223-2610)

External Resources handles all of the purchasing and distribution needs of Digital. This runs the gamut from sourcing raw materials and parts to distributing and shipping final products. Groups described here include Corporate Purchasing, Corporate Distribution, and Technical External Resources.

2.1 CORPORATE PURCHASING

Manager: Jack Batten (ML1-5/B98, 223-3238)

Corporate Purchasing assures supply, competitive cost, and timely delivery of optimum quality materials and services. They coordinate the development of suppliers and make sure that Digital presents one part number, one standard cost, and one face to the suppliers.

Corporate Purchasing also influences strategic business decisions. They participate in the selection of vendors and materials to meet product, design, manufacturing, and administrative goals. The organization also supports Field Service and Marketing, and ensures a formal make-or-buy decision process at all levels in Digital. Whenever practical, actual buying is decentralized to Purchasing groups linked to major Digital organizations. Corporate Purchasing conducts formal training programs and provides guidance on purchasing strategy, policies, and systems. For further information, contact Barbara Birt, ML1-5/B98, 223-2624 or 223-3124.

2.1.1 Engineering/New Products Purchasing

Manager: Tom Cavanaugh (ML21-1/T31, 223-4204)

The group serves the Northeastern engineering community with these distinct services: Tactical Support Purchasing, Project Purchasing, Project Materials Management, Software Purchasing, and Consulting Acquisitions.

Tactical Support Purchasing services Engineering's everyday parts and equipment needs. These include inventory parts for breadboards and prototypes, new items, and out-of-stock items. They handle consultant, maintenance, and service agreements. They can also provide rentals of equipment and capital equipment such as testers. The group will also assist you in locating sources for engineering support materials. Finally, the group can find out who makes any part.

To assist you, the groups needs specification details, part numbers, and catalog data if available. They also need quality standards, if applicable. An authorized Internal Purchase Requisition is also necessary for the group to do business with you. This authorizes the group to commit to a Purchase Order with an outside vendor. It must be completed by the requisitioner with all the necessary signatures. Without this information, order placement may be delayed. For more information on what is required of you, contact the person in your local area from this list:

Rich Bellefuille (HL, 225-4422)
Phil Buscemi (ML5-3/R13, 223-5153)
Tom Culkin (TW/B15, 247-2645)
Jim Ebrecht (LM, 231-4604)
Dave Emus (ZK, 264-8071)
Maureen Hughes (CX, 522-2111)
Phil Terry (MK, 264-5649)

Contact the group whenever an engineering stockroom can't supply your needs. For common breadboard components, it's possible that the material will be in stock.

Because it costs Digital about $35 to place an order, administer it, and generate a check to pay the vendor, it makes sense to group your small items together whenever possible.

Project Purchasing works with design groups to source all new components including fabricated plastic and metal items. The group is organized by commodity specialty, handling active devices, passive devices, fabrication, and plastics.

The group establishes cost-effective sources, evaluating component and metal parts availability, lead time, and the capacities of outside sources. They communicate sourcing risks to both Manufacturing and Engineering, recommending effective risk management. Project Purchasing can also negotiate the most favorable preliminary standard cost, reflecting the proper balance among quality, technical conformance, and expected volumes of lot sizes. The group can also provide a "value analysis" using their internal resources or the vendor base.

Contact the group early in the concept stage of your project. They need sketches or preliminary line drawings with essential dimensions and specifications. The precise format of these requirements is not important in the early phases of your project. For more information, contact:

Bill Annessi (MR1/P71, 231-6110)
Tom Cavanaugh (acting) (ML21-1/T31, 223-3003)
Matt Habinowski (ML5-3/R13, 223-5878)
Lino Mion (ML5-3/R13, 223-2997)
Ulf Stoeckelmann (LM, 231-5139)
Charlie Sullivan (TW/B15, 247-2628)
Alan Worrell (CX, 522-2134)

Project Materials Management exists to aid design engineers in obtaining, controlling, and planning material for prototype builds. They act as an interface to Project Purchasing. As a project-oriented group, Materials aids in documentation control at the preliminary stage by using a PCA (Purchasing Change Authorization) system. The group also structures and maintains, by way of the Parts Lists, an engineering Bill of Materials using software developed by Engineering New Products Purchasing specifically for this purpose. They maintain a product materials cost data base. Finally, the group drives processes for the timely resolution of materials issues among Manufacturing, Engineering, Specification Control Systems, and the Manufacturing plants.

To help you save valuable project time, the group needs an Engineering Parts List, documentation (format unimportant), a willingness to work with the Purchasing Change Authorization (PCA) System, and an Engineering Business Plan (see DEC STD 130) for a new product. Contact them during the concept stage of your product. For more information, contact:

Vic Bellemare (ML5-3/R13, 223-8372)
Charlie Sullivan (acting) (TW/C15, 247-2628)

Software Purchasing assists in locating and obtaining software packages from external sources.

The group acts as a clearing house for externally developed software (do we have license agreements? who uses it? should we acquire it?). They also handle all associated contracts, licenses, and agreements.

Software Purchasing would like to be involved in the concept stage of your project, or as soon as an outside software acquisition is considered. They need a copy of the functional specification and your work plan to expedite acquisition. For more information, contact Ted Prentice, ML21-1/T27, 223-9135.

Consulting Acquisitions assists internal users in the procurement of outside consulting services. The group can assist you in vendor selection (using its outside vendor skills inventory), preparation of work statements, negotiation of terms, conditions, and rates, and contract drafting and legal review. They can also provide all purchase orders for outside consulting services. Please contact Consulting Acquisitions whenever you are considering the use of outside consulting services.

Supervisor: Noel Negroni (ML22-1/T59, 223-2694)
Technical: Steve Kuchun (ML22-1/T59, 223-4142)
Management: Sue Gendron (ML22-1/T59, 223-9133)

2.1.2 Corporate Purchasing/Supply Base Management

Manager: Tom Grablick (ML21-1/P66, 223-2614)

This group prepares 5-year Business Plans for purchasing major commodities and critical raw materials. They ensure that suppliers have the capacity to provide for Digital's expanding material requirements.

The primary responsibilities of the group include coordinating all purchasing activities of today and the next 5 years and ensuring strategies are in place to improve the dollar value of expenditures under contract. Furthermore, the group attempts to reduce raw material and material acquisition costs, measure supplier performance, enhance buyer knowledge, and allocate resources and material.

2.2 CORPORATE DISTRIBUTION

Manager: Carl Kooyoomjian (ML1-5/B98, 223-9735)

This group plans, implements, and directs the efficient flow, storage, and handling of raw materials, in-process inventory, and finished goods from their point of origin to their point of consumption. They have representatives in Digital's plants, product lines, subsidiaries, and administrative groups.

The primary focus of Corporate Distribution is on making an efficient distribution network throughout Digital. Elements of the network include transportation, field distribution centers, warehousing operations, associated systems for communications and control, handling and storage methods, and packaging problem solving.

To assist you, the group can provide a profile of their product design criteria, and an estimate of warehousing and transportation costs and trade-offs. Finally, the group can give you an understanding of the impact of distribution costs on the end user.

If your product needs new distribution schemes, contact the group during the design phase of product development by calling Darlene Hoover, NR1-2, 234-4375.

Questions which must be considered for any new product include: Can the product be stored in our existing warehousing systems? Will a slight design change reduce the storage space required? Can the product be easily handled by Digital and external personnel and equipment? Is the product designed within the requirements for transportation? Can we move the product cost-effectively, safely, and with a minimum of product damage?

Industrial Packaging (manager: Larry Nielsen, ML8-4/B96, 223-2588) designs shipping packages for many different applications. They create package designs for shipping piece parts between facilities, for shipping subassemblies, and for moving products within a facility. They also create package designs for products purchased from vendors, Field Service support, and package designs for shipments to customers.

Industrial Packaging also works closely with Purchasing to evaluate new packaging materials for use by Digital. They evaluate vendor packaging, and build prototypes of new product packages. The group coordinates site activities for on-site packaging engineers, and supports most Digital facilities with centrally run cross-plant projects.

Contact this group when you need shipping packages designed. Members will provide written cost and schedule quotes, and help you develop packing procedures. They will also perform the component engineering function in generating purchase specifications for all packing materials.

They are a service group and need funding well in advance of first shipments, to be of maximum benefit to you. A year ahead of first shipment is not too early to contact them.

2.3 TECHNICAL EXTERNAL RESOURCES

Manager: Don Metzger (NR1-5/B98, 234-4897)

Technical External Resources' goal is to ensure that Digital uses components that provide the best performance, lowest cost, and readiest availability for building cost-competitive, quality products.

The organization provides technical support and consultation to Manufacturing and Engineering on the application and selection of purchased components. They provide documentation to ensure that parts can be procured and tested and are compatible with manufacturing processes.

Technical External Resources is composed of three coordinated efforts: External Technology, Design Component Engineering, and the Regional Technical Offices. These three groups unite to support planning, technology strategies, and new product development activities.

2.3.1 External Technology

Manager: Paul Nix (NR5/A1, 234-4898)

External Technology is made up of Corporate Component Engineering, Specification Control Systems, Component Assurance and Reliability, Training and Development, and two laboratories, the Component Technology Lab and the Evaluation Lab.

2.3.1.1 Corporate Component Engineering
Manager: Paul Nix (NR5/A1, 234-4898)

Corporate Component Engineering facilitates product development by providing a new part introduction process and a wide range of technical support. This support includes:

- Part and vendor selection
- Part qualification and characterization
- Reliability and quality analysis
- Technology consulting
- Regulations (national and international) monitoring equipment and components
- Design and development of test
- Vendor base management and development

2.3.1.2 Specification Control Systems
Manager: John Peachey (NR5/M2, 234-4950)

Specification Control Systems is a central repository containing a wealth of purchased parts information. They ensure the availability of technically accurate purchase specifications to facilitate the design and manufacture of Digital products. They provide the data base tools and controls to enable Engineering and Purchasing to select, test, and procure quality components. Specification Control System's primary focus areas include:

Digital Part Numbers: Each properly completed and approved Part Number Request Form (PNRF) is assigned a Digital part number.

Purchase Specification Generation: The group researches, writes, and edits specifications to established formats.

ECO Processing: The group researches, writes, and processes ECOs (Engineering Change Orders) to purchase specifications.

Electronic Data Processing Entries: Purchased parts data are coded and entered into the Purchase Specification Data Base and are batch-processed daily into EPLS, the Engineering Product Library System.

Purchase Specification Distribution: Purchase specifications are distributed via microfiche (updated weekly) and microfilm. These are distributed to reproduction and microfilm areas and to individual departments.

Component Index Books: The group writes, edits, publishes, and distributes these books, which fall into three categories: Multi-Class, 90 Class, and FCD (Functional Code Descriptor). All indexes are updated periodically and are available to you.

Bulletin Listing All New and ECOed Part Numbers: Every two weeks the group publishes this document with all numbers recently assigned (with related data). It also includes recent ECOs received (with related data).

Incoming Inspection Procedures: These procedures are maintained under ECO control and distributed on microfilm and microfiche.

ROM/PROM Coordination: The group assigns pattern numbers, supplies "how to" information for documenting patterns, and coordinates the information with the Design Library, the LSI Test Center, and vendors.

VSMF (Visual Search Microfilm): These are microfilm cartridges containing most vendor catalogues. By providing a vendor's name, you can be supplied with vendor address, phone number, local sales office and phone number, a list of products offered, and a catalogue sheet of these products. If you know what type of commodity you want, the VSMF can supply you with information about which companies manufacture it, and catalogue sheets from those companies. The VSMF also contains Military, ASTM, and UL Standards.

Qualified Vendor Listing: This information is sorted by Digital Part Number and available on microfiche machines. No hard copy distribution is available.

Purchased Parts Lists: This information is sorted by vendor part number and name and available on microfiche machines. No hard copy distribution is available.

Vendor Code File: This file provides you with the address, phone number, and vendor code number of each Digital supplier.

The group needs complete specification information from you in order to assist you. Sometimes you may be asked for additional component and vendor information to complete your purchase specification. You will be asked to review and sign off a finished specification. Give the group sufficient lead time to establish priorities for completion, review, and approval of the specification.

A convenient "one-stop-shop" method of having your *Part Number Request Form* approved is to leave it and any attached data with Component Engineering. Component Engineering will arrange full approval and submit the PNRF to Specification Control Systems for part number assignment. If you desire, you can bypass the "one-stop-shop" method and obtain approval signatures and part numbers without assistance.

The following Digital Standards will help you do business with Specification Control Systems:

DEC STD 012, Section 0 – Unified Numbering Code: All purchased parts must reflect a Digital-assigned part number before parts lists can be finalized, Purchasing can order, and inventory control can process material.

DEC STD 055 – Purchase Specifications: This standard establishes the general instructions and responsibilities for the preparation and control of Digital Purchase Specifications.

DEC STD 100, Section 2 – ECO Procedures: This standard establishes the procedures for writing, obtaining approval, and submitting the ECO to the Purchase Specifications ECO Coordinator.

Copies of Digital Standards are available from Digital Standards Administration, ML3-2/E56, 223-9475.

For more information, contact: Jim Boice (NR5/M2, 234-4951)
Carl Bull (NR5/M2, 234-4952)

2.3.1.3 Component Assurance and Reliability

Manager: Joe Belliveau (NR5/E2, 234-4920)

Component Assurance and Reliability develops quality strategies to ensure the effectiveness of the Incoming Inspection process, and to improve the quality of purchased components.

2.3.1.4 Component Technology Laboratory

Manager: J.P. Keller (NR5/E21, 234-4949)

Typical activities of the Component Technology Laboratory include the evaluation and characterization of materials, devices, and other parts, failure analysis, and the development of solutions for technical problems.

The Laboratory's customers include Manufacturing, Engineering, Field Service, Design Component Engineering, Supply Base Management, and Corporate Component Engineering.

2.3.1.5 Component Evaluation Laboratory

Manager: Stan Bednarski (NR5/F2, 234-4868)

The Component Evaluation Laboratory provides a wide range of services to a broad customer base. The Laboratory is comprised of three groups, the Qualification Laboratory, Test Engineering, and the Integrated Circuit Test group. Their services include test equipment design and development, evaluation and qualification testing, and test program and software generation.

2.3.1.6 Training and Development

Supervisor: Don Dunn (ML6B-3/E21, 223-6614)

Training and Development works to strengthen Technical External Resources through the employee and organizational development process and by coordinating technical training. They sponsor orientations for newly hired component engineers, and vendor technical seminars to disseminate state-of-the-art technology information.

2.3.2 Design Component Engineering

Manager: Leo Tiernan (NR5/A5, 234-4879)

Design Component Engineering provides many services to Design Engineering. These include direction on new or preferred technologies, vendor liaison, testing methods, and qualification requirements. They assist in getting your product to Manufacturing by interacting with Purchasing, Specification Control Systems, Incoming Inspection, Process Engineering, and Manufacturing. The Design Component Engineer maintains a knowledge of component group activities outside the domain of Component Engineering, including groups working in the areas of fabrication, metals, chemicals, LSI, and others.

2.3.3 Regional Technology Offices

The Regional Technology Offices are located in Tokyo, Japan, and Mountain View, California. They evaluate and disseminate engineering data on technology developments, provide on-site management for new product development, and support the specific programs and project needs of advanced development groups in Engineering and Manufacturing.

Contact the Regional Technology Offices through Design Component Engineering (Leo Tiernan, NR5/A5, 234-4879).

CHAPTER 7

PROCESS TECHNOLOGY DEVELOPMENT

Manager: Will Thompson (QI-1/E21, 280-7300)

1 PHYSICAL INTERCONNECTION TECHNOLOGY

Manager: Joe Chenail (QI-1/B17, 280-7247)

The Physical Interconnection Technology group provides the advanced technology and manufacturing process development engineering required to ensure high volume producibility of computer components and subsystems.

A staff of technical innovators, skilled in manufacturing and process development, and in test systems hardware/software development and applications, forms a major portion of the applied Engineering and Manufacturing Technology Development Group located at the corporate technology cluster in Andover, Massachusetts.

This group should be your initial contact during the concept development phase of product design, since they can provide the "chip to backplane" technical information necessary to assure that ongoing or planned product programs will enter the product life cycle with the best internally available technology.

More detailed information and specific technology development descriptions can be obtained by contacting any one of the individuals listed below:

Materials and Assembly Process Technology (MAPT): George Katronge (BP2, 235-3216)

Manufacturing Test Systems (MTS) Technology: Dick Albright (QI/B17, 280-7238)

Advanced Manufacturing & Engineering Operations (AME): Peter Murphy (QI/B17, 280-7248)

For technologies not specifically listed above, contact the Physical Interconnect Group Manager.

2 PROCESS INFORMATION CONTROL SYSTEMS

Manager: Lou Klotz (QI1/E21, 276-7400)

Process Information Control Systems develops and implements the concept of the collection, processing, and dissemination of process control information as applied to manufacturing processes.

They aim to increase the efficiency of manufacturing operations by interconnecting plant management information systems and by promoting the common use of data. Process Information Control Systems is made up of three major groups:

2.1 PROCESS CONTROL SYSTEMS
Manager: John Ardini (QI1/E18, 276-7589)

This group develops software designed to reduce manufacturing costs and cycle times, and to improve quality. In conjunction with the other Process Technology Groups, Process Control Systems seeks, develops, and implements the applications control software required for new manufacturing technologies.

2.2 NETWORK SYSTEMS
Manager: Marv Horovitz (AC/E77, 232-2546)

Network Systems provides the network architecture required to support Process Information Control Systems. They provide the technical expertise for successful implementation of new developments in the manufacturing environment.

2.3 INFORMATION SYSTEMS
Manager: Bob Lynch (QI2/D21, 276-7451)

Information Systems has a dual function. They provide Management Information Systems for the Process Technology group, through support of hardware and software systems for operations. The group also provides software and software tools development for advanced development projects, including the interconnection of non-Digital devices, language evalution, and the interchange of data between engineering and manufacturing.

2.4 MANUFACTURING TEST APPLICATIONS
Manager: Louis Klotz (QI1/E21, 276-7400)

This organization consisted of six major groups: Automated Manufacturing Systems, Module Test Programming, Manufacturing Test Support, Simulation and Test Applications, Power Supply Test Systems, and the MTA Testability Committee.

This group is in the process of decentralizing to the manufacturing groups. For information concerning these areas, contact your Group or Product Line Test Strategist.

3 COMPUTER-AIDED DESIGN (CAD)
Manager: Pete Straka (ML21-3/T40, 223-3189)

Computer-Aided Design (CAD) is responsible for tools and new processes for the physical design of chip carriers, boards, and backplanes. Physical design is that part of the engineering process that follows logic design and global partitioning, and precedes initiation of the manufacturing build process.

Broad elements of responsibility are:

- CAD Systems
  - CAD Engines
  - CAD Interfaces
- Auto Tools
- Tool-Technology characterization
- Pilot Design Capability
  - New tools and design processes
  - New technologies

The goal of the CAD group is to have characterized tools available for in-place systems when a product design is initiated. If product design requirements precede completion of this event, the CAD group will enter into partnership with the product and technology developers to evolve needed tools and processes.

3.1 CAD ENGINEERING AND APPLICATIONS (CADEA)

Manager: Bill Wehring (ML3-5/T28, 223-3223)

CAD Engineering and Applications (CADEA) develops and distributes computer-based tools for the physical design and layout of backplanes, modules, ceramic substrates, and gate arrays. They work closely with users to respond to new projects and technologies. They also implement general-purpose enhancements to streamline the layout process and protect Digital's investment in CAD systems hardware, such as system foundations, interfaces, layout tools, and automatic design aids. CADEA contains three groups:

Layout Design Applications, supervised by Fred Haefner (ML3-5/T28, 223-2802), is responsible for all physical layout applications.

CAD Systems, supervised by Bob Anderson (ML3-5/T28, 223-5930), is responsible for CAD Systems including system architecture and operating systems, data bases, and design verification and analysis tools.

Site Support, Test, and Release, supervised by Tig Richardson (ML3-5/T28, 223-3325), is responsible for insuring the usability and integrity of the CAD tools it supports at all Engineering sites, and for working closely with local site support people, as well as the control, distribution, testing and archiving of CAD software system.

CAD Engineering and Applications provides services to Digital's entire engineering community. Their purpose is to provide the engineer with the finest, most cost-effective tools available. They work closely with engineering, especially in regard to new technologies at Digital. CAD tools can be both a big benefit and a big limitation. Early communication is a key ingredient in success, through the removal of limitations or in the selection of appropriate alternative design solutions.

3.2 AUTOMATED DESIGN SYSTEMS

Manager: Don Yelton (ML3-5/T28, 223-3437)

Automated Design Systems develops software used to automate the layout and engineering analysis of macro-electronic hardware (ceramic hybrids, printed wiring boards, and backplanes). They also define and implement software to interface macro-electronic CAD systems to other engineering and manufacturing systems. The department consists of two groups:

Automated Design and Analysis Tools, headed by Brian Gordon (ML3-5/T28, 223-8519), is responsible for implementing software to automate the engineering layout and analysis of macro-electronic hardware.

System Interfaces, headed by Don Yelton (acting, ML3-5/T28, 223-3437), is responsible for implementing data interfaces between macro-electronic CAD systems and other engineering and manufacturing systems.

3.3 DESIGN SYSTEMS DEVELOPMENT

Manager: Andrew Matthews (ML4-4/E99, 223-8489)

Design Systems Development provides new CAD software tools, both purchased and developed, and fully characterized design processes to meet the changing needs of physical design implementation used in the Engineering design process. Design capabilities cover interconnect technologies including ceramic hybrids, printed wiring boards, backplanes and other products. Three groups make up Design Systems Development:

Interactive Systems Development, headed by Will Anderson (ML3-5/T28, 223-2742), is primarily responsible for the development of the VAX-based "professional workstation" for engineering design and implementation. They currently focus on systems foundations, and interactive layout software for printed wiring, gate array, ceramic hybrid, and backplane technologies.

Advanced Design Services, headed by Tom Surette (ML4-5/T38, 223-6202), is the CAD user group responsible for intensive CAD tools, design technology, testing and characterization, new CAD process definition, and pilot production use of tools and design technologies. They have the skills and resources to do experimental design layouts beyond current process capabilities.

Advanced CAD Development, headed by Ken Coley (ML4-4/E99, 223-8762), is responsible for CAD capability planning and needs assessment in consultation with Engineering groups, for the advanced development of CAD software and techniques, and for the acquisition of external software.

3.4 CAD PROGRAM OFFICE

Manager: Pete Straka, acting (ML3-5/T28, 223-3189)

The CAD Program Office insures that CAD activities are included in and managed as elements of programs to achieve strategic Process Technology Development goals. The Program Manager insures that the technical, user benefit, and financial aspects of CAD programs are planned, reviewed, measured, and reported, that interdependencies are understood and cross-functional commitments are negotiated, that all the activities of the program are properly coordinated and directed towards the desired results, and that any problems are understood, reported, and resolved. The Program Office is a major contributor to strategic and long-range planning within the Computer-Aided Design group.

4 POWER AND PACKAGING TECHNOLOGY DEVELOPMENT

Manager: Henk Schalke (ML11-3/H19, 223-7103)

Power and Packaging Technology develops base technology, tools, and components for the power and packaging domain. They provide technical consultation and advanced product and process development for the following technology segments:

- Power supply design
- Signal integrity
- Transmission circuits and media
- Power supply test
- Thermal design
- Mechanical CAD/CAM
- Acoustic design
- Materials and mechanical processes
- Enclosure design

4.1 MECHANICAL TECHNOLOGY

Manager: Frank Grimaldi (ML8-3/T13, 223-4177)

Mechanical Technology provides consulting services to address product design and manufacturing process needs in mechanical technologies. Mechanical Technology consists of the following groups:

- Environmental Engineering (product environmental capabilities)
- Advanced Materials and Processes (product/process materials and finishes).
- Product Acoustics (product acoustic noise)
- Solid Mechanics (statics, dynamics, kinematic analysis)
- Thermal Engineering (product cooling)

Mechanical Technology's personnel work as contracted members of new product design teams to help develop quality products with mechanical performance capabilities compatible with manufacturing process goals and methods. They also perform advanced and tool development tasks, maintain Digital Standards, develop design guidelines, provide technical seminars, track external regulations, and participate in appropriate industry associations in their disciplines. Mechanical Technology groups also maintain and operate laboratories to support mechanical technology needs:

Laboratory	*Manager*
Acoustics	Bob Lotz (ML8-3/T13, 223-5774)
Environmental Engineering	Frank Grimaldi (ML8-3/T13, 223-3349)
Thermal Engineering	Robert Hanneman (ML8-3/T13, 223-3349)

The Industrial Packaging laboratory can also be helpful with your mechanical design work. See the section on Corporate Distribution, Section 2.2 of Chapter 6, for more information.

Contact Mechanical Technology as early as possible, to ensure that recommendations and design details can be addressed with a minimum of disruption to prior work or frozen design factors.

4.2 SIGNAL INTEGRITY ENGINEERING

Manager: Don Marshall (ML6A-2/T45, 223-3276)

Signal Integrity Engineering develops and provides engineering support in digital interconnections. They are involved in the development of advanced interconnect techniques and high-speed serial data transmission. They develop simulation and measurement tools and conduct analysis of energy transmission, propagation, and reception. Group members present a corporate technical resource for consultation on electrical integrity over a spectrum of media and devices. Finally, they provide engineering support for the Unibus, Massbus, and other traditional busses.

4.3 CENTRAL POWER SUPPLY ENGINEERING

Manager: Art Rudin (ML8-4/E86, 223-1945)

Central Power Supply Engineering designs and introduces power supplies, power controllers, regulators, battery back-up modules, and power distribution assemblies into production. They also reduce costs and enhance products by adopting different product technologies.

4.3.1 Power Integrity Engineering

Supervisor: Frank Loya (ML8-4/E86, 223-6328)

Power Integrity Engineering is primarily concerned with ac power, its distribution, protection, control, quantity, and quality, to ensure reliable operation of equipment and systems. They also maintain the following Digital Standards:

DEC STD 002	*AC Power Wiring, Grounding Receptacles, and Nameplates*
DEC STD 122	*AC Power Line Standard*
DEC STD 123	*Power Control Bus Standard*

Copies of standards can be obtained by calling Digital Standards Administration, ML3-2/E56, 223-9475.

4.3.2 Storage Systems Power Supply Development

Supervisor: Len Salafia (ML8-4/E86, 223-6804)

This group provides power supply design development and support for Storage Systems Product Development groups.

4.4 POWER CONDITIONING TECHNOLOGY

Manager: William Hazen (ML8-4/E86, 223-4679)

Power Conditioning Technology is responsible for the advance development of power supply technology for all of Digital's products. Through the Technology Management function, they work to merge product needs with power technology opportunities and to provide technology transfer for a timely introduction into product development. They also direct the Power Conditioning Research and Advance Development Committee, provide technical training and development, and manage external research projects.

4.4.1 Power Conversion Technology and Tools
Supervisor: Trey Burns (ML8-4/E86, 223-7626)

Power Conversion Technology and Tools monitors Digital's power needs, and does advance development relating these needs to power conditioning technology. They track this technology in industry, university, and government-associated research activities, and provide analysis and simulation tools for power supply and power system development.

4.4.2 Power Circuit Technology
Consultant Engineer: Jim Gregorich (ML8-4/E86, 223-5173)

Power Circuit Technology does advance development relating Digital's needs to power circuitry, device, and component technology. They provide consultation in these areas for research activities.

4.5 CENTRAL MECHANICAL ENGINEERING
Manager: Don Staffiere (ML11-4/E53, 223-8656)

The Central Mechanical Engineering team develops and implements new mechanical packaging concepts in cabinets and enclosures. Members design, develop, and maintain cross-product enclosures. They also upgrade and modify existing products to meet evolving international safety and regulatory requirements; they analyze, evaluate, and resolve mechanical enclosure problems identified by Field Service and Manufacturing. They also support the manufacturing process for mechanical assemblies. Additionally, the team develops guidelines and standards for cabinet cabling and stability. They work with Thermal and Acoustical Engineering to establish cooling and acoustical guidelines for enclosures, and disseminate information for all mechanical engineering groups.

Team members also serve in a central mechanical engineering resource pool to assist in the development of new products on a project-by-project basis. They furnish consultation on packaging design problems encountered by other groups. Mechanical engineering expertise on the packaging of power supplies is also provided.

5 MECHANICAL CAD
Manager: Dick Anderson (ML11-3/H19, 223-3041)

5.1 MECHANICAL COMPUTER-AIDED ENGINEERING
Manager: Nick Wells (ML11-3/T13, 223-2557)

This operations function provides a multi-user Unigraphics CAD/CAM (computer-aided manufacturing) system facility for product and technology development in the Power and Packaging Technology groups. This facility is one of several similar facilities in the Maynard Mill complex.

5.2 MECHANICAL CAD/CAM TECHNOLOGY
Manager: Art Aronovitz (ML5-1/E31, 223-4805)

This group's goal is to integrate the engineering and manufacturing functions of mechanical CAD/CAM, and to subsequently spread the technology throughout Digital. This is accomplished by maintaining a computer laboratory used for both development and production. Development applications include pure Research and Development, training, system engineering, and special software generation. Production use includes design engineering, tool engineering, and N/C (numerical control) programming.

6 PROCESS TECHNOLOGY DEVELOPMENT PROGRAM MANAGEMENT

Manager: Len Greaney (QI1/B22, 276-7310)

The Program Management group ensures that the Process Technology Development organization properly controls its programs and projects, and communicates plans and activities to Engineering and Manufacturing customers.

Advanced Producibility, managed by Bernie Macdonald (QI1/B22, 276-7280), is a cross-product and cross-systems oriented group that supports Engineering and Manufacturing through DEC STD 030 and the Producibility Handbook.

DEC STD 030, *Module Manufacturing Standard*, establishes the manufacturing and technical requirements for designs and practices for all production printed wiring boards and modules. The standard contains basic design rules to ensure that printed circuit designs can be manufactured quickly and economically.

Advanced Producibility develops tools and systems for applying design and documentation rules. They supply Design Engineering and Engineering Services with information on the requirements and benefits of Producibility. They assist and advise other groups within Process Technology Development on the producibility on new products and processes.

CHAPTER 8

PRODUCT LINE GROUPS

Digital's three major product line groups are Commercial Products, Computer Products, and Technical Products. Each major product line group is made up of a number of discrete product line groups. The product line groups have been described as small companies within the larger corporation, each responsible for its own marketing, advertising, finance, production operations, and engineering (when needed), with a primary responsibility for marketing and market planning.

Most product line groups are based on a particular industry and its needs. The OEM (Original Equipment Manufacturers) product line groups, for example, exist to expand Digital's repertoire of OEM customers and to provide them with the support they need. ECS, the Education Computer Systems Group, caters to the education market: schools, universities, and armed forces training facilities. By adopting the Digital products that fit individual marketplaces, product line groups are able to provide a wide range of specialized equipment and services geared to solving a customer's data processing problems.

Product line groups structure their product offerings around the needs of their particular customers. This structuring is based on a knowledge of how customers do business, what their problems are, and how our products can be designed to solve their problems and help them run their businesses more efficiently.

Therefore, it is very important that you have a clear understanding of customer needs. A product's capabilities and applications are valuable only if they are marketable. State-of-the-art equipment will remain just "art" unless there exists a customer for such equipment. Obviously, design engineers cannot design and implement products in a vacuum. They must look at products from the perspective of the customer.

Products which truly serve the needs of the marketplace are more likely to happen when communication is developed between Engineering and the product line groups. Most of this communication and coordination of efforts is performed by Product Managers from Central Engineering. But they can't do it all. For this reason, it would greatly benefit you and the company if you gained some knowledge of the ultimate use and destination of products developed at Digital.

The following pages contain descriptions of the product lines, the products they market and their applications, and whom to contact for more information.

1 COMMERCIAL PRODUCTS GROUP

1.1 COMMERCIAL OEM GROUP

Manager: Dave Schroeder (MK1-2/H32, 264-5502)

This group sells small business computers through other organizations that add applications and resell the systems to small businesses.

The group is the main OEM (original equipment manufacturer) supplier in the commercial marketplace. Through this channel, the Commercial OEM Group has acquired 10 to 15% of the small business computer market, primarily in the general-purpose data processing environment. The major strengths of the group are in the size of its current distribution network (over 650 commercial OEMs), the availability of a family of compatible products, and the breadth of Digital's Field Service network.

A compatible family of DEC Datasystems running on PDP-8s, PDP-11s, and VAXs are available from the commercial OEM group. They also offer development tools for many applications, and some basic accounting application packages.

The group evaluates and develops marketing programs, support programs, and OEM policies on behalf of the entire Commercial Products Group. OEMs are selected by an OEM Review Committee following analysis of a prospect's marketing plans, financial statements, and cash flow figures. Commercial OEMs who choose to apply and who meet Digital's certification criteria are known as Authorized Digital Computer Distributors.

1.2 TELECOMMUNICATIONS INDUSTRY GROUP

Systems Engineering
Manager: Bill Munson (MK1-1/D29, 264-7436)

The Telecommunications Industry group (TIG) supports Digital's business with worldwide telecommunications companies, including operating telephone companies, telephony research organizations, postal telephone and telegraph administrations, and telephone equipment manufacturers. The Systems Engineering group encompasses the following activities:

- Product planning
- Technical support to Sales and Marketing
- Project, program, and product management of TIG-funded engineering activities
- UNIX (trademark of Bell Laboratories) engineering and field/internal liaison
- Applications consulting with customers, Sales, and Marketing

1.3 MANUFACTURING, DISTRIBUTION, AND CONTROL GROUP

Manager: Steve Gutz (ML5-2/E50, 223-2239)

The Manufacturing, Distribution, and Control (MDC) product group develops products based on PDP-11s and VAXs for use in the manufacture and distribution of tangible products. Systems are sold to customers in the Fortune 500 (International 1000) engaged in either discrete (transportation, electrical, electronics) or continuous (chemicals) manufacturing.

The engineering group does its own hardware, system software, diagnostics, and technical documentation to develop MDC-unique products. The current products include a family of local area network products (the DECdataway), intelligent subsystems, and a line of I/O modules for use in the industrial environment.

2 COMPUTER PRODUCTS GROUP

2.1 GRAPHIC ARTS PRODUCT LINE

Manager: Steve Gross (MK1-1/D11, 264-6118)

The Graphic Arts Product Line engineering group designs computer systems products with applications in the printing, publishing, radio, and television and cable television industries. The products span the spectrum from the small LSI-based "knowledge worker" terminals to the large, 11/70 and 11/780-based multi-terminal systems.

Contact Graphic Arts engineering for market-focused or design consultation in their areas. Their experience gained with multi-processor networks, computing and intelligent terminals, and interfacing to non-Digital processing equipment is available. Specifications, schedules, and budget information will help them to help you.

2.2 TRADITIONAL PRODUCTS LINE

Manager: Don Freniere (NM, 264-7936)

This product line provides continuing engineering support to the customer who is using older systems and add-on hardware. The group also provides an outlet for excess equipment and small volumes of larger systems to support ongoing needs in certain segments of the marketplace.

The group assumes product responsibility for most CPUs no longer actively marketed and manufactured. The group sells refurbished equipment, PDP-11/35, 40, 45, 55, 60, XVM Systems, and PDP-15 Graphics. Its older traditional products include PDP-8, 8I, 8S, 8L, PDP-11/15, PDP-11/20, PDP-12, Industrial 14, PDP-16, and other 18-bit processors (PDP-10, DECsystem-10 and DECSYSTEM 20 traditional products are handled by the Engineering Systems Group, Section 3.4 of this chapter).

All of the group's factory-refurbished equipment is electronically and cosmetically perfect, updated to the latest ECO (engineering change order) levels, and all of the equipment is subjected to the same rigorous testing as Digital's new equipment.

Employees may purchase equipment from the Traditional Products group for personal use. Contact them for more information.

2.3 TERMINALS PRODUCT LINE

Manager: Barry James Folsom (MR2-1/M64, 231-6629)

This group sells terminals and related products. The primary function of the group is to be a major supplier of high-volume terminals to the business segments of the worldwide information market.

The group markets teleprinters (LA34, LA120), video terminals (VT100, VT132, VT101, VT131) and intelligent terminals (PDT11/150) to large volume purchasers. They also sell several specialized versions of these products. These products are aimed at meeting customer needs in an endless variety of data, communications, and information exchange applications. Typical applications include time-sharing, data capture, inquiry and response, transaction processing, telecommunications, and personal business terminals.

2.4 MICROCOMPUTER GROUP
Manager: Jim King (MR2-1/M64, 231-6632)

The primary funtion of this group is to market unbundled LSI-11 systems at the board level to customers who will purchase a required minimum volume. The group serves three classes of customers: high-volume users, low-volume users, and the home hobbyist.

The group sells the LSI-11 and its options, giving users the flexibility to buy the absolutely minimal system and expand it to meet the requirements of the application. They also market tools for hardware and software development, such as the PDP-11V03 and PDP-11T03 development systems and evaluation kits. General purpose interfaces, clocks, analog-to-digital and digital-to-analog converters, and communication options are available for the LSI-11/PDP-11/03. Operating system software, including RT-11 and RSX-11S with languages, is also available.

These products have been designed to supply users with reliable, low-cost systems for industrial process control, inventory control, data formatting, preprocessing, and developmental systems. A home hobby distributor uses many versions of the LSI-11 to provide his or her customers with kits. A photographic laboratory uses a version of the LSI-11 to obtain color separation balance when processing color films. A manufacturer of sheet plastic uses LSI-11s to control the thickness and mix of materials in the manufacture of the product.

2.5 WORD PROCESSING PRODUCT GROUP
Manager: Buzz Brooks (MK1-1/J14, 264-5500)

The Word Processing Product group focuses on two product areas. The first is the DECMATE line of stand-alone word processors, available with vertical applications through dealers and Digital computer stores. The other is the shared-resource word processing line built around the WS200, a PDP-8-based multi-terminal computer, and DECWORD, a PDP-11-based system using RSTS operating system software.

3 TECHNICAL PRODUCTS GROUP

3.1 LARGE COMPUTER GROUP
Manager: Rose Ann Giordano (MR1-1/KL5, 231-4049)

The Large Computer group (LCG) provides DECsystem-10s and DECSYSTEM 20s for a broad range of applications. These include the banking and insurance industries, manufacturing, educational institutions, timesharing, and governmental and private research and development.

Large Systems products are designed for use in a dynamic computing environment, characterized by a large number of users, large data bases, high level languages, and a high throughput requirement. These products function either in a stand-alone mode or as a "host" in a distributed network.

The following are types of processing supported by the DECsystem-10 and DECSYSTEM 20 families of Large Computer products:

- interactive
- concurrent multi-stream
- transaction
- real-time

3.2 TECHNICAL OEM GROUP

Manager: Ward Mackenzie (PK3-1/A60, 223-2884)

The OEM (original equipment manufacturer) buys Digital's products, adds substantial value, and resells or leases the products to a third party who is a separate corporate entity. If the end application of a computer is to be the management or control of a process or product, the OEM is defined as technical.

Applications for Technical OEM products include engineering and scientific (such as simulation, computer-aided design), instrumentation (instrument control and processing of instrument readings), medical (patient monitoring equipment, CAT scanners), industrial, government and telecommunications, and computer system products where Digital's product controls the OEM's product, such as the Xerox page printer and COM (Computer Output Microfilm) equipment.

The value of OEMs may be found in the several contributions which they offer. They multiply the effectiveness of the sales force. They are a stimulus to high-volume manufacturing, resulting in lower product prices for everyone. They provide greater product exposure to first-time computer users who later may buy Digital's end-user products. Technical OEM sales account for approximately 20% of all corporate sales.

3.3 EDUCATION COMPUTER SYSTEMS

Manager: Charles Rose (MR1-1/M40, 231-4360)

This product line group is a leading supplier of educational computing equipment, offering a range of products from small to large multi-user systems. They market standard PDP-11 and VAX-11 products worldwide, providing minicomputer systems, related software and support materials for instructional applications in educational institutions, government, and industry. They also provide computer systems to assist in the financial and operational administration of educational institutions.

In terminals, this group is responsible for the GIGI (VK100) intelligent keyboard, and for the complementary application software under RSTS/E, VMS, and TOPS-20. They have a strong focus on general imaging functions (for example, graphics) for the education environment.

Education Computer Systems designs and sells application software such as VAX-11, PASCAL, WISE, and DECAL, and a series of packages that support the GIGI terminal.

3.4 ENGINEERING SYSTEMS GROUP

Manager: Peter Smith (MR1-1/M42, 231-5160)

This group provides VAX-11/780s, VAX-11/750s, PDP-11s, and associated graphics and peripheral devices with computer-aided design applications to industry segments and engineering disciplines.

For industry, these products have applications in manufacturing, government, utility engineering departments, architectural and consulting engineering companies, design and build companies, and construction companies.

For engineering disciplines, these products have structural, civil, electrical, and electronic engineering applications.

3.5 GOVERNMENT SYSTEMS GROUP

Manager: Dana Lajoie (HZ, 264-7973)

This group sells all of Digital's products to governments outside the US, and to the US Government in Command, Control, Communications, Weapons Systems, Intelligence, and general Automated Data Processing (ADP) areas. They sell to prime contractors in the Command, Control, Communications, Intelligence, and Weapons Systems (C^3IWS) business.

Government Systems Engineering services the needs of these market segments and provides both hardware and software products. The group has specialized expertise in TEMPEST product engineering and other specialized government requirements.

Hardware:	Chuck Cobb (HZ, 264-7978)
Software:	Hobart Mendenhall (HZ, 264-8914)
Product Management:	Suresh Masand (HZ, 264-4878)

3.6 LABORATORY DATA PRODUCTS GROUP

Manager: Bert Bruce (MR2-4/E33, 231-4701)

This group provides computer systems, related software, and applications packages for research and scientific applications in educational and non-profit institutions, medical research, medical industry, and government institutions. Products include MINC and real-time front ends.

The group seeks to address the following scientific and research applications:

- Real-time and off-line acquisition of scientific and research data
- Graphic display of this data
- Multifunction (real-time, batch, timesharing) manipulation and management of scientific and research data
- Control of and data acquisition from scientific instruments and experiments
- Development of programs for acquisition, manipulation, simulation, and display of scientific and research data

The group's hardware and software development area can supply you with functional priorities, specifications, trade-offs, interconnection to other hardware, etc. The group can also tell you more about their applications, market size, and customers.

To assist you, Laboratory Data Products needs a general product description with a statement of the impact of the new product on internal products. They also need developmental costs, a realistic schedule, a first-customer-ship date, and volume schedule. They would also appreciate major specifications, with an analysis of the competition.

3.7 MEDICAL SYSTEMS GROUP

Manager: Wendy Mela (HU/E24, 225-4240)

The Medical Systems Group sells computer systems, related software, and supportive materials to the health care services industry and for occupational health care applications.

Specific areas of group expertise and accomplishment include development of the DSM-11 (Digital Standard MUMPS programming language) systems, and the related VAX-11 DSM layered language product. In the areas of medical image processing and real-time data acquisition, the Medical Systems Group has developed GAMMA-11, an RT-11-based system for nuclear medicine. They have also done work with distributed data processing, large multi-processor networks, and data management systems.

Medical Systems provides hardware and software products in these areas. Contact them for further information.

CHAPTER 9

MANUFACTURING

1 SYSTEMS MANUFACTURING
Manager: Bill Hanson (ML1-4/R14, 223-2238)

Systems Manufacturing has three major areas of responsibility. They are the manufacturing link to the Product Line groups, responsible for the US, Europe, and the General International Area (GIA). They are also Manufacturing's link to Systems Engineering. Systems Manufacturing aims to meet Corporate revenue shipment budget, while ensuring customer satisfaction by shipping quality systems products.

The following are some of the major groups within Systems Manufacturing.

1.1 COMPUTER SYSTEMS MANUFACTURING
Manager: Dave Thorpe (ML1-4/P11, 223-3222)

Computer Systems Manufacturing manages the manufacture of all Digital's computer-based systems. They aim to improve quality, reliability, asset utilization, customer service, and cost effectiveness.

Their links to Central Engineering are especially important to their success. 16-, 32-, and 36-bit Program Strategy Managers work with their counterparts in Engineering on project and program strategy and development. System Program Managers develop and implement strategies with Engineering Managers on specific systems products. On all new products, Manufacturing and Engineering are linked in this way down to the subassembly level. Working with Engineering and other organizations, Computer Systems Manufacturing is involved with products from conception and development to phase-out.

1.2 GIA (General International Area) MANUFACTURING
Manager: Dick Bradley (ML1-4/P14, 223-3143)

GIA Manufacturing provides manufacturing support for *all* of Manufacturing, by providing focus on manufacturing issues such as delivery, performance, quality, and customer satisfaction in the GIA area. The group also provides resources to jointly develop facility strategies for the international area in support of sales and manufacturing.

1.3 TECHNICAL PRODUCTS MANUFACTURING

Manager: Joe Cosgrove (ML1-4/P14, 223-3564)

Technical Products Manufacturing is Manufacturing's interface to the Technical Products product line group. (See Chapter 8, Section 3 for a description of the Technical Products product line group.) Each of the product groups within Technical Products has a Product Group Manufacturing Manager who works closely with a Product Group Manager.

Technical Products Manufacturing's responsibilities include running the Order Scheduling process and the Request/Commit system for expressing material requirements to manufacturing groups. They aid product groups in meeting their goals for Net Operating Revenue (NOR), inventory, and profit margins, and take part in the space, personnel, and production planning process.

1.4 COMMERCIAL AND COMPUTER PRODUCTS GROUP MANUFACTURING

Manager: Lou Gaviglia (NI, 261-2000)

Commercial and Computer Products Group Manufacturing manages manufacturing processes for the Commercial and Computer Products groups. Areas of support are the same as those of the Technical group, with a Product Group Manufacturing Manager assisting each product line. In addition, they manage the Systems Manufacturing distribution network.

1.5 EUROPEAN MANUFACTURING

Manager: Paul Neuman (Geneva, Switzerland: GE, [41]-(22)-933311)

European Manufacturing is divided into Volume Manufacturing and Systems Manufacturing. Volume Manufacturing, managed by Frank McCabe in Galway, Ireland, produces CPUs, memories, power supplies, and mid-range disk products for European markets. Systems Manufacturing supports the Technical and Commercial groups' European markets. In 1981, European manufacturing plants will ship approximately 40% of Digital's total European sales requirements.

1.6 TECHNOLOGY MANAGEMENT

Manager: Dennis O'Connor (ML1-4/P14, 223-4768)

Technology Management integrates product and process technologies developed by Engineering into long-range manufacturing business strategies. They drive new business plans and educate operational management. They also work with universities to aid in the transfer of future technologies for Systems Manufacturing.

1.7 MANAGEMENT INFORMATION SERVICES (MIS) MANAGEMENT

Manager: Pete Zotto (ML1-4/P14, 223-8497)

This group directs the development of Information Services strategies to support Systems Manufacturing's goals for customer services, quality, and cost. They link other manufacturing groups to the Digital Information Services organization.

2 GENERAL MANUFACTURING

Manager: Don Hunt (ML1-4/B21, 223-2859)

General Manufacturing manages four independent businesses:

- Field Service support
- High-technology/high-volume printed wiring boards
- Low volume communications and special application options
- Multifaceted engineering and manufacturing parts and service support

These are cross-group activities and products that do not readily lend themselves to vertical integration. Products approaching the end of their life cycle transfer into General Manufacturing for management of their manufacturing and spares needs. General Manufacturing also supplies unique low-volume products for special systems, and engineering prototypes calling for metal or printed wiring board fabrication, assembly, and test.

General Manufacturing's products include "C" class options, loose piece, module repair, mechanical fabrication, components, modules, printed wiring boards, power supplies, cables, and option repairs. Their customers include the volume product plants, Systems Manufacturing, Field Service Logistics, Engineering Services, and the product lines.

These are General Manufacturing's primary facilities:

Location and Manager	*Products and Processes*
Augusta, Maine Mike Eaton (AS, 271-2240)	Modems, Commercial Group products, options, modules, power supplies, and cable assembly and test
Maynard, Massachusetts Pete Koch (ML5-4/F32, 223-2632)	Modules, power supplies, cable assembly and test, printed wiring board and metal fabrication
Greenville, South Carolina John Caulfield(GS, 354-2212)	Printed wiring board processes: fine line, multilayer, high density, new technologies
Westford, Massachusetts Bob Roche (WJ2, 257-1220)	Field Service manufacturing
Nijmegen, Netherlands Bill Sergeant (JG, [31]-(80)-567000)	European Field Service manufacturing
Woburn, Massachusetts and Salem, New Hampshire Tom MacDonald (ZW, 284-3048)	Module, option, motor, and other repair and test; module, cable, and option assembly; Techmate and Diana Diagnostic Testers, suitcase testers

These functional managers can help you interface to General Manufacturing:

John Harrington, Manufacturing Engineering and Quality Control Manager (ML1-4/B21, 223- 9452)
Bel Cross, Long-Range Planning Manager (ML1-4/B21, 223-9090)
Paul Mantos, Materials Manager (ML1-4/B21, 223-3375)
Rufus Sanders, Manufacturing Information Systems Manager (ML1-4/B21, 223-9453)

3 TERMINALS MANUFACTURING

Manager: Dick Esten (ML1-5/B95, 223-3955)

The Terminals Manufacturing group manufactures and procures these general categories of products: printers, printing terminals, video terminals, microprocessors, and small systems.

Terminals Manufacturing's interface with Engineering is principally in the area of new products, especially in the early stages of planning and information coordination. The plants deal directly with Engineering on the development and support of product manufacturing. Key contacts:

Fred Forsyth, New Product Planning (LJ/D1, 282-2076)
Fred Oldfield, Manufacturing Process Engineering (ML5-1/E31, 223-2235)

They have four plants, a Functional Staff and Service group, an Acquisition Center, and strong ties to the Far East Manufacturing group (see Section 6 of this chapter).

These are Terminals Manufacturing's primary facilities:

Location and Manager	*Products and Functions*
Albuquerque, New Mexico Norm Kalat, Manager Bill Woodard, Planning Manager (AB, 552-2211)	Manufacturing: video terminals, microprocessors
Boston, Massachusetts Ralph Gillespie, Plant Manager Terry Wyszkowski, Planning Manager (BO, 281-2211)	Manufacturing: video terminals
Phoenix, Arizona Barry Cioffi, Plant Manager Herb Erbe, Planning Manager (PN, 551-2211)	Manufacturing: printing terminals, circuit boards
Westfield, Massachusetts Paul McGaunn, Plant Manager Mike Knowles, Planning Manager (WF, 242-2211)	Manufacturing: special video terminals, small systems, printing terminals
Phoenix, Arizona Jack Delbrocco, Materials Acquisition Manager (AA, 602-869-5610)	Acquisition Center: circuit boards, components

Location and Manager	*Products and Functions*
Far East Interface Ed McDonough, Manager (MO, 231-5419) Charlie Polay, Planning Manager (MO, 231-5421)	Manufacturing and purchasing: various products and components

These functional managers can help you interface to Terminals Manufacturing:

Dick Esten, Group Manager (ML1-5/B95, 223-3955)
Dawn Greeley, Planning Manager (ML1-5/B95, 223-7374)
Bob Hopley, Materials Manager (HY, 259-3793)
Lou DiFinizio, Quality Manager (HY, 259-3760)
Fred Forsyth, New Products and Manufacturing Engineering Manager (LJ/D1, 282-2076)
Chad Cutler, Manufacturing Information Systems Manager (HY, 529-3761)
Chris McGill, Marketing Interface Manager (ML1-5/B95, 223-9177)
George Wood, Project Manager (ML1-5/B95, 223-7371)

4 STORAGE SYSTEMS MANUFACTURING

Manager: Bob Puffer (ML1-5/B94, 223-2863)

Storage Systems Manufacturing manufactures the disk, tape, and floppy disk storage products designed by Storage Systems Development. (Storage Systems Development's groups are outlined in Chapter 5, Section 5.) In partnership with Storage Systems Development, they manage Digital's overall storage business strategy.

Storage products are manufactured at these plants:

Location and Manager	*Products and Processes*
Colorado Springs, Colorado Bob Browne (CX, 522-3351)	Disk drives, controllers, cartridges
Natick, Massachusetts Michael Flaherty (NA, 233-2110)	Magnetic disk and tape heads
Springfield, Massachusetts Ron Payne (SP, 243-2240)	Floppy disks, tapes, tape cartridge drives, controllers
Tempe, Arizona Charlotte Frederick (TF, 302-894-5600)	Printed wiring boards

The Western plants, Colorado Springs and Tempe, interface with the Development organization in Colorado Springs. The Massachusetts plants interface with the Maynard Storage Development Groups.

These managers can help you interface to Storage Systems Manufacturing:

Bob Puffer, Vice President and Group Manager (ML1-5/B94, 223-2863)
Ed Barron, Technology Manager (ML1-5/B94, 223-9826)
Bob Jack, Manufacturing/Engineering and New Products Manager (ML1-5/B94, 223-6615)
Pat White, Quality Manager (ML1-5/E30, 223-7557)
Greg Plakias, Manufacturing Manager (Eastern) (ML1-5/T33, 223-9723)
Steve Stolle, Information Systems Manager (ML1-5/B94, 223-9579)
Bill Lowe, Materials Planning and Purchasing Manager (ML1-5/B94, 223-9733)

5 LSI MANUFACTURING

Manager, Jim Cudmore (ML1-5/E30, 223-2393)

LSI Manufacturing is part of the LSI Engineering and Manufacturing group. See Chapter 5, Section 4, for a description of the LSI Engineering organization. The LSI Manufacturing organization includes the 1100-person Hudson Manufacturing plant (HL) and the 700-person Aquisition and Test (A&T) organization.

The Hudson Manufacturing plant, located in Hudson, Massachusetts, houses the Manufacturing and the Semiconductor Engineering group. Their specialized facilities include two wafer fabrication operations, one for metal oxide semiconductors (MOS) and one for bipolar custom LSI. The plant also does pilot assembly and test on in-process wafers and on finished integrated circuits. Pilot assembly in Hudson is supported by a production assembly operation in Digital's Taiwan plant. In addition to normal plant support operations, Hudson also maintains extensive quality, reliability, and product engineering efforts.

Hudson's primary function is to support the production, assembly, and test of the custom integrated circuits designed for Digital's sole use. They provide quick turn-around prototype production during the design debugging of new circuits, and act as a first or second source after release to production. Hudson's primary engineering interaction is with Semiconductor Engineering, as they, in turn, support other engineering groups within Digital.

The 700-person Acquisition and Test (A&T) organization was the sole interface between Digital and the semiconductor industry for the purchase, test, and distribution of all of Digital's LSI and memory requirements. This role is changing as Digital moves to vertically integrate each manufacturing group. The purchase, test, and distribution of mature integrated circuits (those whose specifications, test processes, and yield are stable) is being moved into test centers such as San German, Puerto Rico, Phoenix, Arizona, and Galway, Ireland, to be closer to the site of use and under control of the user. In the long run, A&T will continue to be solely responsible for vendor base management; in the short run, they continue in a substantial production support role. Engineering groups interact often with A&T as they require new integrated circuits. A&T identifies and contracts with suppliers for new circuits. They qualify, establish test specifications, provide specification documentation, and ensure the quality of these new parts. Their substantial purchasing and component engineering resources support engineering requirements in this area.

6 FAR EAST MANUFACTURING ENGINEERING

Manager: Frank Cassidy (MO, 231-5317)

The Far East Manufacturing group does high-volume, low-cost manufacturing. Its several plants are an important part of Digital's manufacturing operation, producing $175 million of products in fiscal 1981. Their current products include memories, power supplies, communication modules, video terminals, power controllers, mass storage controller modules, and others.

Far East Manufacturing Engineering is divided into Memory, Process, and Product Manufacturing Engineering.

All memory manufacturing processs in Digital are the responsibility of the *Memory* Manufacturing Engineering group. Managed by Tom Marmen (MO, 231-5364), this group develops, defines, and maintains memory manufacturing processes, and introduces new memory products. They study the testability of new products, and select, design, and manufacture memory test equipment.

Process Engineering, managed by Steve Cullen (MO, 231-4512), develops test packages, mechanical fabrication processes, and provides process management. They also provide producibility services for Far East printed circuit products. The Producibility group, managed by Dick Dunlop (MO, 231-5543), develops a strategy for corporate standardization of module design rules (as described in DEC STD 030, *Module Manufacturing Standard*). The goals are cost competitiveness, optimum asset utilization, and meeting aggressive productivity goals.

Product Manufacturing Engineering, managed by Ed Doyle (MO, 231-5363), introduces new products into Far East plants. Products are either transferred from a domestic plant or begun as new products.

For products to be manufactured in the Far East, staff engineers must review:

- documentation
- producibility
- tooling
- training plan
- test strategy, process, and procedures
- packaging
- component sourcing

They assist with the development of the Manufacturing Plan and the PMT (Process Maturity Test) Plan. They are also the engineering communication channel for information flow between product users and the Far East plants.

CHAPTER 10

INFORMATION SERVICES

1 DIGITAL LIBRARY NETWORK

There are several library information centers located throughout Digital. The largest is Corporate Technical Information and Systems Library Services (CILS), an information center located in Maynard. It works cooperatively with 11 information centers in the Digital Library Network. Most information centers have information resources covering:

- On-line data bases in engineering, applied science, management, pure science, and other areas
- Books, especially engineering, management, and technology
- Directories, dictionaries, encyclopedias, handbooks, phone books
- Technical reports in engineering and management
- Periodicals
- Indexes and abstracts of periodical and report literature
- Standards
- Audio and video cassettes
- Competitors' manuals and promotional material
- Digital manuals, handbooks, bulletins
- Reference research consultants to assist you with specific engineering, technical, and business questions.

Contact the library information center at your location for assistance with engineering, technical, and business questions.

Digital Library Network

Location		*DTN*	*Personnel and Mailstop*
Colorado Springs		522-3116	Chris Blake, CX
Hudson		225-4771	Joyce Ward, Joan Allard, HL
Marlboro		231-5040	Michelle Johnson, MR1-2/A94
Maynard Corporate		223-6231	Borrowing materials
Information and Library Services		223-5038	Reference research consultants ML4-3/A20
Merrimack		264-5482	Nancy James, Sharon Penasack,
	or	264-6186	Michelle Rodriques, MK1-2/F5
Nashua		264-8036	Charlie Matthews, Dottie Mamos
	or	264-8050	ZK1-3/B31
New York City		333-3350	Frank Mauriac, NY
Rolling Meadows		421-5712	Janean H. Bowersmith, RL
Salem		261-2254	Nancy Sullivan, NI/W22
Santa Clara		521-2283	Lindalee Cummings, WR
Tewksbury		247-2643	Janet Slinn, Janet Potter, TW/B01
	or	247-2423	
Westminster		241-2537	Susan Kelly, WM/A74

Information Services
Each library information center's reference research staff provides professional consulting on employees' questions on a wide variety of topics. The reference research staff uses thousands of published sources and over 150 on-line data bases to obtain timely, critical information to help you with key decisions.

SCAN, SCAN/UPDATE
SCAN is the name for computer-aided reference information services. Usually, the product is an annotated bibliography of abstracts from externally published information sources, which can be ordered in full text from your library information center. If you need to identify what has been written on a specific job-related topic, over 150 data bases of engineering, technical, and management publications and research are covered.

SCAN/UPDATE is a service that can provide you with a monthly update of information sources on your topic. Every Digital employee who has a job-related need can benefit from this service. Trained information specialists will interview you to determine your needs. To use either SCAN service, call your local library information center for a SCAN request form.

Books, Technical Reports, The Library Catalog, and Interlibrary Loan
Books selected for the Digital Library Network contain new and important material in your areas of interest. Recommendations for acquisition are always welcome.

Books are arranged by the Library of Congress alphanumeric classification call number, which also appears on the spine of the book. A COM or printout catalog has replaced the traditional card catalog at many locations. Books are listed in the catalog by author, title, and subject. Audio-visual media are listed as well. In addition to books and technical reports in the Digital Library Network, each library information center has access to 7.5 million volumes in a national on-line network of university and special libraries.

Circulation of Materials
Any Digital employee may borrow material from the Digital Library Network by visiting, sending a request, or telephoning the nearest local library information center, subject to individual library policies.

Books, reports, and audio cassettes are loaned for four weeks, subject to recall after two weeks if requested by another borrower. Periodicals are loaned for two weeks. Video materials and manuals are loaned as needed. If a book, report, or instructional course is on loan, you can request to have your name put on a waiting list or ask if another copy is available in the network. As soon as the item is available, it will be sent to you.

Periodicals (Journals, Newspapers, Newsletters, and Bulletins)
The Digital Library Network subscribes to over 1000 periodicals to benefit employees in their fields of endeavor. Although holdings include microfiche and microfilm, photocopies of any article will be provided on request. Back issues may be borrowed. Photocopies of articles may be requested. Many libraries distribute semiannual lists of their periodicals and indexes.

Audio-Visual Media
Several hundred audio and video cassettes are available in the Digital Library Network. A list is available as part of the Automated Digital Library catalog.

Digital Publications
Each library information center has a reference collection of Digital publications. Hardware manuals, software manuals, handbooks, special publications, and directories are available for use in the library. In addition, local and specialized Digital newsletters and bulletins are available.

Competitors' Publications
Digital exchanges publicly-available information–promotional material, software and hardware manuals–with ten other computer manufacturers. The Corporate Information and Library Services, Maynard, maintains a complete collections of these documents. The competitors' indexes of publications and a list of holdings are available on fiche from Corporate and other library information centers. Copies of each document can be loaned throughout the network.

Purchasing Activities
Corporate Information and Library Services processes internal requistions for books, subscriptions, reports, standards, and association memberships for the BG (St. Bridget's), CF (West Concord), ML (Mill), MS (Powdermill Road), and PK (Parker Street) locations as well as WJ (Westford), and other new sites that do not have a purchasing function. All items must be submitted to CILS Purchasing, HL2-3/A20, on a Digital Internal Purchase Requistion, Form Number EN-1072A-08. If your location is not listed above, check with the purchasing group at your site.

Subscriptions must be authorized by a Vice President or a person designated by a Vice President. It is Digital's corporate policy to purchase only one membership to an organization per cost center. Individual memberships in IEEE and other general professional societies are not paid for by Digital.

Automated Library Systems
In addition to the standard information and technical services, the CILS Operations staff is initiating the beginning phases of an integrated automated library system. This specialized data base manage-

ment system is intended to provide on-line access to cataloging data for books, journals, and Digital-published material. Participating library information centers will be able to identify, locate, and borrow on-line any materials in the Digital Library Network.

Other Information Services
The Digital Library Network is not the only place you can go for information. Another is the Software Standards library. This library maintains a file of ISO, ANSI, FIPS, ECMA, CCITT, and Corporate Standards. Standards and Methods Control can supply you with hard and microfiche copies of Digital Standards. The Market Data Center is a source of marketing and competitive information. The VSMF (Visual Search Microfilm File), maintained by Specification Control Systems, contains manufacturing information, vendor information, industry manuals, specifications, and standards, and military and federal specifications and standards. Some of these libraries are described in detail elsewhere in the manual (see the Index).

2 DATA CENTER SERVICES
Manager: Bart Mecum (PK1/E33, 223-5188)

Data Center Services (DCS) is a part of Information Operations and Services. They provide a variety of information operational services for groups that do not have their own data center, or that are just establishing their own center.

2.1 CORPORATE DATA CENTER
Manager: Norman Shakespeare (PK1/E33, 223-4247)

The Corporate Data Center provides computer access and support services. They employ DECsystem-10, DECSYSTEM 20, and PDP-11/70. VAX/VMS will be available in late 1981. Standard Digital software is used. Their groups include Computer Operations (223-7864), Production Control (223-7872), and Customer Assistance (223-5715).

The Corporate Data Center also helps groups to start up their own data centers.

2.2 DATA CENTER CENTRAL SERVICES
Manager: Wally Majewski (PK1/E33, 223-2314)

Data Center Central Services (DCS) comprises several groups:

The *COM* (Computer-output microfiche) group (223-4794) provides reproductive services such as microfiche and microfilm production, diazo duplication, silver duplication, film processing, and source document filming.

Distribution (223-7881) provides distribution for COM products.

The *Tape Library* (223-8941) stores user tape inputs.

Xerox (223-7643) provides the services of a Xerox 9700: high-speed laser imaging printing, printing multiple impressions per page, printing using different character sets and fonts.

2.3 DATA CENTER PLANNING
Manager: Tom McLellan (PK1/E33, 223-4755)

Data Center Planning forecasts the hardware, capacity and contingency needs of Data Center Services. They also provide EDP (electronic data processing) security for the PK1 facility.

2.4 INTEGRATION AND TECHNICAL SUPPORT
Manager: Joe Johnston (PK1/E33, 223-4675)

Integration and Technical Support provides data communications and network planning for Information Operations and Services, new product and service evaluation, and data communications consulting.

3 MARKET DATA CENTER
Manager: Pamela Gifford Hallaren (PK3-1/S52, 223-2504)

The Market Data Center provides a central source of marketing and competitive information that can be used by all product lines and groups, Sales, Planning, Marketing, Engineering, and functional group personnel. Two primary areas make up the Market Data Center: the Market Data Research Center, and the Customer History Data Base.

3.1 MARKET DATA RESEARCH CENTER
Manager: Pamela Gifford Hallaren (PK3-1/S52, 223-2504)

The Research Center collects and organizes marketing-related information, answers reference inquiries, aids in research for specific projects, lends reports to requesters, and distributes the monthly Market Data Center Memo, a review of newly acquired reports. They maintain a collection of market research reports, directories, competitive files, and various marketing statistics and publications. Most notable are the following:

- *Market Research Reports*: The current collection consists of over 700 reports with subjects that range from in-depth analyses of specific products to broad overviews of certain industries. Information programs subscribed to include the following:
    - Stanford Research Institute's Business Intelligence Program
    - International Data Corporation's Corporate Planning Service
    - Quantum Science's MAPTEK Program
    - INPUT's planning services
    - DATAQUEST's planning services

  These services supply marketing reports of all types on a regular basis.
- *Competitive Information*: Information about our competitors is available from many sources, including:
    - *Competitive Company Files*: Press releases, product brochures, financial statements, news clippings
    - *Competitive Product Information*: Datapro & Auerbach series, competitors' reference manuals

- *Reference Manuals*
- *Annual Reports*: Competitors and Fortune 500 Companies
- *Consulting Organizations/Data Sources*: Organizations involved with marketing research
- *International File*: Market-sizing information on the non-US marketplace
- *Reference Books*: Dun and Bradstreet Directories, Thomas' Register, Moody's, Standard and Poors, State Industrial Directories, Who Owns Whom Directories, Industry Surveys, Industrial Outlook
- *Periodicals*: Harvard Business Review, Journal of Marketing Research, Sales Management, Fortune, Duns, Forbes, Datamation, Computerworld, Electronic News
- *Industry Newsletters*: Electronic Data Processing (EDP) Industry Reports, Autotransaction Industry Report, EFTS Industry Reports, Small Business Computer News, Micrographics Newsletter, Packaged Software Reports

3.2 CUSTOMER HISTORY DATA BASE

Manager: Toni Demars (PK3-1/S52, 223-3690)

This is a computerized data base of Digital's US customers, showing bookings by product line back through the fiscal year of 1972 and revenue by product line back through the fiscal year of 1979. At present, there are only a limited number of scheduled output reports, all quarterly. There are volume analysis reports for the US area, US regions, national accounts, major accounts, and Product Lines. All other requests are handled on an individual basis. Normal turnaround is two to three business days.

CHAPTER 11

CUSTOMER SERVICES

Manager: Jack Shields (PK3-2/A58, 223-2548)

The Customer Services group is made up of six major organizations that are crucial to the continued development of Digital's business: Customer Service Systems Engineering, Accessories and Supplies Product Group, Computer Special Systems Product Group, Educational Services, Field Service, and Software Services. These organizations are described in the paragraphs below.

1 CUSTOMER SERVICE SYSTEMS ENGINEERING

Manager: Steve Davis (PK3-2/S17, 223-2361)

Customer Service Systems Engineering (CSSE) provides technical expertise on customer service issues to Digital's development community during the planning and introduction of new products. They develop service products, Reliability and Maintainability (RAMP) definitions, Customer Service and market needs. CSSE helps to ensure that Digital's products are of high quality, cost-effective, and safe to use.

CSSE provides quantitative consulting services to clients within Customer Services and from other parts of the corporation. They are responsible for the hardware and software engineering of Customer Services' tools.

The three organizations within CSSE are Maintainability Engineering, Customer Service Engineering, and Management Science.

1.1 MAINTAINABILITY ENGINEERING

Managers: Henry Adleman (PK3-2/K41, 223-2638)
Joel Berman (TW/A02, 247-2520)
Walter Manter (MR1-1/S35, 231-6503)
Lee Mickle (WJ1, 257-1142)

Maintainability Engineering is the engineer's interface with Customer Services. They make sure that Digital's products can be serviced by our field organizations. They do this by working closely with the design engineer. They also lead Customer Services' new products introduction team, coordinating efforts to ensure that the tools are available to service a new product, and that field introduction happens smoothly.

Contact Maintainability Engineering early in Phase 0, while product requirements are first being defined. Early consideration of service requirements is critical to the economical design of a product.

If you do not know whom to contact in Maintainability Engineering, call the manager listed below under the type of product you are designing. This person will assign a Maintainability Engineer to work on your project.

Small Systems Hardware:	Howard Janke (WJ1, 257-1127)
Terminals:	Angela Smith (WJ1, 257-1141)
Customer Services CT (Computing Terminal) Program Office:	Darrel Bates (ML5-2/T53, 223-2763)
Advanced VAX Maintainability:	Doug Hanzlik (TW/A02, 247-2525)
Current VAX Maintainability:	Hank Watkins (TW/C18, 247-2577)
Maynard Mass Storage:	John Florentine (PK3-2/H17, 223-2010)
Colorado Springs Mass Storage:	Don Ames (CX, 522-3139)
Commercial Systems Software:	Phyllis Dunn (MK1-1/H02, 264-5157)
Technical Systems Software:	Ken Biddle (ZK1-2/C7, 264-8507)
European (all software products developed in Europe):	Stuart MacKenzie (Reading, England, [07]-(34)-85-131)
Software Communication Products:	Carroll Wright (TW/E92, 247-2155)
Hardware Communication Products:	Mark Hald (MK1-2/C15, 264-5930)
Communications Systems:	Bill Lahtinen (TW/D11, 247-2057)
Large Systems Hardware:	Art O'Donnell (MR1-1/S35, 231-6405)
Large Systems Software:	Jack Walden (MR1-1/S35, 231-5125)
Product Line Engineering (Telco, Graphic Arts, Word Processing, Retail Products, COEM, CSS, CSI, TPL):	Norm Bernard (MK1-2/K13, 264-5935)
Product Line Engineering (LDP, IND, MDC, IND, MDC, ESG, TOEM, MSG, GSG, Terminals, Micros, ECS):	Ed Kenney (MR1-1/S35, 231-5175)

1.2 CUSTOMER SERVICE ENGINEERING

Manager: Chris Ball (PK3-2/S77, 223-3040)

Customer Service Engineering designs, develops, and releases to Manufacturing any products needed to support Customer Services. These include providing tools for Field Service, training delivery systems for Educational Services, and software support tools needed by Software Services.

1.2.1 Remote Diagnosis Engineering

Manager, Hardware Development: Ken Raina (PK3-2/H29, 223-6349)
Manager, Software Development: Ed Spuler (PK3-2/H29, 223-7511)

Remote Diagnosis Engineering develops the remote diagnosis maintenance tools for PDP-11, VAX, and the DECsystem-10 and DECSYSTEM 20 families of products for the entire world. The group provides support to existing and planned Digital Diagnostic Centers. This support takes the form of new host software development, host software enhancements, problem resolution, design of remote diagnosis hardware, and support to existing hardware designs (consoles). For existing hardware designs, support includes problem analysis, the incorporation of ECOs (Engineering Change Orders), modification of equipment for other countries, and approval by Postal Telegraph and Telephone authorities for hookups on their telephone lines.

The Remote Diagnosis Engineering group provides consultation to CPU and peripheral design groups to ensure a product's capability for remote diagnosis, or to determine if new opportunities are possible by remote diagnosis.

Contact the group, via the assigned Customer Service Maintainability Engineer during the concept phases of any central processor or intelligent subsystem that is to be remotely diagnosed. The group will provide the remote diagnosis plan that will include hardware to be connected to the unit under test, and the diagnostic script to be run in the host computer. You will be required to furnish the group with a set of maintainability goals and objectives for the product, and to specify the Remote Diagnosis port interface.

1.3 RELIABILTY AND MAINTAINABILITY PROGRAM (RAMP)

Manager: John Shebell (PK3-2/K30, 223-3101)

RAMP provides a wide variety of support services to Customer Services and to the product development community:

- Measurement and analysis of the availability, reliability, and maintainability of our products and systems
- Power systems, packaging, and environmental engineering support for CSSE and the Accessories and Supplies Group
- Basic technology support for Customer Services for components, physical interconnect, signal integrity, FCC compliance, and similar issues
- Operational support for the Corporate Pricing and Policies Committee and for Customer Services' role in the Phase Review Process
- Long-range technology planning for Customer Services
- Consulting on reliability and maintainability for technology and market areas

Normally, RAMP works through the Customer Services product development teams. Contact RAMP directly, however, for information and support relating to general service strategies and plans, field data analysis and metrics, and technology-intensive issues. RAMP considers itself "the people to call when you don't know whom to contact in Customer Services."

1.4 MANAGEMENT SCIENCES

Manager: Robert Levasseur (PK3-2/S53, 223-5960)

Management Sciences is an internal consulting organization primarily supporting Customer Services and Sales. It contains a consulting and a support systems group.

1.4.1 Management Science Consulting

Managers: Ed Vail (PK3-2/S53, 223-5736)
John Wetmiller (PK3-2/S53, 223-6337)

Management Science Consulting researches areas such as improvement of the engineering design process, branch office modeling, life cycle costing, repair strategies, and logistics. Group managers can help you determine if their work applies to your area.

1.4.2 Management Support Systems

Manager: Frank Polischuk (PK3-2/S53, 223-6053)

Management Support Systems provides Decision Support Systems for Management Science Consulting, Customer Services, and Sales. They develop decision models, and provide continuing support for large ones.

2 ACCESSORIES AND SUPPLIES PRODUCT GROUP

Manager: John Alexanderson (RQ/A30, 264-5160)

The Accessories and Supplies Group (A&SG) consists of two product lines: Computer Supplies and Customer Spares. They provide a complete line of supplies, maintenance, and expansion products and services to complement Digital's hardware products.

2.1 DIGITAL COMPUTER SUPPLIES

Manager: Bruce Rollinson (RQ/N50, 264-5768)

Computer Supplies offers a complete line of operating supplies, site accessories, software documentation and components, and communications options. They also distribute and support add-on products that expand the functions of hardware and software products. Organized to provide responsive service to Digital's worldwide customer base, Computer Supplies' distribution network supplies 48-hour turnaround time for 95% of its products. Contact the product managers listed below for more information about their products.

Group	*Manager*
Senior Product Manager	Steve Grinley (RQ/N50, 264-5799)
Magnetic Media Products	Tom Dixon (RQ/N50, 264-4536)
Ribbons, Paper, and Site Accessories	Bill Choquette (RQ/N50, 264-6786)
Software Documentation	Haywood Gandy (RQ/N50, 264-6805)
Terminals and Add-on Products	Dale Gagnon (RQ/N50, 264-5164)
Communications Devices (Modems)	Ric Allen (RQ/N50, 264-8846)

2.2 CUSTOMER SPARES

Manager: Ron Rando (RQ/E72, 264-6977)

Customer Spares offers a full spectrum of maintenance products and services to customers who elect to perform their own computer hardware maintenance or to expand and enhance their systems. Spare parts are available either singly or in engineer-designed spares kits. Other self-maintenance aids include tools and test equipment, preventive maintenance parts, Field Change Order information and parts, and hardware documentation and diagnostics. The hardware documentation is available by subscription on microfiche as part of the Maintenance Documentation Service.

Aids for customers in determining their inventory needs include the Maintenance Product Recommendation Service, which furnishes inventory recommendations based on a 70% to 98% level of service, and the Parts Availability Service, which provides up to ten years of spares support on a contractual basis. For more information about Customer Spares, contact the following product managers:

Technical Services:	Verne Westgate (RQ/E72, 264-6981)
Product Manager:	Arnold Beauregard (RQ/E72, 264-6980)

2.2.1 Environmental Products and System Accessories

Manager: Gerald Beauchesne (RQ/S61, 264-8721)

This Customer Spares group consists of the following:

Environmental Products (manager: Bill Coleman, RQ/S61, 264-4681) provides enhancements for the computer system environment. Products address the quality of electric power, improvements to raw power, and customer convenience in providing power to a computer system.

System Accessories (manager: Ron Souter, RQ/S61, 264-6807) provides system expansion products such as cables, cabinets, expansion boxes, backplanes, and connector blocks.

3 COMPUTER SPECIAL SYSTEMS PRODUCT GROUP

Manager: Jerry Butler (NP, 264-6209)

This group is devoted to filling customer needs not otherwise satisfied by Digital's standard volume offerings. In performing this function, Computer Special Systems (CSS) engages in two mutually complementary and supportive businesses. First, they design and develop special hardware, software, or turn-key systems for specific customer applications. Second, they design and develop a wide range of hardware and software products which are application-oriented or complement Digital's standard product offerings.

To achieve these ends, the group has its own Marketing, Engineering, and Manufacturing organizations for software as well as hardware. CSS is spread throughout the world: in addition to having three Engineering/Manufacturing facilities in the United States, CSS has facilities in Canada, Australia, Japan, the United Kingdom, France, Sweden, and Germany. Each facility has a marketing, engineering, and production staff, and is capable of designing and manufacturing products to special order.

CSS projects vary from very small to large and complex, and from essentially "standard" products to tailored one-time systems with special hardware and software.

4 FIELD SERVICE

Manager: Dick Poulsen (PK3-2/S87, 223-7429)

Field Service provides high-quality, accessible, cost-effective preventive and remedial maintenance services for Digital's customers. Field Service has segmented its business into three major groups (Terminals, Computers, and Systems) to focus on service-delivery methods most effective in each segment. The Field Service organization includes over 8,000 service representatives operating from a network of over 400 field locations.

Field Service works with Engineering through the Customer Service Systems Engineering (CSSE) organization (see Section 1 of this chapter). CSSE is the primary interface to Engineering within the Customer Services organization. They ensure that products are developed with reliability, availability, maintainability, and productivity (RAMP) features, to meet the service needs of customers at a low cost of ownership. (See Section 1.3 of Chapter 11 for more information on RAMP.)

5 EDUCATIONAL SERVICES

Manager: Del Lippert (BU/E17, 249-4200)

The primary purpose of Educational Services is to communicate information. The organization helps customers and employees make better use of Digital products by acquiring new skills and knowledge. They also provide computing education to the general public.

Over 1200 employees produce courses and instructional products. They also produce technical publications (in print and microfiche), and offer book and media services. Last year the organization operated 250 classrooms at 27 worldwide training centers, presenting over 300 different courses. They provided 500 computer systems for use in 2.5 million student hours of instruction. They also produced 35,000 color slides, 16.6 million microfiche sheets, and published over one million volumes of technical manuals.

Basically, Educational Services is a conduit for technical information. They gather, interpret, organize, and then disseminate information in the most effective and efficient medium.

The organization has tied their course development people and technical writers to Digital's seven Engineering sites across the US and Europe. Their goal is to make sure that courses and publications reflect state-of-the-art information via the latest media and methods. For example, the organization develops new audiovisual courses, uses modern instructional technology (such as video disks and computer-based instruction), and employs computer-generated graphics, visuals, and typesetting.

Using information from Engineering, Marketing, Software Services, and Product Support, the organization transforms this data into three basic products:

- *Instructional Services and Products*: lectures and lecture/lab demonstration, self-paced and computer-aided instruction
- *Technical Documentation*: technical manuals and microfiche, books published by Digital Press
- *Media*: corporate resource for artwork, video tapes, slides, photography, audio tapes, and educational writing and editing

Educational Services serves Digital's customers, Field Service, Software Services, personnel management, Digital Information Systems, and any other group that needs their services.

Contact Education Services on any of the following occasions:

- When you want to take a course
- When you are in the design stage of a product
- When you want to work with technical writers on documenting your new hardware product
- When you want to write a book for Digital Press
- When you need visuals, typography, editing, writing, or audiovisual support services for an upcoming paper or presentation

To enroll in a course at one of the training centers, or at an ILC (Individual Learning Center), contact Bedford (249-4674).

To obtain an Employee Catalogue and more information about courses available, contact Pat Cataldo, US Employee Education Manager (US, 617-568-1431).

For technical documentation and course development assistance, contact Joe Santini (BU/E02, 249-4387), or any of the site managers:

Maynard:	Carl Klempner (PK3-1/T12, 223-2487)
Merrimack:	John Griffin, acting (MK1-2/M26, 264-6600)
Tewksbury:	Judy Jurgens (TW/D04, 247-2621)
Marlboro:	Bob Hymes (MR1-2/T17, 231-5972)
Bedford:	Mike.Padovano (BU/E06, 249-4207)
Reading, England:	Jack Cromwell(RG, [44]-(734)-58-3555)

For Media Services, contact Marvin Rothberg (BU/E35, 249-4020).

For Digital Press, contact Marcia Kenah (BU/E44, 249-4072).

6 SOFTWARE SERVICES

Manager: Don Busiek (PK2/S56, 223-5199)

The primary goal of this organization is to satisfy the software services needs of Digital's customers. The organization ensures that software products and services are easy to sell, install, use, and maintain.

Software Services consists of Field Software Services, the Operations Group, and Corporate Adminstrative Systems.

Field Software Services: The field consists of three areas: the United States, Europe, and the General International Area (GIA). Field Software Services is responsible for providing four basic services to customers, through local offices throughout the world, and through centralized Telephone Support Centers.

- *Warranty Services* are described in the Software Support Categories Addendum to the Software Product Description. These services may include installation of supported Digital software products, answers to written or telephoned inquiries on remedial service and usage questions, and on-site visits when necessary.

- *Sales Support*: Software Services is part of Digital's sales team and as such is responsible for all technical aspects of the sale of software products.

- *Professional Services* offer a wide range of consulting and project management services to customers on a resident, time-and-materials charge, or fixed-price basis.

- *Software Product Services* support standard software products after software product warranties expire. Contractual Software Products Services include Self-Maintenance Service for Software, Basic Service for Software, and DECsupport Service for Software. Software Product Updates are also available.

The *Operations Group* provides centralized technical support to Software Services. They also coordinate training and administrative activities, and act as an intermediary between Field Software Services and other corporate groups. They develop and maintain internal Management Information Systems, and perform code maintenance for certain products.

The Operations Group includes the following groups:

- The *Technical Support Group*, managed by Dave Backman (PK2/S44, 223-7110), provides field technical services for Digital's software products. They interface with other groups involved in the creation and delivery of software products, including Software Engineering and Customer Service Systems Engineering. Support services include back-up support to Field Software Services, maintenance of Large Systems Group products, participation in the introduction of major products, creation of support tools, and assistance with teaching and training services.

- The *Management Information Services Group* (MISG), managed by Bill McCullough (PK2/S44, 223-4876), designs and develops internal programs to aid Software Services in managing and controlling its operations. They run these internal programs in a production environment.

The *Corporate Administrative Systems Group* (CASG), managed by Angela Cossette (PK2/E49, 223-4511), provides support services to Software Services and central services to customers. CASG interfaces with Engineering about functions such as Software Performance Report (SPR) administration, Software Product Descriptions (SPDs), field testing of software products, and publications such as Dispatches and Buffers.

Software Services needs for you to develop reliable, high quality software products to minimize support costs. Software products, ideally, should be easy to sell, install, use, and maintain.

The organization also asks your cooperation in providing prompt Software Performance Report SPR) replies to customers. They also need assistance in conducting effective field testing of new and revised software products. Furthermore, Software Services needs technical assistance in the support of software to meet their goal of having satisfied customers. They also need active participation by Software Product Management in the generation of Software Product Descriptions.

CHAPTER 12

REFERENCES AND RESOURCES

This section references information about Digital's publications, committees, and services. Listed is information that can help you obtain copies of promotional materials, hardware and training materials, software documentation, and financial information. Additionally, some company policies, standards, and specifications are described briefly. For your information, lists of company newsletters, library publications, and current committees are included. Finally, this section highlights resources available in the Digital Telephone Directory as well as what you should know about company transportation and employee training and education.

1 PUBLISHING AND CIRCULATION SERVICES

Manager: Dick Wesche (NR2-2A1, 234-4305)

Printing and Circulation Services (P&CS), a part of Digital Information Services, provides various related services to help you plan, produce, procure, and distribute your communication requirements.

Customer Services assists in coordinating your graphic communications (typesetting, printing and mailing) requirements. They make sure that your job is prepared and organized for production by P&CS or an outside vendor.

Address:	NR2-2/C2
Manager:	234-4403
Supervisor:	234-4220
Hotline:	234-4297

The *Customer Literature Inquiry Service* fills customer requests for promotional literature, where the inquiry is the result of a Digital advertisement, publicity, trade show, or other promotional activity. If you are contacted by someone outside the company looking for this type of literature, forward their requests to this operation.

Order Service:	(inside Digital) 234-4401
	(outside Digital) (617)393-4401

The *Publications/ Literature Order Processing/Fulfillment* group distributes the majority of Digital's promotional materials, technical documentation, and internal general-use printed forms. When a group needs to order this type of material, the cost center manager may contact a "lit (literature) contact" to coordinate requests. P&CS puts out Publications Indexes with lists of materials available from this operation.

To request materials, fill out a Request for Literature form (EN-01878-05), and mail it to NR2-2/W3. Urgent requests can be sent by RCS code (TWX) NR12, or by FAX 234-4257. Accurately indicate the part number of each piece ordered. Orders for literature and forms are normally shipped within 5 work days after receipt. Indicate the date you wish to *receive* the material in the "Date Required" box on the request form.

The *Printing Operation* produces forms, newsletters, manuals, and other printed material for most Digital facilities and offices as requested. A Printing Requisition form (EN-01023-05) must be filled out and signed by your cost center manager for work to be processed. If delivery times are critical, contact P&CS Customer Service well in advance. Contact the Customer Service Hotline (234-4297) for more information on job specification.

Mailing List Maintenance establishes and maintains a variety of mailing lists of Digital personnel, customers, and prospective customers. They also generate mailing labels and print-outs. To establish a new list, update a list, or obtain a print-out, fill out a Request for P&CS Mailing Services form (EN-1186A-05) and return it to Customer Services. The Customer Service Hotline (234-4297) can answer your questions.

The *Mailing Operation* provides complete mailing services to audiences within Digital, its customers, and prospective customers. They distribute periodicals such as Digital This Week (DTW), DECWORLD, and the Annual Report, as well as most of Digital's sales promotion literature and other communications. Smaller mailing distributions are handled when groups lack the resources to do them themselves. The Mailing Operation will also assemble notebooks, press kits, and other media upon request. For assistance from the Mailing Operation, fill out a Request for P&CS Mailing Services form (EN-1186A-05) and send it to Customer Services, or call the Hotline on 234-4297.

2 COMPANY POLICIES, STANDARDS, AND SPECIFICATIONS

DEC STD 001
This document is available from Standards and Methods Control, ML3-2/E56, 223-9475. In three sections it describes the corporate policy for Digital Standards and provides general information about the management and administration of the Digital Standards system. It describes the procedures required to create new standards and make changes to existing ones. It also describes the format and minimum content requirements for Digital Standards.

EL and 7665 Class Documents Index
This index to Digital Standards, Specifications, and Manuals is published periodically in the Engineering Newsletter and is also available from Standards and Methods Control, ML3-2/E56, 223-9475. Digital Standards and Specifications in the Index are arranged by number and areas of interest. The Index contains abstracts, responsible persons, departments, revision level, and date of revision.

Personnel Policies and Procedures
This manual is available from the Personnel Policy Group, PK3-1/C19, 223-4229. It contains corporate personnel notices and administrative procedures. Distributed to all personnel representatives and cost center managers on request.

Corporate Policy Memorandums
This document is available from Win Hindle, ML10-2/A53, 223-2276. It contains general information and guidelines regarding company operations policy. Distribution is restricted.

Software Development Policies and Procedures
This manual is available from Gladys Pannell, ML3-5/B39, 223-5860. It contains policies governing the process of developing software products, including plans, specifications, and a description of the phase review process. Available by subscription.

Computer Industry Standards Summary
This document (document number AA-H728B-TK) is available from the Software Distribution Center. It lists all information processing standards approved by the International Standards Organization (ISO), American National Standards Institute (ANSI), Federal Information Processing Standards (FIPS PUBS), European Computer Manufacturers Association (ECMA), and International Consulting Committee for Telegraph and Telephone (CCITT). Pending ANSI standards are also listed, with approximate completion and approval schedule. A short abstract is provided for ISO, ANSI, and FIPS standards. Call 234-4479 for a copy.

3 RAINBOW BOOKS

Rainbow Books are reports produced and distributed by various organizations in Engineering and Manufacturing. The following list identifies these reports by color and title, distribution, and responsible contacts.

Red Book
Central Engineering Long Range Product Forecast. This book is a five-year marketing and technology forecast for Central Engineering products. It is generated annually within each Central Engineering product development organization, and published by Corporate Product Management. Distribution is strictly controlled. Contact Rick Corben, ML12-1/T39, 223-3123.

Beige Books
Central Engineering Group Operating Plans. Beige Books are three-year operating plans generated annually by product development groups. They contain a base plan for product development, and supporting data such as product summaries and operating budgets. Distribution is controlled by individual development groups.

Blue Book
Manufacturing Management Report. Produced monthly, the Blue Book has limited distribution. Sections of the Blue Book referencing company plans of a highly confidential nature are strictly controlled. Available from Pete Bagg, ML1-4/P69, 223-8533.

Pink Book
Option and Basic System Actual Cost Report. Distributed quarterly, the Pink Book is strictly controlled and confidential. Available from Everett Carr, ML1-5/F31, 223-3841.

Brown Book
Product Line and Area Financial Statements. Produced monthly, the Brown Book has limited distribution and is strictly controlled. Available from Corporate Management Reporting, Barry Marshall, MS/F11, 223-9503.

Yellow Book
Engineering Product Status Report. Central Engineering groups report monthly on schedule, product content, and product development cost changes for each of their Baseplan items, and for various development efforts in Product Line engineering. Operations managers gather input from product managers, and forward it to Central Engineering Operations for publication. Distribution is strictly controlled. Contact Charles Picariello, ML12-1/T42, 223-2848.

Slate Books
Strategies by Process and Function, Planning and Budgeting
Produced periodically by managers of Manufacturing processes and functions. The books have open distribution. Contact Jim Melvin, AC/E48, 223-2310, for more information.

Polka Dot Book
Manufacturing's Report on New Products Being Introduced into Manufacturing. Produced quarterly, the Polka Dot Book has limited distribution and is strictly controlled. Available from Donna Allan, QI-1/E22, 280-7281.

4 FINANCIAL INFORMATION

Chart of Accounts
This document is available from General Accounting, Sharon Duggan, MS/K19, 223-4143. It contains general ledger accounts, cost center numbers, discrete project numbers, product line numbers, sales activity codes, and expense activity codes. Copies are usually sent to all cost center managers.

DEC Standard Price List and Addenda
This document is available from Reference Services, ZX, 253-2472. It is published quarterly on the first Monday of each fiscal quarter. Addenda are published monthly. Distributed on request.

5 GENERAL REPORTS AND DOCUMENTS

Component Index
This is a guide to purchased components in use at Digital. Primarily a design engineering tool, it is available in hard copy and microfiche. It is issued in three separate volumes: Multi-class, 90 class, and FCD (Functional Code Descriptor). Available from Helen Monsen, NR5/M2 234-4958.

DECUS Program Library
The DECUS Program Library, available to both Digital and outside DECUS members, is a clearing house for user programs. It provides a reproduction and distribution service only. No programming assistance can be given. If a program does not work as stated, the problem should be documented and sent to DECUS. It will be forwarded to the author for comment. If the program is deemed inoperable as stated by the author's documentation, the program will be removed from the library.

The description and availability of the software products described in the foregoing catalogues are subject to change without notice. Distribution shall be in accordance with the Standard Policy for each software product.

DECUS Program Library Catalogues

- PDP-11/VAX
- PDP-8, FOCAL 8, BASIC 8
- DECsystem-10 and DECSYSTEM 20

DECUS catalogues are published once a year. Updates are published in the quarterly newsletter DECUSCOPE. The following is a list of DECUS Program Library contacts:

- General Information: 231-4100
- Program Orders: Leslie Dube, MR2-3/E55, 231-4135
- Submissions and Program Information: Liz Clancy, MR2-3/E55, 231-4178

Document Control File (DCF)
This is an automated file with Engineering document number, description, revision, ECO pending, and site location data. For access, contact Carole Fiorentino, ML4-2/E27, 223-3931.

Market Data Center Memos
This index of new reports, recent findings, abstracts, and financial marketing reports is published monthly. Contact Pamela Gifford Hallaren, PK3-1/S52, 223-2504.

Minicomputer, LCG, VAX, and KS10 Libraries
Microfiche compilations of all Digital documentation useful to Field Service engineers. Library contains hardware manuals, diagnostics, and all maintenance-related documentation. Index to fiche is included. Available from Mary Antonelli, 249-4019, Bedford.

Option Module List
This document is available from June Payne, ML3-3/H14, 223-2912. It contains designations of all equipment which has been, is, or will be available for sale by Digital. The list is sorted by model number, and gives the responsibility for and status of each model number (including CSS and Software items) as well as a description and, generically, where it is used. Two versions of the list are published. Both are in hard copy and microfiche.

Version 1 is updated quarterly on hard copy and monthly on microfiche. Status 0 (cancelled), status 1 (unannounced), and status 7 (obsolete) entries are not shown. To be added to the distribution list, contact Jane Hanley (223-6493) or Karen Owens (223-2886).

Version 2 is updated monthly and is a complete listing of options and modules. The list is confidential and is distributed on a need-to-know basis. For a copy, contact Dick Best (223-2273) or June Payne (223-2912).

A *Computer Special Systems* subset of all options and modules is also available on a need-to-know basis. Copies are available from Jane Hanley, ML3-3/H14, 223-6493.

An *Option Module Software Subset List* is also available from Jane Hanley, ML3-3/H14, 223-6493. This list contains option numbers, responsible person, design engineer, product manager, manufacturing representative, status code, product category, description, and what it is used on. Distribution is monthly and restricted to a need-to-know basis.

Purchase Specification Microfiche
This data base contains purchase specifications on components purchased by Digital. It is available to the user at Specification Control Systems, NR5-2/P67, or through distribution by contacting Ann Byra, 234-4964.

Reliability Reports, Mean-Time-To-Repair Options, Summary Reports
This report contains detailed information from the field on systems and options. Available on request from Dori Cohen, PK3-2/S53, 223-2440.

System Software Information
Distributed to Field Service, Sales, and Software personnel, this manual is a reference guide for support information concerning Digital software products. It supplements information found in the software product descriptions. The manual is available from Gladys Pannell, ML3-5/B39, 223-5860.

VSMF (Visual Search Microfilm)
This is a subscription service containing vendor catalogue data on many products and technologies supplied by U.S. manufacturers. It is updated monthly and is available for viewing at Specification Control Systems. Contact Helen Monsen, NR5/M2, 234-4958.

The DEC Dictionary
The DEC Dictionary is designed to define the vocabulary of DEC English, a special language used in some technical writing at Digital. The purpose of DEC English is to decrease the number of words used in documents, making them more accessible to users, especially those not fluent in English. Documents written in DEC English are easier to translate, and may someday be machine-translatable. Contact Phyllis Walsh, BU/E31, 249-4112, for more information.

The JOBS Book
The JOBS Book is Digital's worldwide listing of available career opportunities. Employment organizations forward their job openings for publication. Published every two weeks, the books have sections on US Employment, Europe, and the General International Area. All positions are listed by function. The JOBS Book can help you discover new career opportunities, and contact organizations that can help you make career choices. The JOBS Book is available at several locations. Call Kathy Barnes, CF2-1/J10, 251-1030.

Field Sales Guide
The Field Sales Guide, marketed outside Digital as the Consultant's Reference Guide, is a 6-volume guide to all of Digital's products, services, and policies. Types of information include hardware and software data (configurators, technical summaries, Software Product Descriptions), descriptions of Digital service organizations, product lines and their offerings, technical overview charts, corporate history, sales and service locations, and referrals to a number of supporting publications. The Field Sales Guide/Consultant's Reference Guide is available in most Digital Corporate Libraries, or by calling 223-6955.

In-House Directory of Services
This booklet can help locate many of the services available within Digital. Entries are grouped by type of services, and are indexed and cross-referenced. Some of the topics are: Communications, Education and Training, Hardware Installation and Maintenance, and Standards and Procedures. The In-House Directory of Services is available from Internal DECUS, 231-6767.

Training Resource List
The Training Resource List is a compilation of education and training opportunities from many different sources. It includes workshops relating to Digital Information Systems, Engineering Technical Training, Field Service, Office Education, the Programmer Training Program, Sales Training, and many other groups. The Training Resource List is available from Joy Tucker, 223-9710.

6 COMPANY NEWSLETTERS

The list below represents only some of the newsletters published by Digital organizations. The intent has been to list those newsletters pertinent to Engineering personnel. To receive a newsletter, contact the corresponding responsible person.

Newsletters	*Contact/DTN*
Access (Manufacturing, Distribution & Control)	Catherine Hayward, 264-5712
Added Value (Technical OEM)	Linda Falvella, 223-9696
CAD Newsletter	Louise Lemaire, 223-5327

Newsletters	*Contact/DTN*
CLAS Software Dispatch	Diana Hallett, 223-5886
Consultant's Reference Guide Newsletter (New Products Marketing)	Pat Prevost, 223-6664
DECminster (Westminster Manufacturing)	Judy Shaughnessy, 241-4011
DECsystem-10 Bulletin and Dispatch	Diana Hallett, 223-8726
DECSYSTEM 20 Bulletin and Dispatch	Diana Hallett, 223-8726
DECUScope	Paula Morin, 231-4142
Digital Software News	Diana Hallett, 223-8725
Digital This Week	Available at all facilities
Digitimes(Field Service Manufacturing East)	Michele Barrett, 236-2586
DMS-11 Software Dispatch	Diana Hallett, 223-8725
Educational Computer Systems Newsletter	Jane Goldman, 272-3663
Engineering Newsletter	Karen Owens, 223-2886
ESG Headlines (Engineering Systems Group)	Gail Coutts, 231-6900
External Resources Newsletter	Maryann Reardon, 223-4749
IAS Software Dispatch	Diana Hallett, 223-8725
Inside Marlboro Manufacturing	Diane Lorion, 231-5627
Insight (VAX newsletter)	Pat Ward, 223-6600
Large Buffer (Software DEC 10/20)	Diana Hallett, 223-8725
Mainely DEC (Maine Manufacturing)	Pat Vinje 271-2328
Market Data Center Memo	Jerry Todd, 223-3631
MicroEclectic News	Molly Burton, 225-4821
Microware Newsletter	Bill Vaillancourt, 225-5027
MINC-11 Software Dispatch	Diana Hallett, 223-8725
Mountain Matter (Colorado Springs Manufacturing)	Sloan Devant, 522-3055
New Hampshire View (Merrimack Manufacturing)	Karen Rhine, 264-5003
Office Views	Rosie Rosenzweig, 223-6877
People Paper (West Springfield Manufacturing)	Carolyn Malloy, 244-2145
Personnel Newsletter	Andy Kurtz, 223-4229
Please Post - Library Newsletter	Corporate Library, 223-5821
Que Pasa? (Albuquerque Manufacturing)	Joyce Cardin, (505) 345-3311
Real Times (Internal DECUS and Internal Equipment Group Newsletter)	Joan Silverman, 231-6767
RSMX Software Dispatch	Diana Hallett, 223-8725
RSTS-E Software Dispatch	Diana Hallett, 223-8725
RT-11 Software Dispatch	Diana Hallett, 223-8725
Salem System Highlights (New Salem Manufacturing)	Sue Brander, 261-2455
Sights and Sounds (Woburn Manufacturing)	Michelle Barrett, 236-2586
Small Buffer (Software PDP-8/11)	Diana Hallett, 223-8725
Software Engineering News	Maddie Anastas, 223-2339
Software Tools Development and Methods	John Hrones, 264-8089

Newsletters	*Contact/DTN*
Specification Control Systems Biweekly Bulletin	Alice Daby 223-2275
Sun DEC (Phoenix Manufacturing)	Steve Speck 551-5484
The Minute Man Newsletter (Software Product Service)	Rosemary Eash, 223-8309
The Readout (Westfield Manufacturing)	Scott Danzig, 242-2622
Tidbits (Engineering Information Control Newsletter)	Rosalie Johnson, 223-2403
TMG Crossroads	Rochelle King, 259-3829
US Area News (US Field Personnel)	Nancy Settle, 223-8446
What's Up DEC (Burlington, Vermont Manufacturing)	Prudy Sullivan, 266-2244
Word's Out (Laboratory Data Products)	Jim Andrews, 264-5851

7 LIBRARY PUBLICATIONS

UPDATE – Corporate Library Newsletter
This monthly publication includes a select list of new books, reports, proceedings, and magazines received in the Corporate Library. It also includes current information on library activities and services, book reviews and special features. To be added to the distribution list, contact Jeanne Thompson, ML4-3/A20, 223-5038.

Library Link Lists
These are bibliographic compilations of the Corporate Library's collections on specific subjects, such as computer-aided manufacturing, small business computers, and data communication. Publication of these lists is irregular. Special topical requests can be researched. Contact the Reference Department, ML4-3/A20, 223-2695.

Other Digital Libraries
Contact individual site libraries in the Digital Library Network to discuss the availability of other local library publications, including newsletters and lists of periodicals.

8 DIGITAL COMMITTEES

Committees	*Contact/DTN*
Automated Drafting Systems	Allan Kent, 247-2429
Contracts Review	Steve Brace, 223-4491
Corporate Information Services Standards	Norm Horne, 223-5075
Critical Materials	Zoe Rae, 223-6727
DEC BASIC Standard	Tom Harris, 264-6779
DEC COBOL Standard	Bruce Miller, 264-6684
DEC Keyboard	Paul Nelson, 223-3528
DEC Standard 012 Steering	Joe Kurta, 223-8895
Design Services Steering	Dick Reilly, 223-2982
Diagnostic Engineering Managers (DEMC)	Warren Moncsko, 223-4080

Committees	*Contact/DTN*
Engineering	Allan Kent, 247-2429
Engineering Board of Directors	Bill Long, 223-2819
Environmental	Ed Spuler, 264-6720
Finance/Administration	John Fisher, 223-1933
Group Manufacturing/Engineering	Frank Cassidy, 231-5317
Group Vice Presidents	Ted Johnson, 223-5942
Language Standards	Jeff Rudy, 264-6680
Low End Research and Development	Jesse Lipcon, 223-3207
Major Contracts Review	Royce Fuller, 251-1514
Manufacturing/Engineering	John Holman, 223-5533
Marketing Task Force	Glenn Reyer, 264-5974
Office of Development	Gordon Bell, 223-2236
Operations	Win Hindle, 223-2338
Order Administration	Denny Bjork, 253-2518
Order Administration Managers	Les Norman, 231-5811
PASCAL Internal Standards	Leslie Klein, 247-2653
Patents	Ron Reiling, 223-2991
Personnel	Shel Davis, 223-2838
Personnel Policy Development	Andy Kurtz, 223-4229
Personnel Systems Management	Romney Biddulph, 223-4166
Personnel Systems Working	Jeff Singer, 223-6557
Pricing Policy	Ted Johnson, 223-5942
Printed Circuit Communications	Joe Kurta, 223-8895
Producibility	George Ross, 232-2596
Product Safety	Carlton Davenport, 223-6554
Public User Body (PUB)(CAD Users)	Don DiMatteo, 223-2438
Quality Board of Directors (QBOD)	Art Sturgis, 223-6950
Research and Advanced Development	Lorrin Gale, 223-5703
Technology Managers Committee	Bob Glorioso, 223-5250
Test Measurement Equipment Center	Bill Norris, 242-2238
VAX Architecture	Dileep Bhandarkar, 247-2021
VAX Layered Products	Tom Hastings, 264-6767
VAX New Products	Mike Powell, 247-2856
Wirewrap Communications	Joe Kurta, 223-8895
Workmanship	Bill Yadlon, 232-2497

9 DIGITAL TELEPHONE DIRECTORY

The Digital Telephone Directory contains a plethora of information about the many resources available to you at Digital. The directory is available to all employees at Office Supplies Stockrooms throughout Digital's facilities. Your department secretary can direct you to the proper source or get one for you.

The following information and procedures are contained in the directory:

- North American Customer Assistance
  - Extension and location
  - Important numbers to know within Digital facilities in Massachusetts
- How to update your listing
- Metropolitan Boston Telephone Service

- Dialing instructions for
  - Digital Telephone Network (DTN)
  - WATS lines
  - Metropolitan Boston
  - Long distance
  - International calls
  - Local calls
- Special Telephone Services
  - Credit Card calls
  - Telephone service requests
  - Conference calls
  - Transferring calls
- Corporate Message Services (RCS)
- International Suggested Calling Times
- World Holidays
- Domestic Suggested Calling Times
- Mail Services
  - Post Office
  - Interoffice
  - Field Office
  - Mail arrival/departure schedules
  - Special Services
  - General Information
- Location Codes
- Order Processing Groups
- Personnel Listing
- Departmental Listing
- Domestic Office Listing
- European Listing
- General International Area Listing
- International Distributors
- Emergency Numbers

10 TRANSPORTATION

Interplant
Aircraft and van transportation services are available to and from the various Digital facilities in the New England area. Van schedules are posted on bulletin boards through facilities. Aircraft schedules are posted at the entrances to the facilities and paper fliers are available from receptionists or security guards. Scheduled freight flights (allowing up to 2 passengers) leave Boston every Saturday afternoon for Dublin, Ireland and Frankfurt, Germany. Contact Parker Street travel at 223-5522 for reservations and information.

Commuter
Digital encourages employees to form car pools and van pools to travel to and from work. In fact, Digital will provide a commuter van to anyone who can round up at least 10 riders including a driver. If you are interested in joining a car pool or a van pool, or starting either one yourself, contact the Commuter Transportation Department, CF/B88, 251-1525.

11 EMPLOYEE EDUCATION AND TRAINING

Employee education exists to improve employee job performance by delivering quality education products in a timely, cost-effective manner. General training is open to any employee on a first-come, first-serve basis. The organization offers total programs for groups such as Software Services, Digital Information Systems, and Field Service. They also provide programs for specific job functions such as clerical skills, word processing training, software training, hardware training, and a variety of other programs.

Courses are scheduled at Bedford and other Digital facilities. On-site courses are available by arrangement. Self-paced instruction and audio-visual courses are offered at six Individualized Learning Centers: Maynard; Bedford; Princeton, New Jersey; Rolling Meadows, Illinois; and Los Angeles.

Lecture/lab software courses cover VAX/VMS, RSX, RSTS, DECsystem-10/DECSYSTEM 20, BLISS language, Standard Editor, etc.

New and current users of Word Processors can obtain introductory, basic, intermediate, and advanced courses. Users of the DECsystem-10 and DECSYSTEM 20 can learn the hardware, software, and overall capabilities of the systems as well as specific skills like text formatting and editing. In communications, courses are offered on the Internal Message Switching system (RCS) and the Electronic Mail System (EMS).

The *Employee Education Course Schedule*, published quarterly, details offerings at US locations, announces new courses, and contains information about current educational resources. This publication is sent to all US cost center managers, personnel representatives, and personnel service administrations. If you need a copy, contact the Schedule Editor, BU/E54, 249-4396.

The *Employee Education Catalogs* are published every 12 to 18 months and contain complete descriptions of course contents, prerequisites, and objectives. Separate catalogs exist for Field Service, Software Services, and Office Education courses. For more information about courses, call Employee Education Marketing, 249-4300.

APPENDIX A

How To Protect Digital's Intellectual Property

Digital is a high technology company and a leader in the computer industry. To maintain this leadership, Digital must continue to develop and protect its various forms of proprietary information and knowledge. Such information and knowledge can take the form of ideas embodied in products (both hardware and software), processes to build, assemble, or test those products, business information concerning sales and marketing figures, published information contained in books, manuals, engineering drawings, and other internal information such as new product planning strategies and developments.

Each piece of such information is a valuable asset. Not only can it give Digital a competitive advantage in the marketplace, it could be very valuable data to our competitors. It is, therefore, of the utmost importance that each employee, and in particular those employees dealing with research or product development, be aware that Digital's knowledge and know-how must be properly safeguarded from competitors.

Digital protects its proprietary information, often referred to as intellectual property, by using various methods provided by law. There are four principal areas of intellectual property law to protect this information, namely, patents, trademarks, copyrights, and trade secrets. Several attorneys form part of Digital's Law Department and are responsible for servicing Digital's Engineering groups, particularly with respect to matters involving intellectual property. When issues are raised involving patents, trademarks, copyrights, and trade secrets, the attorney responsible for the particular engineering group should be contacted. If a potential problem is recognized involving Digital information and the attorney is contacted, measures can be taken to adequately protect Digital's information.

The following is a brief overview highlighting the basic concepts involved in the law of intellectual property. It is intended to aid you in spotting these intellectual property issues.

Patents

Congress has passed laws to protect idea information. One form of idea information, inventions, is protected by patents. The grant of a patent is in effect a contract between the government and an inventor. In exchange for a public disclosure of an invention, the government grants the inventor the right to exclude others in this country from making, using, and selling the invention for 17 years. Similar provisions apply in other countries.

An engineer, in the course of his or her work, may develop an "invention" (a new and useful mechanism, article, or method) that has a degree of novelty or uniqueness greater than what a skilled technician or engineer would develop in performing his or her day-to-day work.

It is important for you to continually review your work to determine whether it qualifies as an invention. You are not expected to know whether the invention is patentable or not. The cognizant attorney will determine this. However, you should be able to identify those things that contain some ingenuity and that, to your knowledge, were not previously known or invented by someone else. Once it has been established that an invention has been developed, the invention should be disclosed to the Law Department.

To aid in the protection of inventions incorporated in our products, Digital has established a Patent Committee responsible for determining whether or not to file patent applications on inventions made by Digital personnel. The committee has formulated a basic patent policy under which Digital will attempt to find (and file patent applications for) at least one patentable invention in each product we expect to sell in volume. A patent on our important products may range from protecting a feature in the product to the entire architecture of the product. Although the company is more likely to file for patents on inventions actually incorporated in products, Digital will file for patents on other inventions.

Since the grant of a patent is dependent upon the invention meeting certain timing criteria established by the law, all inventions considered for patenting should be brought to the attention of the Law Department before any disclosure outside the company. This would typically be at the prototype or breadboard stage, or before they are incorporated into products that are announced, shipped, or described in publications. When an invention disclosure is submitted, the cognizant attorney should be advised as to when a public use, sale, or publication of the invention is contemplated.

Patents obtained by Digital are used to prevent other people from making the product. Digital also licenses the use of some of its patents so it is paid a royalty for each product made which is covered by the patent. Business factors will determine if we should share the idea by licensing others to use it.

As part of your responsibility to protect new ideas of the company, all personnel performing scientific or technical work in the fields of research, development, and engineering should maintain accurate and complete records of their work. The purpose of maintaining these records is to have a legal record to substantiate the conception of inventions covered by patent applications. The Digital Engineering Notebook system is a valuable tool developed for this purpose. It is the responsibility of Digital technical personnel to maintain Engineering Notebooks, particularly in those instances involving a description of a development that may be patentable.

Trademarks

A trademark is one or more words, a name, symbol, device, or slogan used by a manufacturer to indicate the source of the goods or services and to distinguish his or her goods and services from those of others. Digital trademarks inform the customer that the product was manufactured by Digital and not someone else. By using a trademark, the owner of the trademark is, in effect, guaranteeing that the trademark product is of the same quality as similarly trademarked products acquired in the past. A trademark is a valuable asset since it provides a highly recognizable link between a customer and the products of the company.

Digital has invested significant amounts of money to associate its trademarks with its products. Marks such as DEC, DECUS, PDP, and the Digital logo are well recognized in the industry and throughout the industrial world. However, trademarks must be protected or they can be lost. It is relatively easy to protect and care for trademarks. The following is a list of some of Digital's more prominent current trademarks:

DEC	**DIBOL**	**PDT**
DECnet	**Digital logo**	**RSTS**
DECSYSTEM 20	**EduSystem**	**RSX**
DECsystem-10	**IAS**	**UNIBUS**
DECUS	**MASSBUS**	**VAX**
DECwriter	**PDP**	**VMS**
	VT	

In addition, Digital is constantly coining new marks. Before a new trademark is announced or used, it should be submitted to an attorney for a trademark infringement search. This will help us to determine if our new trademark will infringe a trademark already belonging to someone else. By having the trademark search performed early, most legal problems will be found before the company incurs advertising and other costs.

If you encounter any suspicious use of our trademarks by a party outside of Digital, or are planning or participating in the process of choosing a trademark for a new product or service, an attorney should be advised.

Copyright

A copyright is a legal right to prevent others from making copies of an author's work provided the work is marked with a proper copyright notice when published. However, a copyright does not protect an author's ideas. It protects only his or her individual expression of those ideas. Ideas expressed in a copyrighted work may be freely used by anyone; however, if someone copies the same expression or modifies it slightly, he or she is not free to use the copy or modification.

Digital information protected by copyright is generally written information. This includes engineering drawings, software, and manuals, but may also be audio-visual training courses and other items. Under the law, as long as we put a copyright notice on our publication (a "c" within a circle, year of publication and owner, for example, © 1979 Digital Equipment Corporation) we have performed the minimum procedures required to obtain copyright protection. DEC STD 197, *Legal Guidelines for Digital Publications*, contains requirements for controlling proprietary information and protecting Digital against liability.

At Digital we make a substantial investment in copyrighted information that we publish. We disseminate to our customers a great deal of desired information about our products. At the same time, we use the exclusivity that copyright laws provide to prevent unfair use of our publications. Such unfair use occurs when a similar product is made by a competitor and our copyrighted material is used to describe the similar product.

You should, therefore, be aware that any written works that are expected to be published must have appropriate copyright protection. In the same manner, we must be careful not to violate the copyright of others when we are using their works.

Trade Secrets

In some situations the patent system is not a suitable method of protection for a company's products or processes. A commonly used alternative is to protect the intellectual property as a trade secret.

The law of trade secrets is based on the recognition that it is unjust to permit the misappropriation of technical or commercial know-how that is not in the public domain. The law provides a legal right to prevent, or to recover damages for, an unauthorized disclosure or use of technical or commercial infor-

mation that is a trade secret. A trade secret may be any confidential formula, pattern, device, or combination of information used in one's business that gives him or her an opportunity to obtain an advantage over competitors who do not know or use it.

A trade secret must be kept "secret" so that it does not become publicly known. A trade secret may be lost by disclosure to others without any limitations. However, the law of trade secrets can be extended into the marketplace by means of contractual arrangements binding the recipient of information to keep it secret.

To adequately prevent a trade secret from becoming publicly known, appropriate internal procedures must be undertaken. These procedures should include as a minimum:

a. insuring that trade secret information is not provided to customer or vendors except under appropriate agreements;

b. restricting access to the information to those employees and agents having a "need to know" and informing those employees and agents having access to the information that it is confidential; and

c. maintaining general security precautions on the premises, avoiding leaving confidential information in open or uncontrolled areas, restricting access to those locations having sensitive information, and so forth.

Digital invests a great deal of money and resources to develop its software as well as its hardware products. Because the software products, once on the market, are easily reproduced and copied (the vast number of delivered Digital computers are a ready market for Digital software), it is important that our company legally protect its software products against improper duplication and distribution. Digital has elected to protect its software by both copyright and trade secret theories, with patent protection also attempted in rare cases.

A software license agreement is the legal vehicle under which our customers are licensed to use the trade secrets and copyrights incorporated in our software. Without some form of license agreement, our trade secrets and copyrights in our software products may not be protected when software is provided to customers. For this reason, Digital places extreme importance in providing our software only under an appropriate licensing agreement.

Sometimes during the course of business we may disclose trade secret information that relates to new products before they are announced. If a business decision is made to disclose Digital information, an appropriate non-disclosure agreement must be signed by the recipient. Although the non-disclosure agreement provides some protection, the best protection, of course, is not to disclose the information. Once released by an outside party, whether accidentally or deliberately, Digital confidential information may become public property and subject to unrestricted use. The first approach always should be to try and find a way to conduct transactions without disclosing or transmitting Digital confidential information. This is particularly true for very sensitive and highly proprietary information.

Just as we do not want to disclose our confidential information without restrictions, neither do our customers and vendors. At times we may visit a customer's plant or see what is going on in his or her business, and often the customer may ask us to execute a non-disclosure agreement to protect his or her trade secret information. This is a dangerous situation. We are a large company with a great deal of internal development work. Also, we are exposed to a large number of ideas from our customers. If we internally develop or receive an idea from a third company which resembles information received under a non-disclosure agreement, Digital's legitimate use of the idea could compromise the customer's proprietary information, even if we have not done so.

It is Digital's general policy not to execute non-disclosure agreements. We refuse to receive any trade secret information submitted to us from companies or persons outside of Digital. If for significant business reasons an exception to this policy must be made, then a specific non-disclosure agreement must be negotiated by the Law Department. An appropriate Vice President must sign the agreement on behalf of Digital.

It must be remembered that all Digital employees are obliged to respect the trade secrets of former employers. Thus, no person at Digital is to be given any information which one has reason to believe is a trade secret of a former employer.

The foregoing should aid in the understanding of how and why Digital protects its information. As individual employees, we can each contribute to the protection of Digital information by accepting the following responsibilities:

a. Reviewing our work to determine whether we have developed an invention, maintaining good records concerning the facts related to such inventions, and submitting innovative ideas to the Law Department;

b. Appreciating the fact that all Digital intellectual property, including trademarks and copyrights, are valuable assets and should be properly cared for;

c. Taking appropriate precautions to maintain in confidence Digital's trade secret information so that it is not disclosed outside the company without proper protecting agreements; and

d. Avoiding receipt of confidential information from outside Digital and contacting the Law Department if such receipt is felt to be justified by significant business reasons.

If you have any questions concerning the above, feel free to contact a lawyer in the Law Department.

APPENDIX B

ACRONYMS

This list of technical and other acronyms used in this manual and around Digital was compiled with the help of the DEC Dictionary.

AA	Affirmative Action
A&SG	Accessories and Supplies Group
ACK	Acknowledge
ACM	Association of Computing Machinery
ACT	Automated Computer Testing
ACU	Automatic Calling Unit
A/D	Analog-to-Digital
ADC	Analog-to-Digital Converter
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
ALGOL	ALGOrithmic Language
ALM	Assembly Library Module
ALU	Arithmetic Logic Unit
AM	Amplitude Modulation
AMS	Administrative Management Systems
AMT	Automated Module Test
ANL	Analog Loop

ANSI	American National Standards Institute
A/P	Accounts Payable
APL	A Programming Language
APST	Automatic Power Supply Test
APT	Automated Product Test
A/R	Accounts Receivable
ASAP	As Soon As Possible
ASCII	American Standard Code for Information Interchange
ASSIST-11	Directory Assistance System
AWT	Automatic Wire Tester
BAC	BAsic program Compilation
BAS	BAsic program Source
BASIC	Beginner's All-purpose Symbolic Instruction Code
BCD	Binary Coded Decimal
BFO	Beat Frequency Oscillator
BIMS	Branch Inventory Management System
BLISS	Basic Language for Implementation of System Software
BOD	Board of Directors
BOM	Bill of Materials
BOT	Beginning of Tape/Transmission
BPG	Business Products Group
BPI	Bits Per Inch
BS	Back Space
CAD	Computer Aided Design
CAI	Computer Aided Instruction
CALDEC	Computer Aided Layout by DEC
CAM	Computer Aided Manufacturing

CAN	Cancel
CAR	Carrier
CBL	COBOL source file extension
CBR	Console Bus Request
CC	Cost Center
CCEG	Central Commercial Engineering Group
CCITT	Comite Consultatif Internationale de Telegraphie et Telephonie, a committee which sets international communications standards.
CCL	Concise Control Language
CCS	Computer Control Store
CCS	Configuration Control Switch
CDC	Corporate Data Center
CER	Central European Region
CIS	Corporate Information Services
CMOS	Complimentary Metal Oxide Semiconductor
CMS	Corporage Message System
CNPR	Console Non-processor Request
COBOL	COmmon Business Oriented Language
COD	Central Order Desk
CODASYL	Conference on Data Systems Languages
COG	Corporate Operations Group
COS	Commercial Operating System
CPG	Commercial Products Group
CPR	Certified Paths of Restraint
CPU	Central Processing Unit
CR	Carriage Return
CR	Central Region
CRT	Cathode Ray Tube

CSA	Canadian Standards Association
CSI	Computer Services Industrial Group
CTS	Clear to Send
CSS	Computer Special Systems
CSR	Control/Status Register
D/A	Digital-to-Analog
DAA	Data Access Arrangement
DAA	Direct Access Arrangement
DAC	Digital Assistance Center
DAM	District Administrative Manager
DAR	Device Address Register
DCG	Digital Components Group
DBMS	Data Base Management
DDC	Digital Diagnostic Center
DDT	Dynamic Debugging Technique
DDP	Distributed Data Processing
DDP	Distributed Data Products
DDT	Dynamic Debugging Technique
DEC	Digital Equipment Corporation
DECnet	DEC Networking Software
DECUS	Digital Equipment Computer Users Society
DFAM	District Finance and Administration Manager
DIBOL	Digital Business Oriented Language
DIBS	Digital Integrated Business Systems
DM	District Manager
DMA	Direct Memory Access
DMT	Design Maturity Test

DOAM	District Order Administrative Manager
DOS	Disk Operating System
DPM	Data Path Module
DPM	Distributed Plant Management
DPSK	Differential Phase Shift Keying
DS	Datasystems
DSO	Days Sales Outstanding
DSPL	DEC Standard Price List
DSR	Data Set Ready
DTL	Data Terminal Loop
DTN	Digital Telephone Network
DTR	Data Terminal Ready
DTW	*Digital This Week*
DVT	Design Verification Test
EAE	Extended Arithmetic Element
EBCDIC	Extended Binary Coded Decimal Interchange Code
EBOD	Engineering Board of Directors
ECC	Error Correction Code
ECL	Emitter Coupled Logic
ECO	Engineering Change Order
ECP	Engineering/Computation Product Line
ECS	Education Computer Systems
EBOD	Engineering Board of Directors
EDP	Electronic Data Processing
EEO	Equal Employment Opportunity
EHQ	European Headquarters or Geneva
EMC	European Marketing Committee

EMI	Electromagnetic Interference
EMS	Electronic Mail System
EOF	End Of File
EOJ	End Of Job
EOM	End Of Message/Medium
EOM	End Of Medium
EON	End Of Number
EOT	End Of Transmission/Tape
EPG	Education Products Group
EPLS	Engineering Product Library Systems
EPROM	Erasable Programmable Read Only Memory
ESE	European Software Engineering
ESG	Engineering System Group
ESS	Electronic Switching System
ETX	End Of Text/Transmission
F&A	Finance and Administration
FA&T	Final Assembly and Test
FCI	Flux Changes per Inch
FCO	Field Change Order
FCS	First Customer Ship
FDM	Frequency Division Multiplexing
FDX	Full Duplex
FET	Field Effect Transfer
FIFO	First In First Out
FIPS	Federal Information Processing Standards
FM	Frequency Modulation
FORTRAN	FORmula TRANslator

FPA	Floating Point Accelerator
FP & E	Facilities Planning and Engineering
FPP	Floating Point Processor
FR	Flux Reversal
FRED	FoRms EDitor
FS	Field Service
FSK	Frequency Shift Keying
F/U	Follow Up
FY	Fiscal Year
FYI	For Your Information
G&A	General & Administrative
GA	Graphic Arts
GCR	Group Code Recording
GIA	General International Area
GIS	Government Information Systems
GM	Gross Margin
GND	Ground
GT	Graphics Terminal
HDX	Half Duplex
HEX	Hexadecimal (H)
HOSS	Home Office Software Services
HS	High Speed
IAS	Interactive Applications System
IC	Integrated Circuit
IDACS	Industrial Data Acquisition Control System
IDEA	Interactive Design Engineering and Automation

IHFS	In House Field Service
ILC	Individual Learning Center
INIT	Initialize Input/Output
I/O	In/Out, Input/Output
IPC	Information Processing Center
IPCF	Inter Process Communication Facility
IPG	Industrial Products Group
IPS	Inches Per Second
IPS	Information Processing Services
IRL	Information Retrieval Language
ISG	Information Systems Group
ISO	International Standards Organization
JCS	Job Control Sheet
JV	Journal Voucher
LARS	Labor Activity Reporting System
LCEG	Large Computer Engineering Group
LCG	Large Computer Group
LDP	Laboratory Data Products, Laboratory Data People, etc. DEC's people and products for the lab research market.
LED	Light Emitting Diode
LIFO	Last In First Out
LP	Line Printer
LQP	Letter Quality Printer
LR	Limited Release
LRC	Longitudinal Redundancy Check
LSI	Large Scale Integration
LTC	Line Time Clock

MACRO-10	Assembly Language for DECsystem-10/20
MACRO-11	Assembly Language for PDP-11
MAR	Mid-Atlantic Region
MBA	MASSBUSS Adapter
MC	Marketing Committee
MDC	Market Data Center
MDG	Market Development Group
MDP	Medical Data Products
MIS	Management Information Services
MLP	Maynard List Price
MOS	Metal Oxide Semiconductor
MPF	Master Parts File
MPS	Micro Processing Systems
MRC	Module Repair Center
MSB	Most Significant Bit
MSD	Most Significant Digit
MSG	Medical Systems Group
MSR	Marketing Support Representative
MTBF	Mean-time Between Failure
MTP	Maynard Transfer Price
MTTR	Mean-time To Repair
MUMPS	Mass General Hospital Utility MultiProcessing System
MUX	Multiplexer
NC	Numerically Controlled
N/C	Numerical Control
NDSC	New DEC Salesman Course
NER	Northeast Region

NOR	Normalize
NOR	Net Operating Revenue
NOP	No Operation
NPG	Non-Processor Grant
NPR	Non-Processor Request
NPSU	New Product Start Up
NRZ	Non-Return to Zero
NRZI	Non-Return to Zero Indiscrete
OD	Organizational Development
ODT	Octal Debugging Technique
OEM	Original Equipment Manufacturer
OL-BS	On-line Budgeting System
OOD	Office of Development
OS	Operating System
OS/S	Operating System for PDP-8
PAL	Programming Assembly Language
PAM	Pulse Amplitude Modulation
PB	Parity Bit
PC	Printed Circuit/Program Counter
PCBA	Printed Circuit Board Assembly
PCB	Printed Circuit Board
PCA	Printed Circuit Assembly
PCM	Pulse Code Modulation
PDM	Pulse Duration Modulation
PDP	Programmed Data Processor
PE	Plant Engineering
PE	Phase Encod/ed/ing

PG	Program Generated
PIP	Peripheral Interchange Program
PK	Parker Street
PL	Product Line
P & L	Profit and Loss Statements
PM	Phase Modulation
PMR	Powder Mill Road Building
PMT	Process Maturity Test
PNRF	Part Number Request Form
PO	Purchase Order
POS	Point Of Sale
PP	Papertape Punch
PPL	Purchased Parts List
PPM	Pulse Position Modulation
PPN	Project Programmer Number
PR	Production Release
PRC	Product Repair Center
PROM	Programmable Read Only Memory
PRTLST	Parts List
PS	Programming Systems
PSA	Personnel Service Administrator
PS/8	PDP-8 Programming System
PSG	Product Steering Group
PSK	Phase Shift Keying
PUN	Punch
QAM	Quadrature Amplitude Modulation
Q1, Q2. etc.	Quarter 1 of Fiscal Year, Quater 2, etc.

QC	Quality Control
QTD	Quarter To Date
QVL	Qualified Vendor List
RAM	Random Access Memory
RAMP	Reliability And Maintainability Program
RD	Remote Diagnosis
RDL	Remote Digital Loop
R&D	Research and Development
RFM	Regional Financial Manager
RFP	Request For Proposal
RFQ	Request For Quote
RIL	Restricted Items List
RJE	Remote Job Entry
RM	Regional Manager
ROAM	Regional Order Administrative Manager
ROI	Return on Investment
ROM	Read Only Memory
RSTS	Resource Sharing Timesharing System
RT	Real Time
R-T/C	Real-Time/Computation
RTS	Real Time System
SABER	Subsidiary Accounting Budgeting Expense Report
SAGE	Simulation of Asynchronous Gate Elements
SBA	Shipping Billing Authorization
SCAN	An automated system for retrieval of printed information
SCB	System Control Block
SCCB	System Control Base

SDC	Software Distribution Center
SDLC	Synchronous Data Line Control
SDP	Software Development Policy
SDS	Software Distribution Services
SI	International Metric System
SJV	Standard Journal Voucher
SMC	Software Services Management Committee
SPD	Software Product Descriptions
ST	Self Test
STUDD	Simulator and Tester Usage for Design and Diagnostics
STX	Start Of Text
SUDS	Stanford University Design System
SWAB	Swap Byte
SWS	Software Services
SYSGEN	SYStem GENeration
SYSLIB	SYStem LIBrary
SYSTAT	System Status
T & Cs	Terms and Conditions
TDM	Time Division Multiplexing
TEM	Test Equipment Manufacturing
TELCO	Telecommunications Industry Group
TEMP	Temporary
TMS-11/CMS-11	Text Management System/Classified Management System
TOPS	Total Operating System
TPG	Terminals Product Group
TPL	Traditional Product Line
TPS	Transaction Processing Systems
TRS	Time Reporting Systems

TTL	Transistor Transition Logic
TU	Tape Unit
UBA	UNIBUS Adapter
UBI	UNIBUS Interface
UET	UNIBUS Exercise Terminator
UDC	Universal Digital Controller
UL	Underwriter's Laboratory
VAX	Virtual Address eXtension
VCD	Variable Center Distance
VMS	Virtual Memory Storage
VSAM	Vestigal Sideband Transmission
VT	Video Terminal
WC	Wage Class
WCS	Writeable Control Store
WIP	Work In Progress
WP	Word Processing
WPS	Word Processing Systems
WR	Western Region
WS	Word Station
WT	Word Terminal
YTD	Year To Date

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