INTRODUCTION

The systems and programming staffs which have grown up within many large organizations may be described with considerable appropriateness as programming "factories." This designation could be used to characterize the programming groups employed by the computer manufacturers and those of the large companies engaged in producing proprietary programs. It is especially descriptive of the technical staff of a large commercial bank.

The idea of regarding the systems and programming resources of a bank as instruments of production has become especially appropriate within the recent past as the emphasis in banking automation has shifted from development of internal systems to systems designed to aid the bank's customers.

This change—and it is a fundamental one—is partly the result of the remarkable progress made to date in automating the voluminous internal accounting and data handling functions of the bank. In commercial banking the "Big Three" applications are demand deposit accounting, savings accounting, and installment loan accounting. In the course of computerizing these applications a great deal of data processing expertise has been developed within the banks, and tremendous equipment capability acquired to perform the work. The banks are now finding themselves in a position to focus their attention away from their own data processing needs and outward to those of their customers.

But this phenomenon has arisen not alone because of the availability of programming and equipment resources to do external tasks. Perhaps of equal importance, it is the result of customer pressure and demand. For, after all, the bank’s programming staff could be reduced (though this would be virtually unparalleled in the annals of modern business) once the internal automation job is largely accomplished. This has not happened though, because the bank’s customers, having become aware of the bank’s technical facilities and of its crucial role in practically all financial transactions, have pressed for development of computer-based services to be made available either on a fee basis or in return for compensating balances.

COMPUTER-BASED CUSTOMER SERVICES

Among the computer based customer services that the banks now offer may be found:
- Account Reconciliation
- Billing
- Classroom Scheduling
And this rather heterogeneous listing of systems is by no means complete.

These systems are of the "retail" type, i.e., oriented towards businesses rather than individual depositors. There are other services which may be described as consumer-oriented. An example of this is a system for automatic bill payment, widely practiced by banks in Europe and elsewhere outside the United States and now beginning to receive attention here. In this service, an individual may accumulate all of his bills to be forwarded to the bank along with a single check, upon receipt of which the bank makes the distribution to the various payees. Alternatively, the bank might receive the bills directly from the merchants, utilities, etc., and automatically pay them by debiting the consumer's account. Thus it may be seen that when one thinks of banking services as being products of a programming factory, they may be further regarded as analogous to both industrial products and consumer goods.

This transformation of the bank's systems and data processing ability from internal to external applications has created a classical business planning situation, one in which there are more opportunities available than there are resources to exploit them. In this instance there are more potential services for which demand exists than there are technical personnel available to develop them.

There is also a highly competitive environment in which the share of market for the bank's more traditional services is affected by the bank's ability to produce and market these new and complex products. The strategic importance of computer-based services raises the fundamental question: How much business will a bank lose or gain by developing or not developing one set of services in preference to another? If a bank elects to offer a payroll service before developing a billing service, it is vulnerable to its competitor who possesses the billing system. And, strategically, this can mean more than merely forfeiting the profit from this service; it may mean the loss of valuable customer relationships which presently exist. For example, a company desirous of having a bank handle its billing may give to the competitive bank not only the profit from doing the billing work, but may also transfer its demand balances and load relationships, its corporate trust work and other business. It is evident that the staks are high and that the consequence of misjudgment in determining which products to fabricate and sell are at least as catastrophic here as in the more conventional manufacturing operations.

**SYSTEM PLANNING AND PRODUCTION**

Let us now consider the major functions involved in product development in any manufacturing company:

- Product planning
- Engineering
- Manufacturing
- Marketing

It should prove instructive to examine the nature of these functions when the product to be manufactured is a system, once again taking the services development work of a large bank as an illustration.

In this context, product planning is concerned with identifying what is potentially both realizable and profitable. It involves, first of all, application analysis to determine the feasibility of producing and operating a generalized system, say one which will perform credit union accounting for a large number of potential customers among the credit unions in the bank's service area. Here there are many alternatives. Perhaps it would be better to design a system around the needs of one or a few potential customers rather than to attempt a somewhat theoretical generalization. By taking this more specific, and more limited approach, the service might be proven in, with the resultant experience later applied to produce a more generally applicable package. To do this would be roughly comparable to producing a pilot or prototype model of any manufactured product.

Product planning for systems is also concerned with the available technology. What tools are needed to produce the service? Should programs be written for an IBM 1410, for example, or should the bank plan to upgrade its equipment by acquiring a newer computer? What will be the impact of data communications on possible services?

Finally, product planning for computer based services must be concerned with the market, and here
the efforts of a professionally trained market research staff may be required. Market research plays a more important role in consumer type services than in the business oriented systems, primarily because the acceptability of a product to the business segment affected can usually be more readily determined. One bank, for example, felt the need to conduct extensive market research before introducing a new revolving credit service in which transfers of funds were made automatically from the loan account to the checking account whenever the checking account became overdrawn. This research extensively probed consumer attitudes toward overdrafts and the use of credit. Other banks have performed market research in conjunction with plans for an automatic bill payment service.

Product planning for new banking services, supported by market research, should result in the establishment of target costs, target prices, and a break-even point based upon a target market. To do this kind of planning, a great deal or rather astute estimating is necessary, supported when appropriate by market research. First of all, the cost of developing the system must be estimated and amortized over the estimated useful life of the product, an extremely difficult task in the volatile field of computer technology. Costs of marketing the system, converting customers to the system, and operating the system must also be detailed. Here the concept of product line profitability accounting can be usefully applied, with estimates pertaining to a given product accumulated and, as the product is developed and marketed, actual costs and revenues accumulated and compared with the estimates.

If there is to be a realistic cost estimating and accounting approach, there will have to be standard costs for machine usage, keypunch operators, messengers, and all other clerical and control personnel involved in operating the service. Preferably, there should be standard rates which are capable of being translated into cost per item processed. For example, it may be necessary to determine the cost per check issued when considering various kinds of payroll services.

One facet of the planning problem and indeed of the entire product development cycle should be noted. System production is the kind of business in which the lead time between product planning and product use is considerable. Even though there is a continuing buildup in technical skills and experience, it still frequently requires months and sometimes years to produce a complex generalized package like an accounts receivable system. This means that a high quality of technical ability combined with business judgment is necessary to do an effective job of product planning in this new industry. It means also that the level of confidence placed upon the product planning estimates cannot be too high. There are too many technological and competitive variables present during the developmental period which militate against firm estimates.

The engineering function, in the sense in which it is used here, can be seen to be systems engineering. Assuming that a computer based service has left the planning stage, the detailed specifications for the service must now be produced. The end result of the engineering activity should be a programmable specification. But before the engineering process is begun, some sort of formal approval for allocation of resources to the project must be obtained. In the organizational environment of a bank, this authorization frequently comes from a committee of senior management. In any case, the funding of a project should usually be viewed as the start of the engineering function.

The engineering function lends itself well to project organization, as in the case with most product engineering. As in most manufacturing businesses, products may be extensively modified while in the engineering state. It has been mentioned that there may be a pilot or prototype model which will yield experience applicable to the design and engineering of the production models. And, of course, some products may have to be abandoned during the engineering phase, although the rejection of systems ideas should more typically occur earlier, as an immediate result of product planning.

The manufacturing function in services development is, basically, programming. In a well run programming factory, there should not be extensive modification of the product once the specifications prepared by systems engineering have been frozen. One difficult question in organizing for production is whether to carry forward the project organization used to accomplish the engineering work or to keep engineering and manufacturing organizationally separate. What is really involved here is the decision confronting any large user of computers: whether he will combine the tasks of systems design and programming within a single group or whether
he will compartmentalize the work between separate groups specializing in system design and in programming. In either case, there must be a manufacturing function which emphasizes program production. This implies the need for tight labor standards and launches the organization into the troubled waters of programmer productivity. Labor standards for software manufacturing are much more nebulous and less controllable than in other kinds of manufacturing operations. Although programming may not be an art, as some assert, it certainly is not at the present time a well disciplined profession. This characteristic has implications for the product planning as well as the manufacturing function, of course, since the ability to produce a marketable product depends ultimately upon the ability of manufacturing to adhere to initial estimates and projections.

The marketing function encompasses a variety of responsibilities, including the firm pricing of the new product, advertising and sales promotion, the selling job itself, and finally the installation of the product, that is, the conversion of the customer to the bank's computer processing.

AN ORGANIZATIONAL VIEW

Let us now take an organizational perspective of the functions just described. Fig. 1 identifies the services activity as well as the internal systems activity of a bank. The systems planning section performs the product planning function as well as the related tasks of analyzing future equipment needs and planning for the internal systems to be used within the bank. The systems development section shown here reflects a functional split between systems engineering and programming, rather than the alternative division which could be made along project lines. The marketing section includes not only sales business research as well. It may be noted that the marketing section becomes involved in services development at two different stages: at the beginning when the service is still in the planning stage and market research is required, and again at the end of the cycle after the system has been programmed and is ready to be marketed. The operations section differs from other computer operations groups in that there must be much more emphasis in terms of organization and personnel on source document control. After all, if the bank undertakes the responsibility of calculating the customer's payroll, there must be every assurance that

A CONCEPTUAL APPROACH

A third way of looking at systems planning and development is somewhat more conceptual in nature, in that it seeks to identify the major phases of planning and development. In Fig. 2, the planning and development of a service is shown in three phases, each demarcated by a vertical line.

1. Preliminary review. This initial study seeks to determine whether, from either a policy, marketing, or operational standpoint, the bank wished to invest further effort in investigating a proposed system. This phase is characterized by very brief analyses of many system proposals. Each arrow shown in the diagram represents one proposed system. At the end of this phase, some proposals are aborted and others are carried forward into the next phase.

2. Detailed investigation. For those proposed systems which appear to have good market potential, further investigation is performed. This results in a final go/no go decision.

3. Implementation. The few systems approved for complete development pass through this final, more protracted phase, the end result of which is an operational system. Unlike phases 1 and 2, phase 3 is typified by many complex subphases and the investment of substantial developmental resources.

The spacing of the vertical lines in the diagram suggests roughly the proportion of calendar time and dollar investment usually involved in the various phases of system planning and development. Actually, the vertical lines should not be straight and parallel as shown in Fig. 2, as the investment of resources may vary considerably in the preliminary review, detailed investigation, or implementation of any one system. Figure 3 suggests a more realistic way of looking at the process. Here the duration of a given systems project varies markedly, especially in the detailed analysis and implementation phases. In terms of organizational responsibility, the services planning section would be responsi-
Figure 1. Systems department.
ble for preliminary review and much of the detailed analysis with the other appropriate organizational components accomplishing the implementation.

CRITICAL PATH SCHEDULING

Figure 3 also shows that the two projects which finally pass through the implementation phase have been planned and controlled by critical path scheduling. Since critical path techniques have been gaining in acceptability for more conventional programming projects, the question of their appropriateness in services planning and development should be considered. If a network could be developed for each potential service during the preliminary review phase, the information produced by such an effort could aid the product planners materially in arriving at better informed go/no go decisions because all facets of the proposed project could be identified and costed. But other factors such as policy and competitive considerations may exercise a more decisive influence on developmental priorities and the allocation of resources than will the detailed projections resulting from critical path scheduling. Furthermore, any expected benefits must be weighed against a number of serious objections to performing critical path analysis at an early stage.

Perhaps the most serious of these has to do with the amount of effort required to apply critical path methods early in a project’s history. As Fig. 2 and 3 show, out of 12 projects selected for study in phase 1, only two eventually come to fruition. Therefore, if a critical path analysis has been performed for each project at the beginning, only about 16 percent of the effort required to perform this analysis would turn out to be ultimately useful. Similarly, only 40 percent of the critical path analysis would prove useful if it were undertaken for projects which had progressed to phase 2.

A second objection centers around the feasibility of performing a critical path appraisal prior to the completion of the detailed investigation phase. Generally speaking, one frequently cannot anticipate the scope of the implementation phase until the detailed investigation phase has been accomplished. Consider, for example, the needs of a customer who wishes to have the bank maintain his accounts receivable. Investigation of this customer’s requirements may reveal that (a) an existing billing system can, with only a little expansion, suffice, or (b) an entirely new system will have to be devised. The implementation steps for course of action (a) would be trivial but for (b) would be tremendous. The point is that the scope of the implementation effort often cannot be analyzed or charted until the detailed investigation phase is completed. If thus appears that the logical place—indeed the only justifiable place—for the efficient exploitation of critical path techniques is during the implementation phase.

This mention of critical path techniques is intended merely to suggest that the tools for project management and control may, for the manufacture of these externally marketed systems, differ from those used previously to control the development of internal systems. Typically, in the latter case, there are considerably fewer choices of projects to undertake, and the characteristics of the systems to be devised are better known at the outset. Thus it is more realistic to draw up a critical path network for an internal system at the beginning because one can be reasonably confident that the effort required to analyze and diagram the project will be effort well spent and that the project will not be aborted.
CONCLUSION

Although these comments about the design and manufacturing of a system have been presented in terms of customer services being developed by commercial banks, they have applicability to any organization which has a variety of programming projects for which the assignment of priorities is of vital importance. One such activity would certainly be the development of programs by a computer manufacturer where there must be planning, scheduling, and control not only of the production of compilers, sorts, operating systems, and the like, but also of application oriented programs for customer use. Should the New Programming Language, COBOL, and FORTRAN compilers all be supported by the manufacturer? Or can the customers be served and satisfied with only one or two of these programs? Accurate answers to such questions as these may, for any company engaged in producing computer based systems for its customers, spell the difference between expansion or decline in share of market.