Basic Systems Analysis and Design Techniques

Basic Systems Analysis and Design Techniques

This manual is intended to assist the beginning applications analyst in learning the basics of systems analysis and design, and will also help the analyst to decide how to proceed into the "what's, how's, and why's" involved in such things as test plans, documents of understanding, testing, tracking mechanisms, etc. A number of topics are addressed, mostly from the "what to do" and "how to do it" point of view. The section "Major Events in Designing and Implementing a System" should help a newcomer to systems analysis to have an idea as to where to begin and the questions to ask.

First Edition (August 1978)

Requests for copies of IBM publications should be made to your IBM representative or to the IBM branch office serving your locality.

Address comments concerning the contents of this publication to IBM Corporation, Marketing Publications, Department 825, 1133 Westchester Avenue, White Plains, New York 10604. IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation whatever. You may, of course, continue to use the information you supply.

Preface

This document is a basic training tool that covers various aspects of a systems analyst's job. It emphasizes, as the title states, "*Basic Systems Analysis and Design Techniques*". There are, of course, many other areas of responsibility. This manual, however, should give the inexperienced analyst a start in the right direction.

A number of topics are addressed, mostly from the "*what to do*" *and* "*how to do it*" point of view. The section "*Major Events in Designing and Implementing a System*" should provide an overall perspective of the things an analyst has to do, and a sequence in which they should be performed. Knowing these, a newcomer to systems analysis should have an idea as to where to begin, and the questions to ask.

Too frequently a person with no systems background or training is made a systems analyst and is perplexed as to where to start and what to do. This manual is intended to assist the applications analyst in learning the basics of analysis and design, and will also help the beginning analyst to decide how to proceed into the "*what's, how's,* and *why's*" involved in such things as test plans, documents of understanding, testing, tracking mechanisms (PERT, Gantt charts), etc.

Author's Note

Most of the ideas in this manual are the result of personal experience in designing and installing systems for IBM customers and internally for the IBM Corporation. Every effort has been made to see that the proper credit has been given to any material knowingly borrowed from others. In other instances, however, the origin of the material is not known as it was taken from notes made while attending classes over the years or from information received from others.

Contents

Introduction

In the full scope of designing and implementing a system, the traditional systems analyst or engineer takes complete responsibility for the project. In some environments, however, the job is broken down into various areas of responsibility – the applications (or user) systems analyst, the programmer-analyst, programmer, and the operational analyst.

This publication is oriented to the newcomer systems analyst in a user environment, and its objective is to give some practical ideas, tools, and principles with which a system can be analyzed, designed, and installed. It is intended to be practical, not theoretical.

Virtually every idea presented herein is used by analysts to good advantage. To obtain a more complete understanding of the meaning, use, and impact of the material presented, a reader should try to visualize an analyst creating an entirely new system for an area in which the analyst has no background or experience. Knowledge gained from system or program maintenance, or of a particular system known intimately, should not be allowed to interfere with this visualization. The reader should keep in mind that this manual uses the following guideline: a system should be designed to meet the needs of the business, and oriented to and for the people that are going to use it. People should run the system and the ultimate requirement for a successful system is its orientation to the needs of the end users.

Definitions

To ensure a clear and consistent understanding of what a system really is and what is meant by systems analysis, the following definitions are provided.

Definition of User

The term "user" as used in this manual does not refer to members of a facility's data processing staff. Instead, the users are expected to be the individuals who actually use the system to carry out their job responsibilities: the foremen or other shop floor workers who use terminals to advise the system that a job has been completed, and request a new job assignment; or the production manager who also uses a terminal to determine the scheduled load on a specific machine group. Or the users may be clerks in the accounts receivable department who use terminals to determine the specific invoice against which a cash receipt should be credited; or the company controller who asks for information concerning the company's cash commitments as opposed to anticipated cash receipts for the next six weeks; or the company president may use a terminal to obtain data concerning the profitability of various product lines. Or the users may be individuals who receive printed reports concerning parts shortages, anticipated receipts, or planned production, for example.

It is recognized that data processing groups also have their own internal systems, procedures, controls, reports, etc., and, therefore, can also be system users. However, in the interest of simplicity, the term user as used herein refers to non-data processing personnel.

Definition of System

Some dictionary definitions for the word *system* include: "a regularly interacting or interdependent group of items forming a unified whole", "a group of devices or artificial objects or an organization forming a network, especially for distributing something or serving a common purpose", "an organized set of doctrines, ideas, or principles usually intended to explain the arrangement or working of a systematic whole", "a coordinated body of methods or a complex scheme or plan of procedure".

All of the above definitions apply to *system* as it is used herein. Further, in this publication, *system* also encompasses the forms; displays and reports; files; telecommunications; instruction manuals and user guides; maintenance activity; edit and audit procedures, routines, and messages; and all the other interrelated elements that must be defined, designed, and/or programmed to produce the desired system objectives.

Definition of Systems Analysis

Systems analysis can be defined as the analyzing and subsequent organizing of a problem to make it suitable for solution or processing by computers and other data processing equipment. This includes the organizing of a system of interrelated data processing equipment to perform a given function or pattern of functions. More specifically, systems analysis is the analysis of an activity to determine precisely what must be accomplished and how to accomplish it.

Definition of a Systems Analyst

A systems analyst is that person who performs the study or who does the "Systems Analysis". More specifically, a systems analyst with respect to data processing (DP) has been defined as an individual who "works with people associated with DP systems to resolve problems and to aid in the development, monitoring, control, and change of a DP system".

A good systems analyst is much like a good cultural anthropologist: to do a good job, the anthropologist has to live with the natives, learn their ways, study them, and yet not become so identified with them that perspective is lost – in short: "Be in their world, but not of it."

And so it is with a good systems analyst: if possible, an analyst must learn an area even better than the people working in it. But at least from the technical or systems viewpoint, the analyst must always keep in mind the basic objectives:

Determine what is really needed to improve the operation.

Determine what is the best way of fulfilling the needs on a reasonable cost basis, and in an appropriate time frame.

The analyst is a business problem solver and the job, as will be seen later, is varied, complex, and significant.

Major Events in Designing and Implementing a System

Before dealing specifically with techniques, it may be desirable to review the general steps or major events in the design and implementation of a system. They are:

- Determination of needs and objectives
- Development of justification for them
- Presentation to management
- Approval to proceed
- Effort sizing. Analysts, programmers, and users
- Commitment to proceed
- Development of general design specifications
- General design acceptance
- Preparation of equipment order
- Preparation of forms order
- Development of detail design specifications
- Detail design acceptance
- Ordering equipment, forms, software, cabling, telephone lines, etc.
- Publishing document of understanding (D.O.U.)
- Approvals of D.O.U.
- Test plan
- Program design
- Program coding
- Installation of equipment/software
- Testing. Program (unit), systems/integration, user acceptance
- Education
- File cleanup
- File initialization
- Pilot run

- Parallel runs
- Formal installation and cutover
- Maintenance/tracking and followup

Essentially, the systems analyst is involved with every event except, perhaps, program design or coding. The importance of the analyst in the total picture of a new system – a number of major events, in each of which the analyst plays a major role, and many of which require totally different approaches and techniques to complete – cannot be overemphasized.

Establish a Foundation

Before a systems analysis can be started a foundation for it must be established. This includes determining the needs, objectives, and approach to be used, and the organization of the project folder or notebook.

Determine Needs and Objectives

The first step in the life cycle of a new system is the identification or determination of a set of high-level needs and objectives.

Initially someone has an idea or a need of a general nature and an analyst is called in to quantify or factor the general conceptions to specific, tangible components.

Generally, the needs or problems surface because of:

I. New ways of doing business caused by:

- New technology
- New products
- Competition
- New laws or regulations

II. Consolidations/mergers

III. Need to reduce costs/improve profits

IV. Revised forecasts, errors, lack of planning, deficiencies, false assump- false assumptions or understanding in existing systems, operations, or procedures, etc.

V. Insufficient information, communications problems, faster and/or more accurate responses required, etc.

At this point a high-level idea, need, or objective has been formulated for some reason, and it is up to the analyst to start the investigation/analysis (Figure 1).

I. OBJECTIVES
The objectives of the system are to: 1. Reduce rework and finished goods inventory of "Built-Not-Shipped" machines for current and future high volume products by controlling release of customer orders, and generation of paperwork to manufacturing. 2. Eliminate indirect personnel required in paperwork update cycles for "Hard Cards" (customer orders). 3. Reduce paperwork costs for "Hard Cards" (customer orders). 4. Provide realtime status tracking of machines and customer orders for high-volume products throughout the manufacturing process. 5. Control disposition of finished machines to ensure no machine is shipped that has had order cancelled or altered after release and is not built to the customer requirement.

Figure 1. An example of some high level objectives. These are, in effect, the primary purposes for developing the system

Approach

There are a number of principles, techniques, or approaches that can be used, depending upon the analyst's background and experience and the nature of the assignment. It should always be remembered that, in most instances, good sound logic and common sense are key ingredients for any system.

Project Folder or Notebook (Documentation)

The development of a project folder or notebook is, perhaps, the most useful tool or idea in good systems analysis. Done well, the project itself soon falls into place, and the analyst usually knows where things stand, and what to do next. In addition, if someone else should have to pick up the project, it becomes relatively easy to do so, minimizing original work loss. In time, the following 17 elements will usually be part of the project folder.

1. General Project Assignment Sheet

This document should "start the ball rolling". It should represent a general summary of where to go, what to look for (or at), and any constraints applicable. This, or something like it, is usually prepared when the analyst first gets the assignment.

Items to be included on the sheet are:

- Date assignment given
- Target dates or time constraints
- Originator of project
- Analyst(s) assigned (name, location, phone, etc.)

- Overall objectives

- General area or areas to study

- Prime Contact:
  Name
  Address/location
  Position
  Phone

- Secondary contact(s)
  Name
  Address/location
  Position
  Phone

- Problem area/functions/objectives to be covered in the analysis

- Pertinent notes/comments

2. An Organization Chart

This may be invaluable in determining whom to see about what. This is not to be looked at as merely a "who reports to whom list", but, it should be developed as both a reporting structure and high-level contact or personnel reference data sheet. It should contain such things as: name, phone no., division or organizational unit, title or position, area of responsibility or speciality, location, etc.

3. An Approach, Schedule, or Outline

This document should show: whom to see, when and for what purpose; what to read or study, when and for what reason; where to visit, when, and the objectives of each visit, tour, or meeting.

4. Interview Sheet

It should be a routine practice to keep accurate notes of each meeting, interview, or work session. Before each meeting/interview, record briefly whom to see, subjects to be addressed, desired objectives, and significant points, comments, and needs to be covered. By determining this information in advance, you will be in a better position to limit the meeting to appropriate subject(s) and avoid discussions that have little bearing on your needs.

During the meeting/interview, it is best to make notes concerning all that is covered. Your prior knowledge of the subjects to be discussed should minimize the effort and time needed to take notes.

After the meeting/interview, compare your notes with the previously determined subject(s) and objective(s) to ensure that they were properly covered. If not, you may need to schedule another meeting.

In many instances, the interview sheet can be closely tied in with an area/systems/operations analysis sheet (see element 6).

5. Glossary

In studying an area, one usually soon learns that a specialized vocabulary exists for almost everything. It is frequently necessary to develop a glossary so that the analyst can communicate effectively and be able to read and study information intelligently.

Following is an illustration as to what the abbreviation P.O. can mean to different people. Several of its dictionary definitions are given along with some common industry meanings. As can be seen, considerable confusion could result if there has not been agreement on the meaning of the abbreviation before a study is started.

Term/Abbreviations	Literal Meaning	Definition/Use
P.O.	Purchase Order	An order...
P.O.	Petty Officer	
P.O.	Postal Order	
P.O.	Post Office	
P.O.	Plant of Origin	
P.O.	Plant Order	

6. Area/Systems/Operations Analysis Sheet

This document is especially useful in "keeping on the right track" when holding interviews or analyzing documentation. It should include such items as: system/area/or operation name and abbreviation (or acronym); a list and description of current problems, including why they exist; a list and description of anticipated problems, and why they are foreseen; goals or objectives to reach; current or future constraints; references to formal documentation; etc. Be certain to record date and attendees or interviewees.

7. Overall Summary

An overall summary or description of the system/area/operation and its main use, mission, or function are also important to obtain. User manuals and operational flowcharts, if available, are usually quite helpful in this respect.

8. Examples or Illustrations

Copies of reports, forms, cards, input (source)/output documents, etc., should be obtained. The analyst should determine how and why they are used, their frequency of generation, and the system they go into and come from. Pertinent field definitions should be developed where applicable. Samples of forms should show actual data/entry/output usage.

9. Procedures, etc.

Copies of procedures (local, divisional, and corporate), company policies, government regulations (federal, state, county, city or foreign government), technical or trade reports or write-ups, program documentation, application briefs, and the like should be obtained.

10. Basic Technical Documentation

Acquire all the technical information available. This includes:

- File formats
- Systems flowcharts
- Operational flowcharts
- Program write-ups/systems overviews
- Unit record (punched card data processing) (PCDP) procedures
- Screen design displays
- Any other available/required information

11. List of Data Processing Equipment and Personnel

Be certain to determine the available DP equipment and staff. Draw up a list of available or "in use" equipment, and a list of planned equipment. Items to be on this list should include equipment name, type, model number, number of units, manufacturer, location, capacity, special features or options, overall use of equipment and specific use as it relates to the area in question or under study, hours used per day, shift usage, weekend work, remote usage, preventive maintenance time, etc.

The analyst should include planned removal dates, if any equipment is being taken out, and disposition of the removed equipment; planned installation dates of any new equipment due in, its location, use, and other pertinent factors.

You should also make a list of DP personnel, including the number on each shift, how many work overtime or weekends and why, etc. Skill levels should also be considered. Should there be an educational program on new equipment before we can implement the system? Will there be a need to change the distribution of personnel between shifts?

NOTE: In the full scope of a true systems analysis, not only computers, terminals, modems, controllers, and input/out devices are noted and examined, but such things as TWX, facsimile reproduction and/or printing equipment, microfilm or microfiche equipment, general office and business machines (such as calculators and addressing machines) are reviewed.

12. Hardware Descriptions

Hardware write-ups or descriptive information.

13. Software Support

Software and/or applications write-ups.

14. Pending or Problem Section

A "Question", "Need to Know", "Don't Understand", or "Need to Resolve" section. This section should contain: (1) The things that an analyst needs to know or do, but have not yet been included in one of the more formal lists, (2) discrepancies and contradictions from one interview to another, or between systems flows and people's comments, or from documentation packages to procedures, and (3) areas that the analyst thought had been fully covered, but now more data is needed.

15. Peripheral or Supplementary Programs

Although much of the information should surface as a result of the material gathered for the examples or illustrations portion (Element 8), it is sometimes useful to develop a special package of information regarding supplementary programs. Since the output of many of these types of programs often is not well known, or distributed, it is wise to ask in interviews if such programs or languages as RPG, GIS, APL, etc., are used, and if so, determine who writes them, who gets the output, etc. Often replacing this type of program is difficult but can sometimes save a substantial amount of money. Sometimes in designing a new system, it becomes mandatory to see that such utility-type user software is available (or, possibly, retained).

16. Interfacing Impact or Interfacing Requirements

It is essential that the whole impact of a system be viewed, and that it not be looked at from one area or perspective only. That is, in analyzing a system, its needs and deficiencies, the analyst must also look at its interfaces with other systems. Very few systems are truly totally independent; and this is especially true of those systems that support more of a business or manufacturing environment than a scientific one.

Frequently, when one looks at a particular area (say what IBM calls a "function" or "project" in a plant), one finds that, in fact, it is served by several, if not many, DP systems; some of which are dedicated primarily to support that area, and some designed to support other areas.

It is imperative in analysis, as well as in design, to look at the interfaces involved. Frequently, the problems are not with a system designed to support an area, but with a system that interfaces with it, or with the interfacing between systems. In studying needs and deficiencies of a system, they should be viewed with respect to any interfacing needs with other systems or subsystems.

17. Potential Goals and Objectives Checklist

A checklist or summary of potential goals, objectives, or needs is an essential part of the folder. This is really the ultimate objective of the analyst. It is quite helpful while analyzing an area or conducting interviews to have a list of categories under which improvements can be made. This is useful in the justification stage, too, for these same categories can be (in fact, must be) quantified or evaluated to justify the system.

In general, potential improvements fall under three broad categories:

I. Reducing costs

II. Improving the information

III. Improving control

These can be further expanded into a meaningful checklist.

I. Reducing costs

A. Reducing people-oriented costs

- Reducing overtime
- Reducing the number of people needed to perform a job
- Changing the nature of a job from more skilled to less skilled requirements, resulting in less costly approach
- Reducing the effort involved so one person or a group can do more jobs in less time

These can often be accomplished by:

- Decreasing the workload by automating the job ("put it on the computer")
- Freeing professional or highly skilled people from routine work
- Keeping output on schedule (minimum downtime)
- Reducing the complexity of a job (reducing the number of manual operations involved, or the difficulty in filling out forms or inputting information; or having the system automatically input data such as date, time, etc.)
- Combining similar jobs and eliminating redundant operations

B. Reducing equipment or supplies costs

- Reducing the number of reports (combining several)
- Reducing the size of reports (going to exception reporting, inquiry, etc.)
- Reducing the frequency of reports (from daily to every other day, from quarterly to on request, etc.)
- Reducing distribution of reports (sharing, use of older reports, etc.)
- Reducing amount of equipment used (more computer-driven machines or operations)
- Increasing effective utilization of DP equipment (additional shift work, better configuration software support, improved job stream, distributed networks, etc.)

- Reducing space (going from lists to microfiche, from manual files to inquiry into the system or special reports, from routine reports to "as requested")

- Reducing direct using space (having computer used as test equipment)

- Reducing or combining forms, cards, etc.

- Minimizing redundant operations (combining data bases, files; providing better user output)

- Changing the type of paper used (quantity, thickness, color, size, etc.)

II. Improving the Information

- Providing more information and/or better reporting elements

- Providing more accurate information (more legible documents, better edits and audits)

- Providing the information faster

- Allowing more flexibility in selecting outputs (user-created utilities)

- Improving exception reporting (showing only the trends, results, problems, etc.)

- Creating measurement and analysis reports and transaction histories rather than just status or summary reports

III. Improving Control

In many cases, this is taken to mean a better understanding of what is happening, when it happens, where it happens, to whom, and why. That is, the overall impact, or control of the operation. Many analysts believe that this type of control is really best handled by improving the information (as addressed earlier).

The other side of the control problem has sometimes been referred to as "asset protection". It involves techniques to prevent embezzlement, fraud, theft, misappropriation of company assets, and the like. It may also include such things as computer control of external and internal entrances, security clearance levels, and so forth.

Getting Started

Once the project folder has been started, what are the various means for information gathering?

How and Where to Get Information

Direct Interviewing

This includes in-depth discussions, questions, and meetings with the individuals directly responsible for the jobs. It may be necessary to interview all levels of management and technical people including administrative, production, and support personnel.

Report and Documentation Review and Analysis

Studying flowcharts, procedures, user manuals, forms, job responsibilities, management and company objectives, reports, policies, regulations, statistics, physical plans, etc.

Physical Review

Actual tours, demonstrations, and walk-throughs of the various areas to be reviewed. Physically seeing the areas in operation is frequently of great value.

Peripheral or Supplemental Information

- Formal company reports
- Industry reports
- Trade journals
- Technical reports
- Government regulations, requests, reports
- Catalogs
- Program documentation
- Application write-ups and briefs

General Factors to Consider in Data Gathering

In utilizing the techniques mentioned in the preceding section, there are some important factors that can be quite helpful.

- The analyst should record all information as presented. Do not prejudge, degrade, or jump to conclusions (either overtly or covertly), or otherwise qualify the data presented.

- Ask questions to clarify what is not clearly presented. Be sure you have heard what was said, see clearly and understand what is being done, and obtain a feel for each person's understanding of why that person is doing what is being done systems-wise. (A person's understanding may not be quite correct, but it may give a valuable clue as to what is right or wrong and why.)

- Try not to problem solve at this point. This is a learning step to determine what is being done, how it is done, by whom, and why.

- The analyst must study the documentation: forms, reports, flowcharts, procedures, etc., to see how things are done. Frequently the way a manager thinks a job is done, the way a flowchart shows it, the way a procedure indicates it, the way an analyst thinks it should be, and the way it actually is done are not identical. Note the various discrepancies. Try to determine when the documentation was done, by whom, and in what capacity. Try to determine why the variations, if any, exist.

- A total approach should be taken. All factors should be addressed as much as reasonably possible from a first-hand approach. Secondary sources are not necessarily reliable.

- If appropriate, several people doing similar jobs should be interviewed. The same overall job or job title does not always imply the same tasks, responsibilities, orientation, or needs. Be careful of apparent similarities that are actually differences.

- The significant events, ideas, problems, or needs should be highlighted as the analyst proceeds. This may take several iterations, but is well worth it. It highlights less obvious relationships and problems and clarifies the situation in the analyst's mind.

- And finally, the whole thing should be "put together". The operation and/or system should be understood thoroughly, and to make certain of that the area under study should be flowed out, that is, flowchart or describe the operation as it is. This will show not only what is known, but should highlight what may have been missed or was undetected. Remember, this is the system as the analyst now understands it to be.

Interviewing Techniques

How and where to obtain information has been reviewed, as well as some general factors considered in information gathering. Now, some techniques that can aid the analyst in interviewing.

- The analyst should always be prepared and should know whom to see, where the interviewee is located, and for what purpose the meeting or interview is going to take place. Make a checklist of questions to ask during the interview.

- Make an appointment for a specific time, and be punctual. Call if detained or if a cancellation is necessary. Set aside enough time to get the desired information (one cannot obtain two hours of information in 30 minutes). Advise the interviewee beforehand of the purpose for the meeting so there will be time to prepare for it. Sometimes, by knowing the purpose, the interviewee will direct the analyst to someone more knowledgeable on a particular subject, thus saving time for both parties.

- Have permission to see the interviewee and make sure there will be no contractual problems created by your meeting. Assure the person that it is permissible to talk to the analyst about the subject. This is especially important when talking to clerks, administrative personnel, and production workers.

- Be aware that approach is all-important in many cases. It is a good idea to start out with an explanation of the purpose for the meeting and the analyst's overall job. Sometimes the right perspective helps dramatically.

- Try to build confidence and respect. Tell the interviewee why the study is being made.

- Be friendly, courteous, and cooperative. Abruptness rarely, if ever, obtains the desired information.

- Do not let the interview become a gripe session. The analyst is there to gather data, understand the job, and identify problems, not to solve personnel problems or deal with pent-up emotions or old feuds. Every effort should be made to stick to the purpose of the meeting.

- Stress the current environment. Too often, people try to go to the past. Do not fall into that trap. Deal with what is happening now.

- Do not be critical of the current process. Change will not always be made. Be open-minded, receptive, and positive.

- Do not appear to be a "know-it-all". Be knowledgeable, but remain a "student".

- Readily acknowledge good points; give "credit where credit is due"; be appreciative for help.

- If the interview turns into a technical problem solving session, reach an agreement with the individual before leaving. At the least, know where the agreements and disagreements lie and why. Do not leave with the interviewee expecting one thing, and the analyst another.

- If the analyst feels that some individuals have done a good job or have gone out of their way to help, thank them and their managers.

- It is also a good idea to let the individuals know if any of their ideas are to be used or implemented.

- Find out the experience level and background of the interviewee in the area under study. This can help the analyst to avoid talking up or down to someone.

- Always keep in mind the objective of the study and the magic questions:

  - What do you do?

  - Why do you do it?

  - How do you do it?

  - Do you have any problems?

  - What do you think could be done to help you?

  - Do you like this job? Why?

If you could manage this department, what would you do?...what changes would you make?

What do you need to know to help you do a better job?

Needs and Objectives

At this point, the analyst should know the system and have a good understanding of its deficiencies and enhancement possibilities, especially as related to specific management objectives.

It is from this knowledge and experience that the overall needs and objectives are drawn up. Sometimes they are of major importance, involving whole new systems or radical changes in procedures and the operating environment. At other times the current system needs to be modified or enhanced. And of course, in some cases, the system is found to serve its purpose well, but the users simply are not using it the way it should be. In that case, education and management involvement will probably suffice in making the necessary improvements.

In considering how needs and objectives are determined, a "checklist or summary of potential goals, needs, and objectives" should point the way toward what to look for. Experience, expecially working with a trained analyst for one or two projects, is the best method for really learning.

It has also been said that the best technique for determining what is needed in a system is role playing. That is, once the operation or system is learned, the analyst should ask, from the position of the worker performing the job, "What would I need to do the job better, faster, more easily, more accurately, or to save (more) money, etc.? Likewise, the analyst should ask, from the position of the various managers over an operation, questions such as:
"What can be done to measure what is happening?"
"How can I measure the productivity of an operation?" "What can be done to reduce costs?"

"To see that the employees have what they need when they need it?"
"To improve my knowledge of the operation?"
"To know the workload volumes, and how they compare to previous time periods and current projections?"

In short, the analyst should ask the kind of questions an aggressive, conscientious employee would ask while trying to improve the operation at every level of responsibility.

Justification

Once the overall needs and objectives have been determined, they must be evaluated from an economic standpoint. This is usually done in two stages or composed of two parts.

1. An estimate of the gross user or operational savings

2. An estimate of the costs to develop, implement, and maintain the new system or any proposed changes or enhancements

   The first figure should be netted against the second to see whether the project is worthwhile, or what the return on investment (ROI) would be. The estimate should be done by individual objective or need to keep the various areas in perspective. That is, it may be advantageous to program some things, but not others. (It is an axiom that almost anything can be programmed; it is just a matter of whether the savings justify the programming costs involved.)

A systems analyst, having full responsibility for a job, would normally perform both aspects of the evaluation.

In some instances, it is the user analyst's job to assess the user savings, while the programming area estimates the development and maintenance expenses.

Potential Savings Categories

To determine what the potential savings should be, the analyst goes back to his "checklist of potential goals, objectives, or needs" and looks at the areas identified. Assuming the needs were met, the analyst then quantifies the savings.

Generally, savings for justification fall into three broad categories:

I. Personnel savings

   A. Regular – determine the number of hours saved and equate it to dollars.

   B. Overtime – determine the number of hours saved and equate it to dollars.

II. Non-personnel savings

   A. Equipment: trucks (external and internal), machines, tools, computers, computer peripherals, desks, file cabinets, parts, raw material, business machines, conveyors, etc.

B. Supplies: forms, computer cards, paper, repair tools, repair equipment, office supplies, etc.

C. Cost of goods purchased: cost value-analysis programs, investing, obtaining or making loans more favorably, telephone/wire services usage, and better buying techniques, accounting practices, inventory control approaches, etc.

D. Building costs: reducing owned or leased space for material, equipment, people, parts, supplies, files, etc.

E. Supplemental costs: insurance, taxes, security, utilities, etc.

III. Control

A. Asset protection: reducing theft, pilferage, embezzlement, etc.

B. Increased operating control: how much of what is where, when, and can the accuracy of that data be proved?

Cost Avoidance

In addition to the three categories listed above, potential savings are sometimes qualified under "cost avoidance". This term is generally applied to those areas where something is forthcoming, and a savings arises, or a cost is avoided if a new system, method, or procedure is implemented. This occurs, for example, when products are transferred, building schedules increase, new government requirements are enacted, or company policy changes (especially accounting or auditing). The qualification itself is still grouped under the various savings categories, but since the cost is not a current one, it is considered as a "cost avoidance".

Cost Estimates

For purposes of this section, the factors involved from a programming and data processing viewpoint are reviewed lightly. In essence, an estimate is made of the time (generally in man-hours, man-months, or man-years) it would take to provide the program design and coding, and to do the program (unit) and systems testing. This is converted to dollars by using an applicable rate. Time is also factored in for file initialization effort as well as parallel runs and file cleanup.

Computer time for assembling, testing, file cleanup, initialization of files and regular run time is also calculated and a dollar value attached to it. Supporting hardware costs, such as peripheral devices, cables, telephone and modems, etc., are also figured in. And these are netted, of course, against any equipment or personnel costs they would replace.

Supplies, forms, cards, and the like should also be considered: those that need to be added and those that will be eliminated and/or combined. In some instances, the cost of direct user involvement is also factored in.

From a systems engineering or total cost consideration, some individuals believe that the analyst's time must also be considered.

The Proposal

What we have just covered is variously referred to as a study, a proposal, a preliminary survey, or a high-level overview analysis.

The prime mission of the study is to determine what can be done to improve an operation and to get an idea as to whether it is practically feasible to implement such recommendations.

In some environments, the analyst:

- Determines the needs and objectives
- Develops the user or gross justification for them
- Presents the findings to management
- Obtains the approval to proceed

A complete sizing yielding a netted justification or estimate is included in the study or proposal, and a formal presentation or package is given to management showing:

- What is recommended
- Why the recommendations are made
- What the costs to develop and maintain the recommendations are estimated to be: people, equipment, etc.
- A proposed schedule

Implementation

At this point, assuming an approval is given, formal design work begins and a plan is developed. Depending upon the size and scope of the mission, and the nature of the job involved, either a General Installation Plan (GIP), covering all facets of the design and installation, is developed or a Preliminary Installation Plan (PIP) followed by a Detailed Installation Plan (DIP) is prepared.

Preliminary Installation Plan

A Preliminary Installation Plan (PIP) is generally developed for major systems or significant systems modifications. The PIP is used as a plan or guide under which specific systems functions and needs are identified and structured, detailed manpower and cost assessments are made, interfacing requirements are delineated, initialization techniques specified, file cleanups outlined, educational requirements formulated, testing plans developed, and the overall plans and specifications brought together in one package.

The results of a PIP are best highlighted by recognizing that it provides:

- Specifications of what to do
- Targets of when to do it
- Manpower required to accomplish it
- Costs anticipated

Detailed Installation Plan

A Detailed Installation Plan (DIP) is usually used as a specific plan under which the actual design, programming, testing, installation, and education are performed.

The results of a DIP are the actual implementation of the system itself. The DIP leads more to "how" than "what". For example, how the system works, how the file initialization will be accomplished, how the interfacing will work, etc.

Fundamentals

Overview

There are a number of fundamental items that are necessary in designing a system. For the most part, they are addressed both in a PIP and DIP; therefore an attempt will be made to look at them and their various aspects from a generalized level.

Basically, all systems can be represented schematically as follows:

Traditionally, in designing a system, the analyst works somewhat backward. He performs "3" then "1" then "2". That is, the output is specifically defined, the input requirements are determined, and finally the processing logic necessary to transform the input into the needed output is specified.

This sequence represents systems analysis and design in a nutshell.

Using this concept, the first thing to look at is the outputs needed. Outputs can be a variety of things, including the following:

- Reports
- Terminal responses or displays
- Updated files
- Interfacing files (disk, tape, card, etc.)
- Microfiche
- Error identification
- Input listings
- Cards
- Control information
- Audible alarms
- Electrical signals

One of the first things to do is to determine the effectiveness of the existing output. The prime questions to ask are: Does the output meet the needs of the business in today's environment and in the foreseeable future? If not, what is needed? When is it needed? And what is its value?

If the area under analysis does not have an automated system, the questions are virtually identical: What is needed to run the business today and what, in our opinion, are future needs? Additionally, what is the value of knowing the answers to these questions?

This is a very detailed and time-consuming task, generally involving weeks, if not months of effort. It is truly the most important phase in terms of ultimate value to the business. For, if we do not know what is needed and its value, nothing else of worth can be developed. This probably cannot be stressed too strongly.

Input

Input requirements are a natural outgrowth of the output needs once what is needed has been determined. The analyst must then concentrate on how to get it. In effect, data comes from:

- Documents or files that already exist
- Documents or files especially created for a particular purpose
- New or modified fields within files
- Recording actions taken (original transactions)

It should be realized that a major portion of the analyst's work is concerned with obtaining the information necessary to provide the needed output, and ensuring that it is available in a data processable format.

Processing

Once the output and input have been formulated, logic or specifications must be developed to convert the input to the proper output. This can be done by a variety of methods, depending upon the situation. One of the more common, yet effective, methods is sometimes referred to as the "dictionary" or "field definition" approach where each field appearing on the various reports, forms, displays, and so on is defined. The definition provides the key to the processing required to produce the output field.

Output - Detail Level Forms

According to Webster, a form is considered to be "a printed...document with blank spaces for insertion of required or requested information". (Obviously, an interactive terminal display can perform the same functions as well as "computer edit" the data for validity as it is entered.)

Considerable time can be spent in covering the many factors that are involved in good forms design and control, especially when both input and output forms are considered. For purposes of eliminating duplicate effort, both types of forms will be more or less addressed together. Following are a number of pertinent factors in forms design:

1. First get some basic idea of the general form size and shape, and proceed from there.

2. Start with a blank printchart (GX20-1818) and lay out what the computer needs to print, and where. Most analysts put an "x" in each space to be computer printed. Decimals are usually represented by a caret or triangle at the bottom of the print block.

3. Next write in the material to be preprinted by the forms supplier, doing such things as field headings and descriptive data first, and then filling in the background or "boiler plate" type of data.

Note: The preprinting refers to the printing done on the form by the printer or supplier, as opposed to the printing done by the computer.

4. If some of the words, sentences, paragraphs, columns or field headings, logos, illustrations or the like already are printed somewhere and are more or less the correct size, cut them out and appropriately paste them on the layout sheet. (Cut the printchart to the appropriate form size.)

5. Determine whether overleaf preprinting is necessary. Frequently, government regulations, company policies, legal requirements, space restraints, clarity, or costs necessitate more data than can be put on one side of a form. Preprinting on the back is often quite helpful or even mandatory.

6. Note whether forms are to be controlled, accounted for, or used as cross-reference documents. If so, sequential prenumbering, preferably in red, usually at the top, may be advisable, or necessary.

7. Determine the number of ultimate users (uses) of the form, so that the correct number of copies (sheets of a form) can be ordered, with the appropriate number of carbons between them.

8. If forms are to be multiple copies, each page should have the user or department it goes to printed on it, preferably at the bottom. It is important that people can distinguish one page from another, and that the printing shows up distinctly and clearly.

9. The more use and/or needs of the business a department has for a copy of a form, the closer to the top that copy should be.

10. Be certain to assign a form control number to each form developed. Also indicate a revision number each time the form is updated. In some instances, the analyst should be sure to check with the location's forms control administrator.

11. Check inventory supplies and systems availability to schedule the new forms in at the proper time without undue expense. Remember to see that forms come in at, or slightly before, testing time (as opposed to installation time).

12. Estimate annual use and order about three or four months' usage plus enough forms for testing and educational needs. (Do not order too many forms the first time because modifications may have to be made due to last minute changes.) Also, be aware that people have a tendency to stock up when new forms or major modifications are installed, that testing purposes generally take many continuous forms, and that setup each time the form is run will usually use a number of forms.

13. Order well enough in advance to ensure the forms are received ontime. Lead times vary, but three to five months may not be unusual when proofs are required and paper is in short supply. In emergency situations, forms can generally be obtained sooner, but usually proofs are not provided, and the cost increases proportionally.

14. Request proofs and review them in detail. Double-check everything, especially such things as abbreviations, commas, block or field size, form numbers, addresses, form size, overleaf data, crimping, etc.

15. Specialized applications may require carbons where some or all information passes through to various copies, and not to others. Consult with the proper people, if necessary, but the possibilities are sometimes quite varied here.

16. Note such things as different techniques for combining sheets. Crimping is excellent.

17. For forms that must be hand decollated, be certain not to let the carbon go all the way to the edge of the sheet--leave room for the hand to hold the paper while breaking it apart.

18. For private, confidential, or restricted use of some data on forms, consider using "blacking out", tear strips, or partial carbons.

19. If the document is a "master sheet" that will receive wear, have additional data stapled to it, be repetitively pushed into files, etc., use "hard" or thick paper rather than paper of regular thickness.

20. Arrange the input, as far as possible, in a logical sequence for input documents. Make it as similar to the input flow as is reasonably possible.

21. Notify the (potential) users in writing of the new form or screen format. Tell them when they should start using it and include an illustration. If it is an input form try to provide instructions for filling it out and an example of one correctly completed. Be sure to emphasize required versus optional fields.

22. Clarity of the form is important. When a form has been designed for manual input, give it to someone and ask for it to be filled out. If the individual has trouble or asks too many questions, something is wrong. The form should be self-explanatory. Perhaps fields should have more explanation, better wording, dashes used--one for each letter or numeral in a field rather than a straight line, or blocks for lettering, etc. Also, run the form by the input specialist who will be using it. What does that person think of it? What suggestions for its improvement?

    Do not forget the programmer. Something may have occurred since the original specs were drawn up to necessitate an alteration, and this data may not have filtered back to the analyst. Give the programmer a chance to review the form.

    Some analysts develop a checklist or signoff sheet to go by. Each affected area is asked to review and approve the form before the formal purchase order is placed. Include both the name of the prime user and the manager of each area on the forms signoff sheet. Ask such questions as: "Does it have everything on it?" "Is anything unnecessary on it?"

23. If a copy of a form is to be filed in a notebook of some sort, rather than a file folder, have the form prepunched with appropriate holes.

24. When the draft of the form has been completed, ask the key question: "Has all standard or repetitive data been designated to be preprinted?"

25. Review the draft to see that there is ample room between lines, blocks, or preprinted material for the computer printing without cramming. Be sure to leave some leeway.

26. For many input documents, it is sometimes advisable to preprint the routing and/or the DP job number on the form. Also, include any unique or special instructions.

27. Determine what, if any, approvals or signatures are needed in the processing of the forms. (This does not mean approval of the form design, but approval of whatever is on the form once it is being used.) Clearly specify who is to sign where.

28. Provide for adequate margins – top and bottom, right and left sides – both for computer forms and manual ones.

29. If it will take several sheets of a particular form to complete a grouping, have the computer sequentially number the sheets in each group. (This is perhaps more of a specification requirement than a forms tool, but it can be quite helpful if problems arise.)

30. For forms that are to be mailed, place the name and address in such a position that window envelopes can be used, whenever possible, thus saving much addressing effort.

31. If the form is to be filed, see that the sequence numbers by which filing is to occur are prominently displayed, usually at the upper right or left. (The form control number is not always the sequence that is used for filing – different areas or departments may use the same form and file it differently for different purposes.)

32. Give an appropriate, meaningful title to the form. This not only helps in general usage, but if the form is misplaced or DP routes it to the wrong area, the title can give a good clue for determining whom to call.

33. Again, when the draft version is completed, if not before, check to make certain that several forms cannot be combined into one. Likewise, objectively view the form to see whether too much is on it – does it try to serve too many purposes, and should it really be two forms? Two keys, here, are size and clarity. Is it standard size, and is the form easy to use and fill out?

34. Be careful on machine decollating and machine bursting instructions for continuous forms. While most forms are machine bursted, the nature of the form and its use will determine whether it is better to automatically or manually decollate it. Some multiple copy forms require signatures, approvals, or additional typing before being sent out, and therefore it would not be wise to automatically decollate them. Others, which require no manual modifications, probably should be machine bursted or machine cut.

35. If certain fields use codes, it is sometimes helpful to print the codes and what they stand for on the form. Also, boxes or places to select, circle, or check are sometimes quite helpful in saving time and in providing clarity.

36. Make certain that significant information is clearly spelled out and is printed well enough to attract the right attention; for example, black or heavy lettering, varying the positioning, increasing the size and/or type of lettering, etc.

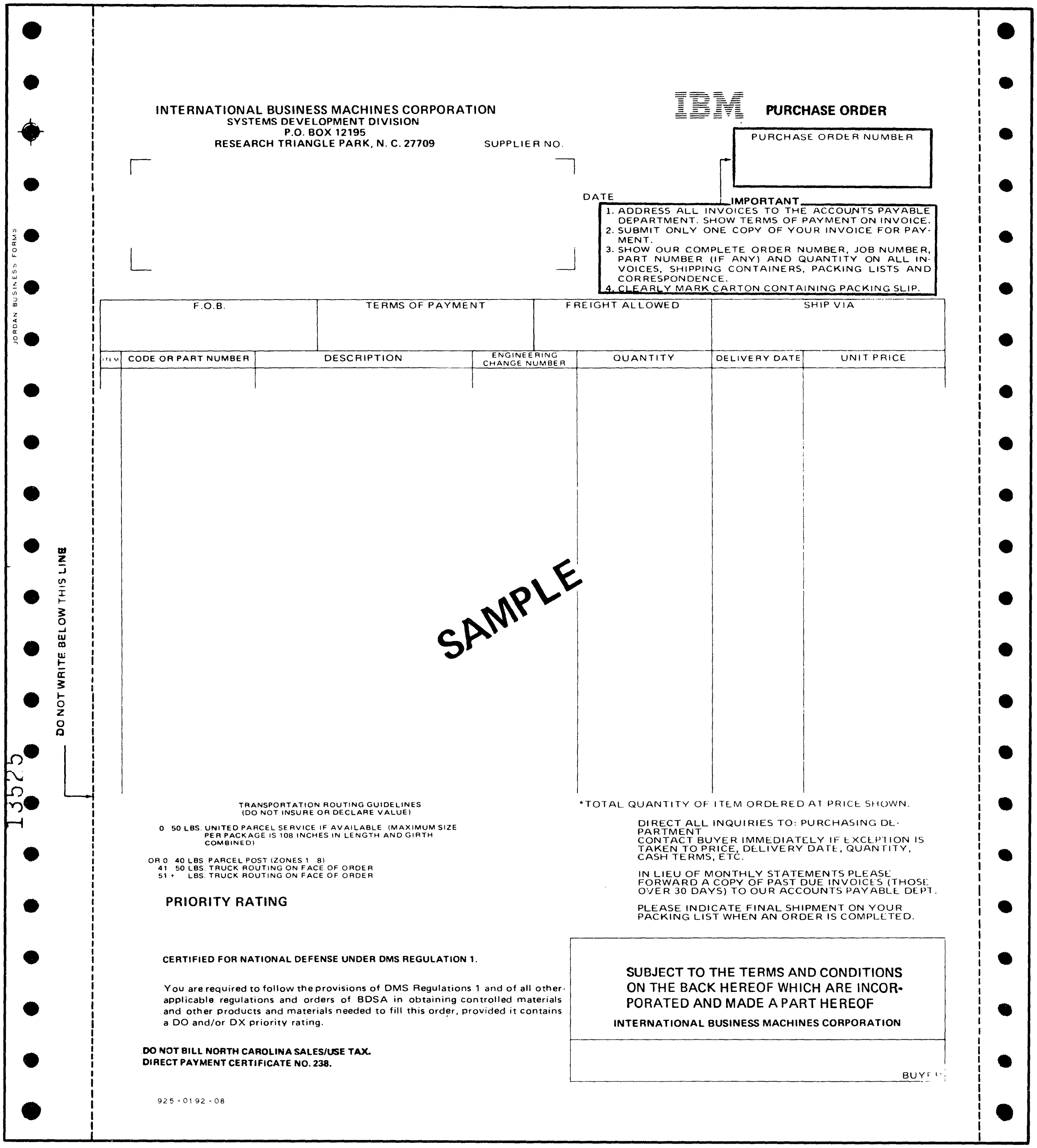
37. If the form is an output form from a computer printer, be certain to know the types of printers that can be used. Review the printer capabilities and restrictions for such things as form size, print speed, number of copies, paper thickness, etc., that the unit can handle.

38. It is generally recommended that the analyst who is inexperienced in this area review a number of various kinds of forms to get ideas. Do not restrict yourself to those forms similar to those being designed. It is technique as well as specifics that can help. Reference books and application manuals may also provide additional assistance.

Purchase Order Examples

It has been said that an army moves on its stomach, and a business on its forms and reports. Indeed, there is no practical way to delineate the numerous forms or types of forms that a business uses. However, to illustrate some types of forms and various aspects of forms design, this section steps through two types of purchase orders, highlighting various points.

Figure 2 shows a typical blank purchase order used by a Parts/Inventory Purchasing System. It is a three-part multicolored form that is used to order from a supplier or vendor something that is going to be used in manufacturing or producing a facility's product.


INTERNATIONAL BUSINESS MACHINES CORPORATION
SYSTEMS DEVELOPMENT DIVISION
P.O. BOX 12195
RESEARCH TRIANGLE PARK, N. C. 27709

SUPPLIER NO.

IBM PURCHASE ORDER

PURCHASE ORDER NUMBER

DATE

IMPORTANT
1. ADDRESS ALL INVOICES TO THE ACCOUNTS PAYABLE DEPARTMENT. SHOW TERMS OF PAYMENT ON INVOICE.
2. SUBMIT ONLY ONE COPY OF YOUR INVOICE FOR PAYMENT.
3. SHOW OUR COMPLETE ORDER NUMBER, JOB NUMBER, PART NUMBER (IF ANY) AND QUANTITY ON ALL INVOICES, SHIPPING CONTAINERS, PACKING LISTS AND CORRESPONDENCE.
4. CLEARLY MARK CARTON CONTAINING PACKING SLIP.

F.O.B.	TERMS OF PAYMENT	FREIGHT ALLOWED	SHIP VIA

ITEM	CODE OR PART NUMBER	DESCRIPTION	ENGINEERING CHANGE NUMBER	QUANTITY	DELIVERY DATE	UNIT PRICE

SAMPLE

DO NOT WRITE BELOW THIS LINE

JORDAN BUSINESS FORMS

TRANSPORTATION ROUTING GUIDELINES
(DO NOT INSURE OR DECLARE VALUE)

0 50 LBS. UNITED PARCEL SERVICE IF AVAILABLE (MAXIMUM SIZE PER PACKAGE IS 108 INCHES IN LENGTH AND GIRTH COMBINED)

OR 0 40 LBS PARCEL POST (ZONES 1 8)
41 50 LBS. TRUCK ROUTING ON FACE OF ORDER
51 + LBS. TRUCK ROUTING ON FACE OF ORDER

PRIORITY RATING

CERTIFIED FOR NATIONAL DEFENSE UNDER DMS REGULATION 1.

You are required to follow the provisions of DMS Regulations 1 and of all other-applicable regulations and orders of BDSA in obtaining controlled materials and other products and materials needed to fill this order, provided it contains a DO and/or DX priority rating.

DO NOT BILL NORTH CAROLINA SALES/USE TAX.
DIRECT PAYMENT CERTIFICATE NO. 238.

925 - 0192 - 08

*TOTAL QUANTITY OF ITEM ORDERED AT PRICE SHOWN.

DIRECT ALL INQUIRIES TO: PURCHASING DEPARTMENT
CONTACT BUYER IMMEDIATELY IF EXCEPTION IS TAKEN TO PRICE, DELIVERY DATE, QUANTITY, CASH TERMS, ETC.

IN LIEU OF MONTHLY STATEMENTS PLEASE FORWARD A COPY OF PAST DUE INVOICES (THOSE OVER 30 DAYS) TO OUR ACCOUNTS PAYABLE DEPT.

PLEASE INDICATE FINAL SHIPMENT ON YOUR PACKING LIST WHEN AN ORDER IS COMPLETED.

SUBJECT TO THE TERMS AND CONDITIONS ON THE BACK HEREOF WHICH ARE INCORPORATED AND MADE A PART HEREOF
INTERNATIONAL BUSINESS MACHINES CORPORATION

BUYER

13525

Figure 2. A typical preprinted purchase order used by a Parts/Inventory Purchasing System

Figures 3A through 3C show the various sheets of the purchase order after it has been processed by the computer or typed. Figure 3A shows the front of the white first sheet, which is sent to the vendor after it is checked for accuracy and signed. The standard terms and conditions that apply to the purchase order are printed on the overleaf of the first sheet.

Figure 3B is the front of the second sheet, which is yellow in color. Note the distribution and copy number clearly preprinted on the bottom center. The preprinted information for the vendor on the lower section of sheet one is not needed by the recipients of the second sheet and is, therefore, not shown. The overleaf of the second sheet is used to record receipts against this purchase order.

Figure 3C shows the front of sheet three and is Purchasing Services' copy of the purchase order. It is green and the preprinted information for the vendor that appears on the lower section of sheet one is repeated here for the buyer to reference, if necessary. The overleaf of sheet three is blank.

The string of holes on both sides of a form indicate that it is a continuous form for automatic feeding, as on a computer's printer, for example. The holes are usually punched into tear strips that are removed after the form has been processed by the computer. In some instances, the holes on one side (usually the left) are also used for binding/filing the form after it has been distributed and, in those instances, the strip containing the holes is not removable.

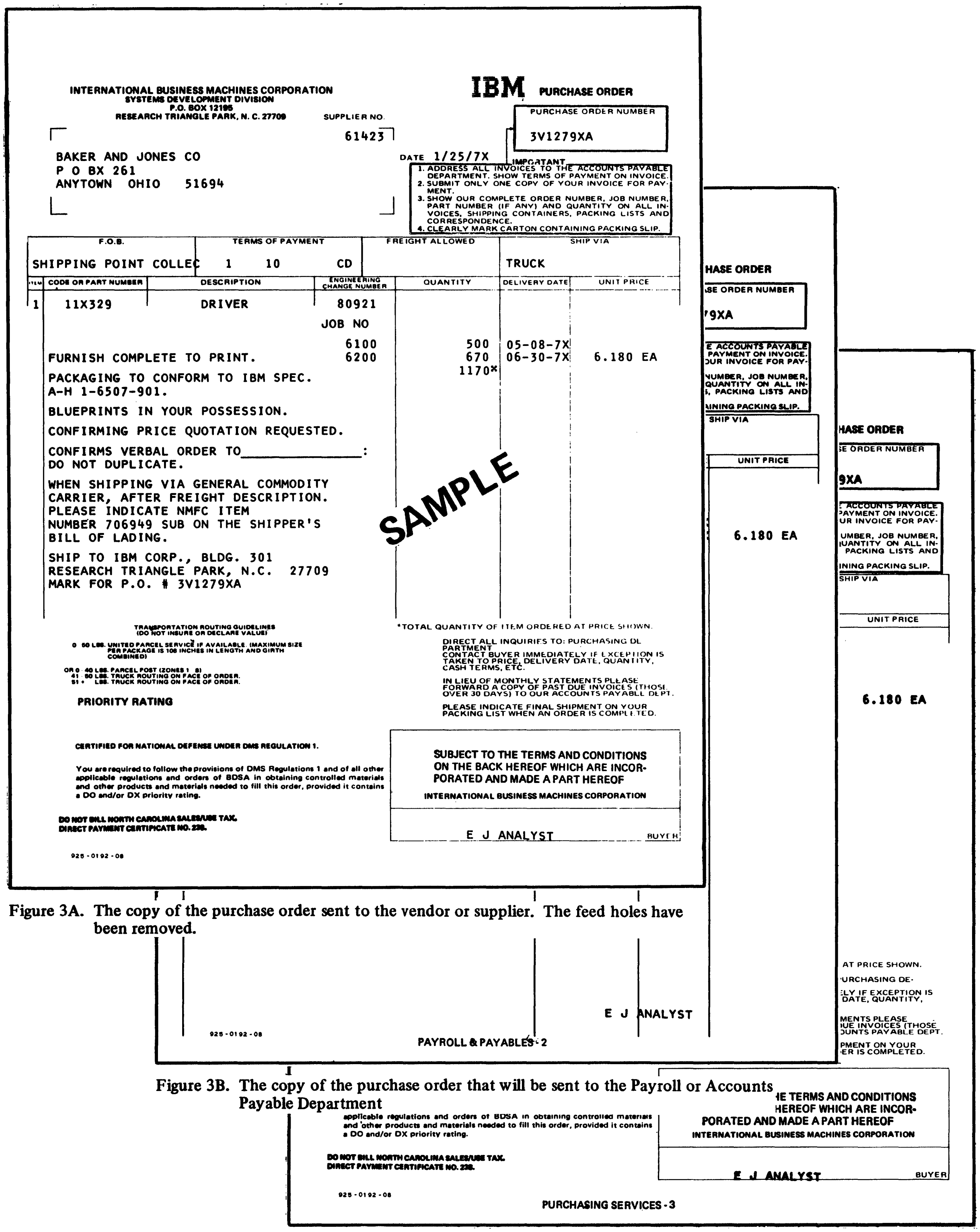
Figure 4 shows two continuous forms, just as they would be fed into a printer.

The next form shown is a blank purchase order used by a non-production Maintenance, Repair, and Operating Supplies (MRO) Purchasing System. It is used to order items that will not enter the production process directly; office furniture, grass seed, preprinted forms, lift trucks, maintenance supplies, safety glasses, uniforms, and television cameras and receivers, for example. Because items such as these are usually charged to a department's budget, there are copies of the purchase order for both the originating department and appropriations control (see Figure 5).

Figure 5 shows an MRO purchase order that has an original and four carbon copies. The first sheet is white and is followed by sheets of yellow, salmon, blue, and orange. As shown in Figure 5, except for the vendor's top sheet, to ensure proper distribution each sheet is labeled at the bottom in red ink.

Figure 6 shows the originator's copy of the purchase order shown in Figure 5. Note the arrow at the top left pointing to the field called "Dept." That field will contain the department number of the originating department after the purchase order is printed. Then, the originator's copy is folded and stapled so the department number and arrow show, and is dropped in the internal mail for delivery to the originating department. The need/cost for an envelope has been eliminated.

In addition to the two tear strips, the top of the first sheet may also be removed to prevent irrelevant or even internal use only information from reaching the vendor. Figure 7 shows this top tear strip removed, and the lower right corner of the first sheet cut off to show how far the carbon extends in relation to the bottom of the document and the tear strip (which has also been removed from the extreme lower right).



INTERNATIONAL BUSINESS MACHINES CORPORATION
SYSTEMS DEVELOPMENT DIVISION
P.O. BOX 12195
RESEARCH TRIANGLE PARK, N. C. 27709

IBM PURCHASE ORDER

SUPPLIER NO. 61423

PURCHASE ORDER NUMBER 3V1279XA

BAKER AND JONES CO
P O BX 261
ANYTOWN OHIO 51694

DATE 1/25/7X

IMPORTANT
1. ADDRESS ALL INVOICES TO THE ACCOUNTS PAYABLE DEPARTMENT. SHOW TERMS OF PAYMENT ON INVOICE.
2. SUBMIT ONLY ONE COPY OF YOUR INVOICE FOR PAYMENT.
3. SHOW OUR COMPLETE ORDER NUMBER, JOB NUMBER, PART NUMBER (IF ANY) AND QUANTITY ON ALL INVOICES, SHIPPING CONTAINERS, PACKING LISTS AND CORRESPONDENCE.
4. CLEARLY MARK CARTON CONTAINING PACKING SLIP.

F.O.B.	TERMS OF PAYMENT			FREIGHT ALLOWED	SHIP VIA
SHIPPING POINT COLLEC	1	10	CD		TRUCK

ITEM	CODE OR PART NUMBER	DESCRIPTION	ENGINEERING CHANGE NUMBER	QUANTITY	DELIVERY DATE	UNIT PRICE
1	11X329	DRIVER	80921			
			JOB NO			
			6100	500	05-08-7X	
		FURNISH COMPLETE TO PRINT.	6200	670	06-30-7X	6.180 EA
				1170*		

PACKAGING TO CONFORM TO IBM SPEC.
A-H 1-6507-901.

BLUEPRINTS IN YOUR POSSESSION.

CONFIRMING PRICE QUOTATION REQUESTED.

CONFIRMS VERBAL ORDER TO______________:
DO NOT DUPLICATE.

WHEN SHIPPING VIA GENERAL COMMODITY CARRIER, AFTER FREIGHT DESCRIPTION. PLEASE INDICATE NMFC ITEM NUMBER 706949 SUB ON THE SHIPPER'S BILL OF LADING.

SHIP TO IBM CORP., BLDG. 301
RESEARCH TRIANGLE PARK, N.C. 27709
MARK FOR P.O. # 3V1279XA

SAMPLE

TRANSPORTATION ROUTING GUIDELINES
(DO NOT INSURE OR DECLARE VALUE)

0 - 50 LBS. UNITED PARCEL SERVICE IF AVAILABLE. (MAXIMUM SIZE PER PACKAGE IS 108 INCHES IN LENGTH AND GIRTH COMBINED)

OR 0 - 40 LBS. PARCEL POST (ZONES 1 - 8)
41 - 50 LBS. TRUCK ROUTING ON FACE OF ORDER.
51 + LBS. TRUCK ROUTING ON FACE OF ORDER.

PRIORITY RATING

*TOTAL QUANTITY OF ITEM ORDERED AT PRICE SHOWN.

DIRECT ALL INQUIRIES TO: PURCHASING DEPARTMENT
CONTACT BUYER IMMEDIATELY IF EXCEPTION IS TAKEN TO PRICE, DELIVERY DATE, QUANTITY, CASH TERMS, ETC.

IN LIEU OF MONTHLY STATEMENTS PLEASE FORWARD A COPY OF PAST DUE INVOICES (THOSE OVER 30 DAYS) TO OUR ACCOUNTS PAYABLE DEPT.

PLEASE INDICATE FINAL SHIPMENT ON YOUR PACKING LIST WHEN AN ORDER IS COMPLETED.

CERTIFIED FOR NATIONAL DEFENSE UNDER DMS REGULATION 1.

You are required to follow the provisions of DMS Regulations 1 and of all other applicable regulations and orders of BDSA in obtaining controlled materials and other products and materials needed to fill this order, provided it contains a DO and/or DX priority rating.

DO NOT BILL NORTH CAROLINA SALES/USE TAX.
DIRECT PAYMENT CERTIFICATE NO. 238.

SUBJECT TO THE TERMS AND CONDITIONS ON THE BACK HEREOF WHICH ARE INCORPORATED AND MADE A PART HEREOF
INTERNATIONAL BUSINESS MACHINES CORPORATION

E J ANALYST BUYER

925-0192-08

Figure 3A. The copy of the purchase order sent to the vendor or supplier. The feed holes have been removed.

E J ANALYST

925-0192-08

PAYROLL & PAYABLES - 2

Figure 3B. The copy of the purchase order that will be sent to the Payroll or Accounts Payable Department

PURCHASING SERVICES - 3

Figure 3C. Sheet 3, Purchasing Services copy of the purchase order

Figure 3.

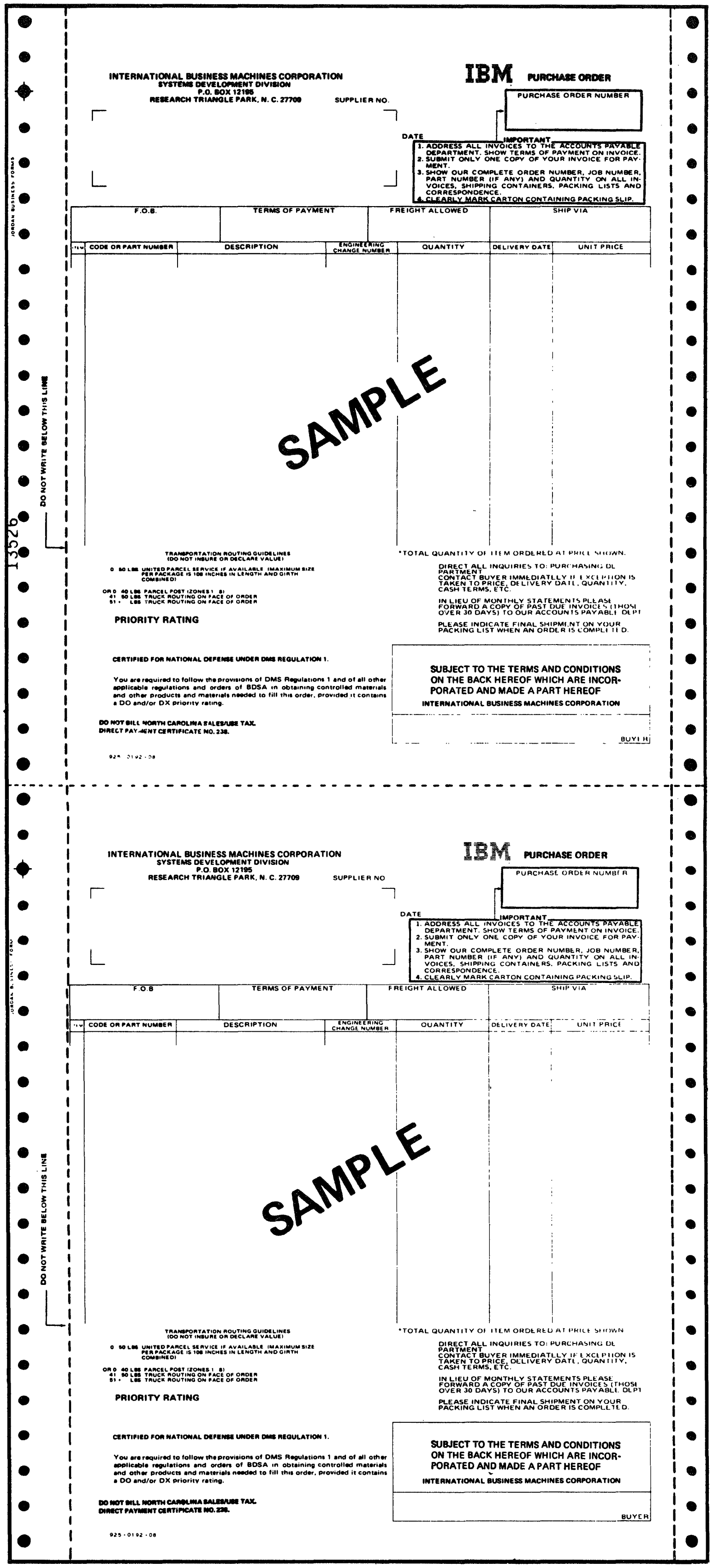


Figure 4. An example of continuous forms

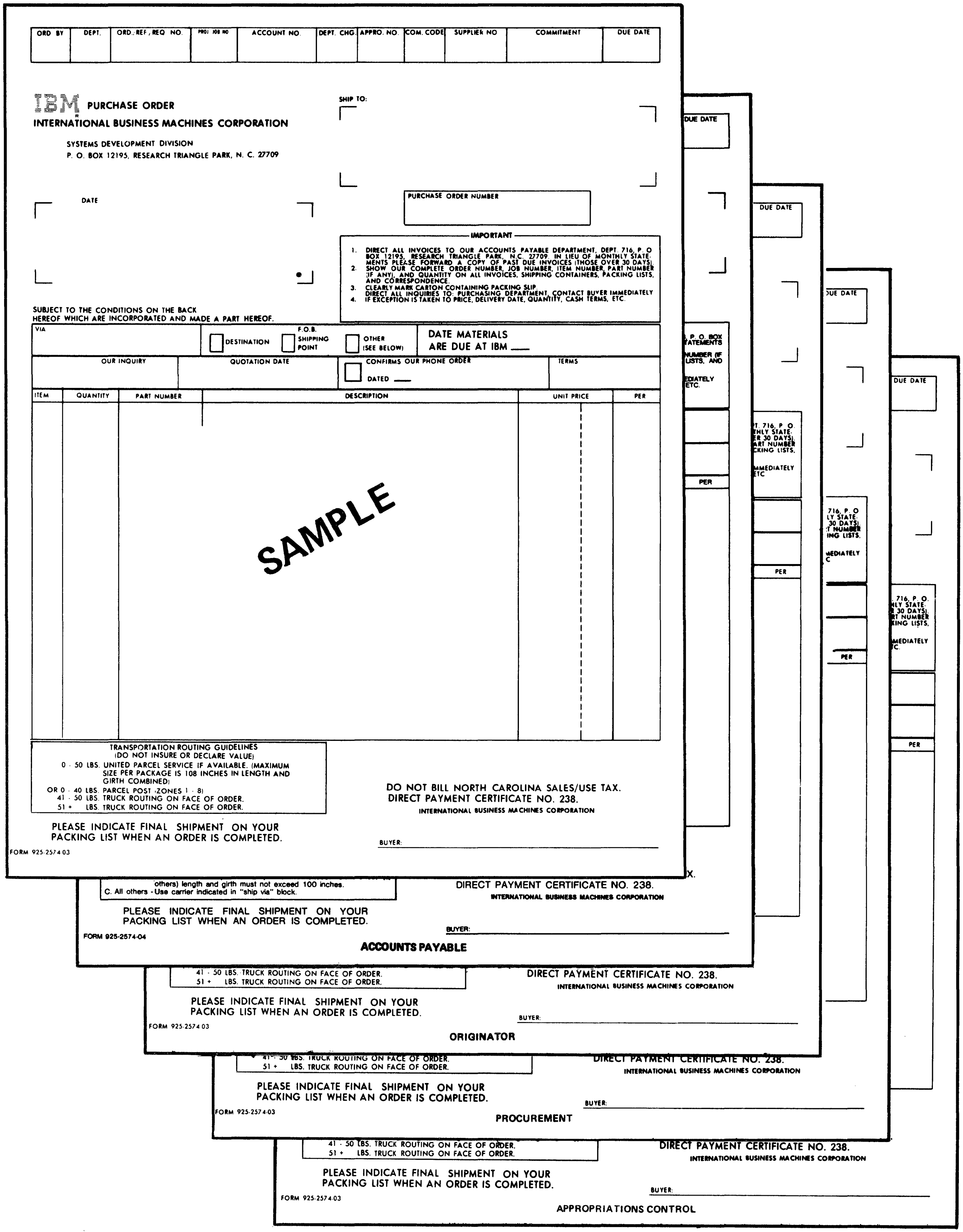


Figure 5. An example of a typical preprinted purchase order used by an MRO Purchasing System

ORD. BY	DEPT	ORD./REF./REQ. NO.	PROJ./JOB NO.	ACCOUNT NO.	DEPT. CHG.	APPRO. NO.	COM. CODE	SUPPLIER NO.	COMMITMENT	DUE DATE

MAIL TO

IBM Purchase Order

INTERNATIONAL BUSINESS MACHINES CORPORATION

SYSTEMS COMMUNICATIONS DIVISION
P. O. BOX 12195, RESEARCH TRIANGLE PARK, N. C. 27709

SHIP TO:

DATE

PURCHASE ORDER NUMBER

IMPORTANT

1. DIRECT ALL INVOICES TO OUR ACCOUNTS PAYABLE DEPARTMENT, DEPT. 716, P. O. BOX 12195, RESEARCH TRIANGLE PARK, N.C. 27709. IN LIEU OF MONTHLY STATEMENTS PLEASE FORWARD A COPY OF PAST DUE INVOICES (THOSE OVER 30 DAYS).
2. SHOW OUR COMPLETE ORDER NUMBER, JOB NUMBER, ITEM NUMBER, PART NUMBER (IF ANY), AND QUANTITY ON ALL INVOICES, SHIPPING CONTAINERS, PACKING LISTS, AND CORRESPONDENCE.
3. CLEARLY MARK CARTON CONTAINING PACKING SLIP.
DIRECT ALL INQUIRIES TO: PURCHASING DEPARTMENT. CONTACT BUYER IMMEDIATELY
4. IF EXCEPTION IS TAKEN TO PRICE, DELIVERY DATE, QUANTITY, CASH TERMS, ETC.

SUBJECT TO THE CONDITIONS ON THE BACK HEREOF WHICH ARE INCORPORATED AND MADE A PART HEREOF.

VIA	F.O.B. ☐ DESTINATION ☐ SHIPPING POINT ☐ OTHER (SEE BELOW)	DATE MATERIALS ARE DUE AT IBM ___

OUR INQUIRY	QUOTATION DATE	☐ CONFIRMS OUR PHONE ORDER DATED ___	TERMS

ITEM	QUANTITY	PART NUMBER	DESCRIPTION	UNIT PRICE	PER
			SAMPLE		

TRANSPORTATION ROUTING GUIDELINES
(DO NOT INSURE OR DECLARE VALUE)

A. 0-50 lbs. - United Parcel Service. Use if available; If not, see below. (Maximum size per package - 108 inches in length and girth combined)
0-40 lbs. - Parcel Post. Zones 1 through 8 size limits - length and girth (between first class post offices) must not exceed 84 inches; (all others) length and girth must not exceed 100 inches.
C. All others - Use carrier indicated in "ship via" block.

PLEASE INDICATE FINAL SHIPMENT ON YOUR PACKING LIST WHEN AN ORDER IS COMPLETED.

DO NOT BILL NORTH CAROLINA SALES/USE TAX.
DIRECT PAYMENT CERTIFICATE NO. 238.

INTERNATIONAL BUSINESS MACHINES CORPORATION

BUYER: ____________________

FORM 925-2574-04

ORIGINATOR

Figure 6. The originator's copy of an MRO purchase order

IBM **Purchase Order**

INTERNATIONAL BUSINESS MACHINES CORPORATION

SYSTEMS COMMUNICATIONS DIVISION
P O BOX 12195, RESEARCH TRIANGLE PARK, N. C. 27709

SHIP TO

DATE

PURCHASE ORDER NUMBER

IMPORTANT

1. DIRECT ALL INVOICES TO OUR ACCOUNTS PAYABLE DEPARTMENT, DEPT 716, P. O. BOX 12195, RESEARCH TRIANGLE PARK, N.C. 27709 IN LIEU OF MONTHLY STATEMENTS PLEASE FORWARD A COPY OF PAST DUE INVOICES (THOSE OVER 30 DAYS).
2. SHOW OUR COMPLETE ORDER NUMBER, JOB NUMBER, ITEM NUMBER, PART NUMBER (IF ANY), AND QUANTITY ON ALL INVOICES, SHIPPING CONTAINERS, PACKING LISTS, AND CORRESPONDENCE
3. CLEARLY MARK CARTON CONTAINING PACKING SLIP. DIRECT ALL INQUIRIES TO: PURCHASING DEPARTMENT. CONTACT BUYER IMMEDIATELY
4. IF EXCEPTION IS TAKEN TO PRICE, DELIVERY DATE, QUANTITY, CASH TERMS, ETC.

SUBJECT TO THE CONDITIONS ON THE BACK HEREOF WHICH ARE INCORPORATED AND MADE A PART HEREOF.

VIA	FOB: ☐ DESTINATION ☐ SHIPPING POINT	☐ OTHER (SEE BELOW)	DATE MATERIALS ARE DUE AT IBM ____

OUR INQUIRY	QUOTATION DATE	☐ CONFIRMS OUR PHONE ORDER DATED ____	TERMS

ITEM	QUANTITY	PART NUMBER	DESCRIPTION	UNIT PRICE	PER
			SAMPLE		

TRANSPORTATION ROUTING GUIDELINES
(DO NOT INSURE OR DECLARE VALUE)

A 0-50 lbs. - United Parcel Service Use if available: If not, see below. (Maximum size per package - 108 inches in length and girth combined)
B 0-40 lbs. - Parcel Post Zones 1 through 8 size limits - length and girth (between first class post offices) must not exceed 84 inches: (all others) length and girth must not exceed 100 inches
C All others - Use carrier indicated in "ship via" block

PLEASE INDICATE FINAL SHIPMENT ON YOUR PACKING LIST WHEN AN ORDER IS COMPLETED.

DO NOT BILL N[redacted]
DIRECT PAY[redacted]
INTE[redacted]

BUYER [redacted]

FORM 925-2574-04

Figure 7. A vendor's copy of an MRO purchase order with the top strip removed

Error Identification, Processing, and Messages

One of the most important aspects of data processing is the integrity of the data, so a great deal of attention should be placed on ensuring that only accurate, complete, and appropriate material is loaded on a file.

To do this, the analyst must define what is not acceptable to the system and what to do when unacceptable information reaches the system. The analyst usually has three choices:

1. The system can reject all the data.

2. The system can reject some of the data.

3. The system can print or display messages indicating the status of suspect information.

Ideally, choice three should be combined with either one or two, depending upon the seriousness of the error. The type of equipment and nature of the systems design (realtime, online, batch, interactive language, etc.) may also play a role in the error identification and correction techniques. In some DP circles, error identification is classified under two broad categories:

"Edits" and "audits"

Webster defines "edit" as:

"To alter, adapt, or refine, especially to bring about conformity to a standard or to suit a particular purpose."

"Audit" is defined by Webster as a "formal...examination and verification."

From a data processing point of view, an edit is often thought of as a check on each individual field to ensure that it meets certain criteria. For example:

1. No alpha characters in a numeric field

2. No numeric characters in an alpha field

3. No special characters or blanks in an alphameric field

4. The existence of only special letters or numbers in a field – for example, only cards with "six" in column 80 should reach this program or that subroutine

5. A "self-checking" routine is used to validate part numbers, etc.

This is considered to be "conformity to a standard" or to "suit a particular purpose".

An audit, from a DP viewpoint, is considered to be a check, not so much on the data itself (for example, a particular field), but on the relationship of one field to another.

For example:

- A sensitive part can be ordered only by analyzer X.

- A certain account code requires that a unit of measure field be input for specific purchase orders.

- An order originated in a nonproduction system cannot be altered by the production system.

- A transaction to delete a record is manually entered, but the record does not meet delete criteria.

- Certain account data is entered on an order, but source code or plant number, or commodity code, etc., requires another (different) account code.

- A final claim is entered against an order that has not been started.

- A receipt is processed for an order that is not on file.

- A file is used that has a date out of range or out of sequence.

Good techniques for error identification include such things as:

- For errors that are serious in nature, reject the whole transaction.

- Where one field on an input transaction containing several or many fields has a minor error, it may be best to process the transaction and print or display an action message stating what needs to be corrected.

- On a rejected or error transaction, print the entire input transaction, just as it was entered, for the user to see. Indicate the position of each column or position of input.

- Write each error message as meaningfully as possible. Specify clearly what is wrong and why it was not accepted; or if it was accepted with an error, tell the user what is required to correct the error condition. The analyst should determine what a novice at the user's job would need to know about inputting data and correcting errors. Be especially empathetic to human factors. Word the message for one who does not know the entire system.

- Think of every possible error and design the system to pick them up. Look for illogical input. That is, what would an untrained person or someone in a hurry do? Oftentimes, it is not the logical, but the illogical error that is the problem.

- Let the user know as soon as possible that an error has been made. If it is an interactive system, using a terminal, try to respond at the point of input. If the system is a daily batch type, try to make the error messages one of the first outputs. If the system is a monthly one, especially of a complex nature, it is sometimes advisable to run an input list and error sheet, and then wait several days before the main programs are run. This, of course, permits a clean, up-to-date current month's run rather than (always) having to wait for the following month to clean up the current month.

- Be certain to give an easily recognizable heading (title), with a date and DP job number, to the error list. Sometimes listing the user department and/or ultimate user on the form is helpful.

- In determining the seriousness of an error, the analyst must be familiar not only with the immediate use of the fields involved, but also with their ultimate use. The analyst, then, must know what other programs use the input data, when they access it, and what use they make of it. Sometimes a minor error in one system is a major one to another interfacing system.

- It is also worthwhile to supplement the error messages themselves with appropriate material in a user manual. This is especially helpful for training new people, or for handling rarely occurring messages.

- One thing to recognize, and try to avoid, is allowing one system to accept data that it feeds to another system that later rejects it. Consistency, in all respects, should be the rule. "Rejection at the earliest possible time" should be considered a basic principle.

Specifying Data Elements, Edits, Audits

Figures 8 through 15 illustrate how the dictionary approach may be used to specify the data elements, the data edits and audits required, and the error messages needed for a claim ending a manufacturing process, the final claim transaction.

In Figure 8, the analyst first provides a short background statement on the needs and advantages of a final claim in a manufacturing environment.

Figure 9 provides a specific definition of the final claim transaction, the entry mode for the transaction, and the data elements required.

FINAL CLAIM

One of the prime advantages of the system is to collect final machine claim transactions from the manufacturing floor, utilize the data internally for order tracking and disposition notification, and then forward the required information to the plant master order system so the open order condition can be updated.

The final claim module should be so structured as to allow input by a department that is different from the department that actually built the unit.

Current plans call for the final test department to be separate from the department that is building the units. The Recon line, at this time, is apparently independent of the new production line.

Figure 8. Example of a background statement concerning needs and advantages

FINAL CLAIM

Definition: An input that indicates that a specific machine serial number (and therefore, generally, a plant order number) has completed the manufacturing build cycle (including testing).

Entry Mode: Final claims should be made primarily by a 3793 with a 3277 as a backup or alternate input mode.

Data Elements: The following data elements should be input manually:

- Machine Serial Number
- Control Field
- Time Audit Override Code

The system should automatically provide the following data elements when the input transaction is made:

- Date of Final Claim
- Time of Final Claim

Note: For final claiming, it is expected that the machine type would be derived automatically by the system from a function key, terminal addressment, or an input code of some kind. Input of the full four position machine type field is the least preferable of all techniques.

Figure 9. A specific definition of the final claim transaction

In Figure 10, the first element is defined in detail, showing specific edits needed. The system responses (messages) to those edits are shown in Figure 11.

Figure 12 shows the data audits required, while Figure 13 shows the system responses (messages) required to report the results of those audits.

The second element (control field) and the edits it requires is shown in Figure 14, while Figure 15 explains the responses needed by those edits.

Because these examples are primarily concerned with edits, audits, and error messages as related to data element definition, it is irrelevant as to whether they are received from an interactive system, on a display, on a keyboard printer, or from a batch system on an overnight, weekly, or monthly schedule. Further, it is left to the reader to address the obvious user questions of: What corrective action is necessary? How do I do it? When do I do it?

DATA ELEMENT EDITS

Field Abbreviation: "MACSR"

Field Name: Machine Serial Number

Field Definition: "A number that identifies a machine within a product type." (Data Element Label is "MACSR" in the plant master order system.)

Field Length: Seven positions

Field Type: Alphameric

Edits: The following edits will be in effect:

1. No blanks permitted, entire field must be utilized.
2. No special characters allowed (*,-, etc.), except "$" in first position.

Figure 10. Definition of the first element and system edits needed

EDIT ERROR MESSAGES FOR MACHINE SERIAL NUMBER

Error response for Edit 1 should contain the following:

A. The exact user input reflecting the column number(s) in which the data was entered.

B. A message such as the following should be displayed:

"Input invalid, transaction rejected. Field not completely used -- blanks occur in input."

Error response for Edit 2 should contain the following:

A. The exact user input reflecting the column number(s) in which the data was entered.

B. A message such as the following should be displayed:

"Input invalid, transaction rejected. Special characters used in alphameric field."

Specific Example for Edit 1:

User inputs Serial Number "2-78901"

The system responds with:

(A) "Serial Number '2-78901' input.

(B) Transaction Rejected due to blanks in input field."

Specific Example for Edit 2:

User inputs Serial Number "24* -901"

The system responds with:

(A) "Serial Number '24* -901' input. Transaction rejected due to special characters in alphameric field."

Figure 11. Example of system responses to the edits needed in Figure 10. These are the responses to the user inputting the element

AUDITS FOR MACHINE SERIAL NUMBER

The following audits should be in effect:

1. The machine serial number must be stored in the data base.

2. The machine (order) must be in an in-process status.

3. The machine must have been in-process for X period of time. (X will be provided by a table that identifies, by machine type-model and production type, a reasonable time for final claiming to be made after first claim. This time will be input by manufacturing.)

Note: This field machine serial number is used in conjunction with the data element "control field".

Figure 12. Example of a statement of data audits required for inputted data

AUDIT ERROR MESSAGES FOR MACHINE SERIAL NUMBER

Error response for Audit 1 should contain the following:

A. The exact user input reflecting the column number(s) in which the data was entered.

B. A message such as the following should be displayed:

"Transaction rejected, machine serial number not stored in the data base."

Error response for Audit 2 should contain the following:

A. The exact user input reflecting the column number(s) in which the data was entered.

B. A message such as the following should be displayed:

"Transaction rejected, machine serial not in an in-process status. Status codes are "XXXX". (Place here the values of the four system status codes W, X, Y, and Z.)

Error response for Audit 3 should contain the following:

A. The exact user input reflecting the column number(s) in which the data was entered.

B. A message such as the following should be displayed:

"Transaction rejected, machine serial number input has not been in process long enough to be completed."

Figure 13. System responses required to report to a user the results of data audits

DATA ELEMENT EDITS

Field Abbreviation: N/A

Field Name: Control Field

Field Definition: The two low-order positions of the Plant Order Number (Data Element Label is "PLORN" on the plant master order system.)

Field Length: Two positions

Field Type: Alphameric

Edits: The following edits will be in effect:

1. No blanks permitted, entire field must be used.
2. No special characters allowed (*,-, etc.).

Figure 14. The second data element and the edits it requires

EDIT ERROR MESSAGES FOR CONTROL FIELD

Error response for Edit 1 should contain the following:

A. The exact user input reflecting the column number(s) in which the data was entered.

B. A message such as the following should be displayed:

"Input invalid, transaction rejected. Field not completely used -- blanks occur in input."

Error response for Edit 2 should contain the following:

A. The exact user input reflecting the column number(s) in which the data was entered.

B. A message such as the following should be displayed:

"Input invalid, transaction rejected. Special characters used in alphameric field."

AUDITS

The following audit should be in effect:

Once a match has been found by machine serial number, on the MALCS data base, a comparison should be made with the two low-order positions of the corresponding Plant Order Number on file and the "Control Field" input. (An exact match must be found prior to this input transaction being accepted.)

Figure 15. System responses needed to report the result of the edits specified in Figure 14

Input Audit Listings

In some ways, principally due to their help in problem solving situations, input listings have been related to error identification listings.

Provide a daily list of all manually input transactions, and a list of all input via card, tape, disk, or terminal from another system. The list should have specific program identification (for example, DP job name and number) and date. Users should keep these listings for a period of time, depending upon the run frequency, long term reference value, and storage availability. Although daily listings are generally the most bulky, saving these for at least six months to a year is not unusual for some types of programs. Retention problems may be resolved by the use of mass storage devices such as the IBM 3850 Mass Storage System. Payroll and some accounting needs may differ drastically from many purchasing, production control, receiving, or manufacturing needs.

Input audit listings, especially for batch systems, have often been invaluable for problem solving.

Master File Listings

For reference purposes, analysis, or operation use, periodic printouts of master files are quite useful, especially for small files. For some new systems, this can be most beneficial.

Control Information

Control information, like input audit listings, is closely related to error messages. In fact, sometimes it is only through such things as record counts that some types of errors can be detected.

There are a number of ways that control information can be used. Some relevant points in developing and using automated control information are:

- Create a count of the number of output records written, by record type, on an interfacing file. (That is, on an output file from one system to be used as an input file in another system.)

- Keep a count of all records, by record type, of all incoming transactions. This is usually most valuable when control counts exist from the system that originated the file, and for those input files that may not have their input listed.

- Program a count of the number of records, both incoming and outgoing, on all master files that are updated by the system, for each program in the system. Match it, if possible, with counts of transactions that add and delete records to the file.

- A count should be taken of the number of each type of output form processed (printed) by the system. In addition, it is sometimes helpful to record totals or subtotals of various kinds within each type of major category (for example, the number of production and the number of nonproduction purchase orders printed).

- Each control sheet should be properly headed, with job name, a DP number and date.

- Clearly and exactly label each total. Avoid colloquial or generic names: be specific (for example use "job", not order, or "cancel" rather than alter, or "delete" rather than cancel if such be the case).

- Make certain that comparative or relational control totals are read as soon as possible to detect errors so that they may be corrected by the computer (reruns, etc.) as much as possible, rather than manually. (There are few things as exasperating as finding that the wrong file has been used, and everything must be re-created or backed out manually because the controls were not verified soon enough.)

- Another form of control, sometimes more closely linked to audits, is date control. Specifications are written so that compares are made to ensure that only the most current file is used, or that files created outside specific date ranges are flagged, or not read into the system (program).

Reports

There are a number of items to be aware of when designing reports – whether they are to be printed or displayed on terminals. Among the things to consider, specify, or use are:

- Give each report a meaningful, clear title descriptive of its nature or use.

- Be certain to put a DP job number and date on the report, preferably at the top of each page.

- Sequentially number each page. If the report is broken into groups to be distributed to different people, make the page number consecutive within each group (rather than for the report as a whole).

- If the report, or sections of it, is confidential or for use only within the company, distinctly label each page accordingly. For example, "Jones Co. Confidential" or "For Jones Co. Internal Use Only", etc. (It should be noted that proper classification also includes knowing when a report can be declassified. In some instances, the date or other conditions under which a form can be declassified are printed on the form.)

- Specify the frequency and time that the report is to be run. For example, daily, weekly, monthly, on request, by 8:00 a.m. each Tuesday, the second and fourth weeks of each month, five days after accounting close, the fifth workday of each month, etc.

- Specify the size of paper.

- Specify the number of copies, that is, single sheet, three part, etc.

- Specify the distribution of the report: include such things as department number, location, bin number, etc.

- Indicate requirements like machine collating and bursting, if necessary.

- Get some basic idea of the size of the report, obtain some blank IBM printcharts (GX20-1818) and start from there. (Figure 16 in this section illustrates and further discusses the printchart.)

- Most IBM printers have 132 print positions. All of these may be used by the analyst in designing reports. (Note, chart position No. 1 is sometimes left blank by some programmers due to certain programming language statements. If this is the case, the printchart is laid out from positions 2-133 rather than 1-132.)

- Lay out the individual field headings, just as they should be when the report is run, always striving for clarity. The key question is: "Can someone who is somewhat familiar with the area read and utilize the report without being confused?" Appropriate abbreviations may be used when the terms are generally known and/or to conserve print space. If the abbreviations used are not those generally known, make certain that the users have a reference document that fully defines them or that a legend or glossary appears on the report.

- Field headings many times can be most effectively written using two lines rather than one.
  For example,

  ```
  Buyer   E.C.   Unit
  Num.    No.    Price
  ```

- Under each field heading mark each space in which printing will be done. Traditionally, an "X" is placed in each utilized field position.

- Leave several lines between the page or report headings and the individual field headings.

- Skip one or two lines between groups or after each group and before and after totals. This is especially helpful where long lists are involved and/or the printing is eight rather than six lines to the inch. Readability is an important factor to consider in report design.

- For reports that are used at various locations, be sensitive to local needs, usage, jargon, slang, etc. Try to make the report more standard or universal.

- Often, in report design, the same data will appear on several reports but in different sequences. It is wise in such cases to devise totals that can be compared from report to report so that if any discrepancies occur, they may be detected early.

- Bring the users in on report design, asking the question: "What do you need?"

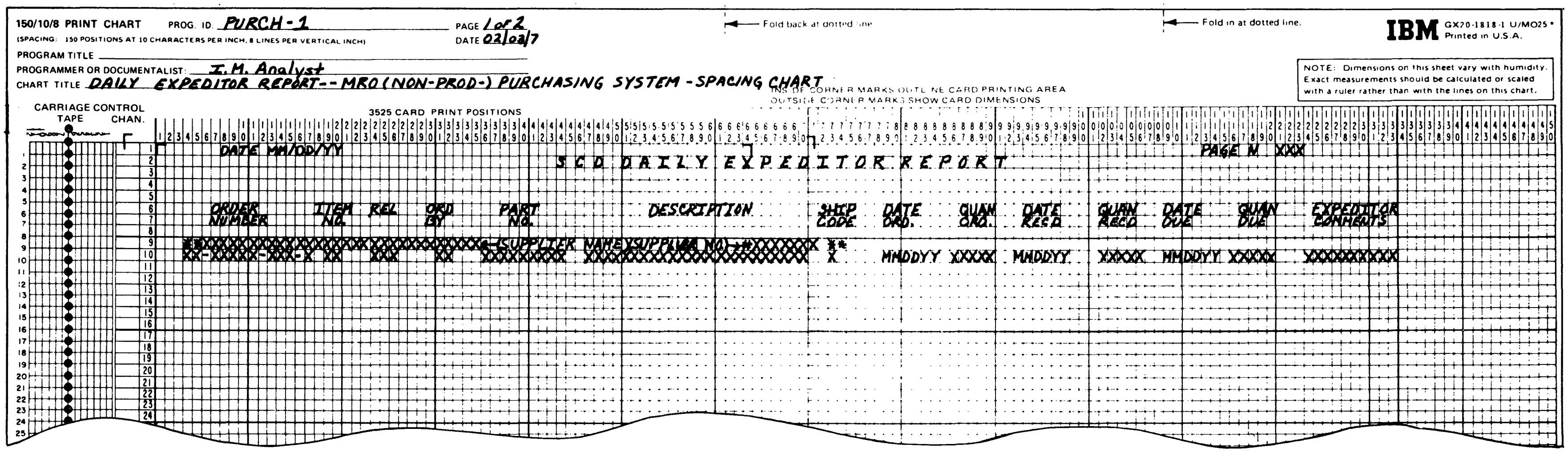


Figure 16. Section A.

This figure shows how an IBM print chart (GX20-1818) – mentioned earlier under Output – Detail Level Forms and in this section – is used to lay out a form. Virtually all computer-prepared reports and forms can be designed using this chart. In Section A the analyst has designed the form and used X's to represent maximum field size. Because some individuals have difficulty visualizing a form/report without actual data, in Section B the analyst has used letters and numbers to show the data. Section C shows an actual report as prepared on the computer

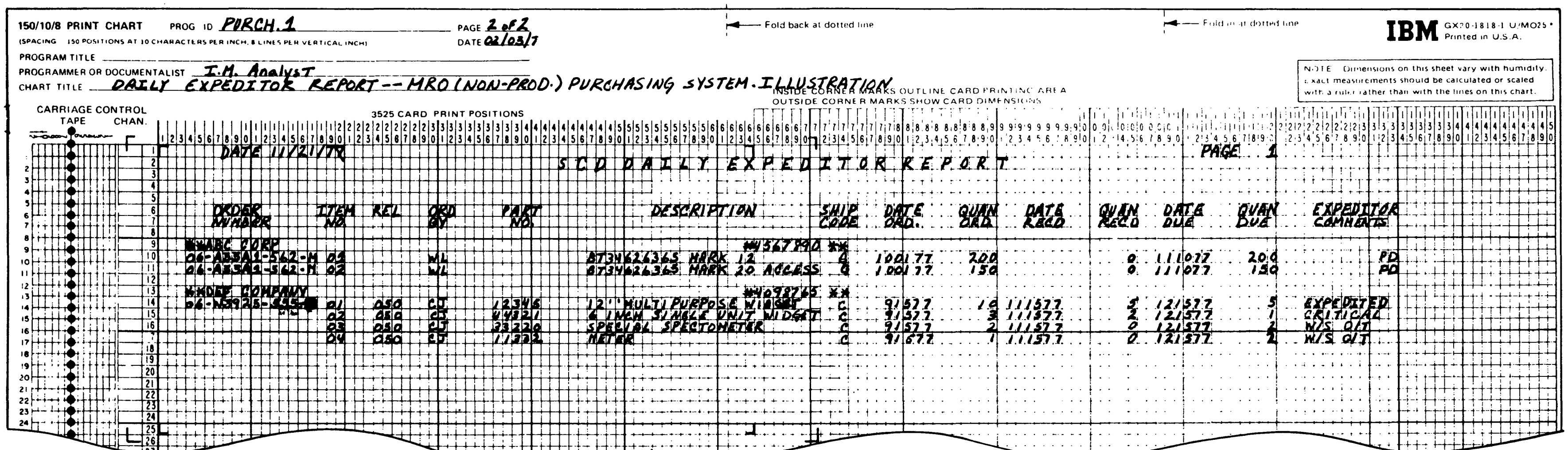


Figure 16. Section B.

DATE 11/21/7X

SCD DAILY EXPEDITOR REPORT

PAGE 2

ORDER NUMBER	ITEM NO.	REL	ORD BY	PART NO.	DESCRIPTION	SHIP CODE	DATE ORD.	QUAN ORD.	DATE RECD	QUAN RECD	DATE DUE	QUAN DUE	EXPEDITOR COMMENTS
**BZM INC					#692665	**							
96-B3498-671-Z	01		LV		ELECTRONIC JABR BADGES	C	110379	200		0	120679	200	
96-B3498-671-Z	02		LV		ELECTRONIC JABR BADGES	C	110379	200		0	120679	200	
96-A3097-766-K	01		TX		BK9440710S CASH ELECTRON	Q	072279	2	101079	2	081579	1	*F* 1 PD
**BZM INC				CHICAGO	#6926655	**							
96-V3211-766-M	02		JS		SUPPLY 100 BADGE INSERTS	C	022479	200	051079	100	121279	100	CR09760779
96-V3211-766-M	03		JS		VENDOR TO RECODE CARD KEY	C	022479	3		0	121279	3	CR09760779
**HARRIS MACHINERY DIV				ENDICOTT	#7538116	**							
96-V3361-773-M	16		JB		GASKET-OUT #K5-1006	C	031479	6	032879	2	033179	4	PD
**KOLAN INCORPORATED				JACKSON	#7459866	**							
96-V3087-559-K	01		SV		RENEW MONTHLY SERVICE	Q	010579	1		0	123179	1	EXPIRES/MO
**KOLAN INCORPORATED					#777849	**							
96-V3149-E80-G	01		RM		SERVICE FOR COPIER,	C	080879	1		0	081979	1	PD
96-V3149-E80-G	02		RM		BOXES 200 SHEETS (BOX)	C	080879	8		0	081979	8	PD
**KOLAN INCORPORATED				KANSAS CITY	#2778490	**							
76-W3839-568-S	00		WE		INSTALLATION UNITS PER MO	G	022279	1		0	011779	1	EXPIRES/MO
76-W3839-568-S	01		WE		MONTHLY MINIMUM ON RENTAL	G	022279	12		0	011779	12	EXPIRES/MO
**CENTRAL MOTOR EXPRESS					#753917	**							
87-B3396-575-M	01		ZM		ZELAG MOTOR MODEL Z31L	Q	110379	1		0	111579	1	PD
**CITY OF DENNIS				DENNIS	#9458720	**							
03-V3024-569-M	01		AC		ADD WATER SERVICE	I	121779	1		0	123179	1	EXPIRES/MO
03-V3027-662-L	01		LJ		FOR ANALYSIS PURPOSES	I	122179	1		0	123179	1	EXPIRES/MO

Figure 16. Section C.

- In report analysis the analyst should not only ask what the users need, but also what an analyst needs or may need to solve problems once the system is installed and operating. For example, when something happens, can it be traced? Some reports or some parts of some reports are designed mostly or solely for error identification and correction. Although such topics as error identification and input lists, etc., are discussed separately, it is also a good reminder in general report design to ask what is needed from this respect also.

- Calculate totals for each group or subgroup in a report, as well as "final" or overall totals.

- Adequate provisions must be made for spacing between fields. Generally speaking, one or two positions is satisfactory.

- The use of special characters, symbols, or codes can often be of help in saving space, easily highlighting certain situations, etc. For instance, an asterisk (*) might designate certain problems or exceptions, and instead of trying to print a lot of complicated messages on each line, requiring significant space, the analyst can create a one to three position field containing various codes, the meanings of which would be printed (as a legend) at the end of each group or subgroup to whom report distribution is made (buyer, analyzer, account, etc.).

- For reports that are shared by one or more divisions of a company or from company to company, be certain to specify the originating location on the report. Also, double-check for confidential or internal use only data before outside distribution is made.

- Many people cannot get a good understanding of a report by looking at a printchart or display design with marks on it. It is often very helpful to show a generalized printchart (with x's on it) and to follow it up with an example of how the report or display would look, using dummy content in the fields and for totals (Figure 16).

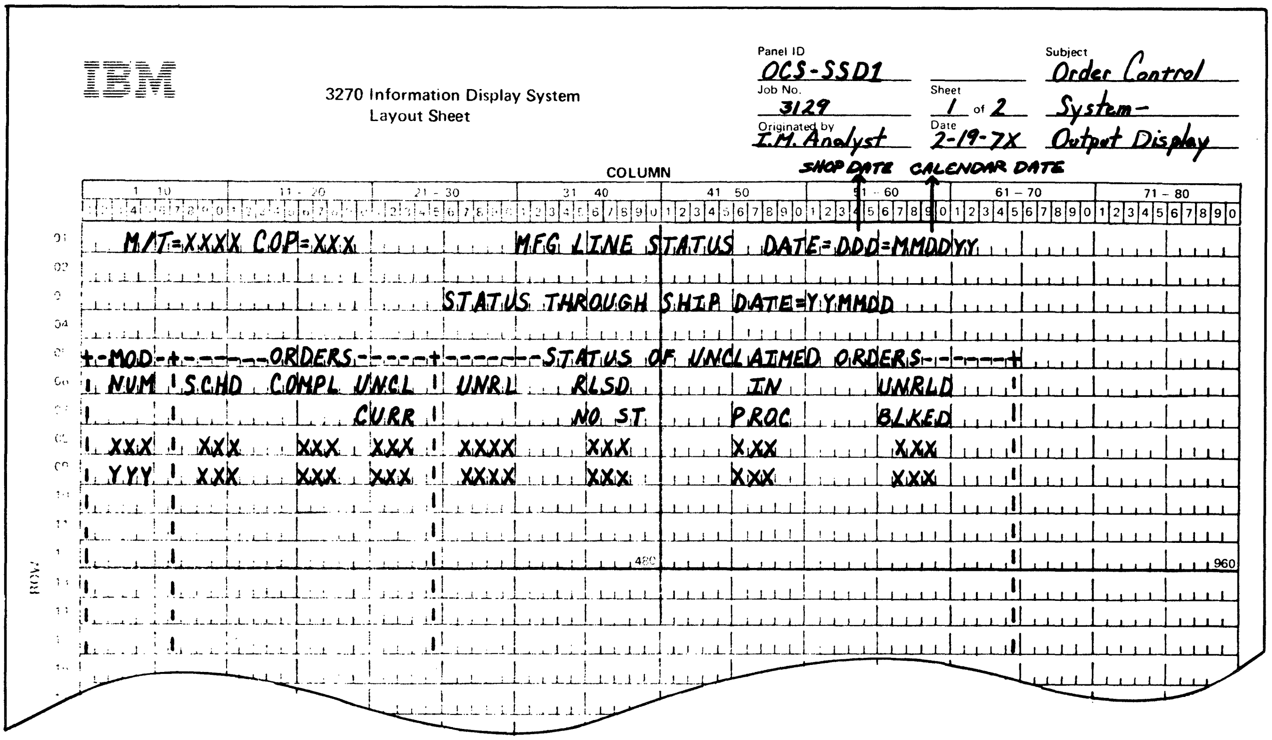
- When designing reports that will appear on visual displays, the analyst must be familiar with the equipment – screen sizes, number of characters to a line, number of lines to the screen, contrast, screen usage restrictions due to software/hardware limitations, location of terminals, sign-on and sign-off abilities, security restrictions and provisions, response time limitations or restrictions, etc.

- In addition, special attention to human factor considerations should be given when designing input and output screens for visual displays. Areas such as element-by-element, line-by-line, or full screen processing must be looked at from hardware/software capabilities, and the needs of the specific jobs involved. Also, the clarity of heading data is very important, particularly if the operator must use a number of different displays and is likely to be interrupted by the telephone, other employees, or management. Examples of screen design are shown in Figure 17.

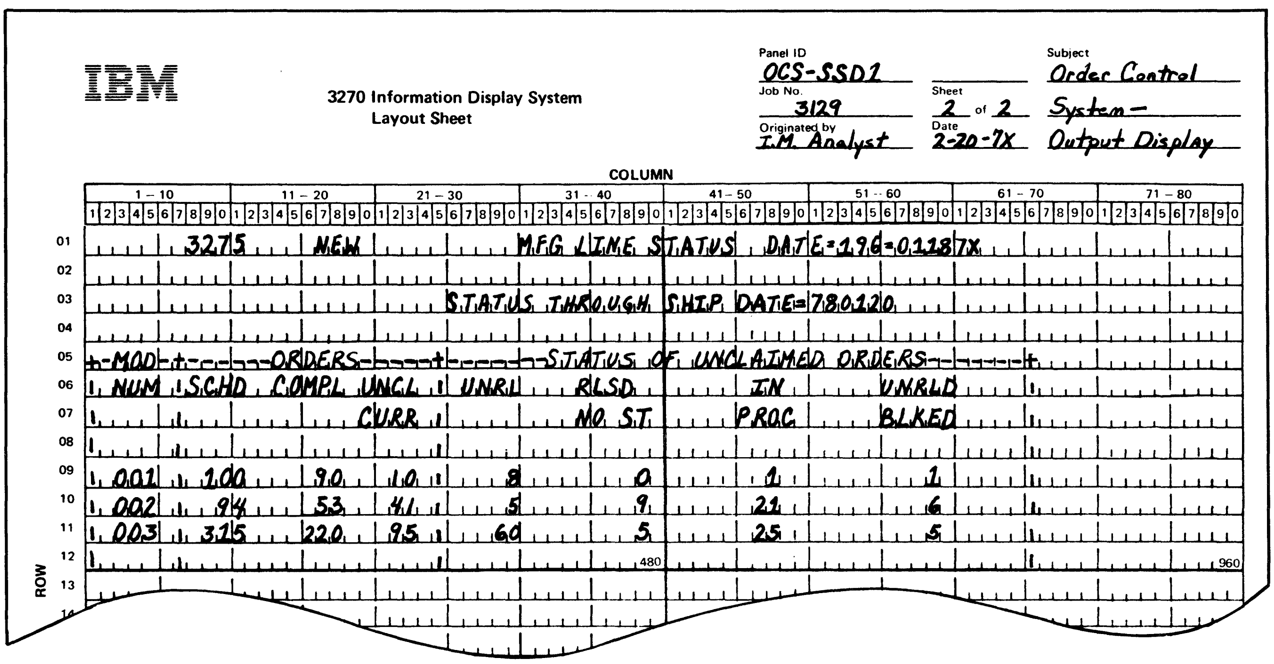
- On the technical side, the analyst should verify that the data from which the report will be generated will be available. Subtleties may exist in ensuring that weekly, monthly, or quarterly reports have the necessary information. Daily, weekly, or monthly temporary files must be created to hold data for a period of time, in some cases.

- Like forms design, there are many considerations to good report design, most of which will come out by working with and designing a number of reports. Asking an experienced analyst to critique a newly designed form or display can often help tremendously.

- Additional help or ideas can often be derived from reviewing and analyzing a number of different reports and displays designed for different areas, needs, and times. The analyst should not adhere only to those related to the analyst's specific area. Often, too, System Reference Libraries, application briefs, write-ups, and books give good supplementary ideas.


IBM
3270 Information Display System
Layout Sheet
Panel ID OCS-SSD1
Job No. 3129
Sheet 1 of 2
Originated by I.M. Analyst
Date 2-19-7X
Subject Order Control System - Output Display
COLUMN
SHOP DATE CALENDAR DATE
M/T=XXXX COP=XXX MFG LINE STATUS DATE=DDD=MMDDYY
STATUS THROUGH SHIP DATE=YYMMDD
+-MOD-+----ORDERS--------STATUS OF UNCLAIMED ORDERS-------+
NUM SCHD COMPL UNCL UNRL RLSD IN UNRLD
CURR NO. ST PROC BLKED
XXX XXX XXX XXX XXXX XXX XXX XXX
YYY XXX XXX XXX XXXX XXX XXX XXX
ROW

Section A.


IBM
3270 Information Display System
Layout Sheet
Panel ID OCS-SSD1
Job No. 3129
Sheet 2 of 2
Originated by I.M. Analyst
Date 2-20-7X
Subject Order Control System - Output Display
COLUMN
3275 NEW MFG LINE STATUS DATE=196=01187X
STATUS THROUGH SHIP DATE=780120
+-MOD-+----ORDERS--------STATUS OF UNCLAIMED ORDERS-------+
NUM SCHD COMPL UNCL UNRL RLSD IN UNRLD
CURR NO. ST PROC BLKED
001 100 90 10 8 0 1 1
002 94 53 41 5 9 21 6
003 315 220 95 60 5 25 5
ROW

Section B.

Figure 17. Section A is an example of a design specification for a visual display. The headings are what the analyst is requesting, X's indicate maximum field size. Section B shows the same display layout with values placed in the various fields to help the users better understand what it is they will receive. It is also an aid to the programmer in developing programming specifications for the display. For a complete specification package, the analyst would also indicate why this output display is necessary; when and how it is to be obtained by the user; edits, audits, and error messages needed to properly process the input request; and each element (field heading) would be defined in the Data Element Dictionary

Updating Master Files

One of the most common needs of a system is updating the master files. This is generally done via manual transactions (cards, terminal, etc.) directly into a system (program), or by interfacing mediums such as cards, tapes, disks, diskettes, or telecommunications from one system to another.

The analyst specifies the files to be updated, their frequency, the proper edits and audits, and detail security techniques. In some cases, it is necessary to install an individual as data manager or data base coordinator to monitor the integrity of the system and the data entering it, and to also create and assign security codes and levels of security.

Processing - Detail

Normally, an analyst is involved with the type of processing and not how the processing is accomplished. (Unless program specifications are being provided, systems engineers or systems analysts usually do not need to get into that level of detail.)

A useful technique is to create a dictionary of each field heading and then specifically define each term used. The following section is an example of a form used for such purposes. Each heading term should appear on a separate sheet.

Although processing is usually considered to be the third aspect in the fundamentals of designing a system, it is really closely linked to the output if one uses the dictionary approach. In giving the report or display requirements, fields must be at least generally defined (abbreviation, name, size, etc.) and it is only a few steps further that the processing requirements and definitions for the various fields can be done. These same principles also apply, in many ways, to input specifications.

It is highly recommended then, for anything but the simplest of systems, to use the dictionary approach.

Form Heading Dictionary Example

Field Abbreviation: (The exact abbreviation or heading as it appears on a report, display or form.) Examples: Bu.; Qty. Ord.; Ord. No.; P.O.

Field Name: The full name of the field. Examples: Buyer, Quantity Ordered, Plant Order Number, Purchase Order (these refer to the above abbreviations)

Brief Description/Meaning/Derivation: The specific definition of a unique field: What it is, from where it is obtained, how it is obtained and/or used. Mathematical formulas, spec definitions, and derivation techniques are all applicable here. Examples: The buyer placing the order, from File X, Field Y. (This might distinguish this field from the buyer assigned to a part number.) The quantity ordered for a specific job number, from File W, Field Z. (This might distinguish this field from the total quantity on order for a part or the total quantity ordered on a P.O. for all jobs on a P.O.)

Update Frequency: (How often, or when is a field updated.)

- As each purchase order is placed. Once only.
- As each job on a purchase order is placed. Once only.

Field Length: (The number of positions the field will occupy.)

Examples: Two positions; seven positions

Field Type: (Alphabetic; numeric, alphameric with no special characters allowed.)

Examples: Alphameric; numeric

Default Values/Rules: Specific rules should be given here to tell what should occur if the field is not found or left blank. For example, a blank in an input field designating originator might always default to "01"; or in defining a sequence, might always be considered one way (ascending); or the date might default to the current date; or the location code, if not input, would default to a specified value; etc.

NOTE: It is sometimes useful to designate whether a field is output or input. Fields should also be designated as system-created, when appropriate. For example, the system might "create" or automatically load the current date and/or time when certain transactions are input. The analyst might specify "MM DD YY" (month, day, year); update frequency as being whenever transaction "ABC" is input, etc.

Utilizing the Dictionary Approach

This section attempts to clarify some of the ways the dictionary approach can be utilized to define various data elements. All examples, Figures 18 through 24, illustrate data elements that were defined for an actual system.

The reader is encouraged to pay special attention to the titles, arrangement of fields, and the various types of information that can be defined using the same headings. Several different types of data elements are illustrated to show how various conditions may be defined.

One analyst who normally uses this approach has prepared a pretyped master sheet for personal use. Whenever additional sheets are needed, a copying machine is used to reproduce the quantity needed.

There are, of course, other approaches available for obtaining "blank" sheets available for analysts to use. If anticipated usage is high enough to justify it, one approach is to have an in-house art department design a master for the form. Then, the master can be used by an in-house reproductions department or an outside printer to prepare the necessary quantity. In some instances, it may also be desirable to have the preprinted forms padded 25 or 50 sheets to a pad.

Field Abbreviation: REL QTY

Field Name: New Order Release Quantity

Brief Description/Meaning/Derivation:

A four-position numeric field indicating the number of orders to be applied against a particular line item input.

Update Frequency: N/A (not applicable)

Field Length: Four positions

Field Type: Numeric

Default Values/Rules: Blank = Defaults to 1 (one)

Field Use: Input

Figure 18. This is an example of the definition of a relatively simple numeric data element having an implied default value

Field Abbreviation: BGN STB

Field Name: Beginning Start-To-Build Date

Brief Description/Meaning/Derivation:

A four-position date indicating the Start-To-Build day for which unreleased orders are to be selected for release. If release is to be confined to a specific range of dates, this date is the first in the range.

This date is the user input field that is equivalent to (that is, matched against) the Data Element Field Label "SCHSB" from the plant master order system.

Update Frequency: N/A (not applicable)

Field Length: Four positions

Field Type: Numeric (month, day; MMDD)

Default Values/Rules: Blank: The system goes back to the oldest day for which any unreleased order exists on the data base.

Field Use: Input

Figure 19. An example of the definition of a data element having a default rule. The element is also used in combination with another data element to show a range of values (See element "END STB" Figure 20)

Field Abbreviation: END STB

Field Name: Ending Start-To-Build Date

Brief Description/Meaning/Derivation:

A four-position date indicating the last day in a range of Start-To-Build days for which orders are to be selected for release.

Update Frequency: N/A

Field Length: Four positions

Field Type: Numeric (month, day: MMDD)

Default Values/Rules: None

If blank, not used. i.e., no range of dates used, if no input in this field.

Field Use: Input

Figure 20. An example of the definition of a data element that is the second element in a range of values (see "BGN STB", Figure 19)

Field Abbreviation: ID CD

Field Name: (Field) Identification Code

Brief Description/Meaning/Derivation:

This code identifies (or designates) which type of data is input in the next field, which is multifunction in nature.

Field Length: One position

Field Type: Alphabetic

Field Values: C = Customer number
O = Order number
S = Machine serial number

Default Values/Rules: None

Field Use: Input

Figure 21. This example shows the definition of a data element that has specific field values and is used to qualify another data element (see "CUST/ORD/SERIAL", Figure 22)

Field Abbreviation: CUST/ORD/SERIAL

Field Name: Customer Number (or) Order Number (or) Machine Serial Number.

Brief Description/Meaning/Use/Derivation:

This field contains the customer number, order number, or machine serial number that is being input to the system. (To be released, blocked, unblocked, etc.).

Field Length:
- Seven numeric positions for customer number (or the first five for a generic customer number).
- Six alphameric positions for order number.
- Seven numeric positions for machine serial number.

Field Type: Alphameric

Default Values/Rules: None

Field Use: Input

Figure 22. This is an example of the definition of a multi-purpose data element whose meaning is determined by the input in another (preceding) field (see "ID CD", Figure 21)

Field Abbreviation: N/A (not applicable)

Field Name: Date Of Final Claim

Brief Description/Meaning/Derivation:

This field is created on the master file by the system when a final operation claim occurs. It shows the month, day, and year that the input was made.

NOTE: If for some reason the input is made on a day after the final claim is made, provision should be made to show the date the machine was actually completed (as opposed to the date the input was made). For further details, see final claim specifications, "Exception Processing" section.

Update Frequency: Once only, at the time of final claim.

Field Length: Six positions

Field Type: Numeric (month, day, year; MMDDYY)

Field Use: Output, see appropriate inquiry displays.

Figure 23. This example illustrates the definition of a data element that is generated by the system

Field Abbreviation: UNREL ORDERS

Field Name: Unreleased Orders

Brief Description/Meaning/Derivation:

The number of unreleased orders on the data base (for a particular machine type/model/day, etc., depending upon the report). The system calculates this field each time the display using this field is requested.

Update Frequency: As releases occur throughout the day

Field Length: Four positions

Field Type: Numeric

Field Use: Output

Figure 24. This example shows the definition of an output data element that is calculated by the system whenever a user requests it

Equipment Space-User Area

In assessing total user needs, adequate provision should be made to ensure that proper space is allocated for any equipment to be placed in the user area. In some instances it may be wise to consult with internal or external experts for guidance. In the industrial sector the facility's industrial engineering department can usually be of assistance, while in other sectors the group may be called office planning, interior design, etc. External groups that can usually provide guidance include the local telephone company, electric utility, etc.

The analyst should be concerned with what equipment (and to some extent, supplies) is needed, and where it is to be placed. Such things as displays, printers, modems, telephones, line printers, control units, cables, etc., as well as proper workstation space furniture, electrical outlets, and storage room should be addressed and provided for. Consideration should also be given to the environmental factors with respect to equipment placement: noise, heat, humidity, location, etc.

User Education

Although user education is a separate phase from the analysis and design portions of an analyst's job, some of the main areas are addressed in this section.

Oftentimes, a quick review of the things necessary for education will highlight a point or two that might have been overlooked in the design phase, especially from the human factors viewpoint. Lack of problem solving or troubleshooting aids available for the system may become apparent.

Deficiencies, inconsistencies, implied double meanings, and so on seem to surface in message wording, sort sequences, input lists, secondary fallback and recovery needs, procedural responsibilities, forms clarity, etc. Many things seem to be magnified when preparing for education classes.

User education should include instruction concerning:

- Inquiry transactions. How to input, when to input, where to input

- Processing transactions. How, when, and where to input, their effect(s) and verification techniques

- Error messages and corrective methods. What comes out, when and where

- Report distribution. Who gets what

- Report requests. How to obtain reports

- Report reading. Meaning and use of a report

- Storage and filing. What to keep, how long, why

Proper filing sequence

- Forms use. Which forms exist, for what purposes, who utilizes them

- Distribution. Before and after input and/or use

- Fallback and recovery techniques. What to do, when to do it, whom to see

- Procedural references. Corporate, plant, department, etc.

- Contact/support personnel. Whom to see for various problems, needs, etc. Name, department, location of analyst, programming, data processing, field engineering, reproductions, phone service, forms, and other interfacing or support areas

- Vital records. Training should include a discussion of the vital records program, identification of files, retention cycles, storage and retrieval times, etc.

- Security. The importance of physical and logical, general company and local requirements, special considerations, audits, etc.

- Equipment usage. Training in the use of equipment – operational (specifically to a job) and technical (general use of equipment)

Vital Records

No manual of this kind would be complete without some mention of vital records. It is necessary, in normal systems design, to provide adequate fallback and recovery techniques for equipment as well as program failure. In addition, a formal disaster plan should be in effect, especially from a file preservation viewpoint, for major catastrophies.

Specific files – usually master files – should be identified as critical to the running of the system, and a formal program initiated to routinely preserve these files, offsite if at all possible. A definite schedule for transporting each file to the secured area should be established, adhered to, and monitored. The schedule for shipment and preservation should be dependent upon the criticality of the file, its update frequency, the number of transactions updating the file, the ability to regenerate the file, its company security sensitivity, security change frequency, and the like.

Examples of files to which this applies include master name and address files (supplier, customer, employee, etc); master parts inventory files; master purchasing files (parts, quotations, consignment, open order, etc.); master receiving files (parts inventory, MRO, etc.); accounts payable; accounts receivable; personnel; etc.

The idea behind a vital records program is to be able to restart the business in case of a fire, tornado, explosion, plane crash, flood, other disaster, with a minimum of effort in a more or less reasonable time.

Each company should have its own internal vital records program. The analyst, in conjunction with the programmer and users, should determine which files should be sent to vital records storage, and the transmission/distribution frequency. It should be up to the data processing organization to operate and maintain the programs. Some organizations require routine user/analyst/programmer reviews of the vital records program, including current files and maintenance schedules.

Functions of a Systems Analyst

This section includes a short review of the more important functions an analyst performs in maintaining or designing a system and a few notes about each for ease of reference.

File Initialization

- Which files to be initialized
- Where the data (fields) to be initialized is to come from (which files)
- Which data elements to include, to extract
- Cleanup techniques
- Error identification and correction techniques
- Statistics, control, and verification methods
- Timing

Interfacing

- Which systems, files, procedures, department involved
- What data (fields, elements, records, files) is needed; how to obtain the data
- Standard error identification and correction techniques
- Control statistics and verification techniques
- Run frequency, timing
- General job stream – defining dependencies

Forms/Cards

- Relation to current: by use and data element
- Responsibility
- "Testing"
- Relation to operating procedures
- Ordering/Number assignment
- Design/Redesign/Modification

Operating Procedures

- New
- Revisions
- Distribution
- Local, Corporate, Functional and/or Departmental

User Manual

- Preparation of Material
- Teaching
- Review Sessions

Special or Unique Selection, Exclusion Control, or Compare Logic

- Identification
- Use, non-use, or replacement, e.g., department codes, analyzer codes, account numbers, product codes, commodity codes, etc.

Edits, Audits, Statistics

- Relation to current
- Clarity of information
- Responsibility
- Changes

Tables

- Identification of required vs optional
- Initialization
- Updating: method and frequency
- Field sizes
- Length
- Relation to current
- Responsibility
- Relation to procedures

Formulas, Variables, Parameters, 'Plug Factors'

- Identification of Required/Default/Optional
- Initialization
- Updating: method and frequency
- Relation to current
- Responsibility
- Relation to procedures
- Modifications, if any

Reports

- Relation to current, by use and data element
- Contrast of content: advantages vs disadvantages
- Frequency
- Distribution
- Responsibility
- Relation to procedures
- Modifications, if any

Testing

- Unit (module) testing
- Systems testing
- User acceptance testing
- Parallel runs
- Test data preparation
- Assurance of proper work area, storage areas, supplies, security provisions, etc.

User Hardware

- Determination of
- Ordering
- Installation coordination
- Education

Transferring Systems

For expediency's sake, programs and whole systems are sometimes picked up from other locations, rather than developing them locally. Evaluating an existing system, subsystem, or program requires an intimate knowledge of the current, local needs as well as an understanding of the system under consideration.

The evaluation points are the same as the needs, goals, and objectives for a new system. The criteria against which they are measured are, in effect, the specs for the new system.

It is wise to draw up a list of questions to address when appraising a system. Start with what it does and does not do; proceed to what the specifics (input and output) indicate; next, how the processing is accomplished; and then go to the interfacing and selection criteria and techniques.

An evaluation is made by both programmer-analysts and systems application analysts to ensure that all aspects are considered.

In picking up another system, or bringing material back to one's own location to evaluate against, a checklist is often useful. The major items to include in such a checklist are shown under "Systems Review/Installation Package".

Systems Review/Installation Package

- User manual
- Operating procedures
- Manufacturers' equipment and installation manuals, operator guides, installation and physical planning manuals, configurators, forms design reference guides, component description manuals, introduction to system books, message manuals, etc.
- Examples of all printed/punched output – forms, reports, cards, etc. Blank and used
- Examples of all input documents
- List of all programs used – name, number, and language
- Source decks
- Special local macros used
- Program listings
- Test decks-programs, test data
- Test results
- Operating system used (requirements)
- Program write-ups

- Program flowcharts
- System flowcharts
- Operational flowcharts
- Data entry/keypunch instructions
- DP procedures and write-ups – computer room (setup sheets), bursting, decollating, distribution instructions, etc.
- List, location, and sample (format) of tables, special algorithms, constants, etc., used and the means to initialize and update them
- List of all department numbers, bin numbers, account codes, account numbers, buyer, analyzer, routing, location, terms, distribution, codes, etc., that are used by the system and to what they refer
- Disk, diskette, tape, card files used (name, number) and their formats
- Sorts used – type used, fields, setup instructions, etc.
- List of equipment used, run schedules, data flow, job stream
- Special (local) utilities used, including GIS, APL, Select/360, RPG, etc.
- Telecommunications needs – lines, modems, speeds, location, times, restraints, etc.
- Identification of any supporting software used for communications purposes, such as TSO, CMS, DATATEXT/360, etc.
- Names, mailing addresses, phone numbers of analysts, programmers, education specialists, and key users to contact

Systems Analyst's Responsibilities

A summary of the responsibilities of a user systems analyst was expressed by Mr. A. B. Case, and is being included to give another perspective.

Responsibilities of a systems analyst assigned to a user organization.

I. *Understanding the User*
A good knowledge of the user's organization, procedures, and practices with emphasis on human interface with data handling systems – both input and output.

II. *Problem Definition*
Regardless of the source, a thorough understanding of the problem as the user sees it.

III. *Problem Analysis*
Independent analysis of the problem, its causes and resultant effects. Thorough examination of all aspects, like: frequency of events, human constraints, machine or program limitations, output required, etc. Must be able to separate "need" from "nice to have" aspects of problem.

IV. *Alternatives Examination*

Evaluation of the various solution alternatives available, including consideration of the time and manpower required and/or available to implement.

V. *Solution Selection*

Selection and presentation of a recommended solution to be implemented.

VI. *Specification Generation*

Detailed analysis of inputs, edits, algorithms, file organization, frequency of operations, and outputs. External interfaces, i.e., other systems, must be considered. "What if" exercising is important. Detailed understanding of existing methods and manual procedures, if any. Complete, concise, timely documentation.

VII. *Implementation Plan*

Time and effort estimates to code, test, and install a working system. Milestone checkpoints included.

VIII. *Tracking*

Tracking and reporting on actual vs plan, both own and support organization's effort.

IX. *Installation*

Test results review, user manuals, key user training, support user generation of procedures, management presentations.

X. *Utilization Monitoring*

Ongoing review of system utilization. Effectiveness, efficiency, measurements of system usage, and identification of deficiencies and/or enhancement needs.

Glossary

Cutover: This is usually defined as that point in time when the official or formal operating change is made from the old way of doing business to the new system.

Document of Understanding (DOU): A document that defines the responsibilities of the various areas involved in designing, installing, and using a system.

DOU: See "Document of Understanding".

File Cleanup: This generally refers to a purification process of the current records and/or files so that the new system will be started with good, clean records. The better the condition of the records used by the new system, the better the initialization and easier the programming.

Installation: The completion of the activities involved with designing and developing a system, and the actual utilization of the new system on a regular, production schedule.

Parallel Runs: Production type runs of a new system that are made while the former system is still running. Usually, detail comparison of output between the two systems is made to ensure that the new system operates as expected.

Pilot Run: The first production run of a new system, using live data. In the case of major modifications or enhancements, the first production run with new programming installed. The analysts and programmers are usually present, and do all they can to assist the users, clear up problems, and ensure data integrity.

Systems Reference Library (SRL): The name IBM uses to designate technical reference manuals.

SRL: See "Systems Reference Library".

Test Plan: A document that defines what is to be tested and by whom. Sometimes it includes such things as dates of testing, equipment to be used, how used.

Selected IBM Publications, Forms, and Tools Useful in Systems Analysis

Form Number	*Description*
GE20-0527	Business Systems Planning, Information Systems Planning Guide
GF20-8102	Decision Tables – A Systems Analysis & Doc. Technique
GC20-8152	Flowcharting Techniques
GC20-8078	Form & Card Design
GA24-3488	Form Design Reference Guide for Printers
GC20-1851	HIPO – A Design Aid & Documentation Technique
GE20-8067	PERT – A Dynamic Project Control Method
GF20-6088	Planning for an IBM DP System
GF20-0074	An introduction to IBM Punched Card DP
SF20-8150	Basic System Study Guide
SF20-8135	Study Organization Plan: The Approach
GX28-1630	Decision Table Worksheet
GX20-8020	Flowcharting Template
GX20-8021	Flowcharting Worksheet
GX20-1971	HIPO Template
GX20-1970	HIPO Worksheet
GX20-1818	150/10/8 Printer Worksheet
GX20-1702	Proportional Record Layout Form
GF20-8172	Installation Management Bibliography
G320-1621	Marketing Publications KWIC Index
SR20-4441	IBM 3270 Screen Design
GC20-1699	Data Processing Glossary
GR29-0280	Computing System Fundamentals: Overview
GR29-0281	Computing System Fundamentals: Techniques
GH20-1511	A COPICS Execution System – Implementation Guide
GH20-1510	A COPICS Execution System – Application Design Guide
GH20-1464	A COPICS Execution System – User's Guide
G320-1974 through G320-1981	Communications Oriented Production Information and Control System (Eight Volumes)
GC20-1670	Data Processing Techniques
GE20-0541	Manufacturing Applications and the 3790 Communication System

GE20-0593-0

Application Manual Basic Systems Analysis and Design Techniques Printed in U.S.A. GE20-0593-0

IBM

International Business Machines Corporation
Data Processing Division
1133 Westchester Avenue, White Plains, N.Y. 10604

IBM World Trade Americas/Far East Corporation
Town of Mount Pleasant, Route 9, North Tarrytown, N.Y., U.S.A. 10591

IBM World Trade Europe/Middle East/Africa Corporation
360 Hamilton Avenue, White Plains, N.Y., U.S.A. 10601