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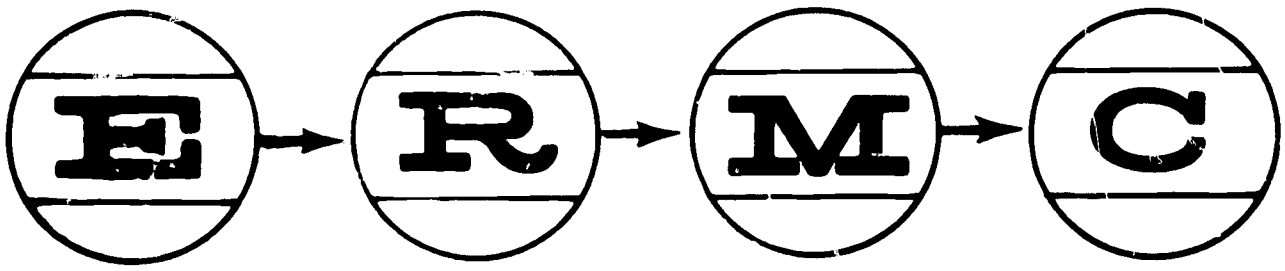
Program Evaluation and Review Technique (PERT) is a statistical technique, developed by the US. Navy, for analyzing and quantifying uncertainties in sequential or parallel activities essential for completing a project within certain parameters. It focuses management attention on points that require remedial action or tradeoff in time (or other resources) to meet a deadline. The PERT flowcharts picture the interdependence of all elements in a project and the branching of subsequent activities resulting from the completion of a prior step. This paper shows in detail the use of PERT charts in the establishment of Northern Virginia Community College in the brief time between the enabling legislation of October 1966 and the opening of the rental campus in September 1967. Separate charts demonstrate the use of the device in overall planning, acquiring furniture and equipment, organizing the library, and providing food and janitorial services. (HH)



PERT AS A MANAGEMENT TOOL FOR EDUCATORS

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PERT AS A MANAGEMENT TOOL FOR EDUCATORS

There is a time in the affairs of men and nations and thereby, of schools and colleges too, when it is essential to act with determination, with imagination and with speed.

For my community and my college that time was the summer of 1965. The tide of enthusiasm for a COLLEGE NOW swept aside all smallness of purpose and fear of failure and pushed a handful of workers into a truly uncharted sea.

It is in such exact unknown and unknowable circumstances that 'PERT', the modern tool of modern management is most valuable. For planning, scheduling, controlling, organizing, motivating--in all management situations, and particularly in those involving first time projects: Research and Development, Product Promotion, Theatrical Productions, College Construction, 'PERT' is probably the most useful of the many devices currently in use throughout the country.

History of PERT

PERT is a statistical technique--diagnostic and prognostic--for quantifying knowledge about the uncertainties faced in completing intellectual and physical activities essential for timely achievement of program deadlines. It is a technique for focusing management attention on danger signals which require remedial decisions, and on areas of effort for which 'trade-offs' in time, resources or technical performance might improve the capacity to meet major deadlines.*

PERT was developed in 1958, by a cooperative effort of Navy Special Projects Office, Lockheed Aircraft, and Booze Allen & Hamilton a management consulting firm, and is credited with cutting years from the Polaris Missile development program.

The basic foundation of PERT is the 'network', a pictorial representation of the interdependencies and inter-relationships of the events and activities which comprise a project from the instant of its conception to the completion of the end product.

Because 'PERT' is particularly useful in the successful management of highly complex, multi-level projects extending over long periods of time, it offers to educators a well tried method of directing, planning and controlling, not only the physical aspects of educational projects, but it enables management to schedule and utilize the intellectual and cerebral resources involved in such activities as curriculum development, test construction or the publications resulting from such activities.

Industries seeking Defense contracts are required to use PERT in preparation of contract bids. Many of these contracts are in the area of Research and Development--many College projects may be so classified. The USOE is underwriting such projects with millions of dollars--education is big business in this sense. It

*PERT Handbook - Department of the Navy.

[Program Evaluation and Review Technique]

seems, therefore, to make good sense to prepare the educational community to accept, understand and use the basic PERT principles in preparation of projects for USOE as well as using it as we did, in the actual creation of a two year college, from scratch.

History of Northern Virginia Community College

To understand the particular conditions surrounding the creation of this College it is necessary to know something of our background in the area, and to understand how circumstances can help to direct planning, controlling and decision making.

Northern Virginia is one part of the complex of independent political entities which constitute the metropolitan area known as the National Capital Area or as the Standard Metropolitan Statistical Area of Washington, D. C. Of the total area population of over two and one half million, the Northern Virginia area accounts for over 800,000 or better than 30% of the total population.

This area, comprising seven political jurisdictions, is listed by the Census Bureau as one of the highest income areas in the entire country, as well as one with a very high level of education--the average family income in 1967 was $12,155 in Fairfax County; and the average local citizen had 12.4 years of education.

The Northern Virginia Area is known nationally for the excellence of one of its school systems--that of Arlington County, while the National Capital Area is nationally recognized for the excellence of the Montgomery School System (Montgomery County, Maryland).

In spite of a climate so favorable to the flowering of educational institutions, this area, with respect to higher education, was, indeed a desert. Although this area sends over 70% of its high school graduates to college (12,000 graduate yearly) 60% of them go out of state for education - evidence enough that this part of the State of Virginia has been poorly served by its public institutions of higher learning.

Such conditions cannot long remain static when the population faces a continuing demand for more and more highly skilled workers, semi professional aids and technicians, as well as for full professional workers. In the National Capital Area demand for unskilled labor is extremely low, while the demand for other categories grows by geometrical progression yearly. The most recent Skill Survey (Spring 1968) figures (not yet officially released) indicate that by 1971 area employment will increase by 35% from 1966, with semi professional workers showing a jump of 88%, skilled trades increase of 36%, and the need for unskilled labor shows a continuing downward trend.

The Skill Survey of 1963 was a signal for real alarm, for its statistics indicated needs as great as those in the 1968 survey. Local leaders of business and industry and the educational community joined forces to make this situation known to their legislative representatives in Richmond. As a result of the growing demands of a highly articulate electorate, the Virginia Assembly in 1964, approved "The Technical College Act", which created a statewide system of 22 technical colleges. (Passage by the next session of the Legislature in 1966 of the Community

College Law transformed these two year technical institutions into full comprehensive colleges.)

Once this legal framework was established, the local communities, by some miracle of cooperation, banded together organized citizen rallys, PTA conferences, Business and Industrial Workshops, and used every means of communication to translater this urgent public need into a personal cause for action.

Public support for a community college must come from the wholehearted local support of such an institution. Only when local committees of business, political, industrial, labor and educational leaders are well organized and work well together to seek the establishment of a college can it be truly a community college, responsive to and responsible for its community. This requirement was fully met in Northern Virginia: There was a tremendous groundswell of approval for the establishment of a college in this highly populated area and evidence of support came from appropriations of public moneys to get the enterprise off the ground. Further evidence of local approval is shown by financial statements: 43% of the funds come from the seven jurisdictions, 30% from the Federal Government and only 27% from the State.

Community Survey

Although the Community Survey does not occur as an "event" on our PERT flow charts, it is one of the very first steps to be taken before a decision is made to seek a charter for a college. The local committee supporting a college in the district commissioned a professional consulting firm to make a survey of the needs of the area concerning both education and employment. Questionnaires were sent to all the graduating classes in Northern Virginia High Schools and to a random sample of parents of such seniors and other local residents. The returns indicated the kinds of training and education most desired by full time day students and the kind of needs of the adult community which some form of evening continuing education might meet. Federal and State employment statistics indicated current and projected manpower needs in this area.

With such documented evidence of the real need for higher education facilities, the citizens were able to petition the government for a charter to establish a two year college, appoint a Board of Trustees, and actually organize the Board for action between December of 1964 and March of 1965. In April the President was appointed, in May he formally took office and in June, he and a small group of educational consultants began the operation of the College in three rooms donated by the city officials of Fairfax City. The College was underway.

Beginning of PERT Activities

In studying the College PERT flow charts it will be noted that almost every line of activity begins with the "event" - "President takes office". Many institutions choose to select their president after much of the physical planning is accomplished; to us, it seemed preferable to have him on duty at as early a date as possible. It must also be noted that this area is fortunate in having available to it such a highly educated population--perhaps no where in the nation are there so many brains per square inch as here.

The United States Office of Education with all its resources is readily available for easy consultation and the government and the armed forces offer a pool of well trained administrators, who are either retiring from service or seeking new fields as consultants. The College has experienced few problems attracting or keeping competent faculty and staff.

You are probably asking yourself: Why did you choose to use PERT in the first place? There were, for us, two over riding reasons--1) The time factor; 2) manpower constraints, and the fact that the President was favorably inclined toward the use of some form of Critical Path Method. Of course, the fact that this kind of operation had never been done before (for a College) made the use of PERT almost inevitable, for its field of greatest usefullness is in initial projects.

Again you may ask: Why did you attempt the impossible--to establish a college in two years is good timing, why try to do it in a summer? I think my lead paragraph explains most of it . . . When conditions are ripe, when enthusiasm is highest, when the iron is hot--STRIKE! We did just that. Once the decision had been made that the need was NOW--it only remained to implement the decision. Here's how it was done.

Gantt Chart to PERT Network

The use of PERT as a management tool must be understood and agreed upon by everyone who will have occasion to be concerned with its operation. Each member of the management team must be aware of his part in the planning of activities. Once the total staff accepts PERT's built in safeguards concerning time, resources, and responsibilities, and if they accept their unit's responsibility as diagrammed on the charts, the complex problems of planning, controlling, expediting, recycling etc. are clearly visible. PERT does not make the decisions, but it assists the director by presenting the basic facts needed for intelligent decision making.

Our President, in selecting his initial staff, made the basic decision to use PERT; as consultants were employed they were immediately involved in the use of this management device. The administrative staff of the College is and has been since the beginning, small compared to other multi-million dollar operations. In June of 1965 there were 6 team members and to them was given the responsibility for accomplishing the nine major work packages as they appeared in the first Gantt chart:

1. Facilities
2. Equipment and Furniture
3. Students
4. Personnel
5. Budget
6. Library and Textbooks
7. Curriculum and Catalogue
8. Contractual Services
9. Policies and Operating Procedures.

From these nine major areas of concern we developed a milestone chart and eventually the PERT Master Flow Chart. We covered one office wall with butcher paper, gummed labels were attached as jobs were established and deadlines and time schedules estimated. Each person was given his exact responsibility, and he was expected to get on with it with little or no direction from the top other than a clear understandin of what was expected of him and when. I believe that it must be emphasized here, that the man chosen as President of the College was a dynamic personality, whose

enthusiasm, determination, and drive were instantly contagious. You came to this College either because you were known to the President or because you, yourself, shared the same enthusiasm for creating this College. Applicants for employment were carefully interviewed, the philosophy of the College was fully described, and each person's responsibility was set forth in clear terms.

There were specific jobs to be done by specific times and it was taken for granted they would be accomplished. You sought no advice, you asked no help from the top, until you had tried every alternative and met defeat. Each morning began with a one hour working conference chiefly devoted to problem solving and "signal calling". Deadlines and the probability of meeting them were given top priority.

If an assignment required additional manpower or other resources it had to come from the manpower and resources of the team. It was agreed that it would require 20,000 man hours to build and open a college--we used 15,000 and had available 12,000.

The extra 3,000 man hours came from staff overtime. There can be little doubt that the use of PERT enabled us to accomplish near miracles in the economic use of time, energies and resources. In the beginning money was not a major problem. Later it was to become one, but it is only fair to attribute some good part of our success to the fact that whatever was needed was secured, and its cost, if it were necessary, was not a major consideration. Waste was certainly not encouraged, but it is truly impossible to add one more day to a calendar and it is difficult to secure results merely by the addition of manpower (even if readily available), therefore, if money could solve a problem, money was obtained.

There were few staff changes in the early days, people were chosen for basic characteristics required by our operation, their skills were fully utilized; as their work production indicated additional abilities, internal adjustments were made, flexibility accounted for much of our success in day to day functioning. Team work was encouraged and every member of the staff was aware of the planning and efforts involved in the decision making process. The writer was charged with the preparation of the PERT charts--the technical production--each team member prepared his own time schedule and made the necessary efforts to meet his deadlines. We did not fully use PERT--in fact, we used those facets of the total program which most specifically assisted in our planning and decision making activities; We did not seek three time estimates; the most likely one alone was used. We did not use a computer services to automate data production. But the check list of some 300 items necessary to construct a college is so clearly set forth in a PERT chart that it makes all jobs easier. Much of our use of PERT centered on the Critical Path Method, for time was our greatest constraint. The daily working conferences working from this diagram which PERT is, made possible the detection of bottle necks and the provision of a remedy for them before they were able to delay essential activities.

0100 - Sites and Buildings

In the Gantt chart which the President prepared for the Board of the new Technical College for the District of Columbia, times required to open a college were set as:

1) Rental Campus -- 1 year

2) Permanent Campus -- 2 years

We believe this represents adequate time provided the College is supplied with ample funds and a competent administrative staff, large enough to provide skills to handle every administrative chore. If PERT is fully utilized, that is, if there is a program written to meet the needs of the job and if automatic data processing takes care of computation and statistical work, a positive statement of conditions may be read out daily or as indicated. Bottlenecks can be detected early and the necessary management decisions made to prevent any major tie ups. It is suggested that one member of the team, who is also an educator be chosen and trained to be the PERT expert. Technical background of the specific job plus the ability to use PERT more than doubles one person's contribution to the team. If you prefer to seek a PERT expert from a consulting firm, this is easily arranged. Once the master charts are complete it is the responsibility of this person to prepare the graphic, visual aids which explain the progress of the project to all members of the team. It is not necessary for the manager to be proficient in PERT, as long as there is one member of his team who can provide the essential work progress reports.

On the chart for the District College we indicated a period of 3 months for a site search for a temporary campus. While the major resources of the management team would be devoted to the temporary site, after the first few weeks, some members would undertake a search for sites for the permanent campus. This will be a long term project, involving public hearings, zoning hearings, etc. and sufficient time must be allotted for a thorough investigation of the best possible site.

In our own case, we were most fortunate in having as a member of our Board of Trustees a highly respected local building construction and real estate operator. Through his help we secured, with relative ease and very quickly, a most advantageous site. Since time was our major constraint, we sought an already constructed building of 50,000 square feet which could be freely remodelled into quarters for instruction of an anticipated 500 students. This for us, was a warehouse, located in the midst of a densley populated area within 5 to 45 minutes driving time of all seven supporting jurisdictions.

Structurally, the building was sound, but aesthetically it left something to be desired; it has earned for us the nickname "Old Warehouse U", but we rather boast of it. For, when our basic ten work packages were complete we had a functional, fully operable, flexible arrangement of classrooms, laboratories, offices, lobby, restrooms, library and cafeteria.

Basic Steps in Temporary Site and Remodelling:

1) Approval of temporary site
2) Lease of temporary building
3) Determination of space requirements
4) Preparation of specifications and invitations
5) Bids opened
6) Contract awarded
7) Begin remodelling
8) Inspections of building
9) Open for storage and student interviews
10) Remodelling completed

In studying the PERT chart for Buildings and Sites, the program seems simple. In actual practice the ten steps involved much time and many energies, with many steps broken down into separate charts. The educational planning itself, is a monumental job, unless you are blessed, as we were, with a man who has a broad knowledge of the basic needs of a new, first time, college. One problem which plagued us was the repeated failure of the contractor to fulfill a part of his contract. When these delays threatened the "end event", all energies were diverted to this job. Here is exactly where PERT is most useful. By simulation, you may try various approaches and you can estimate the carious amounts of time which can be saved by arrangements of the variables. Then the manager makes the final decision to go for one or the other.

In a building less satisfactory than ours, the process would be more complex. Our building consisted of 5 windowless "bays" of 10,000 square feet each, with air conditioning and heating units ready for operation.

In one afternoon the educational specifications were communicated (2 hour telephone call) to the architect. An agreement with him was made on May 15, and on June 7, (15 working days later) the schematic drawings were completed. Preliminary drawings came along 4 days later and 14 days after that, the working drawings were submitted.

The floor plan and the total design were conceived with two main concepts in mind: 1) It was not yet determined what courses would be taught in what rooms or for what period of time instruction would be carried on in the rental building; 2) There was not sufficient time to wait for a detailed study to determine exact courses, therefore, rooms must be readily convertible into larger or smaller units as need would indicate. The whole plan allowed for flexibility of space and general design to provide multi-purpose use of most facilities.

The actual remodelling began July 1, the contract specified occupancy by September 1, but it was September 27, before the building was substantially completed. In fact, we had one weekend in which to set up instructional equipment, chairs, desks and other equipment for the building. PERT showed us the many paths to be covered in accomplishing this monumental task. It enabled us to see the available resources in non critical areas and direct them to this major task for one specific time period.

We estimate that site selection and Building Modification required a total of 740 man hours, or 92 man days of effort.

In preparing sub charts of the master PERT chart, each work package is broken down into its own parts and from this breakdown comes allotment of additional responsibility, and, if you use PERT COST - your cost estimates. For instance three consultants worked on the preparation of specifications for bids and the invitations to bid. Secretarial and clerical assistance in each of these areas is the responsibility of the project leader of that specific job. In remodelling the building, inspection of construction was finally given to one man--therefore, he had to be relieved of some responsibility in other areas of the total job. Such manpower emergencies can be planned for by PERT--by simulation, alternate paths may be examined and the most economic and expeditious program then decided upon.

0200--Equipment and Furniture

On the master PERT chart (No. 1) the securing of equipment and furniture appears to be a simple matter of purchase and receipt. In actual practice this was, because of our time constraints, one of the most difficult and time consuming operations involved in the establishment of the College. This is also the area of operations in which tremendous expenditures of manpower were made in a futile effort to use half a million dollars of 1964-65 fiscal funds, which were available through the U. S. Government, if used within that fiscal year.

We had 20 working days in which to write specifications, receive bids, award contracts and process the miles of paper work. I must say, that we accomplished quite unbelievable amounts of this job, but alas, not the paperwork to prove the expenditure of those dollars by July 1; we could not complete the task within the time limits; however if it had worked we would have secured dollars which could never become available to us again. The writer was one involved in attempts to use Technical College Library funds. With the assistance of a local supplier, we prepared a blue print of the library (later followed by the architect), estimated shelving, seating and table space and equipment, estimated volumes space and submitted a purchase order for the total library. This was blocked in one instance by a strike, in others by lack of required number of bidders under Virginia law. The attempt did not work, although the effort was enormous, it was too late. The chart for the Library does display this and I shall devote time to it later.

We worked at building readiness, equipment, supplies and furniture as a team effort for the first few weeks; on July 1, this was assigned to one full-time person. It became his responsibility to determine needs, write bid specs, work with the State Purchasing Department (they were now involved after the completion of legal status of college operating under State funds) and in general to ride hard for delivery of supplies both for equipment and furnishing. He also worked with the building contractor in an effort to make contracts more binding and to ensure the building being properly remodelled and ready on time.

Under ordinary procedures equipment procurement normally falls into 4 major categories: 1) Determine needs, 2) Order, 3) Delivery, 4) Installation. Usually manpower energies are mainly used in numbers 1 and 2, but because of this College's special situation, the largest part of available energies was expended on 3 and 4, while number 1, (determining need) was quickly based on past experience of the President.

Furniture orders which appear on Chart No. 2, as completed in June, were actually not processed until the end of July. This in turn affected delivery, particularly in the area of library furniture with its very lengthy lead time of 120 days. The furnishing and equipping of a College is a critical area, demanding tremendous attention to detail. The very first step should be a business office in full operation, then there should be a definite procedure for budgeting, bidding, purchasing, receiving, storing and distributing every item purchased. A system of inventory should be established immediately.

Equipment and Furniture required 1620 man hours or 202 man days of effort.

0300--Students

The chief concern of a college is students and one of the first projects begun by the President after taking office was publication on May 24, 1965 of a brochure for delivery to 10,000 local high school students. PERT shows this event immediately following the establishment of the curriculum.

On June 4, the first requests for enrollment were received. Twenty days after the formal announcement of the new college, approximately 400 students had requested applications or information.

On June 10, the College distributed its first application blanks and announced the acceptance of its first two students.

A separate chart for Students does not occur, since curriculum, counselling, faculty, publications, and other lines of activity are all concerned with students and some of them appear in great detail in other PERT charts.

On August 15, the counselling staff began interviews. In these early days, acceptance was based on high school records for the most part; about 75% of applicants were accepted automatically. The remaining 25% were asked to make appointments for counselling and guidance to work out specific educational programs.

The College now uses many tests and evaluative instruments along with high school records and recommendations. CEEB is required of transfer students who plan to enter 4 year colleges seeking a bachelor's degree. Data processing, mechanical programs etc. have their own special testing methods.

In reviewing applications and counselling students, it became apparent that many adults had applied as part-time students seeking to pursue individual programs of study at night. So many applied that it was necessary to plan a special program for them. This necessitated a new end item--the continuing education program. It also soon became apparent that our original estimate of 400 or 500 students would be far exceeded. Again it was necessary to add to the planning. PERT can manage such additions at any time during the life time of the project.

An early profile of our students indicated that while similar colleges in other states showed that the closer a student lives to a college, the more likely he is to attend, in the case of this college the percentages of students were evenly divided among those within 10, 20, 30, and over 30 minutes driving time of the

College. This, I suppose, is further evidence of the great need for institutions of higher education in this particular area.

Time devoted to student affairs: 2325 man hours or 290 man days of effort.

0400--Personnel

In preparing the initial PERT chart Personnel concerns were so complex that a separate chart was at once an obvious need.

Before securing staff and faculty there are 4 prerequisites: 1) President should be on duty, 2) Office space secured 3) Some secretarial staff on hand, 4) At least initial members of a number of Advisory Committees should be appointed.

The first job of these officials is to establish some rough outline of personnel qualifications, then a rough draft of the curriculum should be prepared, and from this, early estimates of personnel requirements can be made. Accurate estimates of numbers of faculty can be determined after rough figures are available from the admissions office, however, the community survey should provide some sensitivity as to numbers of entering freshmen.

It can be seen from Chart No. 3, that Personnel recruitment flowed from three sources: 1) Local applicants who came unsolicited, 2) Services of a professional employment service, 3) Services of agency for temporary help (clerical and secretarial).

Recruitment for personnel at the College proceeded along two lines: When qualified people were known to the President, or when such people applied for administrative positions, they were employed immediately as consultants--many later moved into permanent positions. The second source of qualified personnel came from a professional employment agency. The use of such an agency in the early days provided an efficient and time conserving means of finding qualified faculty. The agency did not employ faculty, they simply directed likely candidates to us. Interviews in depth were carried out by at least three people and accounted for many man hours of work. One official devoted himself almost exclusively to this job for most of the summer.

On an average, sixteen man hours of staff time were used in hiring each faculty member.

The early secretarial staff was secured, chiefly through the efforts of a temporary help agency, on a contract basis--this gave the College an opportunity to evaluate employee abilities before making a commitment. Many moved into permanent positions.

PERT demonstrates graphically these early steps and their prerequisites. The two sources of professional help are in 407 and 408 on PERT master chart. From these two sources came the employment of two Deans, two counsellors and one or two department heads. The College, as a state chartered institution, was required to be governed by state regulations in its staffing.

In the accelerated hiring period (30 staff members in 30 days) and with many immediate jobs to be done, the basic philosophy was as follows: Administrators were hired as consultants, after they demonstrated their capabilities and their value to the College had been analyzed, they received appropriate assignments. During June most of the administrative staff was employed. Their number was small then and it has remained so.

The guiding philosophy (not my own philosophy) in the employment of the instructional staff was: Experienced teachers are important; knowledge of technical subject matter is even more important, it is easier to teach methodology than technology to new instructors.

In the early days, procedures were often affected by time and money. Budget procedures were not specific, neither state nor local policies were fully articulated--both were new. Lack of a business manager and standard operating procedures all hindered recruitment. Applicants who were fully qualified and desirable were often lost because of lack of funds to meet salary demands or delays in processing paper work.

Problems of securing personnel were magnified by several conditions, as they would be anywhere in such a situation: First, the administrative staff was not available early enough to begin to determine personnel requirements and recruit in the normal manner, secondly, without firm curriculum decisions only general qualifications could be estimated and numbers of faculty needed could only be guessed at roughly. Lack of firm salary scale until after mid July also meant loss of potentially valuable people.

Although the hiring period for the College began long after most local school systems had signed teacher contracts, lack of applicants was never a problem, rather the problem was time to adequately process the large number of applications received.

The following procedures for selecting and evaluating personnel were on an individual PERT chart not shown in this package:

10) Assign one person to full-time duty for personnel
15) Appoint panel of 3 to review applicants
20) Recruit by telephone, letter, etc.
25) Review qualifications of all applicants
30) Interview all local applicants
35) Use private and public employment agencies

Each work package had its own specifications determined by the leader of that particular project.

Evaluation and selection of faculty continued from June 21 through September 1 and even later (Data Processing interviewing went on right up to opening of classes).

On September 1 a period of faculty pre-service training began. This is shown on Master chart as event 406. The chart also at this point demonstrates how critical was the personnel path, the Librarian was only employed on Sept. 10 and was not available until September 27, the day classes began.

In all its reports this College has emphasized that one of the vital needs of any college, very early in its existence, is a business manager to pay bills, set up bookkeeping systems, manage local finances, advise the President and Board of Trustees in current fiscal procedures.

The early presence of the Dean of Occupational Education would have been helpful, and the early employment of a number of department heads would have enabled curriculum and courses to be prepared with greater dispatch.

The presence of counsellors at an earlier date than shown on PERT as event 304, August 2, would have facilitated student guidance and eliminated future problems of program choice.

An Administrative Assistant to the President is necessary from the beginning, in order that the President be relieved of routine chores and freed to devote himself to the creative aspects of his job.

Two additional critical appointees should be: 1) Procurement officer for equipment and supplies and 2) Personnel Manager. This College still lacks the latter.

Under ideal circumstances all matters relevant to monies, whether of salaries, site, space, etc. should be determined at an early stage in the history of the institution and the President should be free, within certain defined limits, to employ his required personnel as quickly as individuals are available. Under best of circumstances staffing a college will take a minimum of 3 months.

In summary it should be noted that our staff had little prior teaching experience in a Two Year College, because: 1) There is a shortage of such trained people, particularly in the East where such types of institutions do not have as long a history as in other parts of the country, and 2) The hiring period was after many local people had signed contracts for the coming year.

Meeting little success in staffing the College with fully experienced technical college teachers, it was decided, intentionally, to probe the problem of staffing with people to whom must be communicated philosophies, concepts and procedures in a brief time.

The solution, for us, was to employ 4 lead administrators, each of whom had 20 years of appropriate experience. The Dean of Instruction was chosen because of his experience as a teacher educator. He was assigned responsibility for the pre-service and in-service training program for the staff. The PERT chart for this does not exist, but it was a 15 day workshop of concentrated lectures, seminars, etc. using leading educators across the country. The first half the day was spent in formal situations, the second in informal departmental meetings where the consultants' suggestions were implemented. Both the U. S. Office of Education and the Association of Jr. Colleges gave us valuable assistance.

The instructors at the College present the following profile: Two degrees, twelve years of occupational experience, five years teaching, average age 41 years. One third are retired government or military personnel.

Personnel required 1225 man hours or 153 man days of effort.

0500 - Budget

The first operating and equipment budget was in excess of one million dollars, $400,000 for equipment. Within two months $300,000 was added to this. After arrangements were made for 50% matching monies from Federal Vocational Education Act, and additional $1 million was added to capital expenditures, most of which went for equipment. Expenditures per student: $1000 operational expense, $2000 for equipment.

Rent for building $1.00 per square foot per year; remodelling cost a little over $2.00 per square foot.

Building plans for second campus call for 130 square feet per student at a total cost, including land and buildings of $18.00 per square ft. which averages approximately $2400 per student.

First budget provided for an average instructor salary of $8600, with 1/3 teaching in the summer, 1/3 free for curriculum development, and 1/3 to pursue educational and professional development at the expense of the College.

Budget - 160 man hours or 20 man days of effort.

0600 - Library

As the consultant responsible for the Library, I can speak with greatest knowledge and concern about PERT Chart 5--it is my own project, designed and executed by me. Although I shared responsibility for curriculum, catalogue and a number of other events, it was as Library Consultant that my major energies were expended. Library Services required 660 man hours or 82 man days of effort.

The first step was to decide upon the basic aims and philosophy for the technical college library, estimate the length of time necessary to establish it, and how to proceed in relationship to the time available. The establishment of the college library appears on the Master Chart (No. 1) as a line of six events. The tremendous detail and the varied activities involved in this process necessitated the separate charting of the library, Chart No. 5. A library consultant was one of the early employees. Ideally, the permanent librarian should be available at least six months before the college opens.

Graphically, the course followed in establishing the library flows along four main lines of work in progress:

a. Selection and Purchase of Books

The acquisition of 10,000 volumes; with an additional 5,000 for each 500 students above the first 500-1,000;

technical materials to comprise 70% of the total, the remainder to be composed of reference books and a small general reading section.

The objective in June was to represent the following areas of the curriculum:

1) Mathematics
2) Instrumentation
3) Mechanical
4) Related Sciences
5) Physics
6) Social Sciences
7) Electronics

Periodicals relating to each area of the curriculum as well as those of general interest; top quality newspapers (N. Y. Times, etc.) and local papers were made available. If space and staff permit, audio-visual aids, equipment, etc., should be housed in the library.

A librarian with a Master's Degree in Library Science, and an Assistant with a Bachelor's Degree in Library Science, were employed as well as student aides to ensure adequate service.

Chart No. 5 lists the various relationships established and demonstrates the inter-relationship which developed between activities.

b. Selection of Professional Library Processor

The local processor's fee was $1.85 per book. While this may not be the ideal method of preparation of books for shelving, it is the only way when time and staff are at a premium. The processor received the first book from the publisher on August 9 and by October 8, 400 books were shelved. These events occur along the top line of Chart No. 5 and involve 12 activities; it is also one critical path which exceeded the time allotted - in other words, the chart shows classes beginning September 27 and the library not in operation until October 8. Since the college admitted only freshmen students, the use of the library during the early weeks was not a matter of critical importance.

c. Selection and Purchase of Furniture and Equipment

All furniture is completely moveable, and shelving arrangements are flexible. In an effort to use fiscal 1964-65 funds, initial bids were submitted to the state as early as June 21, but since it was impossible for suppliers to react to these deadlines favorably, the bids were awarded by the State on August 6. Lead time on library furniture

is usually 120 days, and while some shelving was attached to the library walls before the college opened, the rest of the furniture was not delivered until November 1.

d. Procedure for Ordering Library Books

Because of the time element, the fact that instructors were not hired as yet, and the lengthy procedure usually encountered when ordering library books, the task would have been quite difficult without the aid of the U. S. Office of Education Technical Library Guide. This guide shortened the procedure and made possible a realistic selection of books in advance of the employment of the librarian who would normally make recommendations concerning the purchase of books for the library based upon teachers' requests.

The booklist contained in the U. S. Office Guide was used by cutting and pasting by publisher, and the completed sheets were forwarded to the State Purchasing Officer for transmission to the publishers. This involved the consultant, one assistant, and several typists from July 21 to July 28 when the booklist was delivered to the State Department of Technical Education.

The establishment of the library required 53 man days; when the time of the processor is included as well as the hours when the assistant librarian became available; the figure is a total of 81 1/2 days.

0700 - Curriculum and Catalogue; Time: 5/17 - 8/18/65; 950 Man Hours

A. Curriculum

Although on the Master Chart (No. 1), curriculum and catalogue appear as two separate lines of activity, in actual practice so many of the activities are inter-related and occur for the same reasons that the two activities appear on the same flow chart, Chart No. 4 (Each requires the same pre-requisites which are charted vertically, left side Chart No. 4). In reality, the curriculum was determined by selecting large, safe areas of need which could be easily documented, staffed and equipped in reference to the amount of time available to establish the catalogue.

On July 7, the meeting of the first Occupational Advisory Committee was called. The purpose of these committees is to assure that the educational program in the new college will be geared to the needs of the community.

Following the publication of this first curriculum outline, the staff prepared the outlines for the courses of study and detailed the subject matter materials which culminated in the publication of the catalogue on September 3. In addition, a second brochure was prepared concurrently with the catalogue

and published on August 3. The activities and events concerned with the publication of information appear at the far left side of Chart No. 4.

Beginning early in June with event No. 719 on Chart No. 4, the following progression can be noted: Catalogues were requested from two-year technical institutes, two-year community colleges, four-year technical and liberal arts institutions; these, and the courses designed by the Office of Education for use in technical programs, were studied, duplicated, and compared with each other and with the college's outlines of projected courses of study. With these offerings by other colleges as a point of departure, the various courses to be offered were developed; the results were reviewed by the consultants, the Advisory Committees and the local and state Boards (events 723, 724, 735, 726). The final result, after approval by the State Department of Technical Education, was the curriculum as it appears in the college catalogue.

It is estimated that over 430 man hours or 54 man days of work were needed to produce the curriculum and course descriptions. Of this time, 50 hours are the President's work on the first brochure and 80 hours, the Data Processing consultant's work on that particular course of study. Following Chart No. 4 from May 17 to September 27, the time needed for production of the curriculum was 430 man hours of work by the college staff, plus 520 hours of work on the survey of needs - 950 man hours or 118 man days of work.

The rough draft of the curriculum is the prerequisite for a number of other tasks: The establishment of personnel requirements in order for recruitment of personnel to begin; the production of copy for the catalogue; and student recruitment.

Deans and Department Heads, during the planning of the curriculum, could have considered the qualities desirable in the faculty responsible for administering the curriculum; decisions regarding the number of faculty members needed could have been made at an earlier date than was possible.

Since the curriculum will influence prospective students, the early availability of the catalogue or of printed copies of individual curricula would make possible a realistic estimate of the size and number of classes required for each course of study. In the creation of a college, establishment of an excellent and appropriate curriculum is a vital and complex process, and neither time nor effort should be spared in its early completion.

In view of the number of adult applicants for part-time (evening) courses, a modest evening program was initiated concurrently with the Fall Quarter Day program. The regular

courses offered were selected from the first quarter curriculum and included: academic subjects; and technical subjects from the Data Processing, Secretarial Science and Business Science curricula.

The Executive Secretary of the Northern Virginia Apartment Owners Association and the Instructor prepared an outline of the curriculum planned for the special Apartment House Resident Managers Course and submitted it for review and approval.

B. Catalogue

The preparation of the catalogue flows directly from the construction and adoption of the curriculum; on Chart No. 4, event 729 (adoption of curriculum), leads into 717, the event including the revision of the catalogue prior to the President submitting the catalogue to the State Department for general approval; this is followed by delivery to the printer, receipt of the first galley proof and delivery of the catalogue itself from September 3 to September 7.

Along with the production of the final catalogue, a second brochure was worked on concurrently. This is shown at the far left of the chart as preceding the approval of the original dummy of the catalogue. This brochure, which was delivered August 3, served as a catalogue until the receipt of the formal catalogue one month later. A total of approximately 30 days elapsed time was used to design, write, and publish the catalogue; however, the bulk of the work was accomplished in two weekends with an approximate total of 85 man days of energy. It is recommended that, in addition to the catalogue, considerable information be made available to aid in the difficult task of informing the community about the new college and its programs.

0800 - Contractural Services; Time: 7/6 - 9/20/65; 40 Man Hours

Food Service and Janitorial Service appear in two widely-separated areas on the Master Chart (No. 1), but for ease in study they have been combined in one flow chart (No. 6). Both services were secured through submission of bids, and required simple contract forms for their establishment in the college. The College also contracted for Secretarial Service, Employment Agency Service and Educational Consultant Service. These services appear under one of the other major events.

A. Food Service

Lacking both adequate space and type of facility for hot food in the new college, it was decided to use an automatic dispensing "snack bar", with tables and chairs in the large central assembly room, across the hall from the food service room.

Bids were invited from a number of automatic food service firms in the area. The firm selected agreed to take care of all costs involved in installing the machines and the carpentry, electrical and plumbing work connected with them. In addition, the firm guaranteed to provide a full-time attendant during school hours and agreed to secure the necessary permits from the Health Department.

Ten percent of the gross income from this operation comes to NVTC and is made available to the student activity fund.

Food service events appear at the top line of flow chart No. 6.

B. Janitorial Service

Bids for Janitorial Service were advertised on July 16 and six bids were received; the low bidder provided most of the services required under college specifications. The bid was awarded on September 1, 1965. The company employs students of the college on a part-time basis. Janitorial service events appear at the bottom line of flow chart No. 6.

0900 - Policies and Operating Procedures; Time: 5/17 - 9/27/65; 200 Man Hours

The State and the college worked together to solve procedural problems involved in establishing a State system and building the first technical college simultaneously. Problems were compounded by multiple operations and the lack of precedents to follow.

Many difficulties encountered stemmed from the limitations imposed by time. Lack of time prevented the proper definition of clear, firm fiscal policies, procedures, and practices. The intricacies of Federal, State and local monies in funding an entirely new program, directed by an entirely new State Department of Technical Education, required extra energies from the local and state staffs.

Initially, the State policy decision was that State funds would pay all faculty and approved Administrative positions as well as one-half of the State salary scale for clerical personnel. The State is responsible for all instructional costs including supplies, equipment and instructional salaries. The local jurisdictions pay for land, rentals and for construction of buildings.

The sources of purely local funds for the first school year came from the seven jurisdictions by the following formula:

1/4 population
1/4 property values
1/2 count of Senior High School classes in each jurisdiction

For subsequent school years and projected capital outlay this formula was reversed by substituting enrollment in the college at a given time in the school year for high school seniors.

If action had been deferred until the most desirable fiscal relationships and systems had been effected, the opening of the college would have been considerably delayed. See Exhibit A, present operating budget.

Conclusions

Experience indicates that the use of PERT as a management tool for educators enabled a handful of administrators to accomplish the establishment of a two year technical college from scratch, with speed, with competence, and with attention to the multitude of events and activities inherent in an undertaking of such magnitude.

While the College did not make use of the automatic data processing features of PERT, the use of PERT flow charts, graphically portraying the some 300 major events to be completed within a specific period of time, over what is called the "Critical Path", did provide a check list of responsibilities, time constraints, inter relationships and interdependencies which no other form of visual aid, Gantt, or milestone chart or linear programming device can equal.

In a project as complex as the establishment of a College, which demands intellectual as well as physical programming, PERT meets every demand made upon it. If it is understood and used by all the team, if time and resource estimates are honest, "no fudging allowed in PERT estimates", it is possible to foresee major roadblocks, bottle necks; time or man power constraints on any activity can be predicted, alternate plans can be simulated quickly and economically and a new decision made.

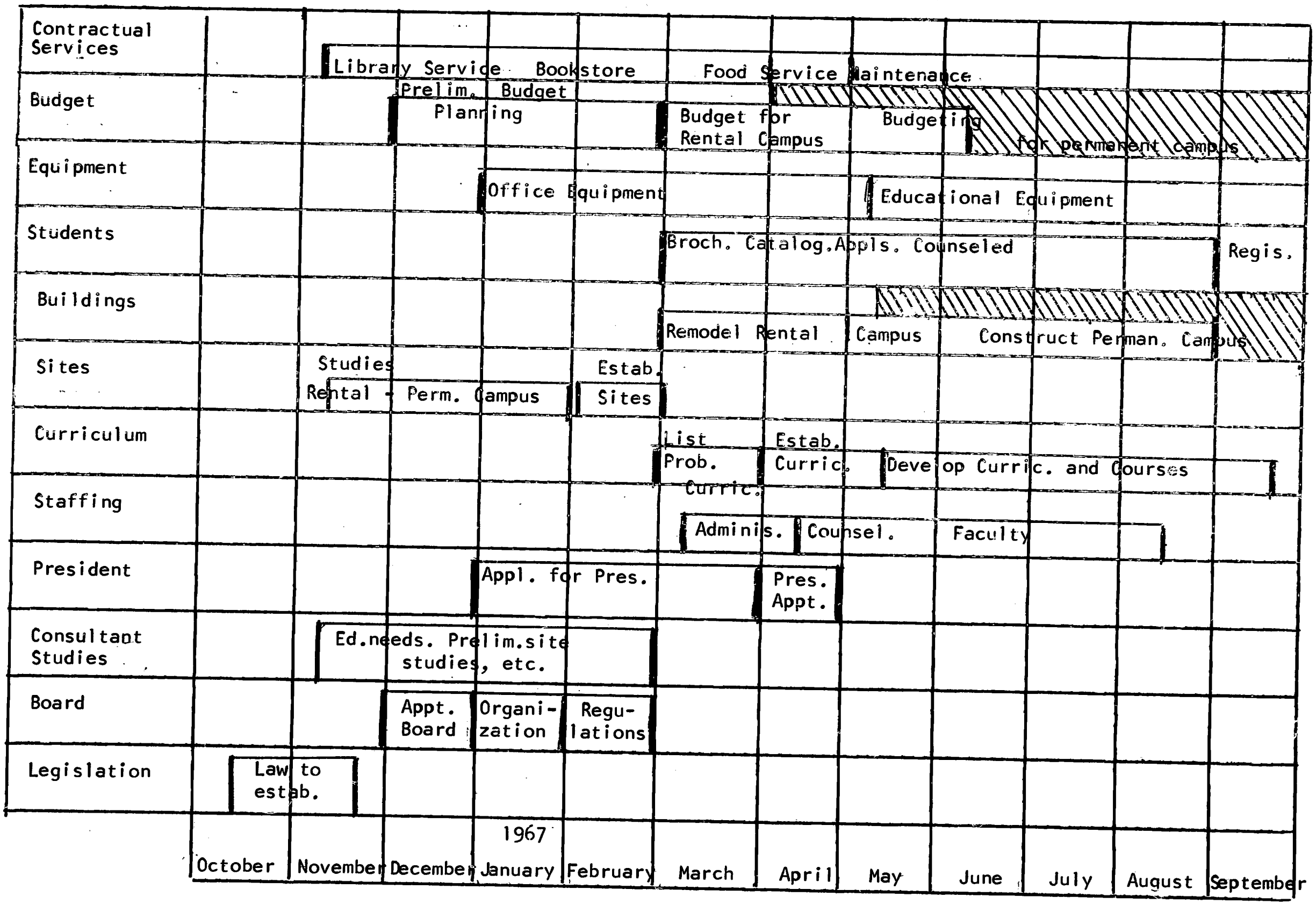
Many of the events on our PERT chart occurred out of sequence, many were altered from a normal situation because of: 1) The short time available to open the college, 2) The budget allowed for a total of 400 students and almost double that number enrolled in the first quarter, 3) Enrollment doubled again at the beginning of the second quarter, 4) Planning for technical and semi-professional programs during the first year of operations was the major factor involved in charting events. However, uncharted man hours of energy were expended in pre-planning the possibility of adding an academic transfer program at the beginning of the second year of operation. (These plans were put into effect in July 1966 when we became a comprehensive community college.)

Major findings: A college can be established in a one or two year period, the critical event being temporary building versus new construction. A two year period is much to be preferred.

A college planning an initial enrollment of 500 to 1000 students should allot a minimum of one year of time for planning and should provide 5 to 8 administrators plus appropriate supporting staff.

According to PERT approximately 8,000 man hours went into major events, plus another 2,000 hours of general planning, conferences and Board meetings. The remaining 5,000 hours, about 1/3 total time, are typical of the small, unplanned, time consuming activities (phone calls) which are forgotten in most man power projection needs. If the approximate number of man hours of energy to establish a college were doubled a more realistic time projection would be obtained.

TIME SEQUENCE CHART
for
RENTAL CAMPUS - 1 YEAR TO OPEN



Open Rental Campus

APPENDIX A

NORTHERN VIRGINIA TECHNICAL COLLEGE
Revised FY 65-66 Budget
5 November 1965

Item	Total Local	Local Spent or Committed 1 Nov.	Total State	State Spent or Committed 1 Nov.	GRAND TOTAL
ADMINISTRATION					
Salaries					
President					
Administration/Registrar					
Accountant					
Asst. Community Relations					
Clerical & Research Analyst					
Sub-Total (Salaries)	23,396.93	4,638.68	39,774.00	11,615.00	63,170.93
Operations					
Contractural Services			400.00	300.00	400.00
Publications & Printing	8,101.25	3,138.75	1,000.00	500.00	9,101.25
Postage & Telegraph	1,000.00	202.34	1,000.00	202.34	2,000.00
Travel (Bd., Staff, Consultants)	2,691.02	740.32	3,000.00	1,131.11	5,691.02
Workmen's Compensation	350.00	-0-		-0-	350.00
Supplies	523.90	41.46			523.90
Social Security	1,718.00	143.48	750.00	158.96	2,468.00
Hospitalization	2,086.30	491.24		-0-	2,086.30
Rental of Office Equipment			623.00	623.00	623.00
Sub-Total (Operations)	16,470.47	4,757.59	6,773.00	2,915.41	23,243.47
TOTAL ADMINISTRATION	39,867.40	9,396.27	46,547.00	14,530.41	86,414.40

Item	Total Local	Local Spent or Committed 1 Nov.	Total State	State Spent or Committed 1 Nov.	GRAND TOTAL
INSTRUCTION					
Salaries					
Division Heads (3)		-0-	32,250.00	7,454.52	32,250.00
Instructors & Occupational Advisors		-0-	273,272.00	45,705.14	273,272.00
Instructors (Part-time)		-0-	52,650.00	-0-	52,650.00
Clerical (4) & Part-Time	11,522.95	2,455.32	(3) 6,857.00	2,355.31	18,379.95
Student Wages	1,239.12	630.25	2,000.00	630.26	3,239.12
Sub-Total (Salaries)	12,762.07	3,085.57	367,029.00	56,145.23	379,791.07
Operations					
Instructional Supplies		-0-	50,000.00	8,220.09	50,000.00
Tuition for Faculty	3,000.00			-0-	3,000.00
Data Processing Lab Equip. Rental		-0-	72,500.00	-0-	72,500.00
Transportation In (on equip.)		-0-	600.00	436.16	600.00
Sub-Total (Operations)	3,000.00	-0-	123,100.00	8,656.25	126,100.00
TOTAL INSTRUCTION	15,762.07	3,085.57	490,129.00	64,801.48	505,891.07
CONSULTANT			2,000.00	-0-	2,000.00

Item	Total Local	Local Spent or Committed 1 Nov 65	Total State	State Spent or Committed 1 Nov 65	GRAND TOTAL
LIBRARY					
Salaries					
Librarian			6,700.00	750.00	6,700.00
Clerical (1)	2,160.00	360.00	1,836.00	360.00	3,996.00
Sub-Total (Salaries)	2,160.00	360.00	8,536.00	1,110.00	10,696.00
Operations	000	-0-	000	-0-	000
TOTAL LIBRARY	2,160.00	360.00	8,536.00	1,110.00	10,696.00
PHYSICAL PLANT					
Salaries					
Janitorial Service	7,456.85	1,106.85	7,456.85	1,106.85	14,913.70
Sub-Total (Salaries)	7,456.85	1,106.85	7,456.85	1,106.85	14,913.70
Operations					
Utilities	12,524.54	2,229.97	12,524.54	2,229.95	25,049.08
Repairs	1,100.00	63.90		-0-	1,100.00
Bldg. Maintenance Supplies	340.86	162.14	340.00		680.86
Insurance	443.01	54.00	1,200.00	801.00	1,643.01
Rent	46,822.55	16,666.68			52,700.00
Sub-Total (Operations)	61,230.46	19,176.69	14,064.54	3,030.95	81,172.95
TOTAL PHYSICAL PLANT	68,687.81	20,283.54	21,521.39	4,137.80	96,086.65

Revised FY 65-66 Budget

Item	Total Local	Local Spent or Committed 1 Nov 65	Total State	State Spent or Committed 1 Nov 65	GRAND TOTAL
CAPITAL OUTLAY					
4 Bay Conversion	98,747.72	90,847.25			98,747.72
Architect Fees	3,135.00	2,835.00			3,135.00
Bay 5 Conversion	15,000.00				15,000.00
Office Equipment			23,152.00	22,152.52	23,152.00
Building & Ground Maintenance			1,000.00		1,000.00
Classrooms @ 1,500			51,589.27	47,089.27	51,589.27
Lecture Rooms @ 1,500					
Library Equipment			8,985.60	8,485.60	8,985.60
Library Books			55,000.00	20,575.55	55,000.00
Data Processing Lab Furniture			13,681.77	5,700.37	13,681.77
Secretarial Science Lab			61,035.60	60,935.60	61,035.60
Business Science			13,020.00	448.00	13,020.00
Electronics (2 Labs)			57,986.39	45,986.39	57,986.39
Engr. Design (Drafting)			51,933.08	26,541.86	51,933.08
Police Science			2,704.00	119.26	2,704.00
Physics Lab			16,814.90		16,814.90
Training Aids			1,600.00 *		1,600.00
TOTAL	116,882.72	93,682.25	358,502.61	238,034.42	475,385.33

* Training aids purchased included in classrooms

Item	Total Local	Local Spent or Committed 1 Nov 65	Total State	State Spent or Committed 1 Nov 65	GRAND TOTAL
RE-CAP					
Administration	39,867.40	9,396.27	46,547.00	14,530.41	86,414.40
Instruction	15,762.07	3,085.57	490,129.00	64,801.48	505,891.07
Consultant			2,000.00		2,000.00
Library	2,160.00	360.00	8,536.00	1,110.00	10,696.00
Physical Plant	68,687.81	20,283.54	21,521.39	4,137.80	96,086.65
Capital Outlay	116,882.72	93,682.25	358,502.61	238,034.42	475,385.33
GRAND TOTAL	243,360.00	126,807.63	927,236.00	322,614.11	1,176,473.45

BALANCE

RECEIPTS	Local		State
Local Jurisdictions (FY 64-65)	10,000.00		
Local Jurisdictions (FY 65-66)	100,000.00	Budgeted FY 66	812,236.00
Out-of-Area Tuition	760.00		
Student Lab Fees	1,600.00		
Advance from State Board of Technical Education	125,000.00		
Research Grant from U. S. Office of Education	6,000.00		
Total Receipts	243,360.00		
EXPENDITURES			
FY 65-66	243,360.00	FY 65-66	927,266.00
BALANCE	-0-		(-115,000.00)

APPENDIX B

EXPENDED ENERGIES
STAFF TIME CHART TO OPEN SCHOOL FOR CLASSES,
September 27, 1965

Administration	Date of Employment	Man Hours	
McKee - President	5/17	744	
Shuler - Dir. of Administration	6/1	656	
Edmands - Registrar	7/29	328	
Cannon -Dean, Day Program	9/18	40	
Caraker - Counselor	9/1	135	
Whitmer - Counselor	7/26	350	
Brannan - Dir. Facilities	8/1	312	
Lehman - Community Relations	6/1	656	
Ripley - Research Assistant	6/15	576	
Parks - Library Assistant	9/1	136	
*Walker - Sec. to Board	4/1-8/15	297	
*Parks, M. - Sec. to Walker	4/1-8/15	396	
*Vickers - Business Mgr.	6/1-8/4	368	
*Hieronymus - Research	6/1-8/13	424	
*Shiflett - Accountant	7/12	432	
	TOTAL		5850

Department Heads

Corcoran - Engr. Design	9/1	136
Hill - Business Science	9/1	136
Holt - Electronics	9/1	136
*McCandless - Data Processing	8/16	232
Stahl - Secretarial Science	8/1	312
Walpole - Police Science	9/1	136
Zawacki - Mathematics	9/1	136

Faculty

Allen	9/20	40
Andrews	9/15	64
Bimstein	9/1	136
Cohen	9/1	136
Coleman	8/23	192
Cordaro	9/1	136
Costello	9/21	32
Culkin	9/15	64
Darden (3/4 time)	9/1	103
Flynn	9/1	136
Fowler	8/15	232

Appendix B - continued

Faculty	Date of Employment	Man Hours	
Kammire	9/20	40	
Kibler	9/1	136	
Koberg	9/1	136	
Lesansky	9/1	136	
Mays	9/20	40	
Mitchell	9/1	136	
Stemp	9/1	136	
Tuhill	8/16	232	
Young	9/20	40	
	TOTAL		3530
Secretarial - Clerical			
Peterson	6/1	656	
Gordon	6/28	504	
Hollen	8/1	312	
Donnelly	9/1	136	
*Hase	5/22-9/1	704	
*Harris	6/5-9/1	488	
*Stansberry	6/1-8/1 (1/2 time)	176	
*Griffe	7/19-7/26	40	
*Zachrison	7/15-8/15 (1/2 time)	88	
*Gough	9/10-9/12	16	
	TOTAL		3120
	TOTAL STAFF ENERGIES		12,500
	Consultants		150
	Staff Overtime		2,350
	GRAND TOTAL MAN HOURS TO OPEN COLLEGE		15,000

*No longer associated with the college and have been replaced by other personnel.

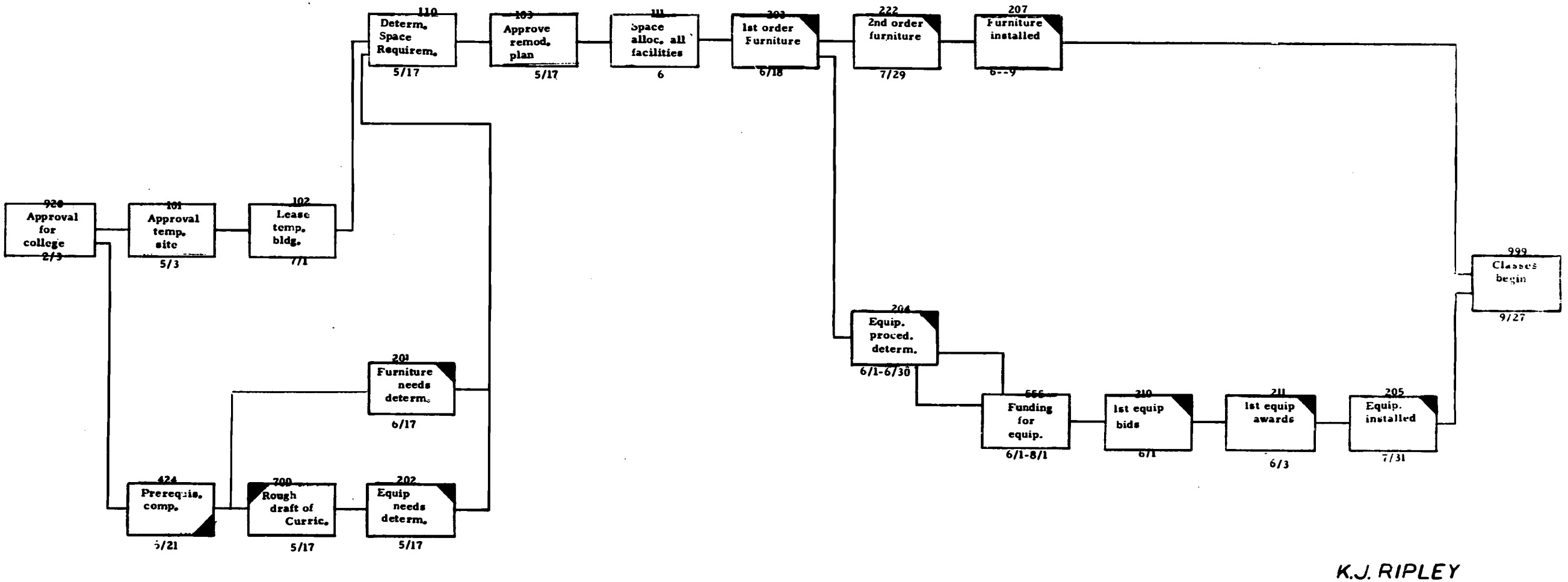
By the Second Quarter, the following additional personnel have been added:

17 Full-time faculty
45 Part-time faculty
2 Administrators

NORTHERN VIRGINIA TECHNICAL COLLEGE

FURNITURE AND EQUIPMENT

CHART NO. 2

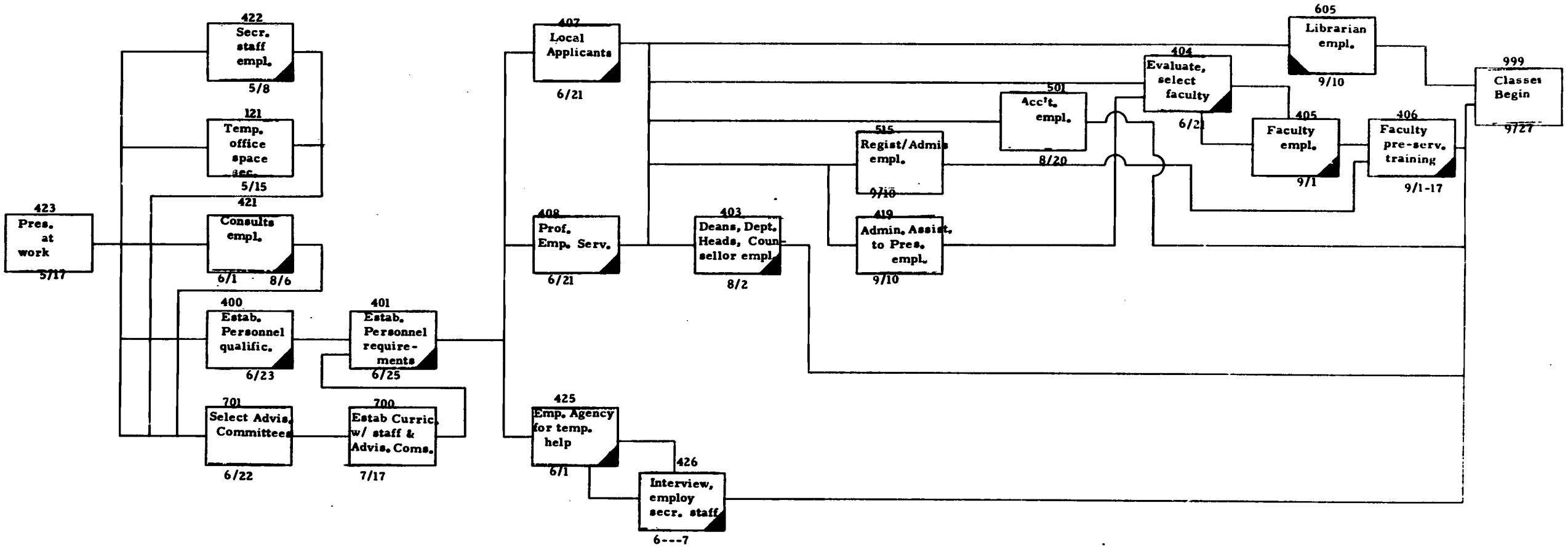


K.J. RIPLEY

NORTHERN VIRGINIA TECHNICAL COLLEGE

PERSONNEL

CHART NO. 3

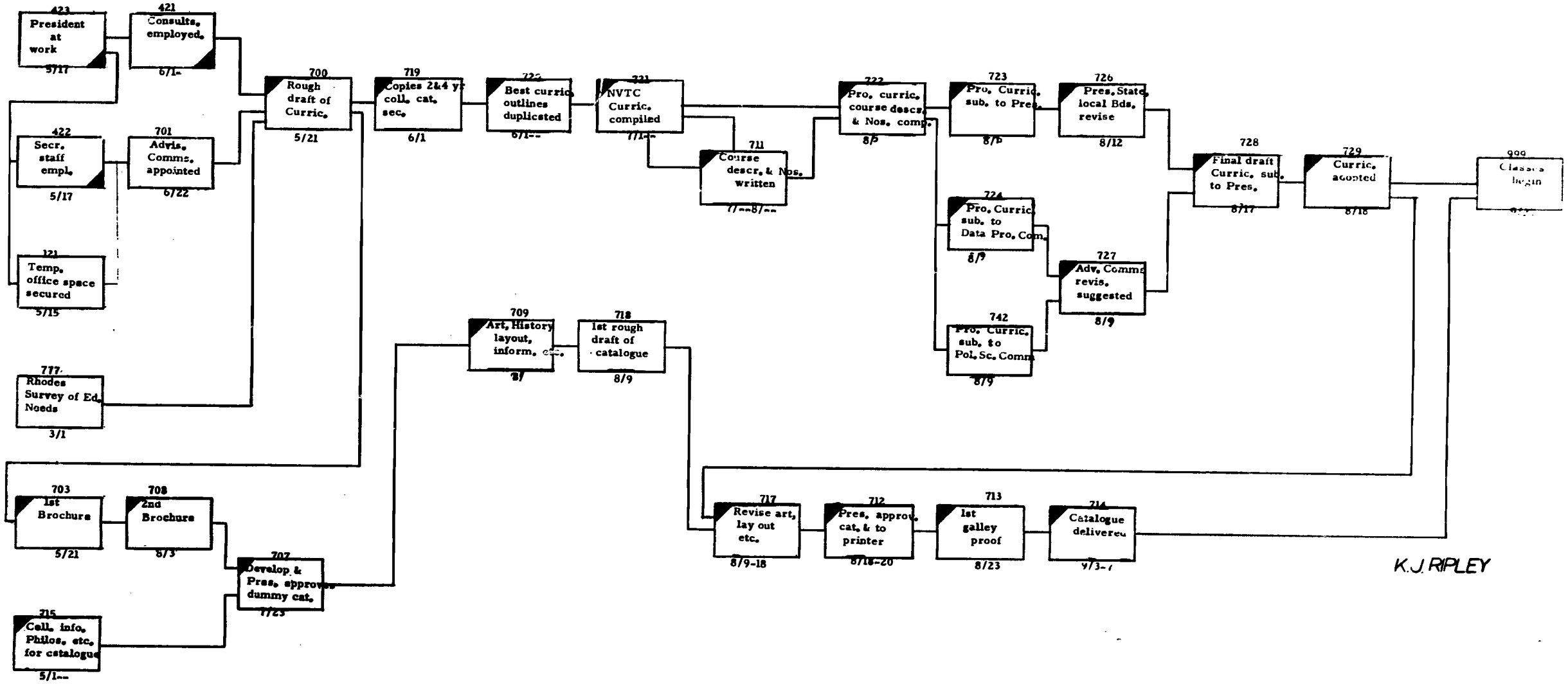


K.J. RIPLEY

NORTHERN VIRGINIA TECHNICAL COLLEGE

CURRICULUM AND CATALOGUE

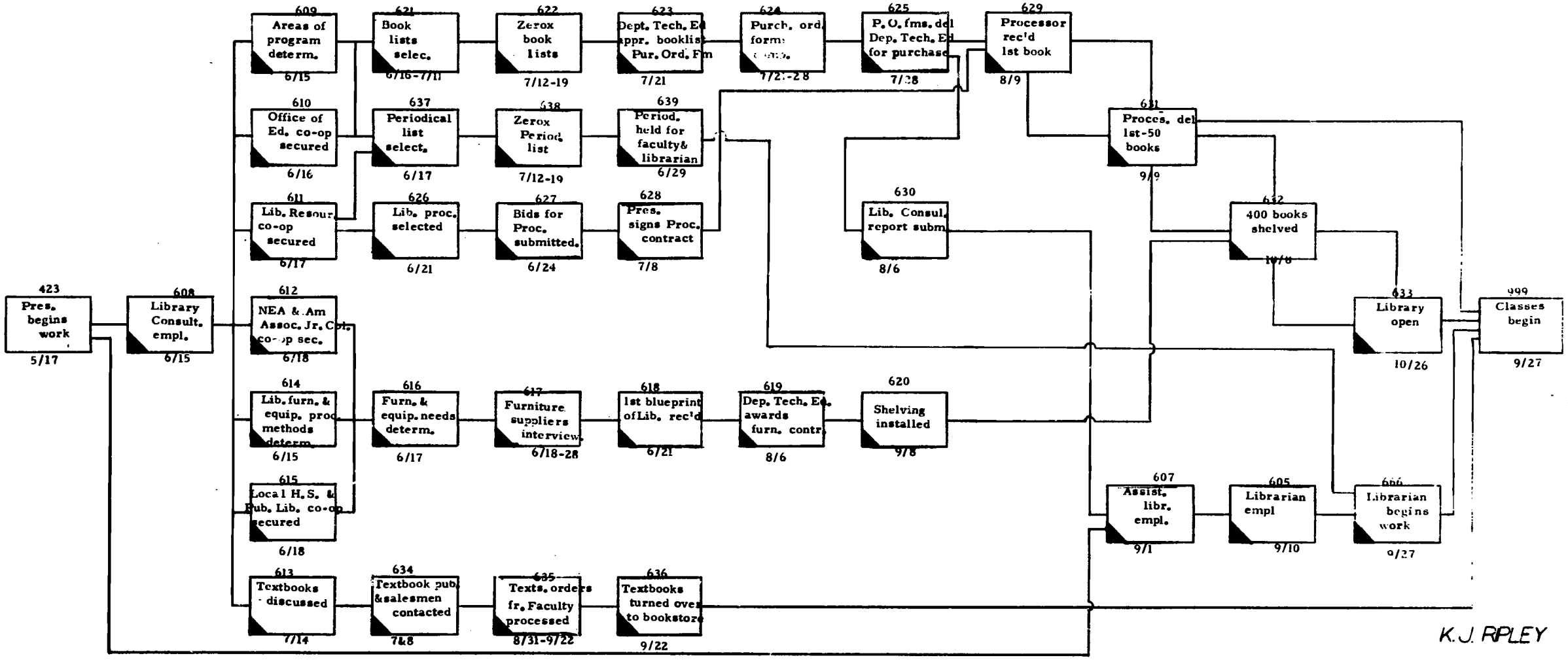
CHART NO. 4



K.J. RIPLEY

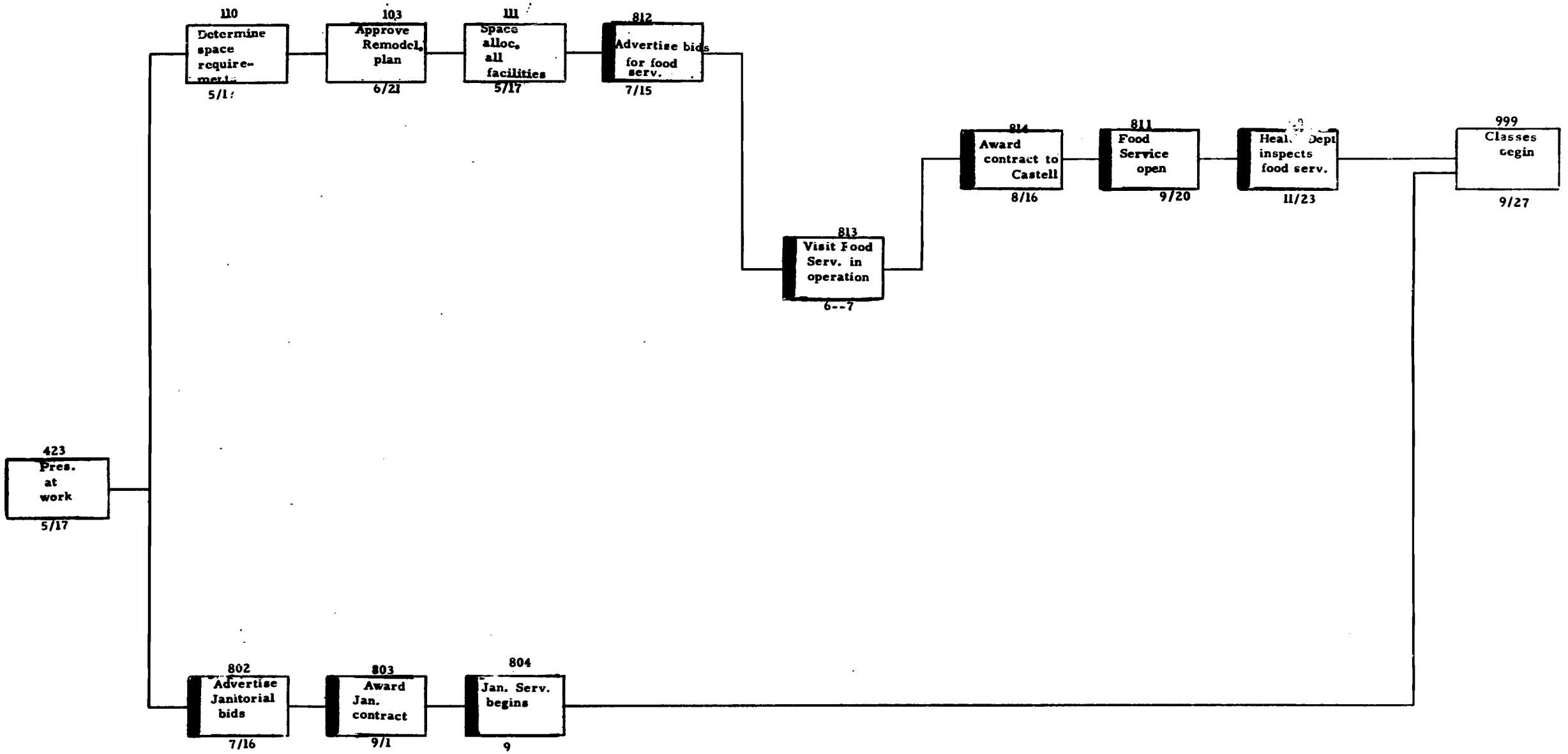
NORTHERN VIRGINIA TECHNICAL COLLEGE

LIBRARY
CHART NO. 5



K. J. RIPLEY

NORTHERN VIRGINIA TECHNICAL COLLEGE
FOOD SERVICE-JANITORIAL SERVICE
CHART NO. 6



KJ. RIPLEY