A HEURISTIC RESOURCE ALLOCATION AND CONTROL ALGORITHM FOR INTERMITTENT SYSTEMS

BY

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A HEURISTIC RESOURCE ALLOCATION AND CONTROL ALGORITHM FOR INTERMITTENT SYSTEMS

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PREFACE

This dissertation is based on the supposition that the sequential accumulation of task progress is analogous to the growth of living organisms. Based on this premise, it is shown that a system of mathematical models can be developed and integrated with the digital computer to formulate a composite algorithm for the allocation and control of resources within intermittent systems.

Therefore, the objective of this dissertation is to develop a diagnostic and prognostic algorithm to place decision-making for the allocation and control of resources within intermittent systems on a quantitative basis. Chapters II, III, and IV are devoted to this objective. A four-section Appendix is included as support material for the test and for future extensions of the heuristic modeling scheme.

Interest began in this area in the fall of 1957 when I noticed a lack of emphasis on quantitative computerized decision-making techniques for intermittent industries. Since monetary limitations seemed to be the prohibitive factor, research was first performed with inexpensive analog computers for small industries. When the analog computer was found not to be adaptable to small industry, interest developed in the realm of this dissertation.

Indebtedness is acknowledged to Brown Engineering Company, Inc.

for sponsoring my academic program and for making available an excellent computer laboratory which made this research possible.

Special indebtedness is due Professor W. J. Bentley, Chairman of my Advisory Committee, for his optimal control of incentives which sustained my fortitude. Also, I would like to acknowledge the contributions of Dr. P. E. Torgersen, Dr. W. J. Fabrycky, Dr. J. L. Folks, and Professor L. J. Fila for their quality instruction and guidance as members of my Advisory Committee.

A debt of gratitude is acknowledged to Rick Cameron who assisted in the translation of my recondite logic into computer language, to Mary Alice Goodwin and Jane Hamby who deciphered and translated my intermittent scribblings into legible form, and to the members of the Systems Engineering Department of Brown Engineering Company, Inc. at Cape Canaveral, Florida, for their assistance in final documentation.

Finally, special credit is due my wife, Nona, who reconciled my absence to my sons, John and Jeffrey, who forfeited many hours of leisure during the research travail.

Robert Neil Braswell

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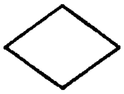
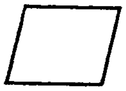
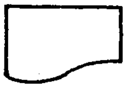
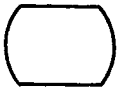
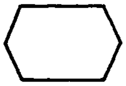
SYMBOLISM

MATHEMATICAL SYMBOLS

α - shaping parameter
β - shaping parameter
C^* - allowable effectiveness deviation
CR - computer run
δ - translation parameter
ϵ_1 - intercept constant
ϵ_2 - asymptotic shaping constant
ω_1 - intercept constant
ω_2 - asymptotic shaping constant
LOD - limits of deviation
POC - project operating characteristic
P(t) - projected task progress
RD - resource depletion
RD(t) - actual resource depletion
ROC - resource operating characteristic
R(t) - projected resource depletion
t - task life
t^* - task life $(t - \delta)$
TOC - task operating characteristic
TP - task progress
TP(t) - actual task progress

FLOW CHART SYMBOLS

	general computational function
	computer decision-making function
	manual decision-making function
	document
	input or output (punched card file)
	input or output (magnetic tape file)
	input for output (manual creation function)
	specific computational function
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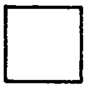
	off page connector
	auxiliary operation

CHAPTER I

INTRODUCTION

There is little doubt that a second world-wide industrial revolution is underway. The evolution of society through the Machine Age and to the existing era of automation and interplanetary exploration has brought about new professions and disciplines to cope with new technologies. These engineering disciplines emerged because of the vast requirements for scientific applications. The contributions of Taylor, Gantt, Emerson, Gilbreth, and others are not exceptions. Through their foresight and dedicated efforts, industrial engineering was born to develop scientific methodology for merging men, materials, and machines. Those techniques are believed to be the fundamental bases for the retaliation capability during World War II.

During this era of increased emphasis on enhancing the best standard of living ever known, the industrial engineer is charged with broad recondite responsibilities. He must not only search for the optimal methods of merging the man and machine but also the optimal methods for controlling them in the work process. The work process is the integration of the objectives, concepts, ideas, men, machines, materials, and monies for the production of goods and services. These goods and services may be of a continuous, repetitive or intermittent nature. Regardless of the nature of the demands, it is the responsibility of the industrial engineer to constantly amplify the effectiveness of methodology for the integration and control of the man-machine systems.

An important aspect of the control facet is deciding upon the precise allocation of resources at any operating time. Several factors have to be considered in making these decisions such as the availability of resources, the nature of the work process, and delivery dates (1).

The complexity of these factors has forced the industrial engineer to focus his attention on quantified and computerized methodology for assisting the decision-maker. Some work has been accomplished toward this goal, but, as yet, emphasis has been on the optimization of systems components rather than the total system. For example, the study of a hypothetical queue, the application of linear programming to a restricted class of problems, and the loading of resources from an activity network are concerned with the system components. There have been some special-purpose pragmatic components developed in industry by using trend functions for planning curves. For example, Brown Engineering Company, Inc. has made some progress by using a logistic function to describe the execution of well planned jobs. In theory and in praxis, all the foregoing components have useful properties but fail to encompass the necessary components for total systems. This author knows of no general algorithm to fulfill the quantitative decision-making desiderata. The literature indicates a void and a dire need for research and development in this area.

A large class of operational systems are amenable to description in terms of an enumerable set of states. For example, the state of a simple inventory system can be given by enumerating the items on hand, on order, and on back order. The state of a fleet of delivery trucks can be specified by giving the number of trucks being loaded, those on different delivery routes, and those being repaired. The state need not describe all the details of the system; it need only include those characteristics which the manager of the operation must know in order to make his decision regarding the next operations of the system. To provide an auspicious basis for decision-making, the decision-maker must be notified periodically or continuously of the state of the system by means of management information feedback. The system will change its state from time to time, either because of the effect of outside influences or because of dynamic decisions of the manager.

Resources, the ingredients that go into the work process, are necessary for work process survival. Task resources are monies which buy machines, material, manpower, and related services. Thus, the monies that will buy all the ingredients will be classified as resources in this investigation. Dollars per manhours will be the standard allocation media and resources will be distributed by increments of time over the task life.

The resource problem, as considered in this investigation, may be described as follows. Random demands are made on a total system.

Because of the nature of the services offered by the system, the demands are channeled by a project planning and control element to task service areas for processing. As a demand enters the system for service, by its nature it has performance characteristics that can be described. This characteristic description has inherent properties which specify the resource requirements for the demanded work process.

The objective of this investigation is to circumvent the existing deficiencies of rules-of-thumb and non-computerized resource allocation and control techniques by developing a system of copious models to put the decision process on a quantitative basis. A heuristic composite algorithm which couples the models with the computer for real and simulated conditions will be the major objective. The hypothesis is that a heuristic diagnostic and prognostic algorithm can be developed to establish decision criteria for allocating, monitoring, and controlling resources within intermittent systems.

The resource allocation and control algorithm developed in this dissertation is heuristic because of

(1) Its ability to guide the decision-maker in exercising management control.

(2) Its dependence on the judgment of the decision-maker to close the loop in the man-machine system.

(3) Its conceptual value in empirical research leading to further extensions of this study.

In the following chapters, it will be shown how the ingredients of a system can be integrated into a heuristic algorithm that will possess the capability and flexibility to allocate and monitor resources for a total system.

CHAPTER II

ALGORITHM BASIS AND CONCEPT

The Intermittent System

A system is an integrated assembly of interacting elements or components designed to carry out cooperatively a predetermined function (2). Intermittent is to appear or to occur in interrupted sequence with emphasis stressed for breaks in continuity (3). An intermittent system is generally non-repetitive and responds only when a demand is placed on it. In essence, an intermittent system is analogous to a job shop operation or system where a demand is created only when an order for the production of some non-stock item is received. The intermittent system does not normally produce items for inventory.

A task is an elemental breakdown of the project and is composed of sub-tasks. The project would encompass a major effort such as the development and design of a vehicle stage for a lunar launch, whereas a task would encompass the hypergolics analysis or the mechanical design of the stage. A project is the level of the project planning and control element, and a task is the next lowest level as illustrated in Figure 1.

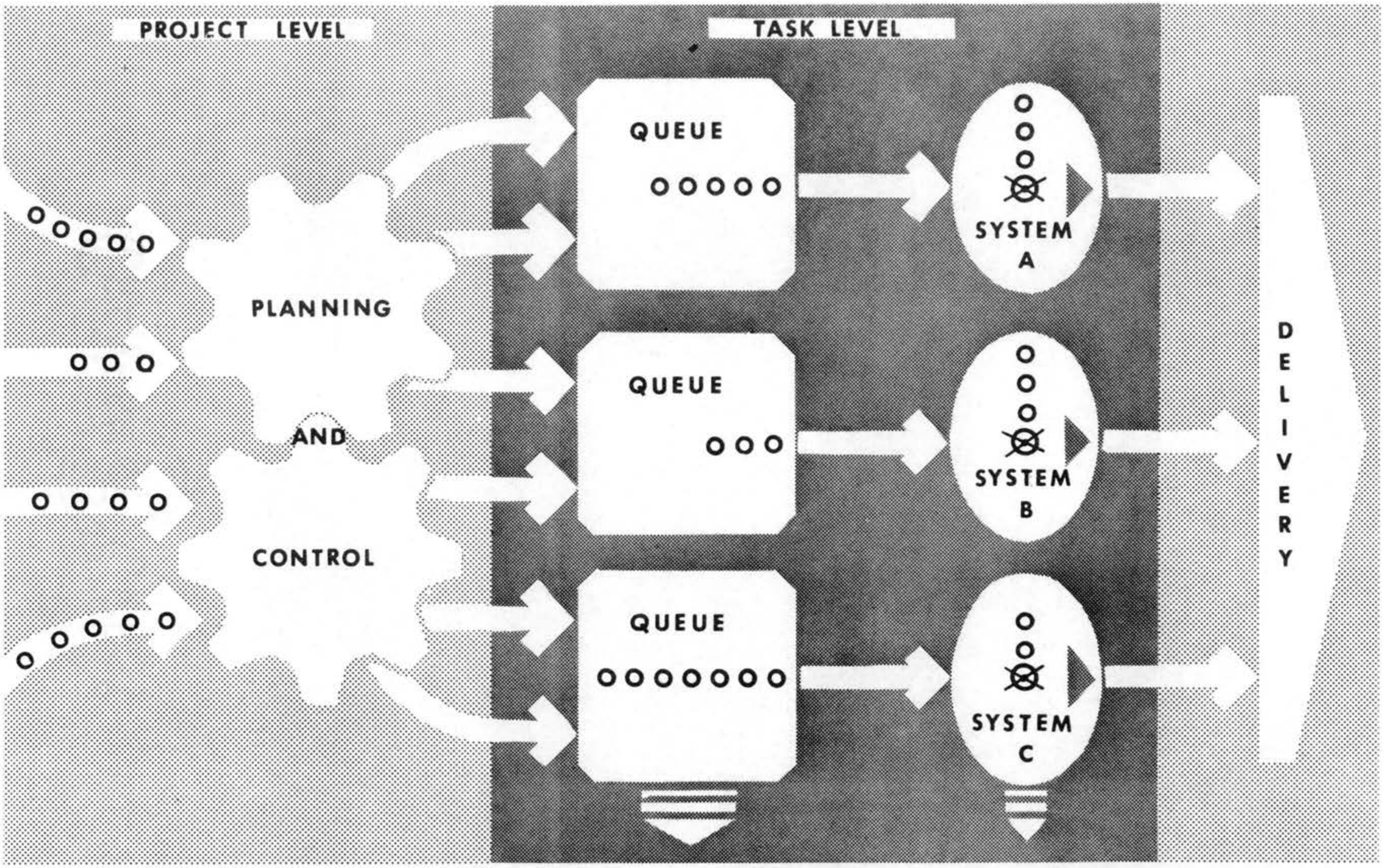


Figure I. Flow Model of Multisource Demands on Intermittent Systems

For the purpose of this investigation, the intermittent systems will be deterministic and will have capacity that will vary only through a controlled management process. As illustrated in Figure 1, System A has a deterministic capability and capacity which can be reduced or expanded by tradeoffs.

The resource problem, as considered in this investigation, may be described as follows. Random demands are made on a total system. Because of the nature of the services offered by the system, the demands are channeled by a project planning and control element to specialized service areas for processing. As a demand enters the system for service, by its nature it has performance characteristics that can be described. This characteristic description has inherent properties which specify the resource requirements for the demanded work process.

The intermittent system will respond only to acceptable task demands. The demands or customers are impatient since they have time-oriented delivery requirements. An overload forms a first come-first served single channel queue, as shown in Figure 1. The queue elements have dynamic priorities. Priority demands, which are overload elements in the system, are sequenced as the first elements in the queue. A demand in service remains in service until complete. As shown in Figure 1, there can be several demands in service simultaneously. Service capabilities are assumed not to be interchangeable among systems.

In this dissertation, the allocation of resources to demand requirements and the control of the resources allocated to the work process will be scrutinized with a task operating characteristic (TOC) curve, a resource operating characteristic (ROC) curve, a task progress (TP) model, and a resource depletion (RD) model, all of which form the basis for a composite computer algorithm.[2] This algorithm allocates the resources and monitors the performance of the total system. The service time for the demands is a random variable with very large variance. The demand input and service time will be empirically simulated on the IBM 1401 computer. This empirical simulation affords the algorithm the flexibility of systems dynamics by allowing the decision-maker to make decisions based on a simulated set of circumstances.

In telephony, the average length of a call is rather small with little variability. However, the generalized algorithm developed in this dissertation must possess the flexibility to satisfy demands requiring very small, as well as very large quantities of resources. Since the mathematical treatment of a service time distribution with a large variance is not feasible, the queue is empirically simulated on the computer.

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[2] Hereafter, these abbreviations will be used to represent their respective redundant forms.

The Operating Characteristic Concept

Zornig (4) used an operating characteristic (OC) curve to describe and judge various acceptance sampling plans over a range of possible quality levels for a submitted product. Newberry (5) used the inventory characteristic (IC) curve to describe inventory investment for various shortage levels. The respective curves illustrate performance characteristics for diagnostic and prognostic judgment about the phenomena under study. Thus, a curve that describes the diagnostic and prognostic performance of task progress over the range of the task's life will be called a TOC curve. Likewise, a curve that describes the diagnostic and prognostic performance of resource depletion over the range of task life will be called a ROC curve.

In considering the progress of a task, it is necessary to develop a relationship for yield versus time; the yield is progress accrued by the application of resources at some controlled rate as a function of time. This phenomena is not unlike the growth of living organisms. Multicellular organisms start as a single cell even though this state is generally of extremely brief duration. The subsequent growth process is the single cell divided into two, four, eight, etc., cells until complete development is attained, assuming that the living multicellular organisms have the required resources to consume. In the case of the human body, growth occurs at some predetermined rate with the application of food and care. This varies for different people but, generally, heredity shapes the growth pattern (4), assuming that the environment and the food (resources) are compatible within reasonable means of standard requirements. This same argument holds for plant life. The over-application of resources (fertilizer, water, etc.) can retard growth since the plant is only capable of consuming some maximum to yield optimal growth progress.

Generally, a living organism begins its growth at a relatively slow rate, increases at a more rapid rate, and then becomes asymptotic to its peak growth or physical maturity (6). For example, the life growth of white male rats follow the characteristic curve as shown in Figure 2. These data are plotted from experimental results by Donaldson (7).

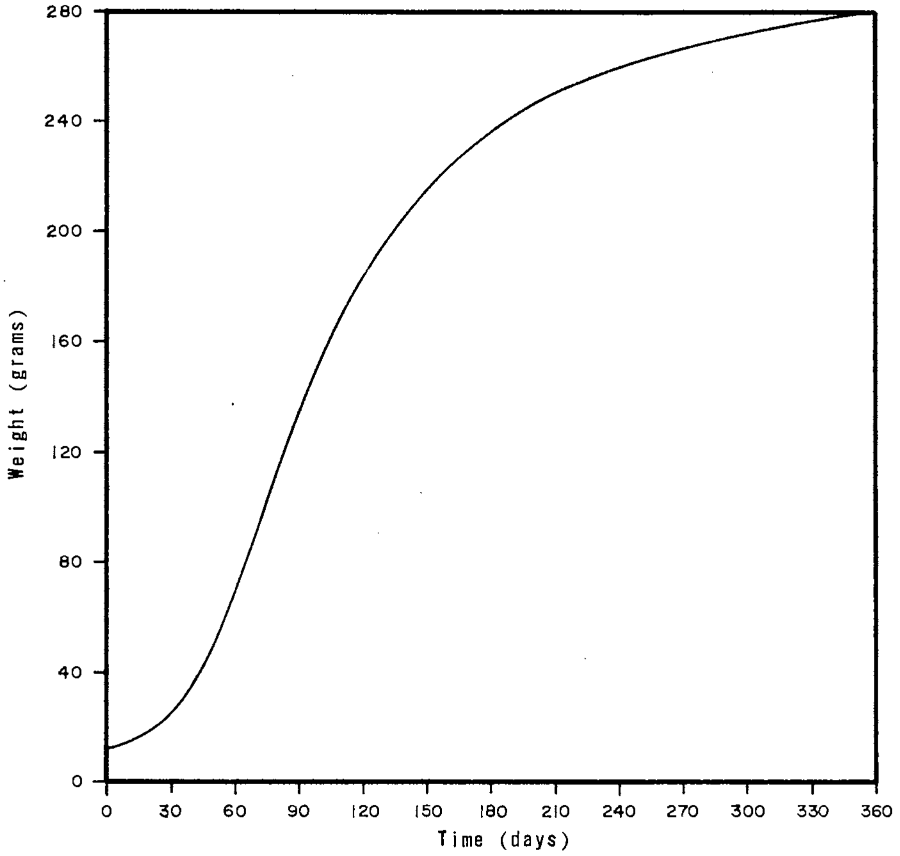

Figure 2. Growth Characteristic Curve for White Rats

The growth characteristic curve of Cucurbita pepo follows a somewhat different pattern but the same basic growth trend as the white rats. This is illustrated in Figure 3, with data taken from the experimental results of Anderson (8).

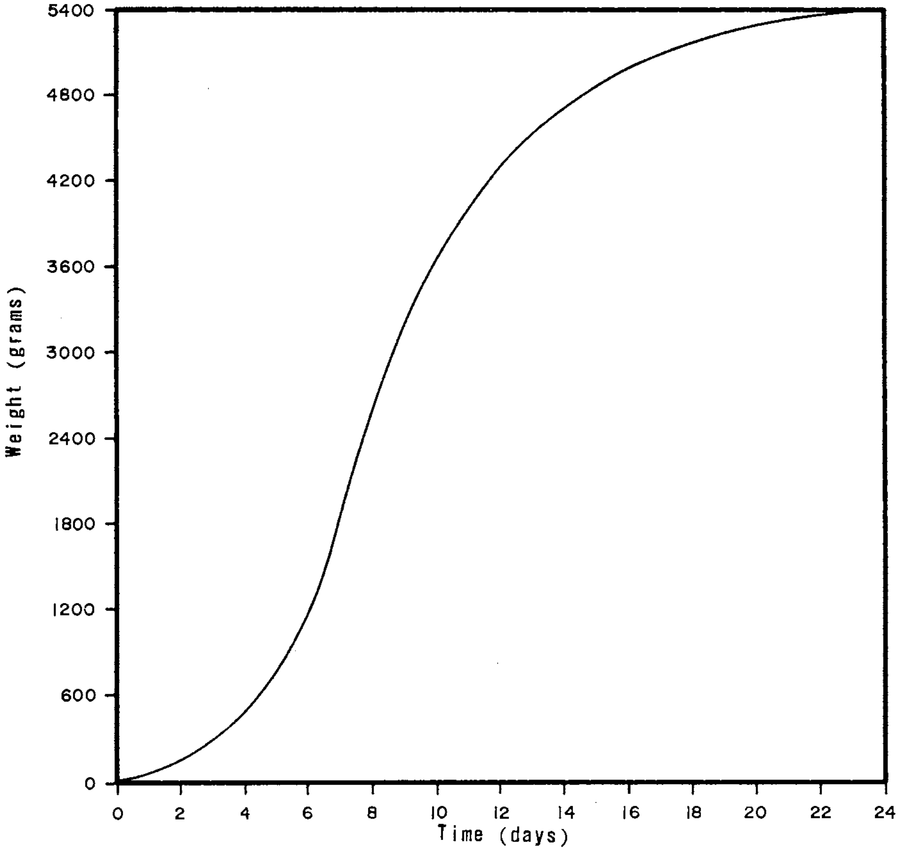

Figure 3. Growth Characteristic Curve of Cucurbita Pepo

The population growth of the United States, plotted from census data, follows the trend as shown in Figure 4. Baumgartner (9) schematically describes a cumulation expenditures budget as illustrated in Figure 5.

In essence, he defines a growth characteristic or performance curve for the time build-up of expenditures. This growth analogy can be extended to other phenomena such as driving the family car to the neighborhood market. Assuming the drive is of such duration that traffic obstacles are nil, the car would be accelerated gradually to an optimal velocity and decelerated to a complete stop at the market. The beginning was slow, a maximum velocity was reached, and the termination was preceded by a deceleration.

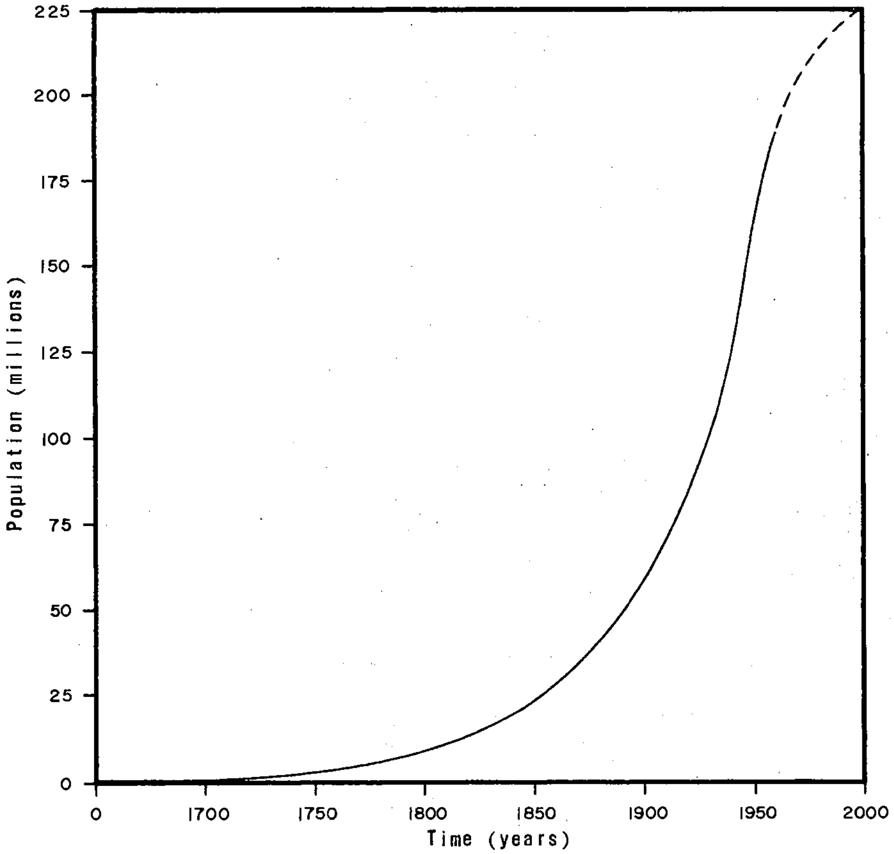

Figure 4. Population Growth Characteristic Curve for the United States

The characteristic growth pattern for multicellular organisms, plants, nations, and budget expenditures is of special interest since a task is also the coalescing or growth of many concepts and ideas into a final product. The growth of living organisms and active budgets

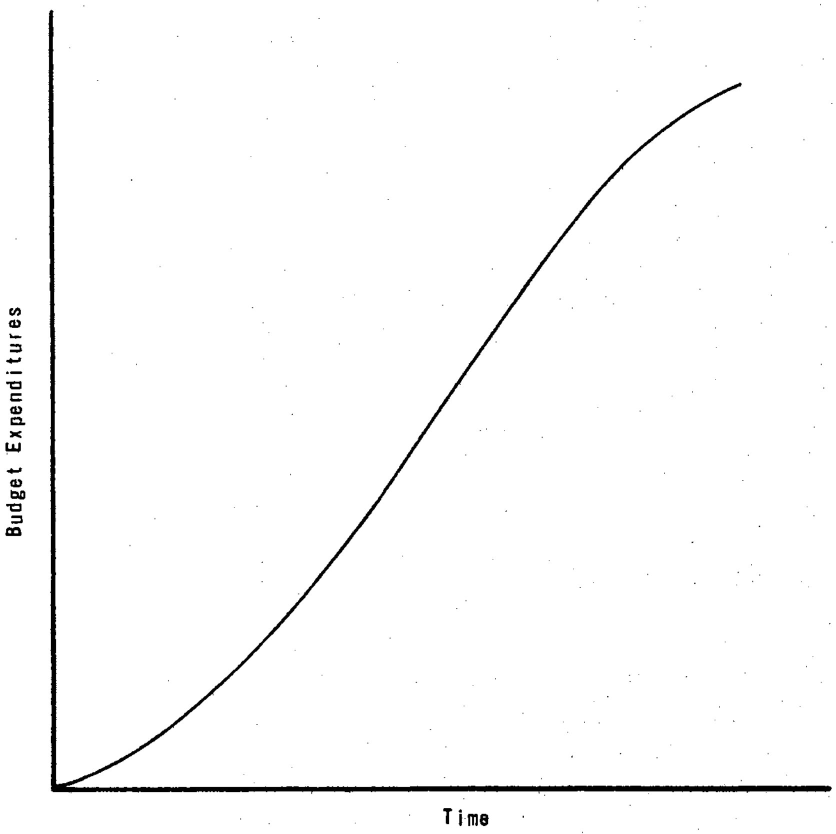

Figure 5. Budget Expenditures

have essentially the same shaped curve. Since the work process for completing a task is the accumulation and integration of concepts and ideas over its active life, it must also have a progress characteristic pattern.

By referring to any typical Gantt chart[3] or any kind of work process plan for a well planned task, it can be seen that the requirement for resources starts slowly for the quasi-creative beginning and the activity requirements increase until the final assembly and inspection phase. During these more tedious phases, resource requirements are

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[3] First developed by Henry L. Gantt in the latter part of the 19th century.

reduced. Then an "S" shaped curve tends to be representative of the resource expenditures over the life of the work process. If productivity were measured for this cycle, it could also represent a growth function since it would be accomplished by the direct consumption of resources. This would be analogous to feeding the white rat to make him grow or fertilizing the Cucurbita pepo to enhance growth.

Actual production and progress for work of a professional nature is very difficult to measure. Probably no single technique would suffice for all purposes. However, since payments of fees and periods for work accomplished usually requires an estimated percent completion, the heuristic models will be based on percent complete. There has been considerable work in setting work standards for professional work so that output could be measured against predetermined standards; but, as yet, the literature has not reflected adequate success for use in a general purpose algorithm. As illustrated in Chapter III, the utility of the Program Evaluation and Review Technique (PERT) model (10), developed for estimating time for activity in a planning network, has been extended for heuristic measures of task progress in percent complete. Baumgartner (9) discussed progress in terms of resources depleted, or cost incurred against a budget plan. Such a plan would be more subjective and intuitive than an average of independent estimates common to the PERT model. The real advantage is that the decision-maker is estimating from the work process environment as the task is in progress.

The rate of progress toward task completion for a given resource allotment is a function of time relative to similar experience, training, incentive, individual capacity, and other pertinent factors. Usually, the initial rate of progress is relatively slow but increases at an increasing rate until a maximum rate of progress is reached somewhere near the midpoint of task life. Then the rate of progress with respect to time tends to increase at a decreasing rate until 100 percent of task completion is achieved. Based upon the foregoing premise, as illustrated in Figure 6, progress versus time for a specific task tends to

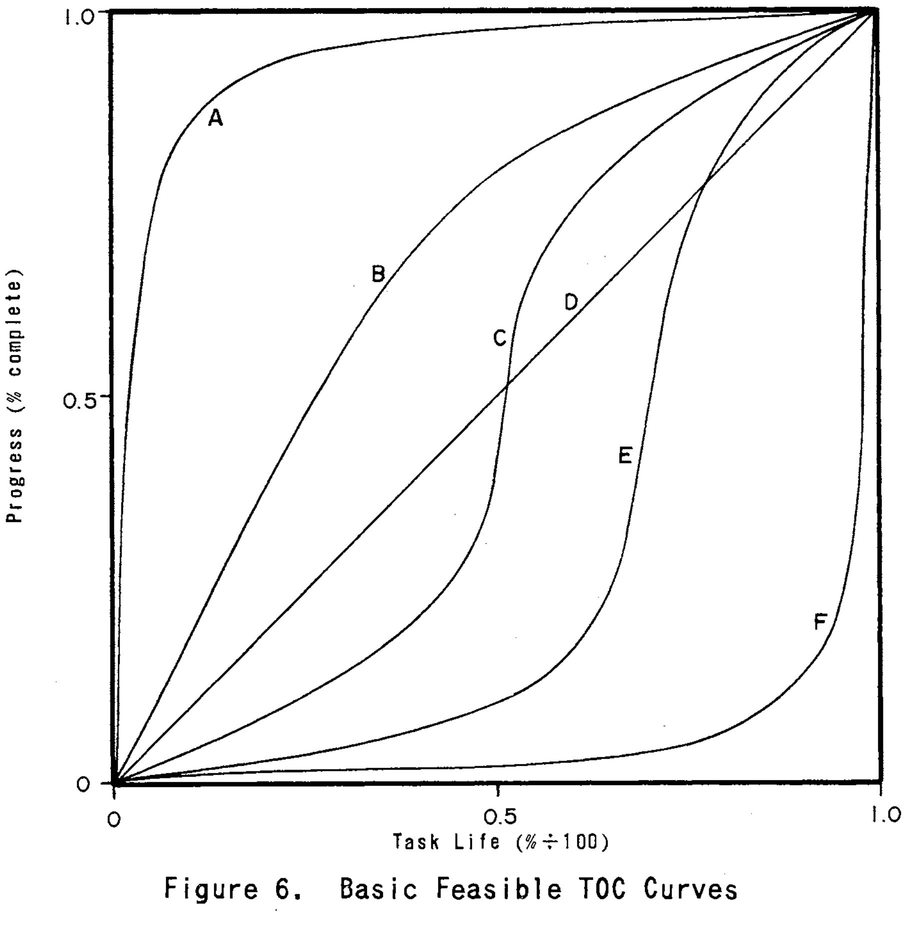

Figure 6. Basic Feasible TOC Curves

form an "S" shaped curve. For the purpose of this investigation, an analogy is made between the growth characteristic of multicellular organisms and the operating characteristics of completing a task. There is obvious similarity between the many possible task operating characteristic curves of Figure 6 and the growth characteristics curves of Figures 2, 3, 4, and 5.

By the same analogy, the time application of resources to an activity of a task follows a backward "S" shaped curve. This can be attributed to the difficulty in defining the task or it can be a result of the principle of diminishing returns where resource density is not directly proportional to productivity after the required resource load has been applied. This would be analogous to the over-application of fertilizer to corn plants. A specified amount becomes the optimal application and results in maximum growth. Figure 7 illustrates that resources can also be allocated in an infinite number of ways.

A demand for service requires some specified amount of resources over time as progress is made on the service requirements. The operating characteristic of resources over the life of a task is inversely proportional to the progress characteristic. These processes are analogous to pouring water from one glass into another - as one is being filled, the other is being depleted. The task theoretically begins with 100 percent of the allotted resources available, and then they are depleted to zero upon completion and delivery of the task.

The over-allocation of resources, as illustrated by Curve A in

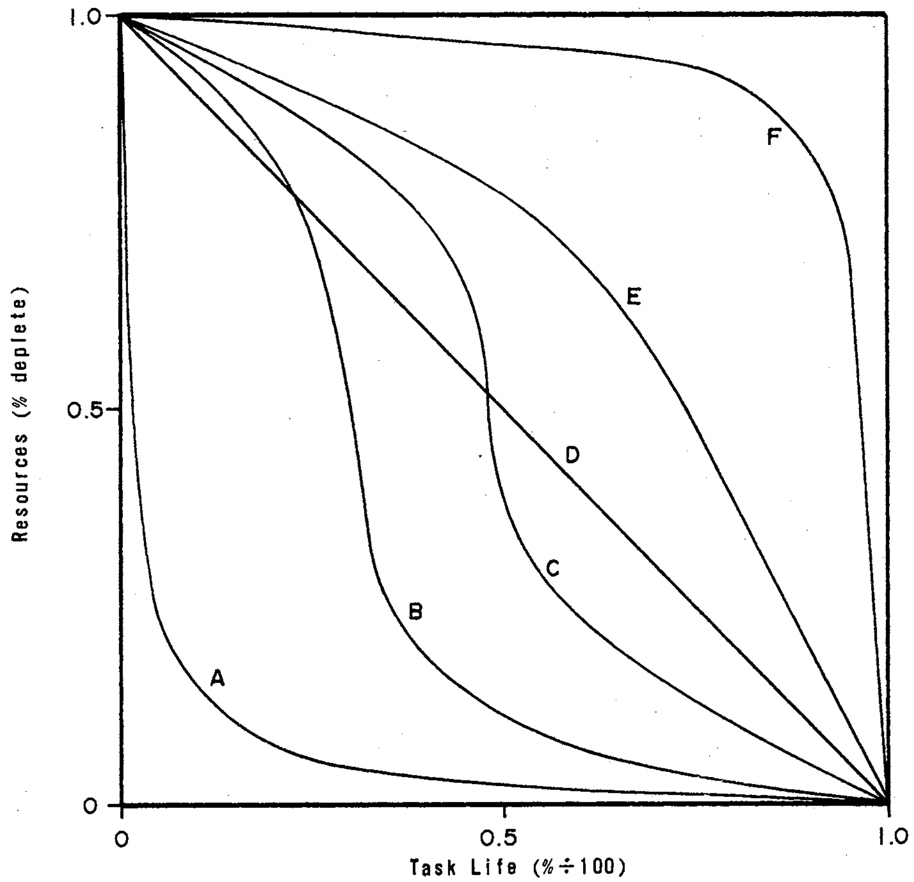

Figure 7. Basic Feasible ROC Curves

Figure 7, results in waste. The under-allocation of resources, as illustrated by Curve F in Figure 7, results in milestone slippage and late deliveries. As in plant growth, there is a most favorable pattern of resource application based on the characteristics of the demand requirements. This most favorable allocation procedure optimizes such management objectives as timely deliveries, resource waste, and schedules.

Four characteristic curves are of interest in the formulation of a heuristic allocation and control algorithm for intermittent systems. These curves are discussed and illustrated in Chapter III. However, they are defined here so that a basis can be established for the development of the basic mathematical models.

The first curve is defined to be the TOC curve. Planning must precede resource allocation within the intermittent system if an acceptable allocation of resources pattern is to be achieved. A specific TOC curve is selected by the decision-maker as a progress standard in view of the characteristics activity required to service the task. Similar task experience, knowledge of total resources available, and delivery dates are essential characteristics which shape the growth pattern. The TOC curve is similar in purpose to the operating characteristic (OC) curve associated with quality control. The OC curve is used to pass judgment upon whether or not a process is currently in statistical control at a given confidence level (11). Similarly, in this algorithm, the TOC curve and the TP curve model are used to pass judgment upon whether or not task progress is in control of a specified percent of resources left for task completion. The TOC curve must be a monotonically increasing function since progress cannot be lost or regressed. In the real world, it is not uncommon for managers to think that progress regressed; however, this can be rationalized when one considers that what was assumed to be progress was not in fact true progress.

The second curve of interest is the ROC curve. This curve represents the operating characteristic of resources applied to demands over their life span, which is the time period from beginning work to final delivery. When the task is initiated, theoretically, a specified amount of resources is made available and depleted as a function of time. Since resources that have been expended are not recoverable, the ROC curve is a monotonically decreasing or decaying function as time elapses during the work process.

The third curve of interest is defined to be the TP curve, which describes the effects of planning, allocation, and control of resources in achieving the desired objective. Whereas the ROC curve represents the behavior of resource depletion, the TP curve is completely dependent upon progress estimates made by the manager, as set forth later in this chapter.

The fourth curve is an empirical description of the actual resource depletion. It is derived from the actual day-to-day resource utilization for accomplishing work on the activity of the tasks. It is called the RD curve and is analogous in utility to the TP curve except that it is determined empirically by the compilation of time expended, bills of material, and other resource expenditures.

Random characteristics peculiar to intermittent systems behavior will cause the TP and RD curves to deviate from the TOC and ROC curves, respectively. The allowable limits of this deviation are defined by upper and lower limits which converge symmetrically on the characteristic curves. The decision-maker can vary the limits of deviation to reflect uncertainty in expected task progress and in resource depletion.

Since the TOC curve is the basis for an associated ROC curve, detailed descriptions will be covered after a mathematical basis for a model is developed. The model's parameters will be variable such that the mathematical function will represent a family of feasible TOC curves. With modifications, the model will also represent a family of ROC curves.

CHAPTER III

THE MATHEMATICAL MODELS

A specific requirement for optimal utility in the composite algorithm is that the characteristic curves be easily controlled and readily manipulated. They must have variable shaping and skewing parameters for describing all desirable shapes. More explicit requirements and conditions are specified in the sequence of development.

Mathematical Basis

Mathematical models that could possibly be modified to describe the TOC and ROC curves are the Gompertz function, an exponential function, a multi-degree polynominal, the Pearl-Reed function, trigonometric functions, and others (12). The particular mathematical model that Pearl used to approximate the population growth characteristic of the United States (6) is

$$y = \frac{be^{ax}}{1+ce^{ax}} \tag{1}$$

Where y = number of people, a, b, and c are parameters, and e is the base for Neperian logarithms. Pearl's work was concerned with trend fitting of growth data; however, since the analogy between growth phenomena and task progress has been conceptually established, the TOC curve[4] will be modeled through modification of Equation (1). Then

$$y = \frac{b}{e^{-ax}(1+ce^{ax})}$$

$$= \frac{b}{c+e^{-ax}} \qquad (2)$$

Now if parameter substitutions are made such that

$$a = -ka'$$

$$b = kc$$

$$c = \frac{1}{m}$$

then Equation (2) becomes

$$y = \frac{k}{[1+m\ \exp(ka'x)]} \qquad (3)$$

and the derivative of y with respect to x is taken

$$\frac{dy}{dx} = -\frac{k^2a'm[\exp(ka'x)]}{\{1+m[\exp(ka'x)]\}^2} \qquad (4)$$

Now by substituting

$$\frac{k^2}{\{1+m[\exp(ka'x)]\}^2} = y^2$$

and

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[4] Later, the ROC curve will be shown to be a function of the TOC curve; therefore, this development will only concern itself with task operating characteristics.

$$me^{ka'x} = \frac{k-y}{y}$$

into Equation (4), then

$$\frac{dy}{dx} = -a'y(k-y)$$

and

$$-a' = \frac{\frac{dy}{dx}}{y(k-y)} \qquad (5)$$

Since the TOC curve must be a monotonically increasing function with time, it can be seen that the time rate of change of y, task progress, varies directly with y and k-y. The function will be asymptotic to the constant k, as time becomes infinitely large.

Since task progress is dependent upon factors that vary with time, f(x) can be substituted for -a', where f(x) is a function of time. Then from Equation (5)

$$\frac{dy}{y(k-y)} = f(x)dx$$

To solve the differential equation

$$\int \frac{dy}{y(k-y)} = \int f(x)dx \qquad (6)$$

let

$$y = \frac{1}{u}$$

$$dy = -\frac{du}{u^2}$$

Substituting into Equation (6)

$$\frac{du}{(1-ku)} = f(x)dx \qquad (7)$$

and taking the indefinite integral of both sides of Equation (7)

$$-k \int \frac{du}{(1-ku)} = -k \int f(x)\,dx$$

and

$$\ln(1-ku)+c_1 = -k \int f(x)\,dx$$

or

$$\ln(1-ku) = -k \int f(x)\,dx - c_1$$

and taking the antilog of both sides

$$1-ku = \exp\left[-k \int f(x)\,dx - c_1\right] \qquad (8)$$

Substituting $u = \frac{1}{y}$ back into Equation (8)

$$\exp\left[-k \int f(x)\,dx - c_1\right] = 1 - \frac{k}{y}$$

Then

$$y = \frac{k}{1-\exp\left[-k \int f(x) - c_1\right]}$$

$$= \frac{k}{1-e^{-c_1}\left\{\left[\exp\ -k \int f(x)\,dx\right]\right\}} \qquad (9)$$

and let

$$c_2 = e^{-c_1}$$

Now solving for c_2 by substituting Equation (2) into Equation (9), and letting $x = 0$ then

$$c_2 = -\frac{1}{c} = -m$$

from Equation (3). Now by substituting the value of c_2 into Equation (9)

$$y = \frac{k}{\left\{1+m\left[\exp\ -k\int f(x)dx\right]\right\}} \qquad (10)$$

$$= \frac{k}{1+m\left\{\exp\left[F(x)\right]\right\}} \qquad (11)$$

where

$$F(x) = -k\int f(x)dx$$

Now if f(x) is represented by a Taylor series

$$y = \frac{k}{1+m\left[\exp(a_0+a_1x+a_2x^2+\cdots+a_nx^n)\right]}$$

$$= \frac{k}{1+m\left[\exp(\sum_{i=0}^{n} a_ix^i)\right]} \qquad (12)$$

Referring to Equation (12), if $m < 0$, y becomes discontinuous at some finite time. Since this cannot hold for task progress, the restriction for $m > 0$ must be established. Also, since values of $k < 0$ would yield negative task progress, which is impossible, the same restriction for $k > 0$ is applicable. Then $0 < y < k$ and y will be asymptotic to the x axis and to k. Also for Equation (11), if

$$F(x) \rightarrow \infty\ ;\quad y \rightarrow 0$$

$$F(x) \rightarrow -\infty\ ;\quad y \rightarrow k$$

$$F(x) \rightarrow 0\ ;\quad y \rightarrow \frac{k}{1+m} \qquad (13)$$

From Equation (12), y_{max} and y_{min} occur when $\frac{dy}{dx} = 0$, and from Equation (4)

$$\frac{dy}{dx} = y(k-y)F'(x) \tag{14}$$

therefore, y_{max} and y_{min} occur when $F'(x) = 0$. Also, since $\frac{dy}{dx} = 0$ when either $y = 0$ or $y - k = 0$ indicates that the model is asymptotic to $y = 0$ and $y = k$.

From Equation (12), it can be seen that if $a_n > 0$, y becomes asymptotic to the x axis as $x \to \infty$ from an intercept at

$$y_0 = \frac{1}{1+m\left[\exp(a_0)\right]}$$

Since task progress cannotregress, certain restrictions and model modifications are necessary.

The desired properties for the TOC curve model are:

(1) $0 \leq P(t) \leq 1.0$ and $0 \leq t \leq 1.0$.

(2) When $t = 0$, $P(t) = 0$ and when $t = 1.0$, $P(t) = 1.0$.

(3) Must be monotonically increasing.

(4) Must possess the flexibility of being both symmetrical and asymmetrical with manipulatable parameters which are easily specified.

The desired properties for the ROC curve model are:

(1) Must be monotonically decreasing.

(2) $0 \leq R(t) \leq 1.0$ and $0 \leq t \leq 1.0$.

(3) When $t = 0$, $R(t) = 1.0$ and when $t = 1.0$, $R(t) = 0$.

(4) Must possess the flexibility of being both symmetrical and asymmetrical with manipulatable parameters which are easily specified.

It can be seen that if the desired properties for a TOC curve can be attained, the ROC curve could be defined such that $R(t) = 1.0 - P(t)$ for all values of t between zero and one. For example, the extrema are satisfied when $t = 0$, $P(t) = 0$, and $R(t) = 1.0$ and when $t = 1.0$, $P(t) = 1.0$, and $R(t) = 0$.

It is desirable for the task progress intercept to be zero when $x = 0$. Since, theoretically, Equation (12) could have some intercept, ω_1, when $x = 0$, then

$$y = \omega_1 + \frac{\omega_2}{1+m\left[\exp\left(\sum_{i=0}^{n} a_i x^i\right)\right]} \qquad (15)$$

where $\omega_2 = k$. Now for symmetry in Equation (15), let $\omega_1 = 0$, $\omega_2 = 1$, $m = 1$, $n = 1$, $y = P(t)$, $x = t$, $a_0 = \alpha$, and $a_1 = \beta$, then

$$P(t) = \frac{1}{1+e^{\alpha+\beta t}} \qquad 0 \leq t \leq 1 \qquad (16)$$

In Equation (16), if $\beta < 0$, $P(t)$ is a monotonically increasing function. Then for $\beta < 0$ substituted, Equation (16) becomes

$$P(t) = \frac{1}{1+e^{\alpha-\beta t}} \qquad (17)$$

In Equation (12), when $F'(x) = 0$ has no real roots, the function is asymmetrical. Since this brings inconvenient terms into the model, a lateral translation of the $P(t)$ axis can approximate the desired asymmetry. Assuming that α and β can be selected such that if $t = 0.5$, then $P(t) = 0.5$. Therefore, the task should theoretically be 50 percent complete when one half of the time has elapsed.

Then

$$0.5 = \frac{1}{1+e^{\alpha-0.5\beta}}$$

and

$$\beta = 2\alpha \qquad (18)$$

Substituting Equation (18) into Equation (17),

$$P(t) = \frac{1}{1+e^{\alpha(1-2t)}} \qquad (19)$$

and

$$P'(t) = \frac{2\alpha \left\{\exp[\alpha(1-2t)]\right\}}{\left\{1+\exp[\alpha(1-2t)]\right\}^2} \qquad (20)$$

The maximum rate of change of P(t) with respect to time occurs at some time t, when P'(t) = 0. Then solving for t in Equation (20), t = 0.5.

Since it is not likely that maximum relative progress will occur when 50 percent of the time has elapsed, it is necessary to make the lateral translation of the P(t) axis represent an asymmetrical function. Then let some new t, say t^*, be defined as illustrated in Figure 8. Then,

$$t^* = t - \delta \qquad (21)$$

Substituting Equation (21) into Equation (19),

$$P(t) = \frac{1}{1+e^{\alpha[1-2(t^*+\delta)]}} \qquad (22)$$

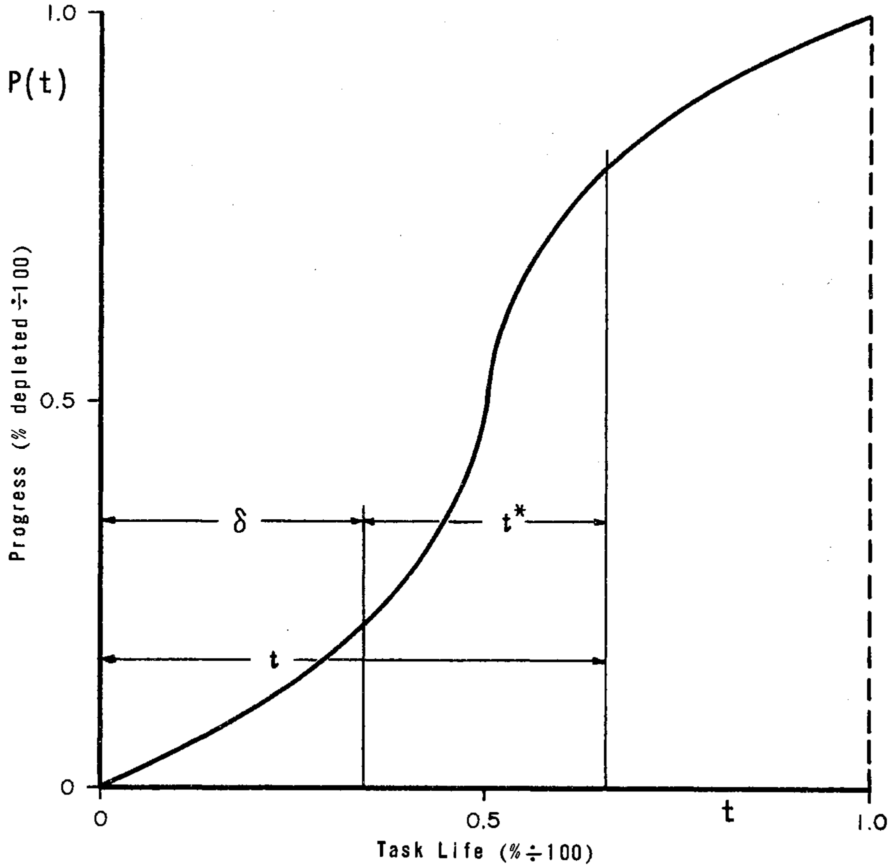

Figure 8. Asymmetric Modification for TOC Curve Model

The maximum P'(t) can now occur at any time such that all TOC curves illustrated in Figure 6, page 16, can be described by varying the shaping parameter α and the translation parameter δ.

By setting the exponent of Equation (22) equal to zero for δ_{min} and δ_{max} at $t^* = 0$ and $t^* = 1$, respectively, it can be seen that $-0.5 \leq \delta \leq 0.5$ for $0 \leq t^* \leq 1$, then t^* is just another t.

It is now necessary to adjust the range of P(t) to equal the range of t, or force P(t) = 0, when t = 0. This fixes task progress at zero when t = 0, which is reasonable since prior knowledge of the work processes would suggest an operating characteristic similar to curve B, rather than curve C or E, refer to Figure 6, page 16, if no similar experience had been realized. Then if $\omega_1 = f(\omega_2)$ such that $\omega_1 = -\epsilon_1 \epsilon_2$ and $\omega_2 = \epsilon_1$, then from Equation (22),

$$P(t) = \epsilon_1 \left[\frac{1}{1+e^{\alpha[1-2(t+\delta)]}} - \epsilon_2 \right] \qquad (23)$$

It is now necessary to find the values of the constants, ϵ_1 and ϵ_2. When $t = 0$, let $P(t) = 0$ and when $t = 1.0$, let $P(t) = 0$. Then from Equation (23), let $t = P(t) = 0$,

$$\epsilon_1 \left[\frac{1}{1+e^{\alpha(1-2\delta)}} - \epsilon_2 \right] = 0$$

Dividing through by ϵ_1 and solving

$$\epsilon_2 = \frac{1}{1+e^{\alpha(1-2\delta)}} \qquad (24)$$

Also, from Equation (23), let $t = P(t) = 1.0$, then,

$$\epsilon_1 \left[\frac{1}{1+e^{-\alpha(1+2\delta)}} - \epsilon_2 \right] = 1$$

Now, substituting ϵ_2,

$$\epsilon_1 = \frac{\{1+\exp[-\alpha(1+2\delta)]\}\{1+\exp[\alpha(1-2\delta)]\}}{\{\exp[\alpha(1-2\delta)]\} - \{\exp[-\alpha(1+2\delta)]\}} \qquad (25)$$

Then substituting for ϵ_1 and ϵ_2 into Equation (23) and simplifying,

$$P(t) = \frac{\{1+\exp[-\alpha(1+2\delta)]\}\{\exp[\alpha(1-2\delta]-\exp[\alpha(1-2t-2\delta)]\}}{\{\exp[\alpha(1-2\delta)]-\exp[-\alpha(1+2\delta)]\}\{1+\exp[\alpha(1-2t-2\delta)]\}} \qquad (26)$$

Now for simplification let $k_1 = \alpha(1-2\delta)$ and let $k_2 = 2\alpha$, then

$$P(t) = \frac{(e^{k_2}+e^{k_1})(e^{k_2 t}-1)}{(e^{k_2}-1)(e^{k_2 t}+e^{k_1})} \qquad (27)$$

and Equation (27) is the model for the TOC curve with parameters k_1 and k_2.

In Equation (26), when $\alpha = 0$ and $\delta = 0$, $P(t)$ must equal t for a linear, one-to-one or straight line relationship between task progress and time. To test Equation (26) for this property, let $k_1 \rightarrow 0$ and $k_2 \rightarrow 0$ in the limit of Equation (27). Then by using the relationship that the lim AB = (lim A) (lim B), the following results are attained,

$$\lim_{\substack{k_1\to 0\\ k_2\to 0}} P(t) = \lim_{\substack{k_1\to 0\\ k_2\to 0}} \left[\frac{(e^{k_2}+e^{k_1})}{(e^{k_2 t}+e^{k_1})}\right] \lim_{k_2\to 0}\left[\frac{(e^{k_2 t}-1)}{e^{k_2}-1}\right]$$

It can be seen that the second term is indeterminate with zero divided by zero. Then L'Hospital's rule can be applied in the derivative as

$$\lim_{k_2\to 0}\left[\frac{\frac{d}{dk_2}(e^{k_2 t}-1)}{\frac{d}{dk_2}(e^{k_2}-1)}\right]$$

and

$$\lim_{k_2 \to 0} \left[\frac{t\, e^{k_2 t}}{e^{k_2}} \right] = t \qquad (28)$$

and $P(t) = t$ in the limit as $\alpha \to 0$. Also, since $P'(t) > 0$ for all t, it can be seen that $P(t)$ is a non-decreasing function as required for a monotonically increasing TOC curve.

Then Equation (26) will give a mathematical expression for all TOC curves and 1-P(t) will give a mathematical expression for all ROC curves. Then

$$R(t) = 1 - P(t)$$

$$= 1 - \left[\frac{e^{k_2} + e^{k_1})\ (e^{k_2 t} - 1)}{(e^{k_2} - 1)\ (e^{k_2 t} + e^{k_1})} \right] \qquad (29)$$

The P(t) and R(t) models were solved approximately 20,000 times for all values of α and δ by using an IBM 7040 computer; the FORTRAN IV program and procedures are given in Appendix A. From this vicarious experimentation, parameters of α and δ were selected such that a family of TOC curves could be represented. The final TOC curve selection is discussed later in this Chapter.

Task Operating Characteristic Curves

As stated earlier, the underlying premise for the TOC curve is that task progress performance is analogous to multicellular organismic growth. It is believed by experienced managers that the nature of a task inherently shapes its progression pattern over time. For the majority of research and development tasks, the progress is inherently slow at the beginning. This seems to be the case for any task that has a quasi-creative beginning. In the case of production, set-up time causes slow initial progress. The tasks that are well defined and repetitive tend to have a one-to-one relationship with time. It is possible, however, for task progress to have a relatively fast start initially. This would happen if considerable similar experience had been acquired on a relatively well defined applied problem. As illustrated by Figure 6, page 16, there are infinite basic feasible performance patterns for accomplishing task objectives. It is obvious, however, that a finite set could represent the majority of typical tasks.

For the purpose of this investigation, the five TOC curves, as illustrated in Figure 9, were selected on the premise that they represent the best range of feasible TOC curves desired for intermittent work. Many solutions to Equation (22) were generated by the use of the IBM 7040 computer, as shown in Appendix A. The family of five curves was selected from these solutions. However, there are no restrictions as to the number of progress patterns that can be used in the composite algorithm that is described in Chapter IV. Even though actual proof would be very subjective and extremely difficult to prove empirically or in the laboratory, it is believed that the five TOC curves will represent approximately 95 percent of tasks within intermittent systems.

The selection process was based first on empirically tracing

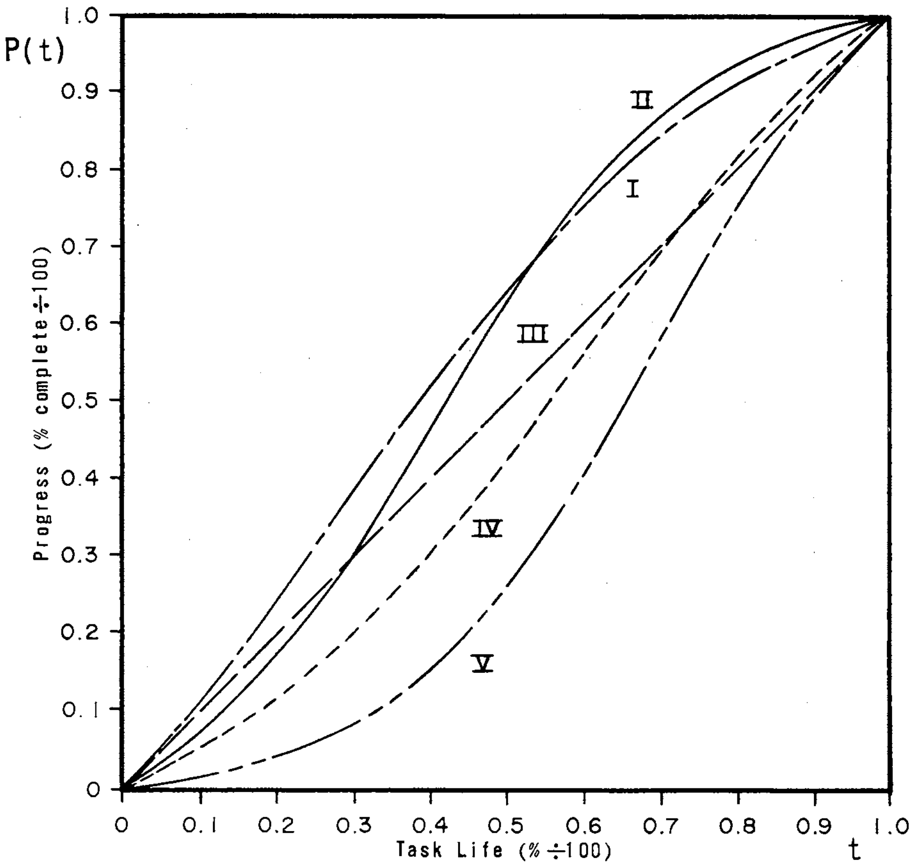

Figure 9. Selected TOC Curves

the approximated progress patterns of ten feasible tasks. From these ten, five were selected as being most representative by comparing the derivatives of the ten feasible TOC curves. The derivatives were of particular interest since consulted decision-makers made constant reference to the time periods of maximum progress. The derivatives for the five TOC curves are shown in Figure 10.

Progress varies non-linearily with time except for TOC curve III, which has a straight line relationship. The mathematical model for the data in Figure 10 is

$$P'(t) = \frac{(e^{k_2}+e^{k_1})\ (e^{k_1}-1)\ (k_2 e^{k_2 t})}{(e^{k_2}-1)\ (e^{k_2 t}+e^{k_1})^2} \qquad (30)$$

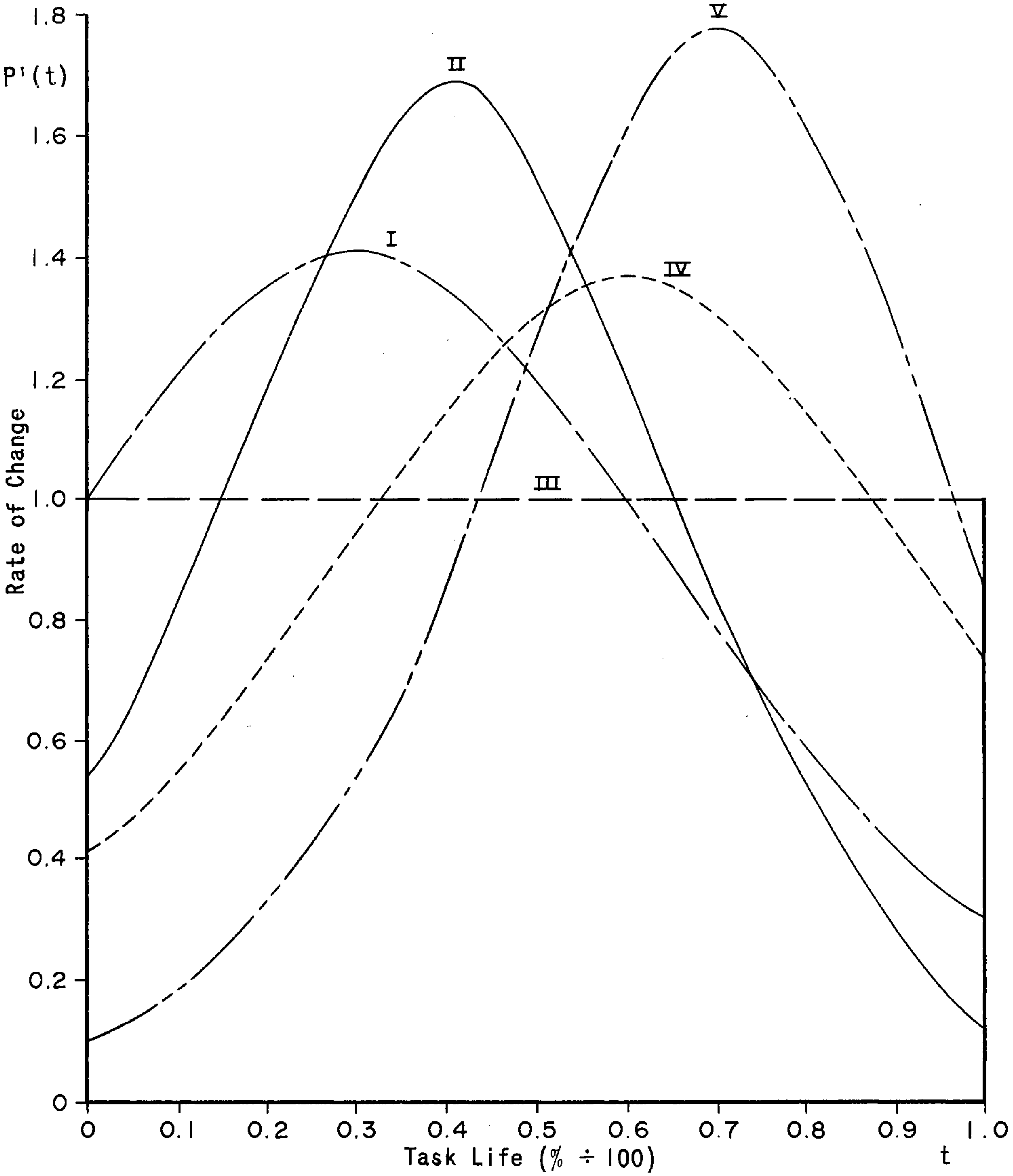

Figure 10. Derivatives of TOC Curves

The parameters for the five TOC curves are given in Table I.

TABLE I

PARAMETERS FOR FIVE TOC CURVES

TOC Curve	α	δ	k_1	k_2
I	2.0	0.2	1.2	4.0
II	3.0	0.1	2.4	6.0
III	0	0	0	0
IV	2.0	-0.1	2.4	4.0
V	3.0	-0.2	4.2	6.0

In summary, the TOC curves were selected to represent typical task progress behavior. The curves cover task from production to system design. A subsequent section gives the selection criteria in terms of typical tasks that each TOC curve best represents.

Resource Operating Characteristic Curves

For each TOC curve there is a ROC curve which conceptually describes the application of resources over the life of the task. This is analogous, also, to the growth of plant life in that each specie of plant has a different water and fertilizer consumption desideratum. Too much water and fertilizer will retard progress, just as too little will retard it.

If a task inherently starts slow, its progress cannot be efficiently enhanced by the addition of excessive resources. For example, a task that is difficult to set up or define, and can be set up by twelve men in twelve days cannot necessarily be accomplished by twenty four men in six days. The resource application to the work process of a task is, therefore, dependent on the nature of task and has some predetermined depletion behavior. Then for each TOC curve there is an associated ROC curve. The nomenclature used in this investigation to associate them will be the numbering procedure. For example, ROC curve I goes with TOC curve I, ROC curve II goes with TOC curve II, etc. As the TOC curve monotonically increases with time, the ROC curve monotonically decreases with time, such that all the conditions are satified that were described in this chapter under "Mathematical Basis."

The criteria and rules for selecting the ROC curves were

(1) The absolute relative rate of change with respect to time for resource depletion had to lead the relative rate of change with respect to time for progress.

(2) The lead requirement as set forth in (1) does not have to hold throughout the entire task life.

(3) The maximum rate of change for resources with respect to time must occur before the maximum rate of change for progress by 10 percent of task life.[5] Expressed symbolically,

$$0 \leq P'(t)_{max} - |R'(t)|_{max} \leq 0.10.$$

---

[5] The 10 percent lead is based on the same theory that was used to select a C* for the limits of deviation for the TP and RD models later in this Chapter. The shift for t_{max} was the application of Equation (16).

The essence of the rules is that even though a task starts slowly, it also starts inefficiently, but somewhere along the sequence of time the application of resources become more efficient as more is learned about the work process.

The relationship of the ROC and TOC curves was determined by comparing their derivatives. Since the ROC curve is dependent on the TOC curve, it was necessary to solve the derivative of each TOC curve on the IBM 7040 computer and plot the results. These results were then compared to the absolute value of the derivative of Equation (24), for varying parameters of α and δ. The model used was

$$|R'(t)| = \frac{(e^{k_2}+e^{k_1})\,(e^{k_1}-1)\,(k_2\,e^{k_2 t})}{e^{k_2}-1)\,(e^{k_2 t}+e^{k_1})^2} \qquad (31)$$

where $k_1 = \alpha(1-2\delta)$ and $k_2 = 2\alpha$.

The derivative of the TOC curves and the ROC curves were graphed as shown in Figures 33-37 of Appendix C-3, with the derivative TOC curves and the absolute derivative ROC curves superimposed to show their relationships in each set of parameters.

The parameters selected for the ROC curve are shown in Table II with the coordinate values and computational algorithm in Appendixes B-3 and B-4.

A composite graph of the five ROC curves is shown in Figure 11, and a composite graph of the absolute derivative of the ROC curves is shown in Figure 12.

TABLE II

PARAMETERS FOR FIVE ROC CURVES

ROC Curve	α	δ	k_1	k_2
I	1.5	0.3	0.6	3.0
II	2.5	0.2	1.5	5.0
III	0	0	0	0
IV	1.5	0	1.5	3.0
V	2.5	-0.1	3.0	5.0

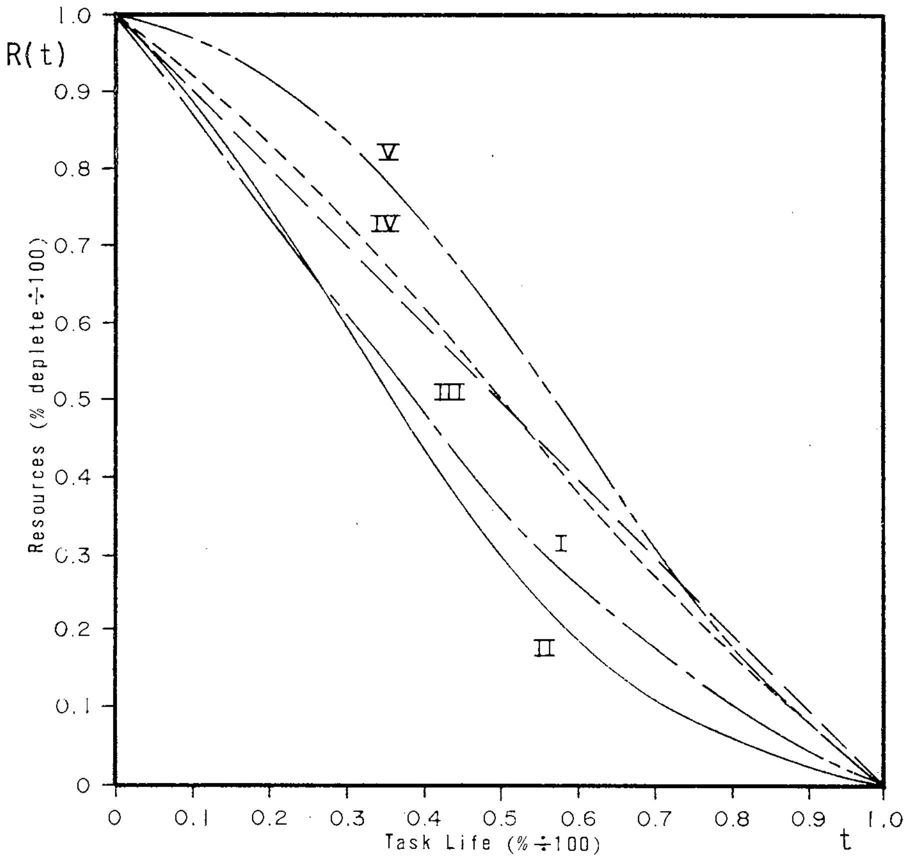

Figure II. Selected ROC Curves

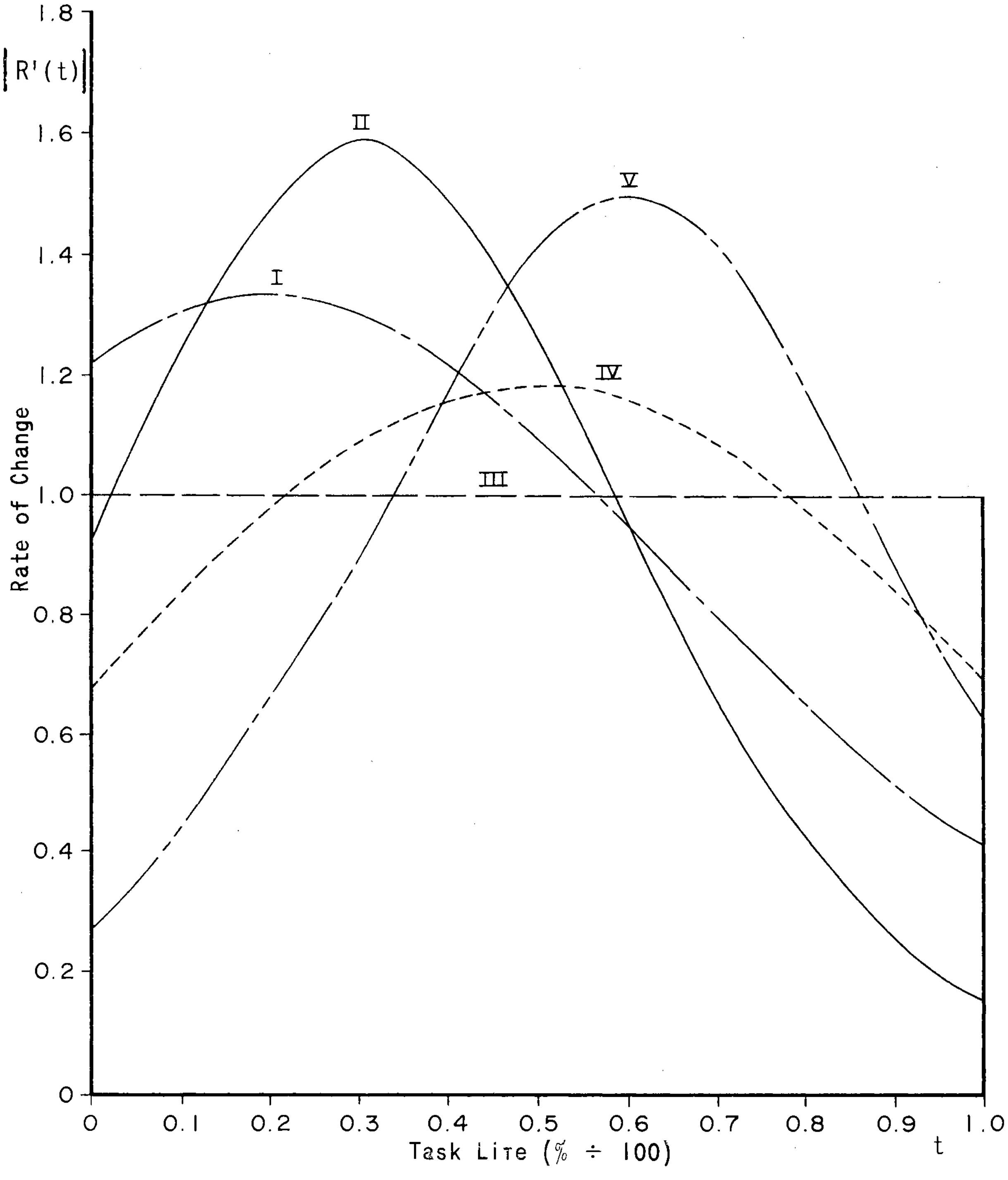

Figure 12. Absolute Derivatives of ROC Curves

By analytically looking at Equation (31), α is inversely proportional to δ in terms of curve orientation. For example, as α decreases and δ is held constant $|R'(t)|_{max}$ decreases, and as δ increases $|R'(t)|_{max}$ is shifted to the left. From Equation (16)

$$t \quad = t-\delta$$

and

$$t_{max} = 0.5-\delta \qquad (32)$$

The $|R'(t)|_{max}$ is at $0.5-\delta$, with δ being a chosen parameter for lateral translation.

The ROC curve is used in the computer algorithm to allocate resources by day or any chosen time increment. The resource allocation model is

$$\begin{aligned} RA &= \left[R(t) \,\middle|\, \Delta t \;)\right]R \\ &= \left[R(t_1 - t_2)\right]R \end{aligned} \qquad (33)$$

where R is the total resources and period t_1 to t_2 is the chosen allocation time period as illustrated in Chapter IV and Appendix D-4.

The ROC curve is the basis for resource allocation for chosen time increments. The allocation patterns for all the selected TOC curves are illustrated by the $|R'(t)|$ functions in Appendix C-3.

For TOC curve IV, the resource allocation for the time increment $\Delta t = t_2 - t_1$. as shown in Figure 13, is

$$R\int_{t_1}^{t_2} \left|R'(t)\right| dt = R \cdot R(t)\Big|_{t_2}^{t_1}$$

$$= R\left[R(t_1) - R(t_2)\right]$$

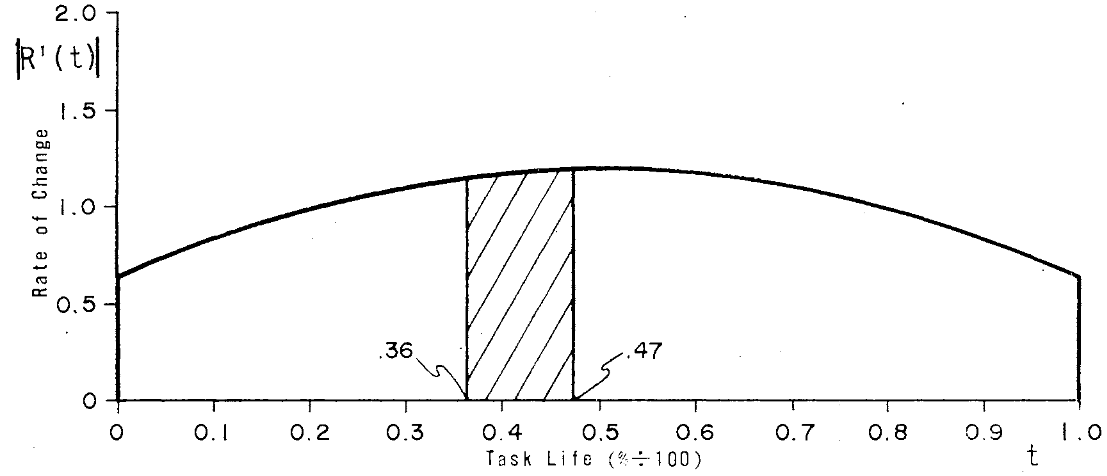

Figure 13. Resource Allocation Technique

From the computed values in Appendix B-4, let t_1 and t_2 equal 0.36 and 0.47, respectively, then

$$R\left[R(t_1)-R(t_2)\right] = R\left[0.66-0.54\right]$$

$$= 0.12R$$

where R = total resources allotted for the task.

Task Progress Model

It is not likely that actual task progress performance will be a smooth pattern as described by the TOC curves because of progress fluctuations. Then the values on the smooth TOC curve are the expected progress values for given values of time, or $P(t) = E\left[P(t)\right]$.

To objectively and independently measure task progress is, itself, a difficult task, as described in Chapter II. If it is measured against some predetermined plan, the measure then becomes a function of the plan. Thus, if the plan is wrong, the progress measure is likely to be wrong. The same problem arose when Malcolm and others (10) found it necessary to estimate time for activity completion within a PERT network. This investigation proposes to extend the utility of the model used in PERT to independently estimate task progress for the TP model. Hereafter, TP will be used to represent task progress.

The TP model includes the TOC curve, a TP curve, and a set of converging limits of deviation (LOD), as illustrated in Figure 14. The TP curve is a non-regressing function based on expected progress derived from three estimates of task status and the PERT model. The estimate of task status is determined by use of

$$E[P] = \frac{a+4m+b}{6} \tag{34}$$

where

$E[P]$ = Expected Progress
a = Pessimistic estimate
m = Most likely estimate
b = Optimistic estimate

These are illustrated in Figure 15. The estimates a and b are chosen such that

$$\int_{-\infty}^{a} f(P)\,dP \cong \int_{b}^{\infty} f(P)\,dP \cong 0.001$$

and

$$\int_{-\infty}^{m} f(P)\,dP \cong \int_{m}^{\infty} f(P)\,dP \cong 0.50$$

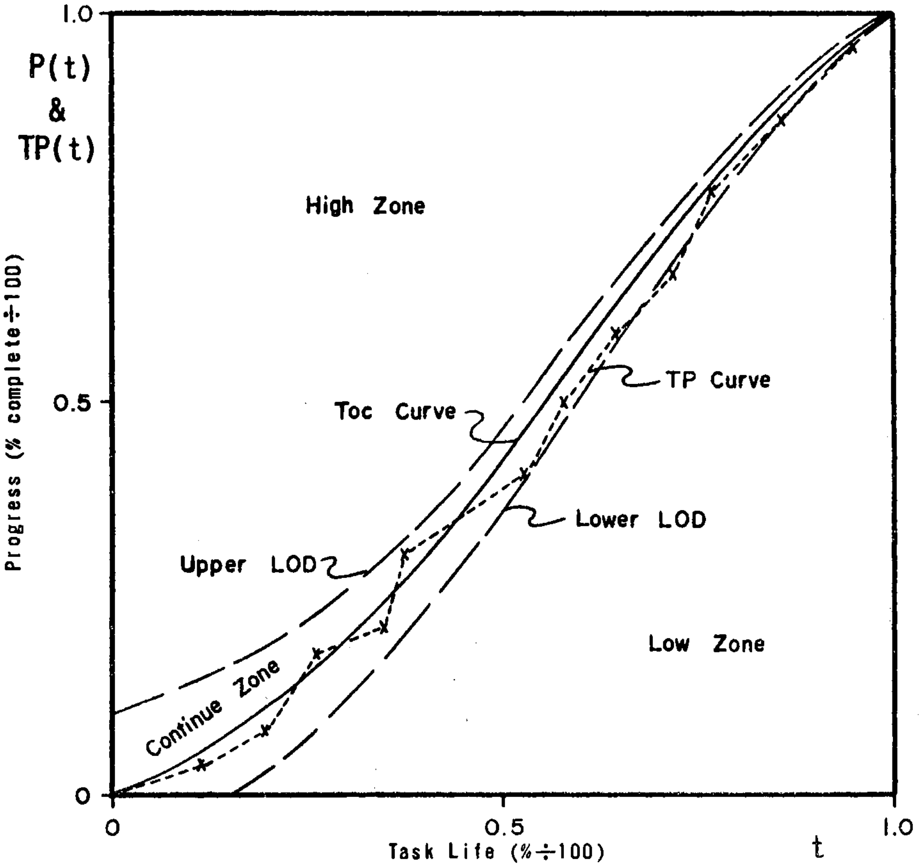

Figure 14. Task Progress Model

It is not necessary to identify the density function in Figure 15 since this information would be of no use in this investigation. For possible further applications, a Beta distribution has been assumed to be a logical fit for defining the variance (10).

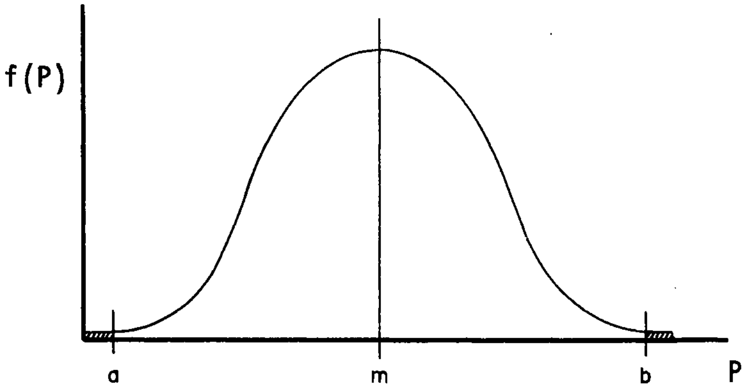

Figure 15. Distribution of Progress Estimates

The limits of deviation are analogous to control limits for a statistical quality control chart in utility only. The limits are a function of C^*, based on the work of Baumgartner's status index and on empirical investigations by this author. Baumgartner's effectiveness curve for "good planning" asymptotically approaches a predetermined status index function, plus or minus performance variance. This author's empirical experimentation has indicated that as knowledge of a task increases, planning effectiveness increases asymptotically to a minimum effectiveness of approximately 10 percent, as illustrated in Figure 16.

For example, if a job of considerable length were almost complete and if an estimate of 60 minutes to complete were made, the actual completion could vary between 54 and 66 minutes. In praxis, closer restrictions seem unrealistic, and at the same time, more latitude is unrealistic. The limits of deviation are a function of time left for completion such that the

$$\text{Upper LOD} = E[P(t)] + C^*(1-t)$$

and the (35)

$$\text{Lower LOD} = E[P(t)] - C^*(1-t)$$

where $C^* = 0.10$ and $(1-t)$ is the time remaining. The decision-maker in praxis would find a C^* that would best fit his environment for variations of desired scrutiny. Table III gives the limit of deviations for the selected TOC curves. The limits of deviation are derived, when needed, with the computer algorithm on each run date, as described in Chapter IV and presented in Appendix D-3.

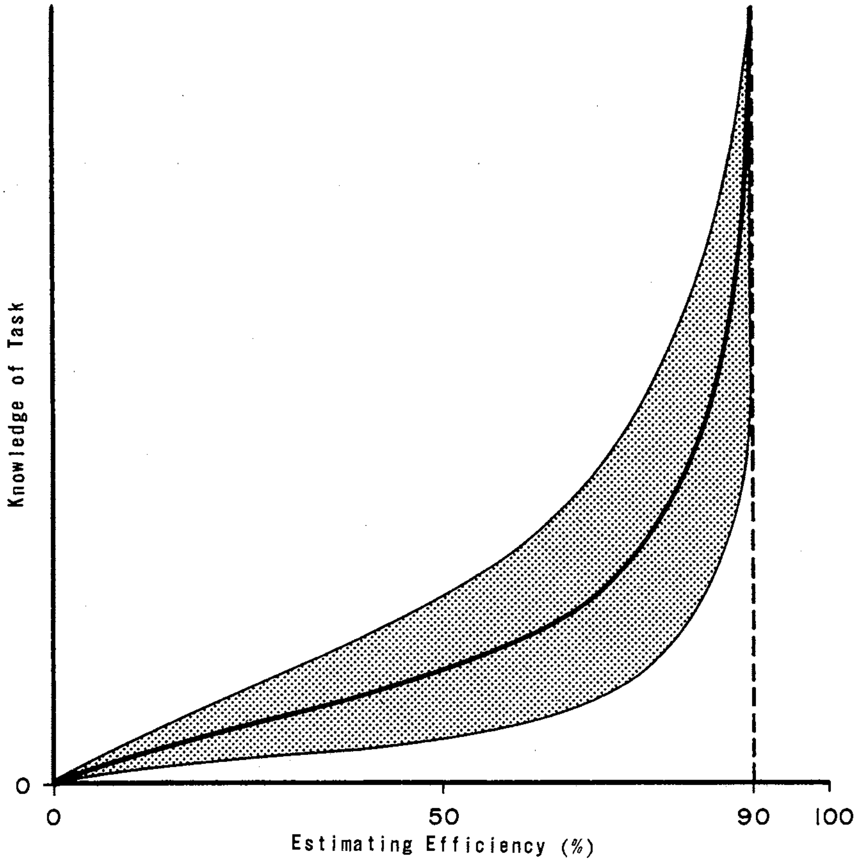

Figure 16. Estimating Efficiency Concept

TABLE III

TOC CURVE LIMITS OF DEVIATION

	TOC CURVES									
t	I		II		III		IV		V	
	ULOD	LLOD	ULOD	LLOD	ULOD	LLOD	ULOD	LLOD	ULOD	LLOD
0	0.10	0	0.10	0	0.10	0	0.10	0	0.10	0
0.1	0.20	0.02	0.16	0	0.19	0	0.14	0	0.10	0
0.2	0.32	0.16	0.25	0.09	0.28	0.12	0.19	0.03	0.12	0
0.3	0.45	0.31	0.37	0.23	0.37	0.23	0.27	0.13	0.15	0.01
0.4	0.58	0.46	0.53	0.41	0.46	0.34	0.36	0.24	0.21	0.09
0.5	0.69	0.59	0.68	0.58	0.55	0.45	0.47	0.37	0.31	0.21
0.6	0.80	0.72	0.81	0.73	0.64	0.56	0.60	0.52	0.44	0.36
0.7	0.87	0.81	0.90	0.84	0.73	0.67	0.72	0.66	0.61	0.55
0.8	0.93	0.89	0.96	0.92	0.82	0.78	0.83	0.79	0.77	0.73
0.9	0.97	0.95	0.99	0.97	0.91	0.89	0.93	0.91	0.90	0.88
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Resource Depletion Model

As was the case for task progress, actual resource depletion will be variable and $R(t) = E[R(t)]$. The RD model consists of a ROC curve, a RD curve, and a set of converging limits of deviation as illustrated in Figure 17. The RD curve represents unexpended resources at chosen discrete time increments; it is a graph of the actual unexpended resources.

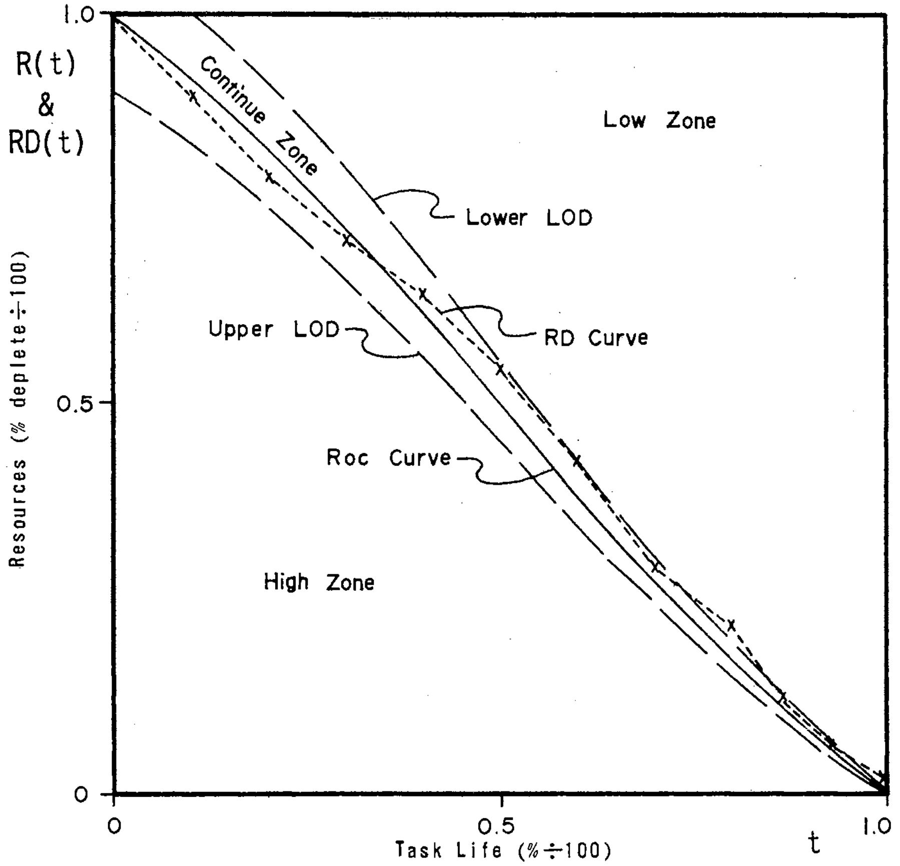

Figure 17. Resource Depletion Model

The converging limits of deviation for sequential scrutiny of resource depletion, as in the case of the TP model, are based on the premise that, at the beginning of a task, resources can be over or under expended up to approximately 10 percent without necessarily jeopardizing a target delivery date.

The limits of deviation are derived as the

$$\text{Upper LOD} = E[R(t)] - C^*(1-t)$$

and the

$$\text{Lower LOD} = E[R(t)] + C^*(1-t)$$

where $C^* = 0.10$ and $(1-t)$ is the time remaining.

Reference Table IV for limits of deviation for all selected ROC curves.

TABLE IV

ROC CURVE LIMITS OF DEVIATION

	ROC CURVES									
t	I		II		III		IV		V	
	ULOD	LLOD	ULOD	LLOD	ULOD	LLOD	ULOD	LLOD	ULOD	LLOD
0	0.90	1.00	0.90	1.00	0.90	1.00	0.90	1.00	0.90	1.00
0.1	0.78	0.96	0.80	0.98	0.89	0.99	0.83	1.00	0.88	1.00
0.2	0.66	0.82	0.67	0.83	0.72	0.88	0.75	0.91	0.83	0.99
0.3	0.54	0.68	0.53	0.67	0.63	0.77	0.66	0.80	0.77	0.91
0.4	0.42	0.54	0.38	0.50	0.54	0.66	0.56	0.68	0.67	0.79
0.5	0.32	0.42	0.25	0.35	0.45	0.55	0.45	0.55	0.55	0.65
0.6	0.22	0.30	0.15	0.23	0.36	0.44	0.34	0.42	0.42	0.50
0.7	0.15	0.21	0.08	0.14	0.27	0.33	0.24	0.30	0.28	0.34
0.8	0.08	0.12	0.04	0.08	0.18	0.22	0.15	0.19	0.16	0.20
0.9	0.04	0.06	0.01	0.03	0.09	0.11	0.07	0.09	0.07	0.09
1.0	0	0	0	0	0	0	0	0	0	0

The computer algorithm derives the limits of deviation for the RD model as it does for the TP model. These results are presented in Appendix D-3. Unlike the TP curve, the RD curve is empirical. It is the day-to-day accumulation of the depleted resouces. The RD curve is the "backbone" of the control procedure; it gives the signals for the decision-maker to proceed in the examination process.

Summary of Selection Criteria for TOC Curves

To summarize the TOC curve selection criteria and procedure, it is necessary to define the general types of tasks that are defined by the predicted characteristics of each TOC curve. (Reference Appendixes B and C for the following discussions.)

(1) TOC curve I. The type of tasks that would follow this pattern are those with relatively little or no set-up time and with considerable similar experience in the intermittent system. More specifically, this would be well defined drafting, general purpose machining, documentation, and other similar tasks. The tasks would be those where the progress could be somewhat enhanced by the application of additional resources such as typing or final documentation when maximum progress was desirable early to meet a critical delivery. For example, the addition of typists could increase the progress to a point of diminishing return and give the manager early indication of a timely delivery. From Appendix B, when 60 percent of the allowable time elapsed, 76 percent of the task would be completed with 74 percent of the resources depleted; this gives the often desired latitude for commitments on early deliveries. Over-use of this TOC curve would result in inefficient use of resources, and in praxis it would be the least used.

(2) TOC curve II. This curve or predicted performance pattern would fit tasks that initially have a slow start but pick up momentum

rapidly. An example would be the reproduction and folding of schematics. The machine would have to be primed and checked for fluid. After the short set-up time, the prints could be reproduced rapidly, but the relative productivity would reduce during the folding and filing sequence. Another typical example would be machining a small precision item from bar-stock steel on a lathe. The initial reduction would be rapid but the precision process would take longer to perfect. For these kinds of tasks, the decision-maker could tend to overload the initial resources by discounting the relatively simple set-up required. Referring to Appendix B, when 20 percent of the time has elapsed only 17 percent of the task is complete and with 25 percent of the resources depleted. Yet, when 50 percent of the time elapsed, 63 percent of the task would be complete with 70 percent of the resources depleted. This indicates a better utilization of resources as the task progresses up to a point.

(3) TOC curve III. This curve would be used for simple tasks with considerable similar experience and usually those tasks of long duration in the range of three months or more. Both the predicted task progress and resource depletion are a constant level throughout task life. This means that a task with a 100 day delivery requiring 100,000 manhours and $10,000 material would progress at the rate of one percent per day, using 1,000 manhours per day and $100 of material per day. If the desired manhour level were not available, the TP and RD models would develop trends to this effect and another TOC curve selection would be necessary. TOC curve III would be the most frequently used of all the TOC curves since it would be the most favorable initial selection when

tasks become difficult to define exactly. The decision-maker would tend to rely on the empirical trends developed by the RD and TP curves as a guide for the correct TOC curve.

(4) TOC curve IV. This curve would represent the performance of pragmatic operations research studies where similar state-of-the-art experience had been acquired. It could also represent systems development, systems design, etc. when phases were quasi research or difficult to define. The experienced decision-maker would recognize this slow beginning without great concern since once this period was past, relative progress would increase rapidly. For example, from Appendix B, when 20 percent of the time elapsed, 11 percent of the task would be complete with 17 percent of the resources depleted; yet when 73 percent of time elapsed, 73 percent of the task would be complete with 76 percent of the resources depleted. This curve would have special utility for industrial engineering and operations research tasks in the aerospace industry.

(5) TOC curve V. This curve would represent tasks with greatest complexity in set-up and definition, such as development where the current-state-of-knowledge had to be acquired. It would represent applied research tasks when the recruitment of special skills was part of the plan. Such tasks have an unusually slow beginning. For example, when 10 percent of the time elapsed, one percent of the task would be completed with three percent of the resources depleted. After this slow period, relative progress would increase to a maximum late in the task cycle. For example, when 80 percent of the time elapsed, 75 percent of the task would be complete with 82 percent of the resources depleted.

The five TOC curves encompass the general types of tasks; however, extreme types of tasks are not included. Extreme cases exist just as they exist in the growth of plant life. There are exceptions for accelerating task progress through special applications of automation and computers just as plant growth can be accelerated through the use of hydroponics. For the purpose of this investigation, it was assumed that the task plan is developed in an environment which defines these parameters in praxis. The algorithm developed in this dissertation is not limited to work environment; it is necessary, however, for the decision-maker to know the environment for TOC curve selection. If automation and computer applications were in the realm of his tools, these considerations would be a factor in the planned task progress pattern.

Optimal Path Model

Since it is not desirable and, in most cases, not feasible to induce a ramp input into the TP and RD curves to program the variations back to the TOC and ROC curves, an optimal path model is developed.[6]

There are 13 exception states depicted by the composite algorithm developed in Chapter IV. Concluding decision rules are presented in Chapter V for each state. These decision rules are, in part, based on the optimal path model. If task progress were exactly on the lower limits of deviation and if resource depletion were exactly R(t) for a given

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[6] Optimal describes the most favorable extension of the TP and RD curves for meeting the planned objectives of the TOC and ROC curves.

t, then the signal would be to increase the progress rate by 10 percent over the remaining life of the task without increasing the resource application rate. Such an increase would guarantee that the task would be 100 percent complete on the delivery date with all the resources depleted.

Also if resource depletion were on the upper limits of deviation and if task progress were also on the upper limits of deviation, then both task progress and resource allocation should be decreased by 10 percent per day for the remaining life of the task. Less than 10 percent per day, for either or both, would result in either an early delivery or an overexpenditure of resources before delivery. The first condition is not detrimental, but it is also not optimal since the finished product has to be maintained in inventory until delivery.

The decision-maker, by comparing the TP model with the RD model, can perform selectivity analysis for TOC curve changes or sensitivity analysis for resource trade-offs. As an example of selectivity analysis, if wrong TOC curves were selected, the TP and RD models would develop trend toward an undesirable or exception condition. In sensitivity, the decision-maker could manipulate the resource allocation and test the expected effect that the manipulation would have on task progress.

The significant feature of the converging limits of deviation are exception guidance that they give the decision-maker in terms of reprogramming, progress strategy, and resource allocation or whichever one is affected. It is a unique control algorithm for "management by exception." The "management by exception rules" are initiated with the RD model since the decision-maker first examines the resource status. If the RD curve shows a point outside the limits of deviation, he inspects the progress status for compatibility. If the RD curve is within the continue zone, he inspects the TP curve, but is only concerned with progress status. If the progress status is outside the limits of deviation, he then looks back to the RD model for possible trade-offs among the allowable resources.

When the RD curve is, at any time, on one of the limits of deviation, the decision-maker knows immediately that the resource expenditure must be increased or decreased by 10 percent (since $C^{*} = 0.10$) to deplete all resources on the specific delivery date. If the RD curve is outside the limits of deviation, a procedure for the optimal utilization of resources can readily be obtained by this deviation percent. For example, if a point on the RD curve were 0.54 when $E[R(t \mid t_0=0.41)] = 0.61$ for ROC curve IV, and the upper limits of deviation = 0.55, the optimal path is a constant decrease of 11.9 percent during the remainer of the task life. Figure 18 illustrates the foregoing example for TOC curve IV. When exceptions occur, there is an optimal procedure for the decision-maker to deploy. Any reduction in depletion rate greater than 11.9 percent is unnecessary since the derived percentage meets the criteria of not over-expending resources. The decision rule covering the state of the system at this point is covered in Chapter V. Assuming the decision-maker chooses to continue with the selected TOC and ROC curves, he must decrease the resource depletion rate by 11.9

percent so that the resources will not be completely expended prior to the task delivery date.

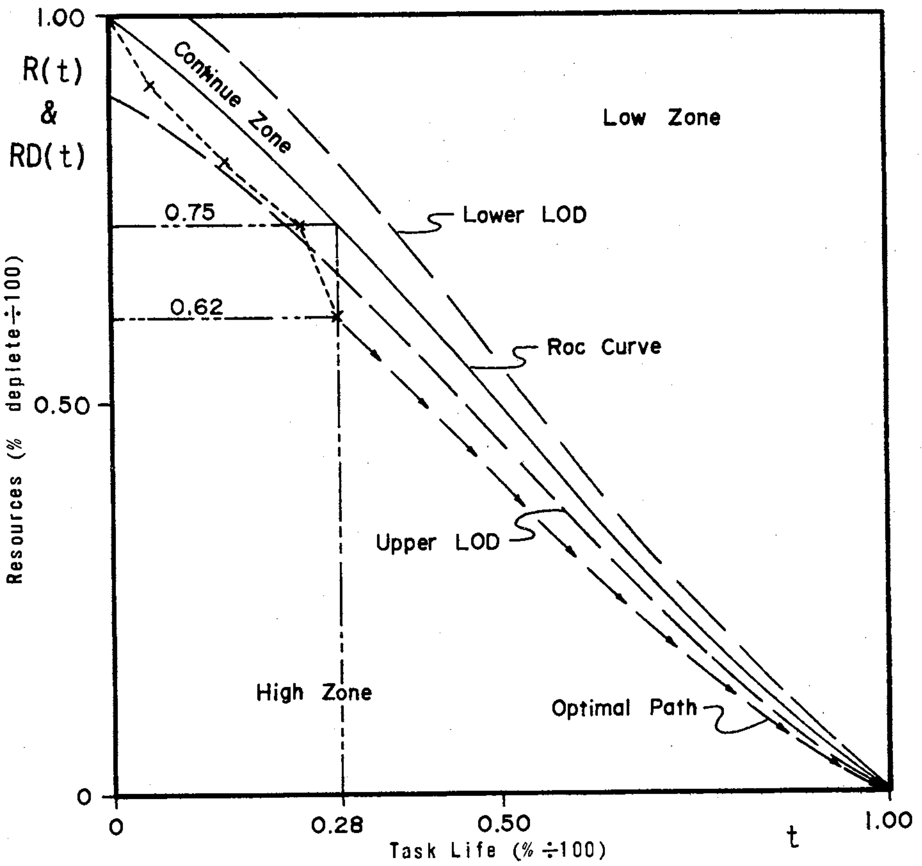

Figure 18. Actual RD in "High Zone"

The prognostic utility of the RD model lies in its ability to indicate potential over-runs in resources before such over-runs become detrimental to the task delivery; at the same time, coupled with the TP model it serves as an analysis and prediction tool for progress slippage. The features are realized by scrutinizing the sequential behavior of both the TP and RD curve trends.

The logic of the optimal path model is the same for both the TP and RD models except for sign convention. To establish this difference, the mathematics are developed for the optimal path model separately. Consider first the TP model as shown in Figure 19.

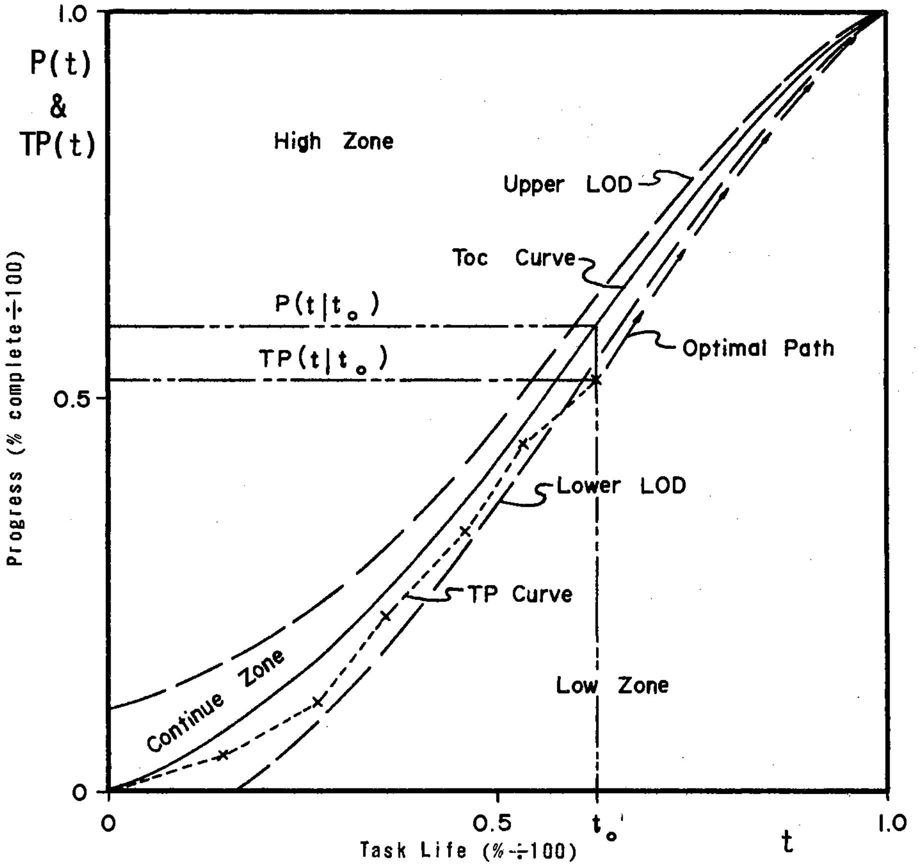

Figure 19. Optimal Path Model for TP Curve

Now let

$$S_P = \frac{\left[P(t)|t_0) - TP(t|t_0)\right]}{(1-t_0)} \qquad (37)$$

Where the strategy S_P is the progress increase rate in percent for the remainder of task life. When $S_P > 0$, the strategy is to increase the progress rate, and when $S_P < 0$, the strategy is to decrease the progress rate.

Using the same logic, consider Figure 20 for the RD model.

Now let

$$S_R = \frac{\left[R(t|t_0) - RD(t|t_0)\right]}{(1-t_0)} \qquad (38)$$

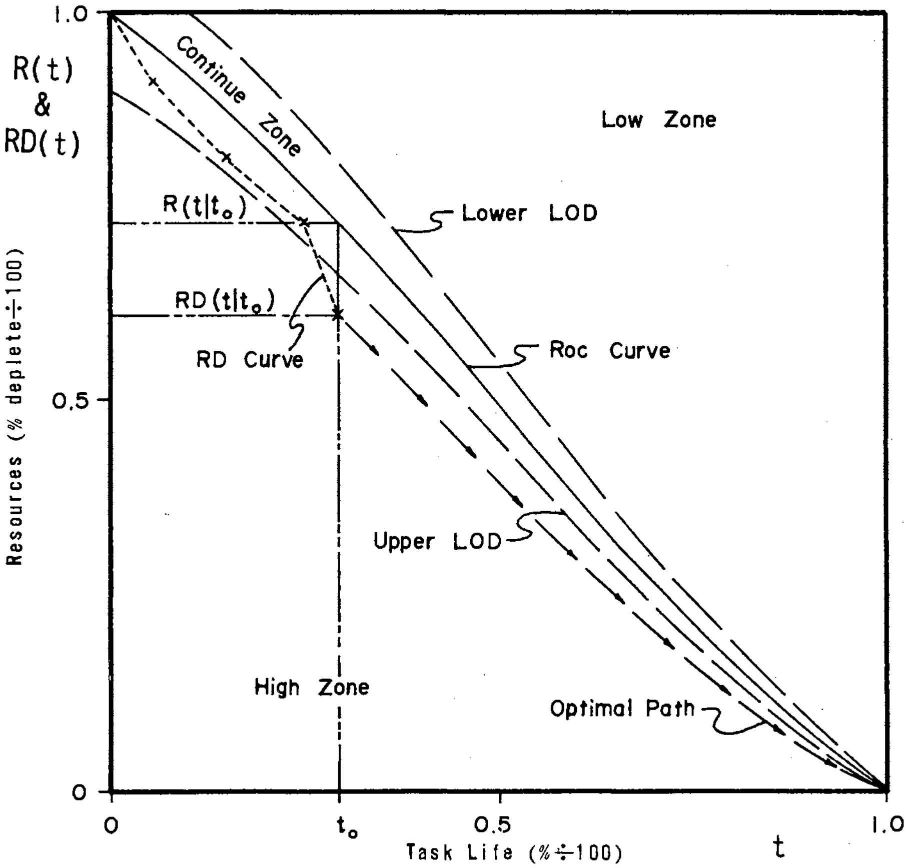

Figure 20. Optimal Path Model for RD Curve

where $S_R > 0$, the strategy is to decrease the depletion rate, and when $S_R < 0$, the strategy is to increase the depletion rate.

A complete summary with decision rules for other states of the system is presented in Chapter V. The computerized allocation and control algorithm presented in Chapter IV uses the models presented in this Chapter.

CHAPTER IV

THE COMPOSITE ALGORITHM

The composite algorithm is a system of computer runs, which develops TOC curve and ROC curve tables from externally defined parameters, assimilates task data, analyzes task data with respect to TOC and ROC curves, and allocates resources in the intermittent system under real and simulated conditions.

Basis of Algorithm

The composite algorithm is assigned no control over the intermittent system; rather, it is designed for use as a tool for control by the decision-maker. The algorithm is based on the assumption that anything can happen to the intermittent system; it can and will be overloaded, underloaded or loaded unevenly, overstaffed or understaffed, or generally mismanaged. The function of the computer algorithm is to accept any set of circumstances and events and analyze their present and future effect on the intermittent system in terms of load, capacity, and time. The analyses are designed as guides for optimum allocation and control of resources.

Basically, the composite algorithm accepts as inputs the intermittent system characteristics, load, and capacity as defined by the decision-maker. This input may be real, simulated, or a combination of both. The outputs of the algorithm are, generally, the status of each task in the service facility, the status of each task in the queue, the status of resources, the resultant load on the service facility, and the resultant load on the intermittent system as a whole (i.e., service facility plus queue and queue overload, if any).

The definitive control of the intermittent system within the composite algorithm rests with the decision-maker rather than with the computer algorithm itself. Thus, the decision-maker has the capability of facile study of effects on the intermittent system by varying the elements of the intermittent system load. Singly or in combination, any of the following can be varied with the remaining elements held constant: load mix (i.e., tasks, resources per task, task delivery dates), task position (in queue or service facility), and intermittent system capacity.

Computational Algorithm

The nucleus of the composite algorithm is contained in computer run (CR) 5, and it is this run toward which all others are directed. Here, the algorithm is in four phases, the first two of which are reiterated to perform the last two. Referring to Figure 21, the first phase reads a task record (1) from master magnetic tape, analyzes the task record, and prints a line with exception messages for that task (2), accumulates data for use in Phase II (3), and repeats this procedure until each master in the facility has been analyzed (4). It then goes on

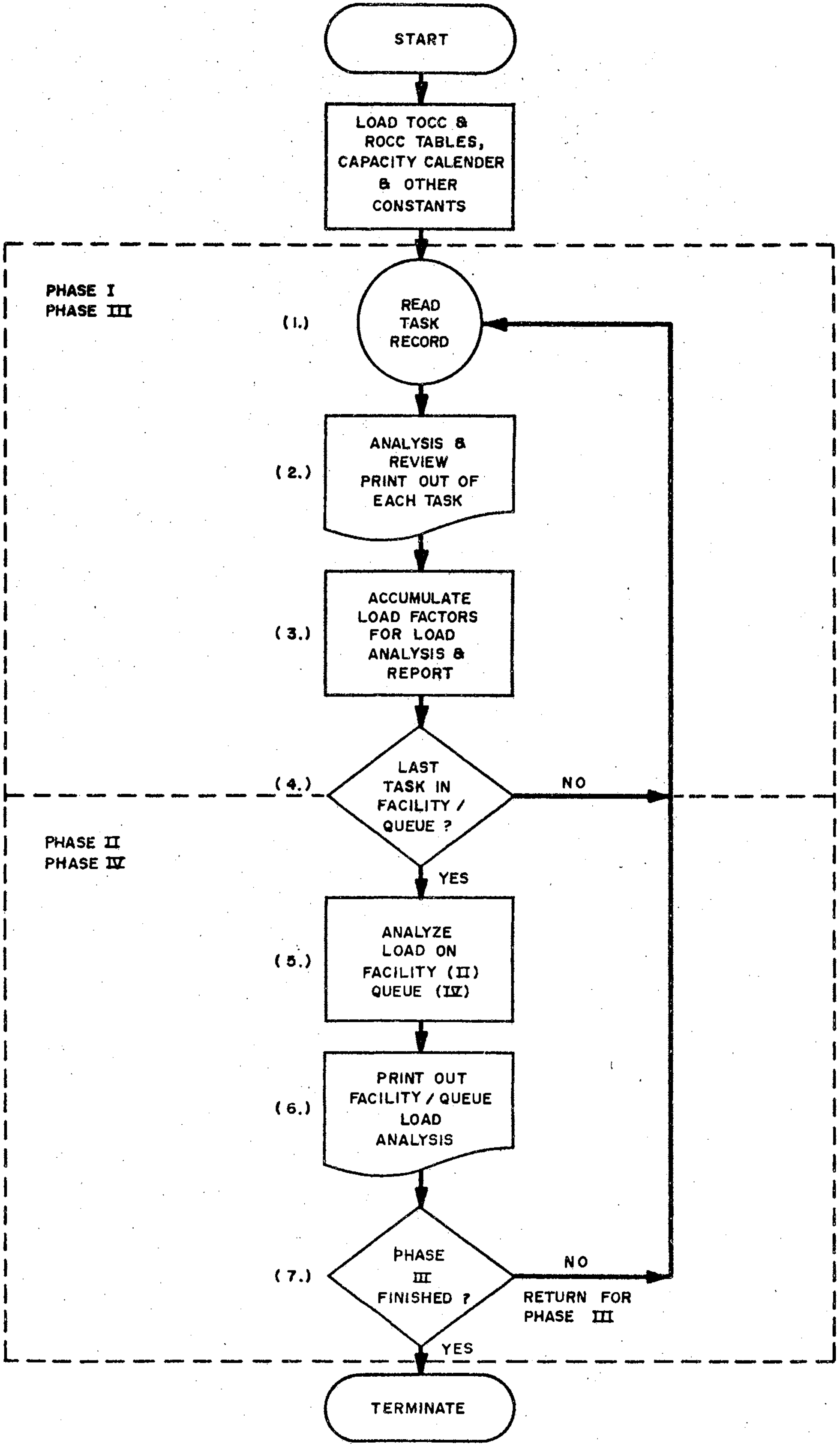

Figure 21. General Flow Chart For CR 5

to Phase II, analyses of the facility load data accumulated in Phase I (5). At the completion of the printing of the facility load analysis (6), the program reiterates Phase I as Phase III (1), which is the analysis and review of each task in the queue. Records continue to be read from tape (1), analyzed (2) and data accumulated (3); however, this time the records are those of the tasks in the queue. When the last record is processed in Phase III, the program continues to Phase IV. First, the data accumulated from Phases I and III are analyzed (5), then the analysis printed out (6), and the decision made to terminate the program (7).

A more comprehensive flow chart of the computational scheme may be found in Appendix D.

The basic input of CR 5 contains:

(1) Date input card.

(a) Run-Julian date.

(b) Run-day number.

(2) Capacity calendar.

(a) Array of Julian dates for days = 1, 2, 3, ... , n.

(b) Corresponding day numbers.

(c) Corresponding system capacity for time increments in days.

(3) ROC curve and TOC curve tableaux.

(a) ROC curve percentages of resources remaining corresponding to each percent increment in time.

(b) TOC curve percentages of task completion corresponding to each percent increment in time.

(4) Task master file.

  (a) Task numeric identification.
  (b) Task alphanumeric nomenclature.
  (c) Resources available at time zero (t_o).
  (d) Resources at time t_o+x.
  (e) Task start date.
  (f) Task deadline or delivery date.
  (g) TOC curve identification.
  (h) ROC curve identification.
  (i) Task progress data (a, m, and b).
  (j) Position in the intermittent system.
  (k) Priority numeric identification.

The capacity calendar, the ROC tableau, and the TOC tableau are first loaded into computer memory where they will be held for random search during the computer multiphase operation. The task master file is in sequence by position in system, (facility first, queue last), priority in system, and task numeric identification (task numeric identification is assigned by the decision-maker which affords subpriority assignment flexibility). The decision-maker has the option, on any execution of CR 5, to insert artifacts into the task master file to actuate the total intermittent system for analysis of effects by simulation. With this simulation capability, any element of a current task may be changed. If desired, simulated task master records are read into another input unit in a sequence analogous to the real task record file. These simulated tasks are matched and merged with the real tasks. Wherever a synonomous condition occurs, the simulated task is processed in lieu of the real task. A non-synonomous condition between simulated and real task records causes the simulated task record to be processed in its sequential position.

All task master records are processed nondiscriminantly. Hence, in the remainder of this chapter, a reference to a task master record may be considered to be to either a real or a simulated task record.

Each task master record has been assigned a start date and a delivery date. As each task master record is read into the computer memory, the dates are converted to a numerical value by random search of the capacity calendar already in the memory. This numerical value corresponds to the working day sequence of that particular date within a range of dates assigned to the calendar by the decision-maker. Thus, if there were to be no weekend work and the calendar range began in February 2, 1964, the first portion of the internal calendar would appear in the computer memory as illustrated by Table V.

The difference between the deadline-day number and the start-time-day number is then computed and is used as the number of working days allotted for task completion. The remainder after subtraction of the start day number from the CR day number, if positive, is the number of days depleted. Number of days depleted divided by days allotted, times one hundred yields the percent of days depleted. The percent time depleted is the calculated abscissa value used as the key to random search routine of the TOC and ROC tableaux. The random search is performed to find the corresponding ordinate values in the memory tableaux; these values are then stored for further utility.

TABLE V

CAPACITY CALENDAR TABLEAU

Week Day	Date	Day No.	Capacity
Mon.	640302	001	XXX
Tue.	640303	002	XXX
Wed.	640304	003	XXX
Thu.	640305	004	XXX
Fri.	640306	005	XXX
Sat.	640307	005	000
Sun.	640308	005	000
Mon.	640309	006	XXX
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
etc.	etc.	etc.	etc.

The decision-maker's estimates have been placed on the record from CR 4. An internal computation of the expected task progress is accomplished by Equation (34). Refer to page 43 for a mathematical and graphical explanation of the task progress model.

The allowable tolerance of the ROC curve at the calculated abscissa is computed by the procedure described in Chapter III. The tolerance values are then added to and subtracted from the ROC curve value for the upper and lower limits of deviation. If an upper limit of deviation is found by the computer to have a value greater than one hundred percent, this value is replaced by one hundred. If a lower limit of deviation is less than zero, its value is replaced by zero. The percentage of resource depletion is then compared to determine if it falls within the continue zone for the given time. If resources remaining are greater than the allowable limits, the message RD LO is set up to print out along the other line data, which means that too many resources are remaining according to the ROC curve plan. Such a message would indicate to the decision-maker that a check on task progress should be made to see if the TP curve is in the low zone. If resources remaining fall below the lower limit of deviation, then the computer prepares to print the message RD HI which means that too few resources are remaining. Such a message would also direct the decision-maker to check status of the task progress.

The allowable deviation values are added to and subtracted from the TOC curve value for upper and lower limits of deviation, respectively. The upper limit of deviation is compared to one hundred percent, and if higher, the value one hundred is substituted. The lower limit of deviation is compared to zero, and if lower, zero is substituted.

The expected progress is checked against the upper and lower limits of deviation within the computer. If the expected progress is in the high zone, the message EP HI is set up to print. If the expected progress falls in the low zone, the message EP LO is prepared for print.

In cases where there is no violation of the limits of deviation in TOC and ROC curves, there are no additional messages printed out. This concept of exception messages is followed throughout the program.

Resources depleted are compared to resources allotted for each task and if greater, the message OVERX is prepared to print.

The computer program compares the start date to the CR date, and in all cases, where it is low (start date past) and the task is in the queue position , the message LATES is readied to print.

All task records, whether in facility or in queue, have their deadline date compared to the CR date to ascertain if the deadline is past. If the deadline has past, the message LATED is prepared for print.

All priority tasks have printed the exception message PRIOR . After all of the above computations and checks have been performed, the computer prints a data line for the last task record processed and all the exception messages prepared for the corresponding task.

After the line is printed for the task, the computer then analyzes the task in terms of load per day. To accomplish this, an internal tableau skeleton is retained in storage which was entered on initiation of the computer algorithm operation. Within this tableau, an accumulator represents day increments of time specified by the decision-maker via the capacity calendar. It is not practicable for the computer to predict the ramifications of exceptions found in the foregoing described functions. Therefore, each task is presumed to have a normal theoretical effect on the intermittent system load, based on the TOC and ROC curves. All exceptions will be accounted for by redefinition of the tasks and capacities within the simulation option by the decision-makers as described later in this chapter. On this basis, the computer program takes the remaining resources (resources allotted minus theoretical resources depleted) and distributes these resources to the applicable load accumulators for each day. This is done by taking the slope of the ROC curve at each day not yet reached and adding the product of that slope and the mean resource depletion to the task into the corresponding day-load accumulator. This procedure is repeated for each task within the facility. Upon encountering the task record for the first task in the queue, the computer ceases printing task data lines This ends Phase I, and embarks on printing the filled-out skeleton tableau for the tasks in the facility, which begins Phase II. A line is printed for each day, indicating that day's load in terms of resources, the system capacity (from the internal capacity calendar), and any difference in terms of excess capacity or overload in resources. Upon completion of this print-out, the data in the tableau is retained and the computer reverts to analyzing and printing data lines for each task; however, this time the tasks are those in the queue, and the day-load tableau contains The day-allocations for each task in the facility, as illustrated by Phase III, in Figure 21, page 62. When the last task in the queue is found, analyzed and printed, the computer enters Phase IV and prints out the intermittent system allocation by day. This analysis is similar in logic and format to the load analysis of Phase II, except that the load of the facility, queue, and queue overload, if any, are analyzed rather than only the facility load. After this output is accomplished, the simulation is terminated.

Procedural System

The procedure of the composite algorithm follows the concept that decision-makers are capable of, and best qualified for, predicting the behavior of progress and resource depletion. The computer can serve the decision-maker as a central data compilation and dispersal point to complement and supplement his experience and knowledge for allocation and control of resources.

The first step into the computer algorithm (see Figure 22a) was the definition by management of the general range of TOC and ROC curves that are to be considered as potential curves to represent operating characteristics of tasks to be serviced by the particular intermittent system. With the parameters for the general area of examination defined, a program was written in FORTRAN IV language to make a cursory examination of this wide range of curves. The program was written in such a manner that a plot of the general characteristics of each curve could be obtained for 10 percent increments of time in order to facilitate subsequent analysis by management.

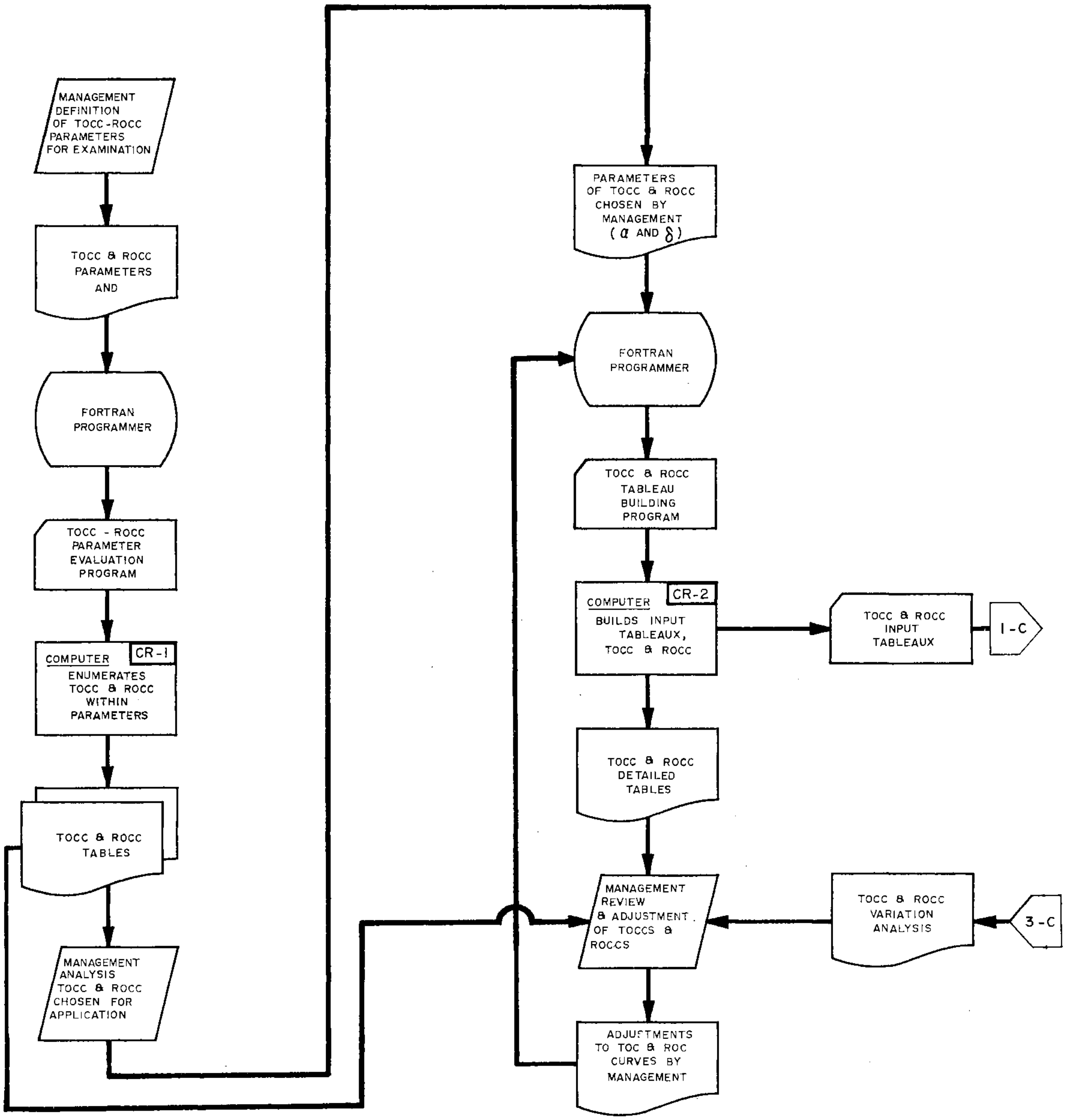

Figure 22a. Composite Algorithm Flow Chart

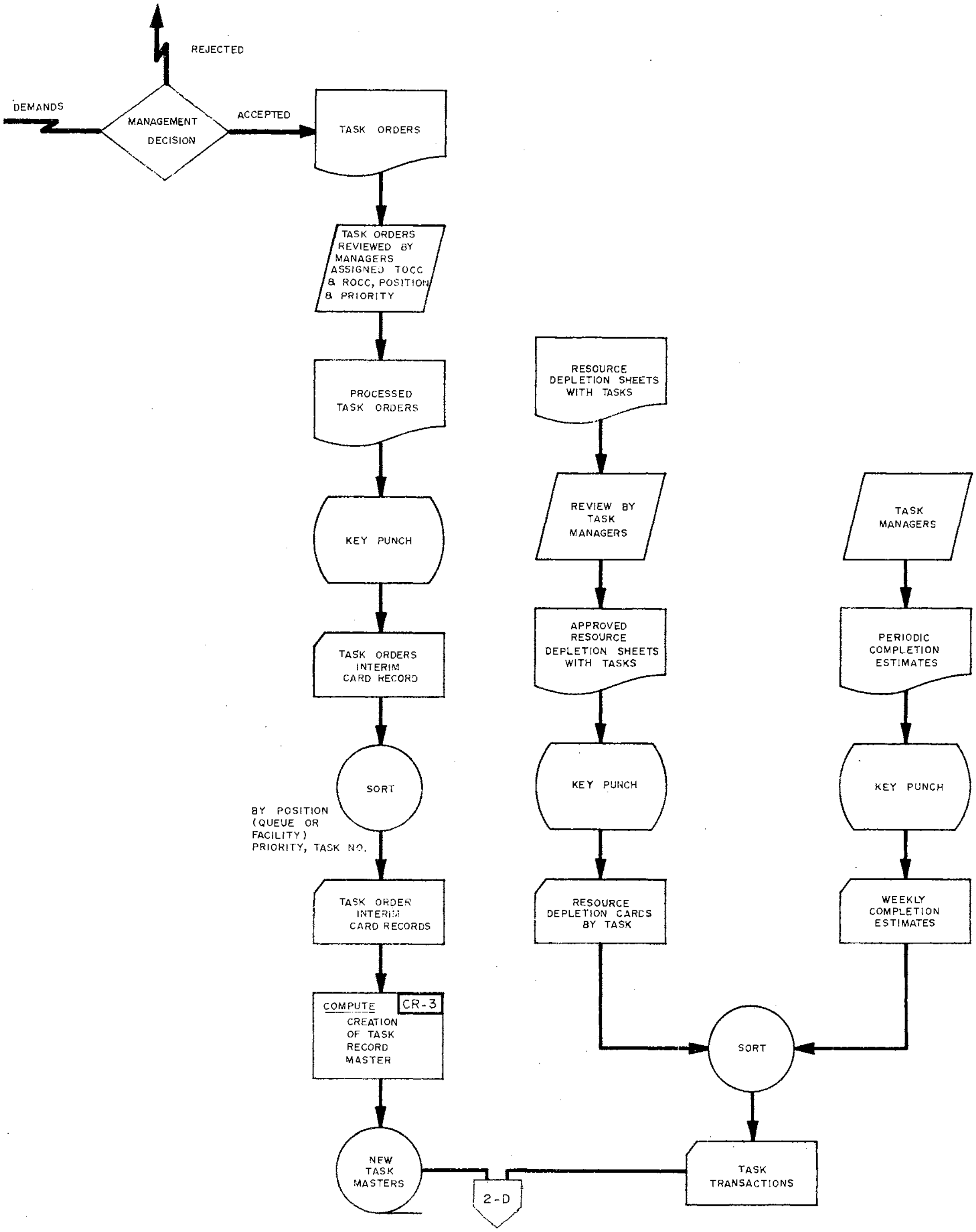

Figure 22b. Composite Algorithm Flow Chart

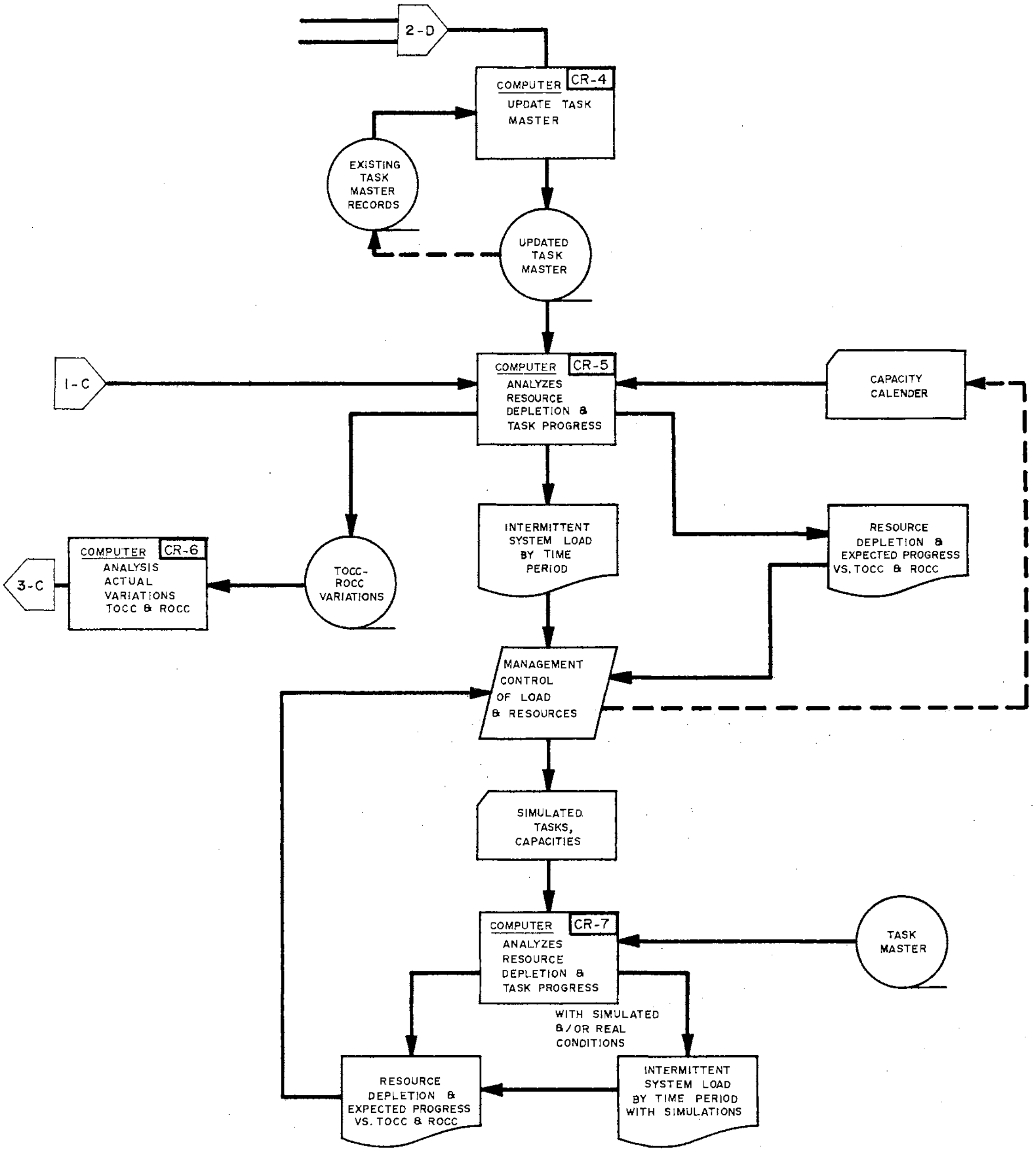

Figure 22c. Composite Algorithm Flow Chart

The tables produced by the preceding program are then perused by decision-makers to find a set of operating curves that fit the characteristics of their work, based on experience and knowledge, as discussed in Chapter II. These tables are also held in abeyance for later referral in analysis of the task behavior in conjunction with the family of curves selected.

The particular curves that the decision-maker selects for possible task operating characteristics within his specific system are redefined for calculation of detailed and precise tableaux of TOC and ROC values for implementation of the composite algorithm. The ROC values are dependent upon the selected TOC values, as described in Chapter III. This definition is used as input to a modification of the FORTRAN program for producing punched cards in the format to be used as an input to CR 5 (see Figure 22). This procedure is for the purpose of building internal tableaux of TOC and ROC curves within the computer memory.

Another more dynamic and repetitive function of the decision-maker is the definition of a capacity calendar. This calendar sets forth the criteria for the allocation of resources for day increments and the intermittent system capacity within each day increment. By changing this calendar as desired, the effects of different work schedules and capacities on the intermittent system can be examined by vacarious experimentation. This will be discussed in more detail later in this chapter.

Once the intermittent system parameters have been defined, the periodic procedure of the algorithm can be initiated. This periodic procedure is described in the following treatise and illustrated in Figure 22.

As demands are made on the total system, they are routed to the appropriate intermittent system and decision-maker. The decision-maker may desire to accept them as task orders into the system immediately or analyze them to determine their effects upon the system before making the accept or reject decision. The former case shall be described first in order to facilitate description of the latter.

The decision-maker accepts a task or processing and assigns it a TOC curve; automatically, a ROC curve is associated with the selected TOC curve. The task is entered into the work load system, and thus given a start date if one has not already been designated. It is also positioned in the system (facility or queue) and assigned a priority, if applicable. The task is now ready for entry into the system for resource application.

The task data are keypunched in a standard format into unit records with one task order per record. These unit records are sequenced for use throughout the computer algorithm; the major control is position in system; the secondary control is priority; the minor control is task number. These unit records are then transformed into a magnetic tape record. This record becomes the task master record.

Periodically, resource utilization reports are submitted for approval by the decision-maker. These reports contain the

(1) Task number.

(2) Resources depleted for the report period.

Upon approval by the decision-maker the resource utilization reports are keypunched into unit records. These records are held for processing with other task transactions.

Periodic completion estimates are made by the decision-makers. These estimates include the

(1) Task number.

(2) Pessimistic percent progress made (a) to date.

(3) Most likely percent progress made (m) to date.

(4) Optimistic percent progress made (b) to date.

The foregoing estimates are retained in unit records.

The unit records and the estimate inputs are sequenced by task number to form a task transaction file. This file is then used as input to CR 4 which updates the task master file. This CR produces an up-to-date task master file from the new task master records created in CR 3, the existing task master records, and the task transactions. The file now includes current status (task and/or queue), resources depleted to date, decision-maker's progress estimates, changes in priority, and/or curve assignment.

The newly produced task master file, the TOC and ROC curve input tableaux, and the capacity calendar are now available as input to CR 5, which is the nucleus of the computer algorithm. Refer to the preceding section for detailed description of CR 5.

In general, this program transcribes each task master record, and with the data contained in the record, performs the following functions:

(1) Computation of percent resources depleted.

(2) Computation of expected percent progress.

(3) Computation of percent time depleted.

(4) Performance of random search for TOC and ROC coordinates for each percent time depleted.

(5) Computation of limits of deviation of TOC and ROC coorinates found in search routine.

CR 5 displays all of the above facets for each task as illustrated in Appendix D-3. Exception messages are printed for the following conditions:

(1) Resource depletion in the high zone.

(2) Resource depletion in the low zone.

(3) Expected progress in the high zone.

(4) Expected progress in the low zone.

(5) Start date past and task still in queue.

(6) Deadline date past and task not complete.

(7) Priority task.

(8) Resources over expended.

As a by-product two other outputs are produced from CR 5. They are intermittent system load-by-day increments and the TOC and ROC variations for subsequent analysis in CR 6. For the intermittent system load-by-day refer to Appendix D-4. This by-product is the result of the allocation of all resources theoretically not used, as a function of time and using the ROC curve. For each work day defined in the capacity calendar, the load for that day is accumulated and displayed, along with the capacity, the excess capacity, and the overload. The actual resource depletion versus ROC curve coordinates, the expected progress values versus TOC curve coordinates, and the intermittent system resource allocation analysis by day, are now available for management information as to the status of the system and for use in controlling task progress and resource depletion.

The same program can be utilized with artifacts for systems simulation. Thus, proposed remedies to exceptions noted in CR 5 can be simulated in CR 7 before testing them in the real world. For instance, to alleviate an overload, start dates of several tasks might be moved back in time by means of pseudo task records, and the effects effects of alterations can be analyzed. The effects of any alteration on the total intermittent system can be scrutinized with simulation on one or any combination of the factors of load mix, capacity, or work day schedule.

The same simulation can be used to assist decision-makers making their decisions on any task or group of tasks, and under what conditions to make them. The decision-maker can simulate a task into the total intermittent system to determine if its requirements overload the system at any time. In the event that the results cause an overload state, the amount of overload is indicated and can then be used to determine the cost of the acceptance of the job. The anticipated cost would then be weighed against the expected income and intangibles in order to determine the profitability of accepting or rejecting the job. Decision-makers would perform viacarious experimentation with possible solutions to a system overload to determine the effectiveness and feasibility of the solutions.

Conversely, excess capacity could be analyzed to determine which types of jobs would be the best to solicit at any particular time. The factors in determining such marketing parameters are the duration of an excess capacity condition and the amount of excess capacity in increments of time. Obviously, the range of start and delivery dates and the size of tasks are partially defined by the valleys in the load. It is necessary to fill these valleys and smooth the overloads to optimize the allocation within specified capacity.

Any combination of tasks, delivery dates, start dates, resource allocation schemes, and capacity and work schedules can be defined and analyzed by the computer algorithm by the decision-makers.

The second by-product of CR 5 is an analysis in CR 6 of variations of real data from the TOC and ROC curves in 10 percent range increments of time depleted, and the progress and resources depleted. The number of variations is recorded along with the total number of points in the range. Any consistent pattern of deviations from the curve becomes readily apparent in this cross-indexed analyses. When observed over time, an analysis of variations will yield necessary adjustment to the TOC and ROC curves.

The generated states of the intermittent system are:

(1) State A. Systems balanced (demand = capacity).

(2) State B. Priority tasks.

(3) State C. System underloaded.

(4) State D. System overloaded.

(5) State E. RD in continue zone with E[TP] in continue zone.

(6) State F. RD in continue zone with E[TP] in high zone.

(7) State G. RD in low zone with E[TP] in high zone.

(8) State H. RD in low zone with E[TP] in continue zone.

(9) State J. RD in low zone with E[TP] in low zone.

(10) State I. RD in high zone with E[TP] in high zone.

(11) State K. RD in continue zone with E[TP] in low zone.

(12) State L. RD in high zone with E[TP] in continue zone.

(13) State M. RD in high zone with E[TP] in low zone.

The foregoing decision criteria are generated for inspection by the decision-maker. For real world applications, each decision-maker would find particular sets of execution rules that best fit his environment, but generally, the following sets are applicable. Refer to Figure 12, page 41, and Figure 15, page 46, for the zone descriptions of the TP and RD models.

State A. System balanced. This state is brought about when the demands are equivalent in terms of requirements for capacity as there is capacity available. In terms of an allocation and control concept, the decision-maker would continue work in anticipation of relieving capacity prior to the arrival of new business.

State B. Priority tasks in system. In this state tasks with priority are placed as the first element in the queue or in the facility if capacity is available. If more than one task had priority, they would be sequenced according to first-come first-served priority task.

State C. System underloaded. The system will be underloaded when the total demand is less than the available capacity. This condition would exist when the computer prints out only the "facility" load. Refer to Appendix D-4 for this state. The decision-maker could take this information to the marketing function for increased emphasis on sales in chosen areas.

State D. System overloaded. The system is overloaded when the demand becomes greater than the capacity. This state would be realized when the computer listed both "facility" and "queue", as illustrated in Appendixes D-3 and D-4. The decision-maker would hold all overload work in a single channel queue for service on a first-come first-served basis unless a priority demand is received, in which case exception of state B is applicable. The computer would print a late start message. The late start would normally cause delivery slippage.

State E. RD in continue zone with $E[TP]$ in continue zone. This is optimal state and the decision-maker would concern himself with trend only. If the trend were toward the limits of deviation, he would use the prognostic feature of the algorithm.

State F. RD in continue zone with $E[TP]$ in high zone. This is an acceptable state. The actual resource depletion is as planned. Thus, since the E[TP] is an estimated point, the decision-maker would look upon the state as very desirable.

State G. RD in low zone with E[TP] in high zone. The decision-maker would realize that the initial total resources were more than actually needed and depending on his environment, he would either consider the potentially unexpended resources as additional capital gains or return them as unused resources. In either case, he normally would not act until the task delivery date since the E[TP] point is an estimate of progress.

State H. RD in low zone with E[TP] in continue zone. This is a favorable state since progress is acceptable with a low resource depletion. It indicates that if the same relationship prevailed, the task would be completed prior to using all the resources. The system's environment would supply the decision criteria for the disposition of the remaining resources.

State I. RD in low zone with E[TP] in low zone. This state would indicate that the wrong TOC curve had possibly been selected or that optimal utilization of resources had not been perfected. The first rule would be for the decision-maker to increase the resource utilization in accordance with the optimal path model described in Chapter III. If the RD curve failed to follow the optimal path, the decision-maker would review the selected TOC and ROC curves. If the selected TOC curve was I, II, III, or IV, then a general rule would be to examine the curve with the next highest number (the one with the next larger alpha and the next smaller delta). Then, if such a state exists, the decision-maker would execute the optimal path model described in Chapter III to attempt to increase progress by the application of additional resources. In praxis, this would normally develop trend toward the desired results.

State J. RD in high zone with E[TP] in high zone. This state represents the opposite of State I. As a result, the opposite strategy would be used. Rather than shifting to the TOC curve with the next higher Roman identification numeral, the decision-maker would shift to the next lower identification numeral until the empirical state was matched with its appropriate performance characteristic. If a TOC curve with an $\alpha = 2.0$ and a $\delta = 0.2$, which are the parameters of TOC curve I (see Appendix D), were needed the algorithm possesses this flexibility. However, as described in Chapter II, the necessity of such parameters would be rare. The optimal decision would be to use the optimal path model described in Chapter III to cause the RD curve to approach 100 percent as $t \rightarrow 1.0$. In essence, resource utilization can be reduced so that when $t=1.0$, actual RD = 1.0. This would generally mean that the task was completed prior to delivery with unused resources.

State K. RD in continue zone with E[TP] in low zone. This state would indicate that productivity per resource unit is lower than planned. Such a situation would direct the decision-maker to first re-examine the total allotted resources for the task to determine if an adequate quantity had been allotted. After re-examination, if total resources were realistic, the decision-maker would examine the system's environment to depict potential cause of low productivity. Corrections would be made dependent on the judgment of the decision-maker.

State M. RD in high zone with E[TP] in low zone. This state is probably the least desirable of all states. It indicates that inadequate total resources were allotted at the outset of the task. As a result the decision-maker must develop a new resource requirements plan. This could result in monetary losses if contractual arrangements were binding or if additional resources were not available. Otherwise, the decision-maker's decision would be absolutely dependent on the system's environment.

State L. RD in high zone with E[TP] in continue zone. This state primarily indicates the possibility of over expenditures of resources. The decision-maker would first try the optimal path model to attempt to bring the RD curve back to its upper limit of deviation without causing the TP curve to approach its lower limit of deviation. Also, total allotted resources at the beginning of the task would be examined. If total resources were under-allotted, adjustments and limitations analogous to State J would be required.

In conclusion, the conceptual phenomena and mathematical models, linked with the computer to form a composite algorithm, served as valid bases for an allocation and control algorithm for intermittent demands on work process systems. It is anticipated that the heuristic modeling procedure will serve as basis for further research in quantitatively describing work process systems.

CHAPTER V

This concluding chapter will be composed of three sections. The first will summarize the total dissertation in terms of the objective, purpose, and hypothesis. The second will conclude the findings of the investigation. The third will propose some future extensions of the investigation.

Summary

The objective of this investigation was to develop a diagnostic and prognostic algorithm to place decision-making for the allocation and control of resources on a quantitative basis. The purpose was to circumvent the existing rules-of-thumb, subjective, and non-computerized decision-making methodologies with the algorithm. The hypothesis was that a heuristic algorithm can be developed to establish quantitative criteria for allocating, monitoring, and controlling resources within intermittent systems.

To accomplish the objective, a system of mathematical models was conceived and developed for simulation on the computer. Vicarious experimentation was used to indicate the validity of the algorithm. The models were developed with manipulatable parameters such that all basic feasible conditions could be examined.

The system of models was based on the premise that task progress was the growth of concepts or the accumulation of produced items in work processes. This premise was used to develop a TOC curve which served as the basis for a ROC curve, a TP model, a RD model, and an optimal path model. These models were integrated with the IBM 1401 and 7040 computers for a composite resource allocation and control algorithm.

Conclusions

Based on the supposition that task progress is analogous to the growth of multicelluar organisms, a TOC curve was conceived, developed, and used as the basis for a ROC curve, a TP model, and a RD model. These mathematical models were integrated with the computer for the development of a composite algorithm. The computer algorithm was used to develop a set of states for intermittent systems, and decision rules were postulated to encompass each state. Through vicarious experimentation, the hypothesis was accepted.

An optimal path model was conceived and developed for the decisonmaker to use for exception management. The model afforded guidance to the decision-maker when the actual resource depletion and expected progress were outside the continue zone of the respective models. The research performed in this investigation supported the validity of mathematically describing and computerizing criteria of industrial systems normally described by non-mathematical and non-computerized techniques.

The final results circumvented the existing rules-of-thumb, subjective, and non-computerized techniques and validated the feasibility of quantitatively describing physical industrial phenomena through the applications of operations research methodology and the digital computer. It is anticipated that the results of this investigation will find many useful applications in praxis. The heuristic properties of the models and the composite algorithm developed in this investigation should pave the way for continued research and development, not only for this area of industrial engineering, but for many neophyte areas where subjective methodology is being debilitated by the advent of the complexity of the aerospace industry.

Recommendations for Extensions

The pertinent computational algorithms, data, flow charts, and experimental results were retained in the Appendixes to assist in future extensions. The models were developed without dimensions so that maximum flexibility was sustained for model manipulations. There are several possible extensions to the algorithm; some would only enhance the efficiency of computer utilization, which will not be explicitly discussed.

A logical extension would be for the inclusion of the project concept (reference Figure 1, page 6) where a project operating characteristic (POC) curve would be the average of all TOC curves representing the tasks that make up the total project. It seems reasonable that since the TOC curves are dimensionless, an average would represent the total project performance characteristics. Such an experiment could possibly be performed in the laboratory where actual standards were predetermined so that comparisons could be made of predicted versus actual progress. The multi-task project complexity could be varied to determine a planning-difficulty index. Resources in the laboratory could be artifically defined in terms of losses for failing to produce quantities as prescribed by the rules of the experiment. If the investigation were not feasible for laboratory experimentation, then a heuristic modeling scheme for the extension appears feasible using vicarious experimentation. If the two approaches were not feasible alone, perhaps they could be investigated simultaneously. Another extension would be to perform replications of like-tasks to statistically determine the TOC curve parameters. For example, if a $10,000 mechanical design task were received into the system, a nomogram could be used to select the appropriate TOC curve. The mathematical model for the nomogram could be derived from the examination of repetitive tasks performed in chosen environments or through a heuristic modeling scheme.

Future study could be made on the control concept by investigating the limits of deviation from a statistical viewpoint. The TP and RD models could be examined in terms of a sequential sampling plan based on chosen Type I and II errors and on other properties of the intermittent system analogous to a lot tolerance percent defective and an acceptable quality level defective. The lot tolerance percent defective could be negotiated with the consumer for the service being performed. The acceptable quality level could be analogous to the C^* used in this investigation. The computer could sequentially depict the points to examine during task life. The reject and accept decisions could be tempered to exception rules since it would be unlikely that a decision-maker would reject a task in process just because his progress was below expectation by a statisticaly significant amount.

It is believed by this author that the algorithm developed will fit any growing or accumulation process; thus this universal flexibility should avail many prolific extensions.

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APPENDIXES

FOREWORD TO THE APPENDIXES

The computational algorithms presented in the four sections of this Appendix were written in FORTRAN IV for the IBM 7040 computer and in AUTOCODER for the IBM 1401 computer.

Appendix A contains the computational algorithm and data for Equations (26), Appendix B for Equations (27) and (29), and Appendix C for Equations (30) and (31). Appendix D contains the computational models and simulation outputs for the composite algorithm.

The data, graphs, and flow charts are included as support material for the text and to eliminate redundant research for future extensions.

APPENDIX A

COMPUTATIONAL ALGORITHM FOR BASIC MODEL

APPENDIX A-I

FORTRAN IV PROGRAM FOR IBM 7040 COMPUTER

FORTRAN IV PROGRAM LISTING OF TOC CURVE COORDINATES

```
      REAL K1,K2
      DIMENSION X(5,20),Y(5,20)
      DO8KK = 1,15
      GO TO (1,2,3,4,5,21,12,13,14,15,16,17,18,19,20),KK
    1 ALP = 2.
      DEL = .1
      GO TO 6
    2 ALP = 3.
      DEL = 0.
      GO TO 6
    3 ALP = .01
      DEL = 0.
      GO TO 6
    4 ALP = 2.
      DEL = -.2
      GO TO 6
    5 ALP = 3.
      DEL = -.2
      GO TO 6
   21 ALP = 1.5
      DEL =   .15
      GO TO 6
   12 ALP = 2.5
      DEL =   .05
      GO TO 6
```

```
13 ALP = .01
   DEL =   .05
   GO TO 6
14 ALP = 1.5
   DEL =  -.25
   GO TO 6
15 ALP = 2.5
   DEL =  -.25
   GO TO 6
16 ALP =  1.5
   DEL =   .2
   GO TO 6
17 ALP = 2.5
   DEL =   .1
   GO TO 6
18 ALP =  .01
   DEL =   .1
   GO TO 6
19 ALP =  1.5
   DEL =  -.3
   GO TO 6
20 ALP =  2.5
   DEL =  -.3
 6 DO7I = 1,5
   DO 7 J = 1,20
   X(I,J) =FLOAT((I-1)*20+J)/100.
   T= X(I,J)
```

```
      K1=ALP*(1.-2.*DEL)
      K2=2.*ALP
      B=(1.+EXP(K1-K2))
      C=(EXP(K1)-EXP(K1-K2))
      D=(EXP(K1)-EXP(K1-K2*T))
      E=(1.+EXP(K1-K2*T))
      Y(I,J)=((B)/C)*(D/(   E))
    7 CONTINUE
      PRINT 10, ALP ,DEL
   10 FORMAT(1H1//// 40X,7HALPHA =F4.1//40X  7HDELTA = F4.1////
     14X,1HT 1 4X,3HTOC,5X,1HT,4X,3HTOC,5X,1HT,4X,3HTOC,5X,1HT,
     4X,3HTOC,5X,1HT, 24X,3HTOC)
      DO 8 J = 1,20
    8 PRINT11, (X(I,J),Y(I,J),I =1,5)
   11 FORMAT(/10X, 5(F7.2,F6.2))
      STOP
      END
```

APPENDIX A-2

COMPUTED COORDINATES FOR

$0.1 \leq \alpha \leq 9.6$ and $-0.5 \leq \delta \leq 0.4$

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

ALPHA = 0.1

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
0.2	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
0.3	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
0.4	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
0.5	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
0.6	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.7	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
0.8	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
0.9	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 0.2

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
0.2	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
0.3	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
0.4	0.39	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
0.5	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
0.6	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.7	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
0.8	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
0.9	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 0.3

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
0.2	0.19	0.19	0.19	0.20	0.20	0.20	0.20	0.20	0.20	0.20
0.3	0.29	0.29	0.29	0.30	0.30	0.30	0.30	0.30	0.30	0.31
0.4	0.39	0.39	0.39	0.40	0.40	0.40	0.40	0.40	0.41	0.41
0.5	0.49	0.49	0.49	0.50	0.50	0.50	0.50	0.50	0.51	0.51
0.6	0.59	0.59	0.59	0.60	0.60	0.60	0.60	0.60	0.61	0.61
0.7	0.69	0.69	0.70	0.70	0.70	0.70	0.70	0.70	0.71	0.71
0.8	0.79	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.81	0.81
0.9	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 0.4

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10
0.2	0.19	0.19	0.19	0.19	0.19	0.20	0.20	0.20	0.21	0.21
0.3	0.28	0.28	0.29	0.29	0.29	0.30	0.30	0.30	0.31	0.31
0.4	0.38	0.38	0.39	0.39	0.39	0.40	0.40	0.41	0.41	0.41
0.5	0.48	0.48	0.49	0.49	0.50	0.50	0.50	0.51	0.51	0.52
0.6	0.58	0.59	0.59	0.59	0.60	0.60	0.61	0.61	0.61	0.62
0.7	0.69	0.69	0.69	0.70	0.70	0.70	0.71	0.71	0.71	0.72
0.8	0.79	0.79	0.79	0.80	0.80	0.80	0.81	0.81	0.81	0.81
0.9	0.89	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.91	0.91
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 0.5

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.11
0.2	0.18	0.18	0.18	0.19	0.19	0.20	0.20	0.20	0.21	0.21
0.3	0.27	0.28	0.28	0.29	0.29	0.30	0.30	0.31	0.31	0.32
0.4	0.37	0.38	0.38	0.39	0.39	0.40	0.40	0.41	0.42	0.42
0.5	0.47	0.48	0.48	0.49	0.49	0.50	0.51	0.51	0.52	0.52
0.6	0.57	0.58	0.58	0.59	0.60	0.60	0.61	0.61	0.62	0.62
0.7	0.68	0.68	0.69	0.69	0.70	0.70	0.71	0.71	0.72	0.72
0.8	0.78	0.79	0.79	0.80	0.80	0.80	0.81	0.81	0.82	0.82
0.9	0.89	0.89	0.90	0.90	0.90	0.90	0.91	0.91	0.91	0.91
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 0.6

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.08	0.08	0.09	0.09	0.09	0.10	0.10	0.10	0.11	0.11
0.2	0.17	0.17	0.18	0.18	0.19	0.19	0.20	0.21	0.21	0.22
0.3	0.26	0.27	0.27	0.28	0.29	0.30	0.30	0.31	0.32	0.32
0.4	0.36	0.36	0.37	0.38	0.39	0.40	0.41	0.41	0.42	0.43
0.5	0.46	0.47	0.47	0.48	0.49	0.50	0.51	0.52	0.53	0.53
0.6	0.56	0.57	0.58	0.59	0.59	0.60	0.61	0.62	0.63	0.64
0.7	0.67	0.68	0.68	0.69	0.70	0.70	0.71	0.72	0.73	0.73
0.8	0.78	0.78	0.79	0.79	0.80	0.81	0.81	0.82	0.82	0.83
0.9	0.89	0.89	0.89	0.90	0.90	0.90	0.91	0.91	0.91	0.92
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

ALPHA = 0.7

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.08	0.08	0.08	0.09	0.09	0.09	0.10	0.10	0.11	0.11
0.2	0.16	0.17	0.17	0.18	0.19	0.19	0.20	0.21	0.21	0.22
0.3	0.25	0.26	0.27	0.27	0.28	0.29	0.30	0.31	0.32	0.33
0.4	0.34	0.35	0.36	0.37	0.38	0.40	0.41	0.42	0.43	0.44
0.5	0.44	0.45	0.47	0.48	0.49	0.50	0.51	0.52	0.53	0.55
0.6	0.55	0.56	0.57	0.58	0.59	0.60	0.62	0.63	0.64	0.65
0.7	0.66	0.67	0.68	0.69	0.70	0.71	0.72	0.73	0.73	0.74
0.8	0.77	0.78	0.79	0.79	0.80	0.81	0.81	0.82	0.83	0.83
0.9	0.88	0.89	0.89	0.90	0.90	0.91	0.91	0.91	0.92	0.92
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 0.8

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.11
0.2	0.15	0.16	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23
0.3	0.24	0.24	0.26	0.27	0.28	0.29	0.30	0.32	0.33	0.34
0.4	0.33	0.34	0.35	0.37	0.38	0.39	0.41	0.42	0.44	0.45
0.5	0.43	0.44	0.46	0.47	0.48	0.50	0.52	0.53	0.54	0.56
0.6	0.53	0.55	0.56	0.58	0.59	0.61	0.62	0.63	0.65	0.66
0.7	0.65	0.66	0.67	0.68	0.70	0.71	0.72	0.73	0.74	0.76
0.8	0.76	0.77	0.78	0.79	0.80	0.81	0.82	0.83	0.84	0.84
0.9	0.88	0.89	0.89	0.90	0.90	0.91	0.91	0.92	0.92	0.93
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 0.9

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.07	0.07	0.07	0.08	0.08	0.09	0.10	0.10	0.11	0.12
0.2	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.24
0.3	0.22	0.23	0.25	0.26	0.27	0.29	0.30	0.32	0.34	0.35
0.4	0.31	0.33	0.34	0.36	0.38	0.39	0.41	0.43	0.45	0.47
0.5	0.41	0.43	0.44	0.46	0.48	0.50	0.52	0.54	0.56	0.57
0.6	0.52	0.53	0.55	0.57	0.59	0.61	0.62	0.64	0.66	0.67
0.7	0.63	0.65	0.66	0.68	0.70	0.71	0.73	0.74	0.75	0.77
0.8	0.75	0.76	0.78	0.79	0.80	0.81	0.82	0.83	0.84	0.85
0.9	0.87	0.88	0.89	0.90	0.90	0.91	0.92	0.92	0.93	0.93
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 1.0

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.06	0.06	0.07	0.08	0.08	0.09	0.10	0.10	0.11	0.12
0.2	0.13	0.14	0.15	0.16	0.17	0.18	0.20	0.21	0.23	0.24
0.3	0.21	0.22	0.23	0.25	0.27	0.29	0.31	0.33	0.34	0.36
0.4	0.29	0.31	0.33	0.35	0.37	0.39	0.41	0.44	0.46	0.48
0.5	0.39	0.41	0.43	0.45	0.48	0.50	0.52	0.55	0.57	0.59
0.6	0.50	0.52	0.54	0.56	0.59	0.61	0.63	0.65	0.67	0.69
0.7	0.62	0.64	0.66	0.67	0.69	0.71	0.73	0.75	0.77	0.78
0.8	0.74	0.76	0.77	0.79	0.80	0.82	0.83	0.84	0.85	0.86
0.9	0.87	0.88	0.89	0.90	0.90	0.91	0.92	0.92	0.93	0.94
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 1.1

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.05	0.06	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13
0.2	0.12	0.13	0.14	0.15	0.17	0.18	0.20	0.22	0.23	0.25
0.3	0.19	0.21	0.22	0.24	0.26	0.28	0.31	0.33	0.35	0.38
0.4	0.28	0.30	0.32	0.34	0.36	0.39	0.42	0.44	0.47	0.49
0.5	0.37	0.40	0.42	0.45	0.47	0.50	0.53	0.55	0.58	0.60
0.6	0.48	0.51	0.53	0.56	0.58	0.61	0.64	0.66	0.68	0.70
0.7	0.60	0.62	0.65	0.67	0.69	0.72	0.74	0.76	0.78	0.79
0.8	0.73	0.75	0.77	0.78	0.80	0.82	0.83	0.85	0.86	0.87
0.9	0.86	0.87	0.88	0.89	0.90	0.91	0.92	0.93	0.94	0.94
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 1.2

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.05	0.05	0.06	0.07	0.08	0.08	0.10	0.11	0.12	0.13
0.2	0.11	0.12	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26
0.3	0.18	0.19	0.21	0.23	0.26	0.28	0.31	0.33	0.36	0.39
0.4	0.26	0.28	0.30	0.33	0.36	0.39	0.42	0.45	0.48	0.51
0.5	0.36	0.38	0.41	0.44	0.47	0.50	0.53	0.56	0.59	0.62
0.6	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.70	0.72
0.7	0.59	0.61	0.64	0.67	0.69	0.72	0.74	0.77	0.79	0.81
0.8	0.72	0.74	0.76	0.78	0.80	0.82	0.84	0.86	0.87	0.88
0.9	0.86	0.87	0.88	0.89	0.90	0.92	0.92	0.93	0.94	0.95
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

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                    ALPHA = 1.3                                                ALPHA = 1.4

                                DELTA                                                      DELTA
          -0.5 -0.4 -0.3 -0.2 -0.1  0.   0.1  0.2  0.3  0.4   -0.5 -0.4 -0.3 -0.2 -0.1  0.   0.1  0.2  0.3  0.4
 T
0.1        0.04 0.05 0.05 0.06 0.07 0.08 0.09 0.11 0.12 0.14   0.04 0.04 0.05 0.06 0.07 0.08 0.09 0.11 0.12 0.14

0.2        0.10 0.11 0.12 0.14 0.15 0.18 0.20 0.22 0.25 0.27   0.09 0.10 0.11 0.13 0.15 0.17 0.20 0.22 0.25 0.28

0.3        0.16 0.18 0.20 0.22 0.25 0.28 0.31 0.34 0.37 0.40   0.15 0.17 0.19 0.21 0.24 0.27 0.31 0.35 0.38 0.42

0.4        0.24 0.26 0.29 0.32 0.35 0.39 0.42 0.46 0.49 0.53   0.23 0.25 0.28 0.31 0.35 0.38 0.43 0.47 0.51 0.54

0.5        0.34 0.36 0.39 0.43 0.46 0.50 0.54 0.57 0.61 0.64   0.32 0.35 0.38 0.42 0.46 0.50 0.54 0.58 0.62 0.65

0.6        0.45 0.47 0.51 0.54 0.58 0.61 0.65 0.68 0.71 0.74   0.43 0.46 0.49 0.53 0.57 0.62 0.65 0.69 0.72 0.75

0.7        0.57 0.60 0.63 0.66 0.69 0.72 0.75 0.78 0.80 0.82   0.55 0.58 0.62 0.65 0.69 0.73 0.76 0.79 0.81 0.83

0.8        0.70 0.73 0.75 0.78 0.80 0.82 0.85 0.86 0.88 0.89   0.69 0.72 0.75 0.78 0.80 0.83 0.85 0.87 0.89 0.90

0.9        0.85 0.86 0.88 0.89 0.91 0.92 0.93 0.94 0.95 0.95   0.84 0.86 0.88 0.89 0.91 0.92 0.93 0.94 0.95 0.96

1.0        1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00   1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

                    ALPHA = 1.5                                                ALPHA = 1.6

                                DELTA                                                      DELTA
          -0.5 -0.4 -0.3 -0.2 -0.1  0.   0.1  0.2  0.3  0.4   -0.5 -0.4 -0.3 -0.2 -0.1  0.   0.1  0.2  0.3  0.4
 T
0.1        0.03 0.04 0.05 0.05 0.06 0.08 0.09 0.11 0.13 0.15   0.03 0.04 0.04 0.05 0.06 0.07 0.09 0.11 0.13 0.15

0.2        0.08 0.09 0.10 0.12 0.14 0.17 0.20 0.23 0.26 0.29   0.07 0.08 0.10 0.11 0.14 0.16 0.20 0.23 0.27 0.30

0.3        0.14 0.15 0.18 0.20 0.23 0.27 0.31 0.35 0.39 0.43   0.12 0.14 0.17 0.19 0.23 0.27 0.31 0.36 0.40 0.44

0.4        0.21 0.23 0.26 0.30 0.34 0.38 0.43 0.47 0.52 0.56   0.19 0.22 0.25 0.29 0.33 0.38 0.43 0.48 0.53 0.57

0.5        0.30 0.33 0.37 0.41 0.45 0.50 0.55 0.59 0.63 0.67   0.28 0.31 0.35 0.40 0.45 0.50 0.55 0.60 0.65 0.69

0.6        0.41 0.44 0.48 0.53 0.57 0.62 0.66 0.70 0.74 0.77   0.39 0.43 0.47 0.52 0.57 0.62 0.67 0.71 0.75 0.78

0.7        0.53 0.57 0.61 0.65 0.69 0.73 0.77 0.80 0.82 0.85   0.52 0.56 0.60 0.64 0.69 0.73 0.77 0.81 0.83 0.86

0.8        0.68 0.71 0.74 0.77 0.80 0.83 0.86 0.88 0.90 0.91   0.66 0.70 0.73 0.77 0.80 0.84 0.86 0.89 0.90 0.92

0.9        0.84 0.85 0.87 0.89 0.91 0.92 0.94 0.95 0.95 0.96   0.83 0.85 0.87 0.89 0.91 0.93 0.94 0.95 0.96 0.96

1.0        1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00   1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

                    ALPHA = 1.7                                                ALPHA = 1.8

                                DELTA                                                      DELTA
          -0.5 -0.4 -0.3 -0.2 -0.1  0.   0.1  0.2  0.3  0.4   -0.5 -0.4 -0.3 -0.2 -0.1  0.   0.1  0.2  0.3  0.4
 T
0.1        0.03 0.03 0.04 0.05 0.06 0.07 0.09 0.11 0.13 0.16   0.02 0.03 0.03 0.04 0.05 0.07 0.09 0.11 0.13 0.16

0.2        0.06 0.07 0.09 0.11 0.13 0.16 0.19 0.23 0.27 0.31   0.06 0.07 0.08 0.10 0.13 0.16 0.19 0.23 0.28 0.32

0.3        0.11 0.13 0.15 0.18 0.22 0.26 0.31 0.36 0.41 0.46   0.10 0.12 0.14 0.17 0.21 0.26 0.31 0.37 0.42 0.47

0.4        0.18 0.20 0.24 0.28 0.32 0.38 0.43 0.49 0.54 0.59   0.16 0.19 0.22 0.27 0.32 0.38 0.44 0.50 0.56 0.61

0.5        0.26 0.30 0.34 0.39 0.44 0.50 0.56 0.61 0.66 0.70   0.24 0.28 0.32 0.38 0.44 0.50 0.56 0.62 0.68 0.72

0.6        0.37 0.41 0.46 0.51 0.57 0.62 0.68 0.72 0.76 0.80   0.35 0.39 0.44 0.50 0.56 0.62 0.68 0.73 0.78 0.81

0.7        0.50 0.54 0.59 0.64 0.69 0.74 0.78 0.82 0.85 0.87   0.48 0.53 0.58 0.63 0.69 0.74 0.79 0.83 0.86 0.88

0.8        0.65 0.69 0.73 0.77 0.81 0.84 0.87 0.89 0.91 0.93   0.64 0.68 0.72 0.77 0.81 0.84 0.87 0.90 0.92 0.93

0.9        0.82 0.84 0.87 0.89 0.91 0.93 0.94 0.95 0.96 0.97   0.81 0.84 0.87 0.89 0.91 0.93 0.95 0.96 0.97 0.97

1.0        1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00   1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
```

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

ALPHA = 1.9

T	DELTA -0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.02	0.02	0.03	0.04	0.05	0.07	0.09	0.11	0.14	0.17
0.2	0.05	0.06	0.07	0.09	0.12	0.15	0.19	0.24	0.29	0.33
0.3	0.09	0.11	0.13	0.16	0.21	0.25	0.31	0.37	0.43	0.49
0.4	0.15	0.18	0.21	0.26	0.31	0.37	0.44	0.51	0.57	0.63
0.5	0.23	0.26	0.31	0.37	0.43	0.50	0.57	0.63	0.69	0.74
0.6	0.33	0.37	0.43	0.49	0.56	0.63	0.69	0.74	0.79	0.82
0.7	0.46	0.51	0.57	0.63	0.69	0.75	0.79	0.84	0.87	0.89
0.8	0.62	0.67	0.71	0.76	0.81	0.85	0.88	0.91	0.93	0.94
0.9	0.80	0.83	0.86	0.89	0.91	0.93	0.95	0.96	0.97	0.98
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 2.0

T	DELTA -0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.02	0.02	0.03	0.04	0.05	0.06	0.08	0.11	0.14	0.17
0.2	0.04	0.05	0.07	0.09	0.11	0.15	0.19	0.24	0.29	0.35
0.3	0.08	0.10	0.12	0.16	0.20	0.25	0.31	0.38	0.44	0.50
0.4	0.14	0.16	0.20	0.24	0.30	0.37	0.44	0.52	0.58	0.64
0.5	0.21	0.25	0.30	0.36	0.42	0.50	0.58	0.64	0.70	0.75
0.6	0.31	0.36	0.42	0.48	0.56	0.63	0.70	0.76	0.80	0.84
0.7	0.44	0.50	0.56	0.62	0.69	0.75	0.80	0.84	0.88	0.90
0.8	0.61	0.65	0.71	0.76	0.81	0.85	0.89	0.91	0.93	0.95
0.9	0.80	0.83	0.86	0.89	0.92	0.94	0.95	0.96	0.97	0.98
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 2.1

T	DELTA -0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.02	0.02	0.03	0.03	0.05	0.06	0.08	0.11	0.14	0.18
0.2	0.04	0.05	0.06	0.08	0.11	0.14	0.19	0.24	0.30	0.36
0.3	0.07	0.09	0.11	0.15	0.19	0.25	0.31	0.38	0.45	0.52
0.4	0.12	0.15	0.19	0.23	0.30	0.37	0.45	0.52	0.60	0.66
0.5	0.19	0.23	0.28	0.34	0.42	0.50	0.58	0.66	0.72	0.77
0.6	0.29	0.34	0.40	0.48	0.55	0.63	0.70	0.77	0.81	0.85
0.7	0.42	0.48	0.55	0.62	0.69	0.75	0.81	0.85	0.89	0.91
0.8	0.59	0.64	0.70	0.76	0.81	0.86	0.89	0.92	0.94	0.95
0.9	0.79	0.82	0.86	0.89	0.92	0.94	0.95	0.97	0.97	0.98
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 2.2

T	DELTA -0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.01	0.02	0.02	0.03	0.04	0.06	0.08	0.11	0.15	0.18
0.2	0.03	0.04	0.06	0.07	0.10	0.14	0.19	0.24	0.31	0.37
0.3	0.07	0.08	0.10	0.14	0.18	0.24	0.31	0.39	0.46	0.53
0.4	0.11	0.14	0.17	0.22	0.29	0.36	0.45	0.53	0.61	0.67
0.5	0.18	0.22	0.27	0.33	0.41	0.50	0.59	0.67	0.73	0.78
0.6	0.28	0.33	0.39	0.47	0.55	0.64	0.71	0.78	0.83	0.86
0.7	0.41	0.47	0.54	0.61	0.69	0.76	0.82	0.86	0.90	0.92
0.8	0.58	0.63	0.69	0.76	0.81	0.86	0.90	0.93	0.94	0.96
0.9	0.78	0.82	0.85	0.89	0.92	0.94	0.96	0.97	0.98	0.98
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 2.3

T	DELTA -0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.01	0.01	0.02	0.03	0.04	0.06	0.08	0.11	0.15	0.19
0.2	0.03	0.04	0.05	0.07	0.10	0.13	0.18	0.24	0.31	0.38
0.3	0.06	0.07	0.10	0.13	0.18	0.24	0.31	0.39	0.48	0.55
0.4	0.10	0.13	0.16	0.21	0.28	0.36	0.45	0.54	0.62	0.69
0.5	0.17	0.20	0.26	0.32	0.41	0.50	0.59	0.68	0.74	0.80
0.6	0.26	0.31	0.38	0.46	0.55	0.64	0.72	0.79	0.84	0.87
0.7	0.39	0.45	0.52	0.61	0.69	0.76	0.82	0.87	0.90	0.93
0.8	0.56	0.62	0.69	0.76	0.82	0.87	0.90	0.93	0.95	0.96
0.9	0.77	0.81	0.85	0.89	0.92	0.94	0.96	0.97	0.98	0.99
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 2.4

T	DELTA -0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.01	0.01	0.02	0.03	0.04	0.05	0.08	0.11	0.15	0.19
0.2	0.03	0.03	0.05	0.06	0.09	0.13	0.18	0.25	0.32	0.39
0.3	0.05	0.07	0.09	0.12	0.17	0.23	0.31	0.40	0.49	0.56
0.4	0.09	0.12	0.15	0.20	0.27	0.36	0.45	0.55	0.64	0.70
0.5	0.15	0.19	0.24	0.31	0.40	0.50	0.60	0.69	0.76	0.81
0.6	0.24	0.30	0.36	0.45	0.55	0.64	0.73	0.80	0.85	0.88
0.7	0.37	0.44	0.51	0.60	0.69	0.77	0.83	0.88	0.91	0.93
0.8	0.55	0.61	0.68	0.75	0.82	0.87	0.91	0.94	0.95	0.97
0.9	0.76	0.81	0.85	0.89	0.92	0.95	0.96	0.97	0.98	0.99
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

ALPHA = 2.5

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.01	0.01	0.02	0.02	0.03	0.05	0.08	0.11	0.15	0.20
0.2	0.02	0.03	0.04	0.06	0.09	0.13	0.18	0.25	0.32	0.40
0.3	0.05	0.06	0.08	0.11	0.16	0.23	0.31	0.40	0.50	0.58
0.4	0.08	0.11	0.14	0.19	0.27	0.36	0.46	0.56	0.65	0.72
0.5	0.14	0.18	0.23	0.30	0.40	0.50	0.60	0.70	0.77	0.82
0.6	0.23	0.28	0.35	0.44	0.54	0.64	0.73	0.81	0.86	0.89
0.7	0.36	0.42	0.50	0.60	0.69	0.77	0.84	0.89	0.92	0.94
0.8	0.53	0.60	0.68	0.75	0.82	0.87	0.91	0.94	0.96	0.97
0.9	0.75	0.80	0.85	0.89	0.92	0.95	0.97	0.98	0.98	0.99
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 2.6

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.01	0.01	0.01	0.02	0.03	0.05	0.07	0.11	0.15	0.21
0.2	0.02	0.03	0.04	0.05	0.08	0.12	0.18	0.25	0.33	0.41
0.3	0.04	0.05	0.07	0.11	0.16	0.22	0.31	0.41	0.51	0.59
0.4	0.07	0.10	0.13	0.18	0.26	0.35	0.46	0.57	0.66	0.73
0.5	0.13	0.16	0.22	0.29	0.39	0.50	0.61	0.71	0.78	0.84
0.6	0.21	0.27	0.34	0.43	0.54	0.65	0.74	0.82	0.87	0.90
0.7	0.34	0.41	0.49	0.59	0.69	0.78	0.84	0.89	0.93	0.95
0.8	0.52	0.59	0.67	0.75	0.82	0.88	0.92	0.95	0.96	0.97
0.9	0.74	0.79	0.85	0.89	0.93	0.95	0.97	0.98	0.99	0.99
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 2.7

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.01	0.01	0.01	0.02	0.03	0.05	0.07	0.11	0.16	0.21
0.2	0.02	0.02	0.03	0.05	0.08	0.12	0.17	0.25	0.34	0.42
0.3	0.04	0.05	0.07	0.10	0.15	0.22	0.31	0.41	0.52	0.61
0.4	0.07	0.09	0.12	0.18	0.25	0.35	0.46	0.57	0.67	0.75
0.5	0.12	0.15	0.21	0.28	0.38	0.50	0.62	0.72	0.79	0.85
0.6	0.20	0.25	0.33	0.43	0.54	0.65	0.75	0.82	0.88	0.91
0.7	0.32	0.39	0.48	0.59	0.69	0.78	0.85	0.90	0.93	0.95
0.8	0.50	0.58	0.66	0.75	0.83	0.88	0.92	0.95	0.97	0.98
0.9	0.73	0.79	0.84	0.89	0.93	0.95	0.97	0.98	0.99	0.99
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 2.8

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.01	0.01	0.01	0.02	0.03	0.04	0.07	0.11	0.16	0.22
0.2	0.02	0.02	0.03	0.05	0.07	0.11	0.17	0.25	0.34	0.43
0.3	0.03	0.04	0.06	0.09	0.14	0.21	0.31	0.42	0.53	0.62
0.4	0.06	0.08	0.11	0.17	0.24	0.35	0.46	0.58	0.68	0.76
0.5	0.11	0.14	0.20	0.28	0.38	0.50	0.62	0.72	0.80	0.86
0.6	0.19	0.24	0.32	0.42	0.54	0.65	0.76	0.83	0.89	0.92
0.7	0.31	0.38	0.47	0.58	0.69	0.79	0.86	0.91	0.94	0.96
0.8	0.49	0.57	0.66	0.75	0.83	0.89	0.93	0.95	0.97	0.98
0.9	0.73	0.78	0.84	0.89	0.93	0.96	0.97	0.98	0.99	0.99
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 2.9

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.01	0.01	0.02	0.03	0.04	0.07	0.11	0.16	0.22
0.2	0.01	0.02	0.03	0.04	0.07	0.11	0.17	0.25	0.35	0.44
0.3	0.03	0.04	0.06	0.09	0.14	0.21	0.31	0.42	0.54	0.63
0.4	0.05	0.07	0.11	0.16	0.24	0.34	0.47	0.59	0.70	0.77
0.5	0.10	0.13	0.19	0.27	0.37	0.50	0.63	0.73	0.81	0.87
0.6	0.17	0.23	0.30	0.41	0.53	0.66	0.76	0.84	0.89	0.93
0.7	0.29	0.37	0.46	0.58	0.69	0.79	0.86	0.91	0.94	0.96
0.8	0.47	0.56	0.65	0.75	0.83	0.89	0.93	0.96	0.97	0.98
0.9	0.72	0.78	0.84	0.89	0.93	0.96	0.97	0.98	0.99	0.99
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 3.0

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.01	0.01	0.01	0.02	0.04	0.07	0.11	0.16	0.23
0.2	0.01	0.02	0.02	0.04	0.06	0.10	0.17	0.25	0.35	0.45
0.3	0.02	0.03	0.05	0.08	0.13	0.20	0.30	0.42	0.54	0.65
0.4	0.05	0.07	0.10	0.15	0.23	0.34	0.47	0.60	0.71	0.79
0.5	0.09	0.12	0.18	0.26	0.37	0.50	0.63	0.74	0.82	0.88
0.6	0.16	0.21	0.29	0.40	0.53	0.66	0.77	0.85	0.90	0.93
0.7	0.28	0.35	0.46	0.58	0.70	0.80	0.87	0.92	0.95	0.97
0.8	0.46	0.55	0.65	0.75	0.83	0.90	0.94	0.96	0.98	0.98
0.9	0.71	0.77	0.84	0.89	0.93	0.96	0.98	0.99	0.99	0.99
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

ALPHA = 3.1

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.01	0.01	0.02	0.04	0.06	0.11	0.16	0.23
0.2	0.01	0.01	0.02	0.04	0.06	0.10	0.16	0.25	0.36	0.46
0.3	0.02	0.03	0.05	0.08	0.12	0.20	0.30	0.43	0.55	0.66
0.4	0.04	0.06	0.09	0.14	0.22	0.34	0.47	0.60	0.72	0.80
0.5	0.08	0.11	0.17	0.25	0.36	0.50	0.64	0.75	0.83	0.89
0.6	0.15	0.20	0.28	0.40	0.53	0.66	0.78	0.86	0.91	0.94
0.7	0.27	0.34	0.45	0.57	0.70	0.80	0.88	0.92	0.95	0.97
0.8	0.45	0.54	0.64	0.75	0.84	0.90	0.94	0.96	0.98	0.99
0.9	0.70	0.77	0.84	0.89	0.94	0.96	0.98	0.99	0.99	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 3.2

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.01	0.01	0.02	0.04	0.06	0.10	0.16	0.24
0.2	0.01	0.01	0.02	0.03	0.06	0.10	0.16	0.25	0.36	0.47
0.3	0.02	0.03	0.04	0.07	0.12	0.19	0.30	0.43	0.56	0.67
0.4	0.04	0.06	0.08	0.14	0.22	0.33	0.47	0.61	0.73	0.81
0.5	0.08	0.11	0.16	0.24	0.36	0.50	0.64	0.76	0.84	0.89
0.6	0.14	0.19	0.27	0.39	0.53	0.67	0.78	0.86	0.92	0.94
0.7	0.25	0.33	0.44	0.57	0.70	0.81	0.88	0.93	0.96	0.97
0.8	0.43	0.53	0.64	0.75	0.84	0.90	0.94	0.97	0.98	0.99
0.9	0.69	0.76	0.84	0.90	0.94	0.96	0.98	0.99	0.99	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 3.3

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.01	0.01	0.02	0.03	0.06	0.10	0.17	0.24
0.2	0.01	0.01	0.02	0.03	0.05	0.09	0.16	0.25	0.37	0.49
0.3	0.02	0.02	0.04	0.07	0.11	0.19	0.30	0.44	0.57	0.68
0.4	0.03	0.05	0.08	0.13	0.21	0.33	0.47	0.62	0.74	0.82
0.5	0.07	0.10	0.15	0.23	0.35	0.50	0.65	0.77	0.85	0.90
0.6	0.13	0.18	0.26	0.38	0.53	0.67	0.79	0.87	0.92	0.95
0.7	0.24	0.32	0.43	0.56	0.70	0.81	0.89	0.93	0.96	0.98
0.8	0.42	0.51	0.63	0.75	0.84	0.91	0.95	0.97	0.98	0.99
0.9	0.68	0.76	0.83	0.90	0.94	0.97	0.98	0.99	0.99	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 3.4

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.01	0.01	0.02	0.03	0.06	0.10	0.17	0.25
0.2	0.01	0.01	0.02	0.03	0.05	0.09	0.15	0.25	0.37	0.50
0.3	0.01	0.02	0.04	0.06	0.11	0.18	0.30	0.44	0.58	0.69
0.4	0.03	0.05	0.07	0.12	0.20	0.32	0.48	0.63	0.75	0.83
0.5	0.06	0.09	0.14	0.22	0.35	0.50	0.65	0.78	0.86	0.91
0.6	0.12	0.17	0.25	0.37	0.52	0.68	0.80	0.88	0.93	0.95
0.7	0.23	0.31	0.42	0.56	0.70	0.82	0.89	0.94	0.96	0.98
0.8	0.41	0.50	0.63	0.75	0.85	0.91	0.95	0.97	0.98	0.99
0.9	0.67	0.75	0.83	0.90	0.94	0.97	0.98	0.99	0.99	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 3.5

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.01	0.02	0.03	0.06	0.10	0.17	0.25
0.2	0.01	0.01	0.01	0.02	0.05	0.08	0.15	0.25	0.38	0.50
0.3	0.01	0.02	0.03	0.06	0.10	0.18	0.30	0.44	0.59	0.71
0.4	0.03	0.04	0.07	0.12	0.20	0.32	0.48	0.63	0.76	0.84
0.5	0.06	0.08	0.13	0.22	0.34	0.50	0.66	0.78	0.87	0.92
0.6	0.11	0.16	0.24	0.37	0.52	0.68	0.80	0.88	0.93	0.96
0.7	0.22	0.29	0.41	0.56	0.70	0.82	0.90	0.94	0.97	0.98
0.8	0.39	0.50	0.62	0.75	0.85	0.92	0.95	0.98	0.99	0.99
0.9	0.66	0.75	0.83	0.90	0.94	0.97	0.98	0.99	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 3.6

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.01	0.01	0.03	0.05	0.10	0.17	0.26
0.2	0.00	0.01	0.01	0.02	0.04	0.08	0.15	0.25	0.38	0.51
0.3	0.01	0.02	0.03	0.05	0.10	0.17	0.29	0.45	0.60	0.72
0.4	0.02	0.04	0.06	0.11	0.19	0.32	0.48	0.64	0.77	0.85
0.5	0.05	0.08	0.12	0.21	0.34	0.50	0.66	0.79	0.88	0.92
0.6	0.10	0.15	0.23	0.36	0.52	0.68	0.81	0.89	0.94	0.96
0.7	0.21	0.28	0.40	0.55	0.71	0.83	0.90	0.95	0.97	0.98
0.8	0.38	0.49	0.62	0.75	0.85	0.92	0.96	0.98	0.99	0.99
0.9	0.65	0.74	0.83	0.90	0.95	0.97	0.99	0.99	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

ALPHA = 3.7

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.01	0.01	0.03	0.05	0.10	0.17	0.26
0.2	0.00	0.01	0.01	0.02	0.04	0.08	0.14	0.25	0.39	0.52
0.3	0.01	0.02	0.03	0.05	0.09	0.17	0.29	0.45	0.61	0.73
0.4	0.02	0.03	0.06	0.10	0.19	0.31	0.48	0.65	0.77	0.86
0.5	0.05	0.07	0.12	0.20	0.33	0.50	0.67	0.80	0.88	0.93
0.6	0.10	0.14	0.23	0.35	0.52	0.69	0.81	0.90	0.94	0.97
0.7	0.19	0.27	0.39	0.55	0.71	0.83	0.91	0.95	0.97	0.98
0.8	0.37	0.48	0.61	0.75	0.86	0.92	0.96	0.98	0.99	0.99
0.9	0.65	0.74	0.83	0.90	0.95	0.97	0.99	0.99	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 3.8

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.01	0.01	0.02	0.05	0.10	0.17	0.27
0.2	0.00	0.01	0.01	0.02	0.04	0.07	0.14	0.25	0.39	0.53
0.3	0.01	0.01	0.02	0.05	0.09	0.16	0.29	0.45	0.61	0.74
0.4	0.02	0.03	0.05	0.10	0.18	0.31	0.48	0.65	0.78	0.87
0.5	0.04	0.07	0.11	0.19	0.33	0.50	0.67	0.81	0.89	0.93
0.6	0.09	0.13	0.22	0.35	0.52	0.69	0.82	0.90	0.95	0.97
0.7	0.18	0.26	0.39	0.55	0.71	0.84	0.91	0.95	0.98	0.99
0.8	0.36	0.47	0.61	0.75	0.86	0.93	0.96	0.98	0.99	0.99
0.9	0.64	0.73	0.83	0.90	0.95	0.98	0.99	0.99	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 3.9

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.01	0.01	0.02	0.05	0.09	0.17	0.27
0.2	0.00	0.00	0.01	0.02	0.03	0.07	0.14	0.25	0.40	0.54
0.3	0.01	0.01	0.02	0.04	0.08	0.16	0.29	0.45	0.62	0.75
0.4	0.02	0.03	0.05	0.09	0.17	0.31	0.48	0.66	0.79	0.87
0.5	0.04	0.06	0.10	0.19	0.32	0.50	0.68	0.81	0.90	0.94
0.6	0.08	0.13	0.21	0.34	0.52	0.69	0.83	0.91	0.95	0.97
0.7	0.18	0.25	0.38	0.55	0.71	0.84	0.92	0.96	0.98	0.99
0.8	0.35	0.46	0.60	0.75	0.86	0.93	0.97	0.98	0.99	1.00
0.9	0.63	0.73	0.83	0.91	0.95	0.98	0.99	0.99	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 4.0

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.01	0.02	0.05	0.09	0.17	0.28
0.2	0.00	0.00	0.01	0.02	0.03	0.07	0.14	0.25	0.40	0.55
0.3	0.01	0.01	0.02	0.04	0.08	0.16	0.28	0.46	0.63	0.76
0.4	0.02	0.03	0.05	0.09	0.17	0.30	0.48	0.66	0.80	0.88
0.5	0.04	0.06	0.10	0.18	0.32	0.50	0.68	0.82	0.90	0.94
0.6	0.08	0.12	0.20	0.34	0.52	0.70	0.83	0.91	0.95	0.97
0.7	0.17	0.24	0.37	0.54	0.72	0.84	0.92	0.96	0.98	0.99
0.8	0.34	0.45	0.60	0.75	0.86	0.93	0.97	0.98	0.99	1.00
0.9	0.62	0.72	0.83	0.91	0.95	0.98	0.99	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 4.1

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.09	0.17	0.28
0.2	0.00	0.00	0.01	0.01	0.03	0.06	0.13	0.25	0.40	0.56
0.3	0.01	0.01	0.02	0.04	0.07	0.15	0.28	0.46	0.64	0.77
0.4	0.01	0.02	0.04	0.08	0.16	0.30	0.48	0.67	0.81	0.89
0.5	0.03	0.05	0.09	0.17	0.31	0.50	0.69	0.83	0.91	0.95
0.6	0.07	0.11	0.19	0.33	0.52	0.70	0.84	0.92	0.96	0.98
0.7	0.16	0.23	0.36	0.54	0.72	0.85	0.93	0.96	0.98	0.99
0.8	0.32	0.44	0.60	0.75	0.87	0.94	0.97	0.99	0.99	1.00
0.9	0.61	0.72	0.83	0.91	0.96	0.98	0.99	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 4.2

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.09	0.17	0.28
0.2	0.00	0.00	0.01	0.01	0.03	0.06	0.13	0.25	0.41	0.57
0.3	0.01	0.01	0.02	0.03	0.07	0.15	0.28	0.46	0.64	0.78
0.4	0.01	0.02	0.04	0.08	0.16	0.30	0.49	0.68	0.81	0.89
0.5	0.03	0.05	0.09	0.17	0.31	0.50	0.69	0.83	0.91	0.95
0.6	0.07	0.11	0.19	0.32	0.51	0.70	0.84	0.92	0.96	0.98
0.7	0.15	0.22	0.36	0.54	0.72	0.85	0.93	0.97	0.98	0.99
0.8	0.31	0.43	0.59	0.75	0.87	0.94	0.97	0.99	0.99	1.00
0.9	0.60	0.72	0.83	0.91	0.96	0.98	0.99	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

ALPHA = 4.3

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.09	0.17	0.29
0.2	0.00	0.00	0.01	0.01	0.03	0.06	0.13	0.24	0.41	0.58
0.3	0.00	0.01	0.01	0.03	0.07	0.14	0.28	0.46	0.65	0.78
0.4	0.01	0.02	0.04	0.07	0.15	0.29	0.49	0.68	0.82	0.90
0.5	0.03	0.04	0.08	0.16	0.30	0.50	0.70	0.84	0.92	0.96
0.6	0.06	0.10	0.18	0.32	0.51	0.71	0.85	0.93	0.96	0.98
0.7	0.14	0.22	0.35	0.54	0.72	0.86	0.93	0.97	0.99	0.99
0.8	0.30	0.42	0.59	0.76	0.87	0.94	0.97	0.99	0.99	1.00
0.9	0.59	0.71	0.83	0.91	0.96	0.98	0.99	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 4.4

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.09	0.17	0.29
0.2	0.00	0.00	0.00	0.01	0.02	0.06	0.12	0.24	0.41	0.59
0.3	0.00	0.01	0.01	0.03	0.06	0.14	0.27	0.47	0.66	0.79
0.4	0.01	0.02	0.03	0.07	0.15	0.29	0.49	0.69	0.83	0.91
0.5	0.02	0.04	0.08	0.16	0.30	0.50	0.70	0.84	0.92	0.96
0.6	0.06	0.09	0.17	0.31	0.51	0.71	0.85	0.93	0.97	0.98
0.7	0.13	0.21	0.34	0.53	0.73	0.86	0.94	0.97	0.99	0.99
0.8	0.29	0.41	0.59	0.76	0.88	0.94	0.98	0.99	1.00	1.00
0.9	0.59	0.71	0.83	0.91	0.96	0.98	0.99	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 4.5

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.08	0.17	0.30
0.2	0.00	0.00	0.00	0.01	0.02	0.05	0.12	0.24	0.42	0.59
0.3	0.00	0.01	0.01	0.03	0.06	0.13	0.27	0.47	0.66	0.80
0.4	0.01	0.02	0.03	0.07	0.14	0.28	0.49	0.69	0.84	0.91
0.5	0.02	0.04	0.07	0.15	0.29	0.50	0.71	0.85	0.93	0.96
0.6	0.05	0.09	0.16	0.31	0.51	0.72	0.86	0.93	0.97	0.98
0.7	0.13	0.20	0.34	0.53	0.73	0.87	0.94	0.97	0.99	0.99
0.8	0.28	0.41	0.58	0.76	0.88	0.95	0.98	0.99	1.00	1.00
0.9	0.58	0.70	0.83	0.92	0.96	0.98	0.99	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 4.6

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.01	0.01	0.04	0.08	0.17	0.30
0.2	0.00	0.00	0.00	0.01	0.02	0.05	0.12	0.24	0.42	0.60
0.3	0.00	0.01	0.01	0.02	0.06	0.13	0.27	0.47	0.67	0.81
0.4	0.01	0.01	0.03	0.06	0.14	0.28	0.49	0.70	0.84	0.92
0.5	0.02	0.03	0.07	0.14	0.29	0.50	0.71	0.86	0.93	0.97
0.6	0.05	0.08	0.16	0.30	0.51	0.72	0.86	0.94	0.97	0.99
0.7	0.12	0.19	0.33	0.53	0.73	0.87	0.94	0.98	0.99	0.99
0.8	0.27	0.40	0.58	0.76	0.88	0.95	0.98	0.99	1.00	1.00
0.9	0.57	0.70	0.83	0.92	0.96	0.99	0.99	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 4.7

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.08	0.17	0.30
0.2	0.00	0.00	0.00	0.01	0.02	0.05	0.11	0.24	0.42	0.61
0.3	0.00	0.00	0.01	0.02	0.05	0.13	0.27	0.47	0.68	0.82
0.4	0.01	0.01	0.03	0.06	0.13	0.28	0.49	0.70	0.85	0.92
0.5	0.02	0.03	0.06	0.14	0.28	0.50	0.72	0.86	0.94	0.97
0.6	0.05	0.08	0.15	0.30	0.51	0.72	0.87	0.94	0.97	0.99
0.7	0.11	0.18	0.32	0.53	0.73	0.87	0.95	0.98	0.99	1.00
0.8	0.26	0.39	0.58	0.76	0.89	0.95	0.98	0.99	1.00	1.00
0.9	0.56	0.70	0.83	0.92	0.97	0.99	0.99	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 4.8

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.08	0.17	0.31
0.2	0.00	0.00	0.00	0.01	0.02	0.05	0.11	0.24	0.43	0.62
0.3	0.00	0.00	0.01	0.02	0.05	0.12	0.26	0.47	0.68	0.82
0.4	0.01	0.01	0.02	0.05	0.13	0.27	0.49	0.71	0.85	0.93
0.5	0.02	0.03	0.06	0.13	0.28	0.50	0.72	0.87	0.94	0.97
0.6	0.04	0.07	0.15	0.29	0.51	0.73	0.87	0.95	0.98	0.99
0.7	0.11	0.18	0.32	0.53	0.74	0.88	0.95	0.98	0.99	1.00
0.8	0.26	0.38	0.57	0.76	0.89	0.95	0.98	0.99	1.00	1.00
0.9	0.55	0.69	0.83	0.92	0.97	0.99	0.99	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

ALPHA = 4.9

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.08	0.17	0.31
0.2	0.00	0.00	0.00	0.01	0.02	0.04	0.11	0.23	0.43	0.62
0.3	0.00	0.00	0.01	0.02	0.05	0.12	0.26	0.47	0.69	0.83
0.4	0.01	0.01	0.02	0.05	0.12	0.27	0.49	0.71	0.86	0.93
0.5	0.01	0.03	0.06	0.13	0.28	0.50	0.72	0.87	0.94	0.97
0.6	0.04	0.07	0.14	0.29	0.51	0.73	0.88	0.95	0.98	0.99
0.7	0.10	0.17	0.31	0.53	0.74	0.88	0.95	0.98	0.99	1.00
0.8	0.25	0.38	0.57	0.77	0.89	0.96	0.98	0.99	1.00	1.00
0.9	0.55	0.69	0.83	0.92	0.97	0.99	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 5.0

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.08	0.17	0.32
0.2	0.00	0.00	0.00	0.01	0.02	0.04	0.10	0.23	0.43	0.63
0.3	0.00	0.00	0.01	0.02	0.05	0.11	0.26	0.48	0.69	0.84
0.4	0.00	0.01	0.02	0.05	0.12	0.27	0.49	0.72	0.86	0.94
0.5	0.01	0.02	0.05	0.12	0.27	0.50	0.73	0.88	0.95	0.98
0.6	0.04	0.06	0.14	0.28	0.51	0.73	0.88	0.95	0.98	0.99
0.7	0.09	0.16	0.31	0.52	0.74	0.89	0.95	0.98	0.99	1.00
0.8	0.24	0.37	0.57	0.77	0.90	0.96	0.98	0.99	1.00	1.00
0.9	0.54	0.68	0.83	0.92	0.97	0.99	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 5.1

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.07	0.17	0.32
0.2	0.00	0.00	0.00	0.01	0.01	0.04	0.10	0.23	0.44	0.64
0.3	0.00	0.00	0.01	0.02	0.04	0.11	0.25	0.48	0.70	0.84
0.4	0.00	0.01	0.02	0.05	0.12	0.26	0.49	0.72	0.87	0.94
0.5	0.01	0.02	0.05	0.12	0.27	0.50	0.73	0.88	0.95	0.98
0.6	0.03	0.06	0.13	0.28	0.51	0.74	0.88	0.95	0.98	0.99
0.7	0.09	0.16	0.30	0.52	0.75	0.89	0.96	0.98	0.99	1.00
0.8	0.23	0.36	0.56	0.77	0.90	0.96	0.99	0.99	1.00	1.00
0.9	0.53	0.68	0.83	0.93	0.97	0.99	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 5.2

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.07	0.17	0.32
0.2	0.00	0.00	0.00	0.01	0.01	0.04	0.10	0.23	0.44	0.65
0.3	0.00	0.00	0.01	0.02	0.04	0.11	0.25	0.48	0.71	0.85
0.4	0.00	0.01	0.02	0.04	0.11	0.26	0.49	0.73	0.88	0.94
0.5	0.01	0.02	0.05	0.12	0.26	0.50	0.74	0.88	0.95	0.98
0.6	0.03	0.06	0.12	0.27	0.51	0.74	0.89	0.96	0.98	0.99
0.7	0.08	0.15	0.29	0.52	0.75	0.89	0.96	0.98	0.99	1.00
0.8	0.22	0.35	0.56	0.77	0.90	0.96	0.99	0.99	1.00	1.00
0.9	0.52	0.68	0.83	0.93	0.97	0.99	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 5.3

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.07	0.17	0.33
0.2	0.00	0.00	0.00	0.00	0.01	0.04	0.09	0.23	0.44	0.65
0.3	0.00	0.00	0.01	0.01	0.04	0.10	0.25	0.48	0.71	0.86
0.4	0.00	0.01	0.02	0.04	0.11	0.25	0.49	0.73	0.88	0.95
0.5	0.01	0.02	0.04	0.11	0.26	0.50	0.74	0.89	0.96	0.98
0.6	0.03	0.05	0.12	0.27	0.51	0.75	0.89	0.96	0.98	0.99
0.7	0.08	0.14	0.29	0.52	0.75	0.90	0.96	0.99	0.99	1.00
0.8	0.21	0.35	0.56	0.77	0.91	0.96	0.99	1.00	1.00	1.00
0.9	0.51	0.67	0.83	0.93	0.97	0.99	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 5.4

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.07	0.17	0.33
0.2	0.00	0.00	0.00	0.00	0.01	0.03	0.09	0.22	0.44	0.66
0.3	0.00	0.00	0.00	0.01	0.04	0.10	0.24	0.48	0.72	0.86
0.4	0.00	0.01	0.01	0.04	0.10	0.25	0.49	0.74	0.88	0.95
0.5	0.01	0.02	0.04	0.11	0.26	0.50	0.74	0.89	0.96	0.98
0.6	0.03	0.05	0.12	0.26	0.51	0.75	0.90	0.96	0.99	0.99
0.7	0.08	0.14	0.28	0.52	0.76	0.90	0.96	0.99	1.00	1.00
0.8	0.21	0.34	0.56	0.78	0.91	0.97	0.99	1.00	1.00	1.00
0.9	0.51	0.67	0.83	0.93	0.93	0.99	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

ALPHA = 5.5

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.07	0.17	0.33
0.2	0.00	0.00	0.00	0.00	0.01	0.03	0.09	0.22	0.44	0.67
0.3	0.00	0.00	0.00	0.01	0.03	0.10	0.24	0.48	0.72	0.87
0.4	0.00	0.01	0.01	0.04	0.10	0.25	0.49	0.74	0.89	0.95
0.5	0.01	0.02	0.04	0.10	0.25	0.50	0.75	0.90	0.96	0.98
0.6	0.02	0.05	0.11	0.26	0.51	0.75	0.90	0.96	0.99	0.99
0.7	0.07	0.13	0.28	0.52	0.76	0.90	0.97	0.99	1.00	1.00
0.8	0.20	0.33	0.56	0.78	0.91	0.97	0.99	1.00	1.00	1.00
0.9	0.50	0.67	0.83	0.93	0.98	0.99	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 5.6

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.17	0.34
0.2	0.00	0.00	0.00	0.00	0.01	0.03	0.09	0.22	0.45	0.67
0.3	0.00	0.00	0.00	0.01	0.03	0.09	0.24	0.48	0.73	0.87
0.4	0.00	0.00	0.01	0.03	0.10	0.24	0.49	0.75	0.89	0.96
0.5	0.01	0.01	0.04	0.10	0.25	0.50	0.75	0.90	0.96	0.99
0.6	0.02	0.04	0.11	0.25	0.51	0.76	0.90	0.97	0.99	1.00
0.7	0.07	0.13	0.27	0.52	0.76	0.91	0.97	0.99	1.00	1.00
0.8	0.19	0.33	0.55	0.78	0.91	0.97	0.99	1.00	1.00	1.00
0.9	0.49	0.66	0.83	0.94	0.98	0.99	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 5.7

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.16	0.34
0.2	0.00	0.00	0.00	0.00	0.01	0.03	0.08	0.22	0.45	0.68
0.3	0.00	0.00	0.00	0.01	0.03	0.09	0.23	0.48	0.73	0.88
0.4	0.00	0.00	0.01	0.03	0.09	0.24	0.50	0.75	0.90	0.96
0.5	0.01	0.01	0.03	0.10	0.24	0.50	0.76	0.90	0.97	0.99
0.6	0.02	0.04	0.10	0.25	0.50	0.76	0.91	0.97	0.99	1.00
0.7	0.06	0.12	0.27	0.52	0.77	0.91	0.97	0.99	1.00	1.00
0.8	0.19	0.32	0.55	0.78	0.92	0.97	0.99	1.00	1.00	1.00
0.9	0.48	0.66	0.84	0.94	0.98	0.99	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 5.8

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.16	0.34
0.2	0.00	0.00	0.00	0.00	0.01	0.03	0.08	0.22	0.45	0.69
0.3	0.00	0.00	0.00	0.01	0.03	0.09	0.23	0.48	0.74	0.88
0.4	0.00	0.00	0.01	0.03	0.09	0.24	0.50	0.75	0.90	0.96
0.5	0.01	0.01	0.03	0.09	0.24	0.50	0.76	0.91	0.97	0.99
0.6	0.02	0.04	0.10	0.25	0.50	0.76	0.91	0.97	0.99	1.00
0.7	0.06	0.12	0.26	0.52	0.77	0.91	0.97	0.99	1.00	1.00
0.8	0.18	0.31	0.55	0.78	0.92	0.97	0.99	1.00	1.00	1.00
0.9	0.48	0.66	0.84	0.94	0.98	0.99	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 5.9

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.16	0.35
0.2	0.00	0.00	0.00	0.00	0.01	0.03	0.08	0.21	0.45	0.69
0.3	0.00	0.00	0.00	0.01	0.03	0.08	0.23	0.49	0.74	0.89
0.4	0.00	0.00	0.01	0.03	0.09	0.23	0.50	0.76	0.91	0.96
0.5	0.01	0.01	0.03	0.09	0.24	0.50	0.76	0.91	0.97	0.99
0.6	0.02	0.04	0.09	0.24	0.50	0.77	0.91	0.97	0.99	1.00
0.7	0.06	0.11	0.26	0.51	0.77	0.92	0.97	0.99	1.00	1.00
0.8	0.17	0.31	0.55	0.79	0.92	0.97	0.99	1.00	1.00	1.00
0.9	0.47	0.65	0.84	0.94	0.98	0.99	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 6.0

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.16	0.35
0.2	0.00	0.00	0.00	0.00	0.01	0.02	0.08	0.21	0.45	0.70
0.3	0.00	0.00	0.00	0.01	0.03	0.08	0.23	0.49	0.75	0.89
0.4	0.00	0.00	0.01	0.03	0.08	0.23	0.50	0.76	0.91	0.97
0.5	0.00	0.01	0.03	0.09	0.23	0.50	0.77	0.91	0.97	0.99
0.6	0.02	0.03	0.09	0.24	0.50	0.77	0.92	0.97	0.99	1.00
0.7	0.05	0.11	0.25	0.51	0.77	0.92	0.97	0.99	1.00	1.00
0.8	0.17	0.30	0.55	0.79	0.92	0.98	0.99	1.00	1.00	1.00
0.9	0.46	0.65	0.84	0.94	0.98	0.99	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

ALPHA = 6.1

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.16	0.35
0.2	0.00	0.00	0.00	0.00	0.01	0.02	0.07	0.21	0.46	0.70
0.3	0.00	0.00	0.00	0.01	0.02	0.08	0.22	0.49	0.75	0.90
0.4	0.00	0.00	0.01	0.03	0.08	0.23	0.50	0.77	0.91	0.97
0.5	0.00	0.01	0.03	0.08	0.23	0.50	0.77	0.92	0.97	0.99
0.6	0.02	0.03	0.09	0.23	0.50	0.77	0.92	0.97	0.99	1.00
0.7	0.05	0.10	0.25	0.51	0.78	0.92	0.98	0.99	1.00	1.00
0.8	0.16	0.30	0.54	0.79	0.93	0.98	0.99	1.00	1.00	1.00
0.9	0.46	0.65	0.84	0.94	0.98	0.99	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 6.2

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.16	0.36
0.2	0.00	0.00	0.00	0.00	0.01	0.02	0.07	0.21	0.46	0.71
0.3	0.00	0.00	0.00	0.01	0.02	0.08	0.22	0.49	0.76	0.90
0.4	0.00	0.00	0.01	0.02	0.08	0.22	0.50	0.77	0.92	0.97
0.5	0.00	0.01	0.03	0.08	0.23	0.50	0.77	0.92	0.97	0.99
0.6	0.01	0.03	0.08	0.23	0.50	0.78	0.92	0.98	0.99	1.00
0.7	0.05	0.10	0.24	0.51	0.78	0.92	0.98	0.99	1.00	1.00
0.8	0.15	0.29	0.54	0.79	0.93	0.98	0.99	1.00	1.00	1.00
0.9	0.45	0.64	0.84	0.95	0.98	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 6.3

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.16	0.36
0.2	0.00	0.00	0.00	0.00	0.01	0.02	0.07	0.20	0.46	0.72
0.3	0.00	0.00	0.00	0.01	0.02	0.07	0.22	0.49	0.76	0.90
0.4	0.00	0.00	0.01	0.02	0.07	0.22	0.50	0.77	0.92	0.97
0.5	0.00	0.01	0.02	0.08	0.22	0.50	0.78	0.92	0.98	0.99
0.6	0.01	0.03	0.08	0.23	0.50	0.78	0.93	0.98	0.99	1.00
0.7	0.04	0.10	0.24	0.51	0.78	0.93	0.98	0.99	1.00	1.00
0.8	0.15	0.28	0.54	0.80	0.93	0.98	0.99	1.00	1.00	1.00
0.9	0.44	0.64	0.84	0.95	0.98	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 6.4

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.16	0.36
0.2	0.00	0.00	0.00	0.00	0.01	0.02	0.07	0.20	0.46	0.72
0.3	0.00	0.00	0.00	0.01	0.02	0.07	0.21	0.49	0.77	0.91
0.4	0.00	0.00	0.01	0.02	0.07	0.22	0.50	0.78	0.92	0.97
0.5	0.00	0.01	0.02	0.07	0.22	0.50	0.78	0.93	0.98	0.99
0.6	0.01	0.03	0.08	0.22	0.50	0.78	0.93	0.98	0.99	1.00
0.7	0.04	0.09	0.23	0.51	0.79	0.93	0.98	0.99	1.00	1.00
0.8	0.14	0.28	0.54	0.80	0.93	0.98	0.99	1.00	1.00	1.00
0.9	0.44	0.64	0.84	0.95	0.98	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 6.5

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.16	0.36
0.2	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.20	0.46	0.73
0.3	0.00	0.00	0.00	0.01	0.02	0.07	0.21	0.49	0.77	0.91
0.4	0.00	0.00	0.01	0.02	0.07	0.21	0.50	0.78	0.93	0.97
0.5	0.00	0.01	0.02	0.07	0.22	0.50	0.78	0.93	0.98	0.99
0.6	0.01	0.03	0.07	0.22	0.50	0.79	0.93	0.98	0.99	1.00
0.7	0.04	0.09	0.23	0.51	0.79	0.93	0.98	0.99	1.00	1.00
0.8	0.14	0.27	0.54	0.80	0.94	0.98	0.99	1.00	1.00	1.00
0.9	0.43	0.64	0.84	0.95	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 6.6

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.15	0.37
0.2	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.20	0.46	0.73
0.3	0.00	0.00	0.00	0.01	0.02	0.07	0.21	0.49	0.77	0.92
0.4	0.00	0.00	0.01	0.02	0.07	0.21	0.50	0.79	0.93	0.98
0.5	0.00	0.01	0.02	0.07	0.21	0.50	0.79	0.93	0.98	0.99
0.6	0.01	0.02	0.07	0.21	0.50	0.79	0.93	0.98	0.99	1.00
0.7	0.04	0.08	0.23	0.51	0.79	0.93	0.98	0.99	1.00	1.00
0.8	0.13	0.27	0.54	0.80	0.94	0.98	1.00	1.00	1.00	1.00
0.9	0.42	0.63	0.85	0.95	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

ALPHA = 6.7

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.15	0.37
0.2	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.19	0.47	0.74
0.3	0.00	0.00	0.00	0.00	0.02	0.06	0.20	0.49	0.78	0.92
0.4	0.00	0.00	0.00	0.02	0.06	0.21	0.50	0.79	0.93	0.98
0.5	0.00	0.01	0.02	0.07	0.21	0.50	0.79	0.93	0.98	0.99
0.6	0.01	0.02	0.07	0.21	0.50	0.79	0.94	0.98	1.00	1.00
0.7	0.04	0.08	0.22	0.51	0.80	0.94	0.98	1.00	1.00	1.00
0.8	0.13	0.26	0.53	0.81	0.94	0.98	1.00	1.00	1.00	1.00
0.9	0.42	0.63	0.85	0.95	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 6.8

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.15	0.37
0.2	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.19	0.47	0.74
0.3	0.00	0.00	0.00	0.00	0.02	0.06	0.20	0.49	0.78	0.92
0.4	0.00	0.00	0.00	0.02	0.06	0.20	0.50	0.79	0.93	0.98
0.5	0.00	0.01	0.02	0.06	0.20	0.50	0.80	0.94	0.98	0.99
0.6	0.01	0.02	0.07	0.21	0.50	0.80	0.94	0.98	1.00	1.00
0.7	0.03	0.08	0.22	0.51	0.80	0.94	0.98	1.00	1.00	1.00
0.8	0.12	0.26	0.53	0.81	0.94	0.98	1.00	1.00	1.00	1.00
0.9	0.41	0.63	0.85	0.95	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 6.9

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.15	0.37
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.19	0.47	0.75
0.3	0.00	0.00	0.00	0.00	0.02	0.06	0.20	0.49	0.79	0.93
0.4	0.00	0.00	0.00	0.02	0.06	0.20	0.50	0.80	0.94	0.98
0.5	0.00	0.00	0.02	0.06	0.20	0.50	0.80	0.94	0.98	1.00
0.6	0.01	0.02	0.06	0.20	0.50	0.80	0.94	0.98	1.00	1.00
0.7	0.03	0.07	0.21	0.51	0.80	0.94	0.98	1.00	1.00	1.00
0.8	0.12	0.25	0.53	0.81	0.94	0.99	1.00	1.00	1.00	1.00
0.9	0.40	0.63	0.85	0.96	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 7.0

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.15	0.38
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.19	0.47	0.75
0.3	0.00	0.00	0.00	0.00	0.01	0.06	0.19	0.49	0.79	0.93
0.4	0.00	0.00	0.00	0.01	0.06	0.20	0.50	0.80	0.94	0.98
0.5	0.00	0.00	0.02	0.06	0.20	0.50	0.80	0.94	0.98	1.00
0.6	0.01	0.02	0.06	0.20	0.50	0.80	0.94	0.99	1.00	1.00
0.7	0.03	0.07	0.21	0.51	0.81	0.94	0.99	1.00	1.00	1.00
0.8	0.11	0.25	0.53	0.81	0.95	0.99	1.00	1.00	1.00	1.00
0.9	0.40	0.62	0.85	0.96	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 7.1

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.15	0.38
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.18	0.47	0.76
0.3	0.00	0.00	0.00	0.00	0.01	0.05	0.19	0.49	0.79	0.93
0.4	0.00	0.00	0.00	0.01	0.06	0.19	0.50	0.80	0.94	0.98
0.5	0.00	0.00	0.01	0.06	0.20	0.50	0.80	0.94	0.99	1.00
0.6	0.01	0.02	0.06	0.20	0.50	0.81	0.94	0.99	1.00	1.00
0.7	0.03	0.07	0.21	0.51	0.81	0.95	0.99	1.00	1.00	1.00
0.8	0.11	0.24	0.53	0.82	0.95	0.99	1.00	1.00	1.00	1.00
0.9	0.39	0.62	0.85	0.96	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 7.2

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.15	0.38
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.18	0.47	0.76
0.3	0.00	0.00	0.00	0.00	0.01	0.05	0.19	0.49	0.80	0.93
0.4	0.00	0.00	0.00	0.01	0.05	0.19	0.50	0.81	0.94	0.98
0.5	0.00	0.00	0.01	0.05	0.19	0.50	0.81	0.95	0.99	1.00
0.6	0.01	0.02	0.06	0.19	0.50	0.81	0.95	0.99	1.00	1.00
0.7	0.03	0.07	0.20	0.51	0.81	0.95	0.99	1.00	1.00	1.00
0.8	0.11	0.24	0.53	0.82	0.95	0.99	1.00	1.00	1.00	1.00
0.9	0.38	0.62	0.85	0.96	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

ALPHA = 7.3

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.14	0.38
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.18	0.47	0.77
0.3	0.00	0.00	0.00	0.00	0.01	0.05	0.19	0.49	0.80	0.94
0.4	0.00	0.00	0.00	0.01	0.05	0.19	0.50	0.81	0.95	0.98
0.5	0.00	0.00	0.01	0.05	0.19	0.50	0.81	0.95	0.99	1.00
0.6	0.01	0.02	0.05	0.19	0.50	0.81	0.95	0.99	1.00	1.00
0.7	0.02	0.06	0.20	0.51	0.81	0.95	0.99	1.00	1.00	1.00
0.8	0.10	0.23	0.53	0.82	0.95	0.99	1.00	1.00	1.00	1.00
0.9	0.38	0.62	0.86	0.96	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 7.4

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.14	0.39
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.18	0.47	0.77
0.3	0.00	0.00	0.00	0.00	0.01	0.05	0.18	0.49	0.80	0.94
0.4	0.00	0.00	0.00	0.01	0.05	0.19	0.50	0.81	0.95	0.99
0.5	0.00	0.00	0.01	0.05	0.19	0.50	0.81	0.95	0.99	1.00
0.6	0.01	0.01	0.05	0.19	0.50	0.81	0.95	0.99	1.00	1.00
0.7	0.02	0.06	0.20	0.51	0.82	0.95	0.99	1.00	1.00	1.00
0.8	0.10	0.23	0.53	0.82	0.95	0.99	1.00	1.00	1.00	1.00
0.9	0.37	0.61	0.86	0.96	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 7.5

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.14	0.39
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.17	0.48	0.78
0.3	0.00	0.00	0.00	0.00	0.01	0.05	0.18	0.49	0.81	0.94
0.4	0.00	0.00	0.00	0.01	0.05	0.18	0.50	0.82	0.95	0.99
0.5	0.00	0.00	0.01	0.05	0.18	0.50	0.82	0.95	0.99	1.00
0.6	0.00	0.01	0.05	0.18	0.50	0.82	0.95	0.99	1.00	1.00
0.7	0.02	0.06	0.19	0.51	0.82	0.95	0.99	1.00	1.00	1.00
0.8	0.09	0.22	0.52	0.83	0.95	0.99	1.00	1.00	1.00	1.00
0.9	0.36	0.61	0.86	0.96	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 7.6

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.14	0.39
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.17	0.48	0.78
0.3	0.00	0.00	0.00	0.00	0.01	0.05	0.18	0.49	0.81	0.94
0.4	0.00	0.00	0.00	0.01	0.05	0.18	0.50	0.82	0.95	0.99
0.5	0.00	0.00	0.01	0.05	0.18	0.50	0.82	0.95	0.99	1.00
0.6	0.00	0.01	0.05	0.18	0.50	0.82	0.95	0.99	1.00	1.00
0.7	0.02	0.06	0.19	0.51	0.82	0.95	0.99	1.00	1.00	1.00
0.8	0.09	0.22	0.52	0.83	0.96	0.99	1.00	1.00	1.00	1.00
0.9	0.36	0.61	0.86	0.96	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 7.7

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.14	0.39
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.17	0.48	0.79
0.3	0.00	0.00	0.00	0.00	0.01	0.04	0.17	0.50	0.82	0.95
0.4	0.00	0.00	0.00	0.01	0.04	0.18	0.50	0.82	0.95	0.99
0.5	0.00	0.00	0.01	0.04	0.18	0.50	0.82	0.96	0.99	1.00
0.6	0.00	0.01	0.05	0.18	0.50	0.82	0.96	0.99	1.00	1.00
0.7	0.02	0.05	0.18	0.50	0.83	0.96	0.99	1.00	1.00	1.00
0.8	0.09	0.21	0.52	0.83	0.96	0.99	1.00	1.00	1.00	1.00
0.9	0.35	0.61	0.86	0.97	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 7.8

DELTA

T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.14	0.39
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.17	0.48	0.79
0.3	0.00	0.00	0.00	0.00	0.01	0.04	0.17	0.50	0.82	0.95
0.4	0.00	0.00	0.00	0.01	0.04	0.17	0.50	0.82	0.96	0.99
0.5	0.00	0.00	0.01	0.04	0.17	0.50	0.83	0.96	0.99	1.00
0.6	0.00	0.01	0.04	0.18	0.50	0.83	0.96	0.99	1.00	1.00
0.7	0.02	0.05	0.18	0.50	0.83	0.96	0.99	1.00	1.00	1.00
0.8	0.08	0.21	0.52	0.83	0.96	0.99	1.00	1.00	1.00	1.00
0.9	0.35	0.61	0.86	0.97	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

ALPHA = 7.9

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.14	0.40
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.16	0.48	0.79
0.3	0.00	0.00	0.00	0.00	0.01	0.04	0.17	0.50	0.82	0.95
0.4	0.00	0.00	0.00	0.01	0.04	0.17	0.50	0.83	0.96	0.99
0.5	0.00	0.00	0.01	0.04	0.17	0.50	0.83	0.96	0.99	1.00
0.6	0.00	0.01	0.04	0.17	0.50	0.83	0.96	0.99	1.00	1.00
0.7	0.02	0.05	0.18	0.50	0.83	0.96	0.99	1.00	1.00	1.00
0.8	0.08	0.21	0.52	0.84	0.96	0.99	1.00	1.00	1.00	1.00
0.9	0.34	0.60	0.86	0.97	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 8.0

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.13	0.40
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.16	0.48	0.80
0.3	0.00	0.00	0.00	0.00	0.01	0.04	0.17	0.50	0.83	0.95
0.4	0.00	0.00	0.00	0.01	0.04	0.17	0.50	0.83	0.96	0.99
0.5	0.00	0.00	0.01	0.04	0.17	0.50	0.83	0.96	0.99	1.00
0.6	0.00	0.01	0.04	0.17	0.50	0.83	0.96	0.99	1.00	1.00
0.7	0.02	0.05	0.17	0.50	0.83	0.96	0.99	1.00	1.00	1.00
0.8	0.08	0.20	0.52	0.84	0.96	0.99	1.00	1.00	1.00	1.00
0.9	0.34	0.60	0.87	0.97	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 8.1

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.13	0.40
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.16	0.48	0.80
0.3	0.00	0.00	0.00	0.00	0.01	0.04	0.16	0.50	0.83	0.95
0.4	0.00	0.00	0.00	0.01	0.04	0.17	0.50	0.83	0.96	0.99
0.5	0.00	0.00	0.01	0.04	0.17	0.50	0.83	0.96	0.99	1.00
0.6	0.00	0.01	0.04	0.17	0.50	0.83	0.96	0.99	1.00	1.00
0.7	0.02	0.05	0.17	0.50	0.84	0.96	0.99	1.00	1.00	1.00
0.8	0.08	0.20	0.52	0.84	0.96	0.99	1.00	1.00	1.00	1.00
0.9	0.33	0.60	0.87	0.97	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 8.2

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.13	0.40
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.16	0.48	0.81
0.3	0.00	0.00	0.00	0.00	0.01	0.04	0.16	0.50	0.83	0.96
0.4	0.00	0.00	0.00	0.01	0.04	0.16	0.50	0.84	0.96	0.99
0.5	0.00	0.00	0.01	0.04	0.16	0.50	0.84	0.96	0.99	1.00
0.6	0.00	0.01	0.04	0.16	0.50	0.84	0.96	0.99	1.00	1.00
0.7	0.01	0.04	0.17	0.50	0.84	0.96	0.99	1.00	1.00	1.00
0.8	0.07	0.19	0.52	0.84	0.97	0.99	1.00	1.00	1.00	1.00
0.9	0.32	0.60	0.87	0.97	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 8.3

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.13	0.40
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.15	0.48	0.81
0.3	0.00	0.00	0.00	0.00	0.01	0.03	0.16	0.50	0.83	0.96
0.4	0.00	0.00	0.00	0.01	0.03	0.16	0.50	0.84	0.96	0.99
0.5	0.00	0.00	0.01	0.04	0.16	0.50	0.84	0.96	0.99	1.00
0.6	0.00	0.01	0.04	0.16	0.50	0.84	0.97	0.99	1.00	1.00
0.7	0.01	0.04	0.17	0.50	0.84	0.97	0.99	1.00	1.00	1.00
0.8	0.07	0.19	0.52	0.85	0.97	0.99	1.00	1.00	1.00	1.00
0.9	0.32	0.60	0.87	0.97	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 8.4

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.13	0.41
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.15	0.48	0.81
0.3	0.00	0.00	0.00	0.00	0.01	0.03	0.16	0.50	0.84	0.96
0.4	0.00	0.00	0.00	0.01	0.03	0.16	0.50	0.84	0.97	0.99
0.5	0.00	0.00	0.01	0.03	0.16	0.50	0.84	0.97	0.99	1.00
0.6	0.00	0.01	0.03	0.16	0.50	0.84	0.97	0.99	1.00	1.00
0.7	0.01	0.04	0.16	0.50	0.84	0.97	0.99	1.00	1.00	1.00
0.8	0.07	0.19	0.52	0.85	0.97	0.99	1.00	1.00	1.00	1.00
0.9	0.31	0.59	0.87	0.97	0.99	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

ALPHA = 8.5

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.13	0.41
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.15	0.48	0.82
0.3	0.00	0.00	0.00	0.00	0.01	0.03	0.15	0.50	0.84	0.96
0.4	0.00	0.00	0.00	0.01	0.03	0.15	0.50	0.84	0.97	0.99
0.5	0.00	0.00	0.01	0.03	0.15	0.50	0.85	0.97	0.99	1.00
0.6	0.00	0.01	0.03	0.16	0.50	0.85	0.97	0.99	1.00	1.00
0.7	0.01	0.04	0.16	0.50	0.85	0.97	0.99	1.00	1.00	1.00
0.8	0.06	0.18	0.52	0.85	0.97	0.99	1.00	1.00	1.00	1.00
0.9	0.31	0.59	0.87	0.97	1.00	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 8.6

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.12	0.41
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.15	0.48	0.82
0.3	0.00	0.00	0.00	0.00	0.01	0.03	0.15	0.50	0.84	0.96
0.4	0.00	0.00	0.00	0.01	0.03	0.15	0.50	0.85	0.97	0.99
0.5	0.00	0.00	0.01	0.03	0.15	0.50	0.85	0.97	0.99	1.00
0.6	0.00	0.01	0.03	0.15	0.50	0.85	0.97	0.99	1.00	1.00
0.7	0.01	0.04	0.16	0.50	0.85	0.97	0.99	1.00	1.00	1.00
0.8	0.06	0.18	0.52	0.85	0.97	0.99	1.00	1.00	1.00	1.00
0.9	0.30	0.59	0.88	0.97	1.00	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 8.7

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.12	0.41
0.2	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.14	0.48	0.82
0.3	0.00	0.00	0.00	0.00	0.01	0.03	0.15	0.50	0.85	0.96
0.4	0.00	0.00	0.00	0.01	0.03	0.15	0.50	0.85	0.97	0.99
0.5	0.00	0.00	0.01	0.03	0.15	0.50	0.85	0.97	0.99	1.00
0.6	0.00	0.01	0.03	0.15	0.50	0.85	0.97	0.99	1.00	1.00
0.7	0.01	0.04	0.15	0.50	0.85	0.97	0.99	1.00	1.00	1.00
0.8	0.06	0.18	0.52	0.86	0.97	0.99	1.00	1.00	1.00	1.00
0.9	0.30	0.59	0.88	0.98	1.00	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 8.8

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.12	0.41
0.2	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.14	0.49	0.83
0.3	0.00	0.00	0.00	0.00	0.01	0.03	0.15	0.50	0.85	0.97
0.4	0.00	0.00	0.00	0.01	0.03	0.15	0.50	0.85	0.97	0.99
0.5	0.00	0.00	0.01	0.03	0.15	0.50	0.85	0.97	0.99	1.00
0.6	0.00	0.01	0.03	0.15	0.50	0.85	0.97	0.99	1.00	1.00
0.7	0.01	0.03	0.15	0.50	0.85	0.97	0.99	1.00	1.00	1.00
0.8	0.06	0.17	0.51	0.86	0.97	1.00	1.00	1.00	1.00	1.00
0.9	0.29	0.59	0.88	0.98	1.00	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 8.9

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.12	0.42
0.2	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.14	0.49	0.83
0.3	0.00	0.00	0.00	0.00	0.00	0.03	0.14	0.50	0.85	0.97
0.4	0.00	0.00	0.00	0.00	0.03	0.14	0.50	0.86	0.97	0.99
0.5	0.00	0.00	0.00	0.03	0.14	0.50	0.86	0.97	1.00	1.00
0.6	0.00	0.01	0.03	0.14	0.50	0.86	0.97	1.00	1.00	1.00
0.7	0.01	0.03	0.15	0.50	0.86	0.97	1.00	1.00	1.00	1.00
0.8	0.06	0.17	0.51	0.86	0.97	1.00	1.00	1.00	1.00	1.00
0.9	0.29	0.58	0.88	0.98	1.00	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 9.0

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.12	0.42
0.2	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.14	0.49	0.83
0.3	0.00	0.00	0.00	0.00	0.00	0.03	0.14	0.50	0.85	0.97
0.4	0.00	0.00	0.00	0.00	0.03	0.14	0.50	0.86	0.97	0.99
0.5	0.00	0.00	0.00	0.03	0.14	0.50	0.86	0.97	1.00	1.00
0.6	0.00	0.01	0.03	0.14	0.50	0.86	0.97	1.00	1.00	1.00
0.7	0.01	0.03	0.15	0.50	0.86	0.97	1.00	1.00	1.00	1.00
0.8	0.05	0.17	0.51	0.86	0.97	1.00	1.00	1.00	1.00	1.00
0.9	0.28	0.58	0.88	0.98	1.00	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

COMPUTED COORDINATES FOR BASIC FEASIBLE TASK CHARACTERISTIC CURVES

ALPHA = 9.1

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.12	0.42
0.2	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.14	0.49	0.84
0.3	0.00	0.00	0.00	0.00	0.00	0.03	0.14	0.50	0.86	0.97
0.4	0.00	0.00	0.00	0.00	0.03	0.14	0.50	0.86	0.97	1.00
0.5	0.00	0.00	0.00	0.03	0.14	0.50	0.86	0.97	1.00	1.00
0.6	0.00	0.00	0.03	0.14	0.50	0.86	0.97	1.00	1.00	1.00
0.7	0.01	0.03	0.14	0.50	0.86	0.97	1.00	1.00	1.00	1.00
0.8	0.05	0.16	0.51	0.86	0.98	1.00	1.00	1.00	1.00	1.00
0.9	0.28	0.58	0.88	0.98	1.00	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 9.2

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.12	0.42
0.2	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.13	0.49	0.84
0.3	0.00	0.00	0.00	0.00	0.00	0.02	0.14	0.50	0.86	0.97
0.4	0.00	0.00	0.00	0.00	0.02	0.14	0.50	0.86	0.97	1.00
0.5	0.00	0.00	0.00	0.02	0.14	0.50	0.86	0.98	1.00	1.00
0.6	0.00	0.00	0.03	0.14	0.50	0.86	0.98	1.00	1.00	1.00
0.7	0.01	0.03	0.14	0.50	0.86	0.98	1.00	1.00	1.00	1.00
0.8	0.05	0.16	0.51	0.87	0.98	1.00	1.00	1.00	1.00	1.00
0.9	0.27	0.58	0.88	0.98	1.00	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 9.3

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.11	0.42
0.2	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.13	0.49	0.84
0.3	0.00	0.00	0.00	0.00	0.00	0.02	0.13	0.50	0.86	0.97
0.4	0.00	0.00	0.00	0.00	0.02	0.13	0.50	0.86	0.98	1.00
0.5	0.00	0.00	0.00	0.02	0.13	0.50	0.87	0.98	1.00	1.00
0.6	0.00	0.00	0.02	0.14	0.50	0.87	0.98	1.00	1.00	1.00
0.7	0.01	0.03	0.14	0.50	0.87	0.98	1.00	1.00	1.00	1.00
0.8	0.05	0.16	0.51	0.87	0.98	1.00	1.00	1.00	1.00	1.00
0.9	0.27	0.58	0.89	0.98	1.00	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 9.4

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.11	0.42
0.2	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.13	0.49	0.85
0.3	0.00	0.00	0.00	0.00	0.00	0.02	0.13	0.50	0.86	0.97
0.4	0.00	0.00	0.00	0.00	0.02	0.13	0.50	0.87	0.98	1.00
0.5	0.00	0.00	0.00	0.02	0.13	0.50	0.87	0.98	1.00	1.00
0.6	0.00	0.00	0.02	0.13	0.50	0.87	0.98	1.00	1.00	1.00
0.7	0.01	0.03	0.14	0.50	0.87	0.98	1.00	1.00	1.00	1.00
0.8	0.05	0.15	0.51	0.87	0.98	1.00	1.00	1.00	1.00	1.00
0.9	0.26	0.58	0.89	0.98	1.00	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 9.5

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.11	0.43
0.2	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.13	0.49	0.85
0.3	0.00	0.00	0.00	0.00	0.00	0.02	0.13	0.50	0.87	0.97
0.4	0.00	0.00	0.00	0.00	0.02	0.13	0.50	0.87	0.98	1.00
0.5	0.00	0.00	0.00	0.02	0.13	0.50	0.87	0.98	1.00	1.00
0.6	0.00	0.00	0.02	0.13	0.50	0.87	0.98	1.00	1.00	1.00
0.7	0.01	0.03	0.13	0.50	0.87	0.98	1.00	1.00	1.00	1.00
0.8	0.04	0.15	0.51	0.87	0.98	1.00	1.00	1.00	1.00	1.00
0.9	0.26	0.57	0.89	0.98	1.00	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALPHA = 9.6

	DELTA									
T	-0.5	-0.4	-0.3	-0.2	-0.1	0.	0.1	0.2	0.3	0.4
0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.11	0.43
0.2	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.13	0.49	0.85
0.3	0.00	0.00	0.00	0.00	0.00	0.02	0.13	0.50	0.87	0.98
0.4	0.00	0.00	0.00	0.00	0.02	0.13	0.50	0.87	0.98	1.00
0.5	0.00	0.00	0.00	0.02	0.13	0.50	0.87	0.98	1.00	1.00
0.6	0.00	0.00	0.02	0.13	0.50	0.87	0.98	1.00	1.00	1.00
0.7	0.01	0.02	0.13	0.50	0.87	0.98	1.00	1.00	1.00	1.00
0.8	0.04	0.15	0.51	0.87	0.98	1.00	1.00	1.00	1.00	1.00
0.9	0.26	0.57	0.89	0.98	1.00	1.00	1.00	1.00	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

APPENDIX B

COMPUTATIONAL ALGORITHMS, COMPUTATIONS, AND GRAPHS OF SELECTED TOC AND ROC CURVES

APPENDIX B-I

FORTRAN IV PROGRAM FOR IBM 7040 COMPUTER FOR SELECTED TOC CURVES

FORTAN IV PROGRAM LISTING OF TOC CURVE COORDINATES

```
   REAL K1,K2
   DIMENSION X(5,20),Y(5,20)
   DO8KK = 1,5
   GO TO (1,2,3,4,5),KK
1  ALP = 2.
   DEL =   .2
   GO TO 6
2  ALP = 3.
   DEL = .1
   GO TO 6
3  ALP = .1
   DEL = 0.
   GO TO 6
4  ALP = 2.
   DEL = -.1
   GO TO 6
5  ALP = 3.
   DEL = -.2
6  DO7I = 1,5
   DO 7 J = 1,20
   X(I,J) =FLOAT((I-1)*20+J)/100.
   T= X(I,J)
   K1=ALP*(1.-2.*DEL)
   K2=2.*ALP
   B=EXP(K1) + EXP(K2)
```

```
      C = EXP(K2) - 1.
      D = EXP(K2*T)  - 1.
      E = EXP(K2*T) + EXP(K1)
      Y(I,J)=((B)/C)*(D/(  E))
    7 CONTINUE
      PRINT 10, ALP ,DEL
   10 FORMAT(1H1//// 40X,7HALPHA =F4.1//40X  7HDELTA = F4.1////
      14X,1HT 1 4X,3HTOC,5X,1HT,4X,3HTOC,5X,1HT,4X,3HTOC,5X,
      1HT,4X, 3HTOC,5X,1HT, 24X,3HTOC)
      DO 8 J = 1,20
    8 PRINT11, (X(I,J),Y(I,J),I =1,5)
   11 FORMAT(/10X, 5(F7.2,F6.2))
      STOP
      END
```

APPENDIX B-2

COMPUTATIONS AND GRAPHS FOR SELECTED TOC CURVES

DATA FOR TOC CURVE I

ALPHA = 2.0

DELTA = 0.2

T	TOC	T	TOC	T	TOC	T	TOC	T	TOC
0.01	0.01	0.21	0.25	0.41	0.53	0.61	0.77	0.81	0.92
0.02	0.02	0.22	0.27	0.42	0.54	0.62	0.77	0.82	0.92
0.03	0.03	0.23	0.28	0.43	0.56	0.63	0.78	0.83	0.93
0.04	0.04	0.24	0.29	0.44	0.57	0.64	0.79	0.84	0.94
0.05	0.05	0.25	0.31	0.45	0.58	0.65	0.80	0.85	0.94
0.06	0.06	0.26	0.32	0.46	0.60	0.66	0.81	0.86	0.95
0.07	0.08	0.27	0.34	0.47	0.61	0.67	0.82	0.87	0.95
0.08	0.09	0.28	0.35	0.48	0.62	0.68	0.83	0.88	0.95
0.09	0.10	0.29	0.36	0.49	0.63	0.69	0.84	0.89	0.96
0.10	0.11	0.30	0.38	0.50	0.64	0.70	0.84	0.90	0.96
0.11	0.12	0.31	0.39	0.51	0.66	0.71	0.85	0.91	0.97
0.12	0.13	0.32	0.41	0.52	0.67	0.72	0.86	0.92	0.97
0.13	0.15	0.33	0.42	0.53	0.68	0.73	0.87	0.93	0.98
0.14	0.16	0.34	0.43	0.54	0.69	0.74	0.87	0.94	0.98
0.15	0.17	0.35	0.45	0.55	0.70	0.75	0.88	0.95	0.98
0.16	0.19	0.36	0.46	0.56	0.71	0.76	0.89	0.96	0.99
0.17	0.20	0.37	0.48	0.57	0.72	0.77	0.89	0.97	0.99
0.18	0.21	0.38	0.49	0.58	0.73	0.78	0.90	0.98	0.99
0.19	0.23	0.39	0.50	0.59	0.75	0.79	0.91	0.99	1.00
0.20	0.24	0.40	0.52	0.60	0.76	0.80	0.91	1.00	1.00

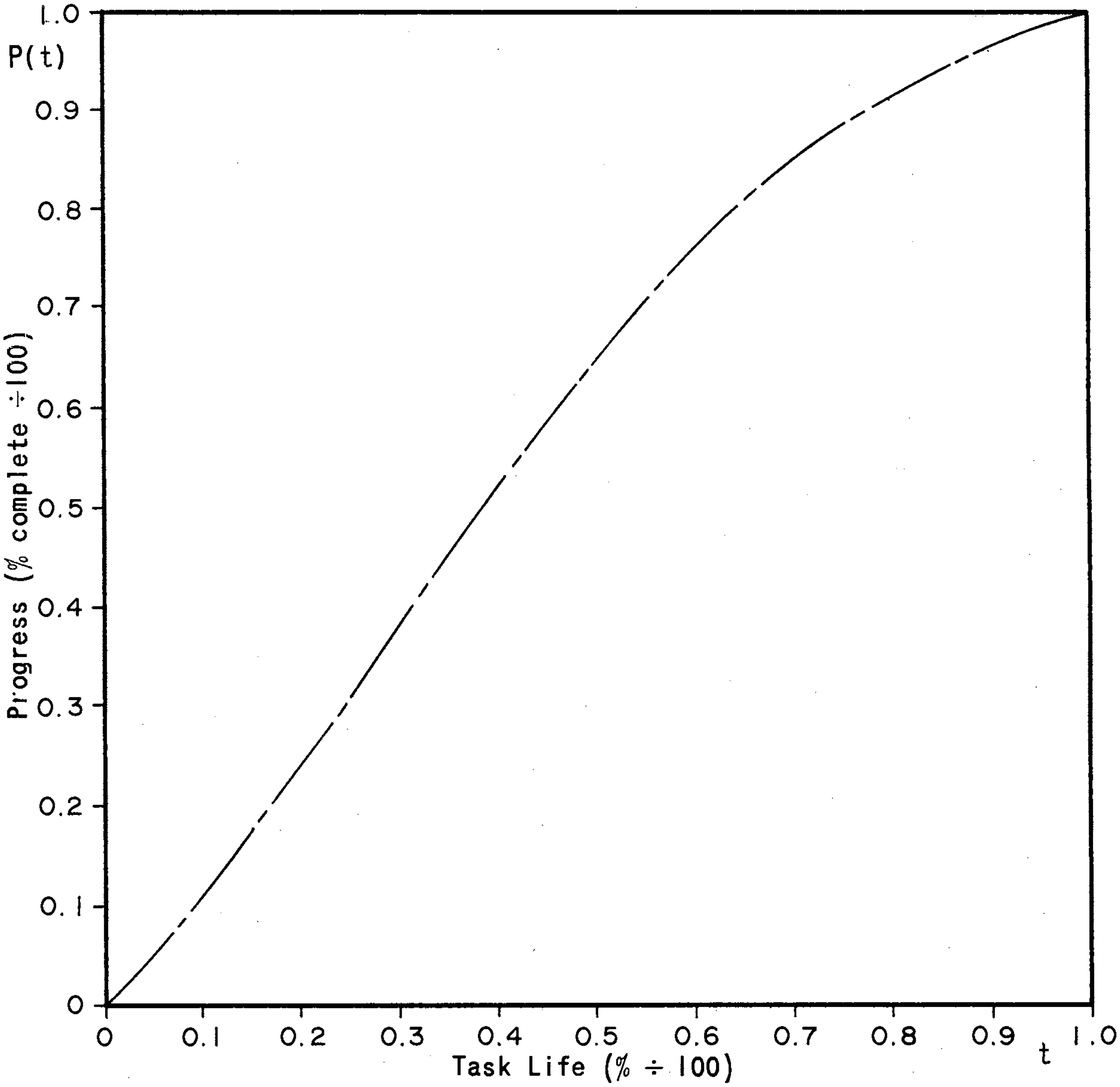

Figure 23. TOC Curve I

DATA FOR TOC CURVE II

ALPHA = 3.0

DELTA = 0.1

T	TOC	T	TOC	T	TOC	T	TOC	T	TOC
0.01	0.01	0.21	0.18	0.41	0.49	0.61	0.78	0.81	0.94
0.02	0.01	0.22	0.19	0.42	0.50	0.62	0.79	0.82	0.95
0.03	0.02	0.23	0.20	0.43	0.52	0.63	0.80	0.83	0.95
0.04	0.02	0.24	0.22	0.44	0.54	0.64	0.81	0.84	0.96
0.05	0.03	0.25	0.23	0.45	0.55	0.65	0.82	0.85	0.96
0.06	0.04	0.26	0.25	0.46	0.57	0.66	0.83	0.86	0.96
0.07	0.04	0.27	0.26	0.47	0.58	0.67	0.84	0.87	0.97
0.08	0.05	0.28	0.27	0.48	0.60	0.68	0.85	0.88	0.97
0.09	0.06	0.29	0.29	0.49	0.62	0.69	0.86	0.89	0.97
0.10	0.07	0.30	0.30	0.50	0.63	0.70	0.87	0.90	0.98
0.11	0.07	0.31	0.32	0.51	0.65	0.71	0.88	0.91	0.98
0.12	0.08	0.32	0.34	0.52	0.66	0.72	0.89	0.92	0.98
0.13	0.09	0.33	0.35	0.53	0.68	0.73	0.89	0.93	0.99
0.14	0.10	0.34	0.37	0.54	0.69	0.74	0.90	0.94	0.99
0.15	0.11	0.35	0.38	0.55	0.71	0.75	0.91	0.95	0.99
0.16	0.12	0.36	0.40	0.56	0.72	0.76	0.91	0.96	0.99
0.17	0.13	0.37	0.42	0.57	0.73	0.77	0.92	0.97	0.99
0.18	0.14	0.38	0.43	0.58	0.75	0.78	0.93	0.98	1.00
0.19	0.15	0.39	0.45	0.59	0.76	0.79	0.93	0.99	1.00
0.20	0.17	0.40	0.47	0.60	0.77	0.80	0.94	1.00	1.00

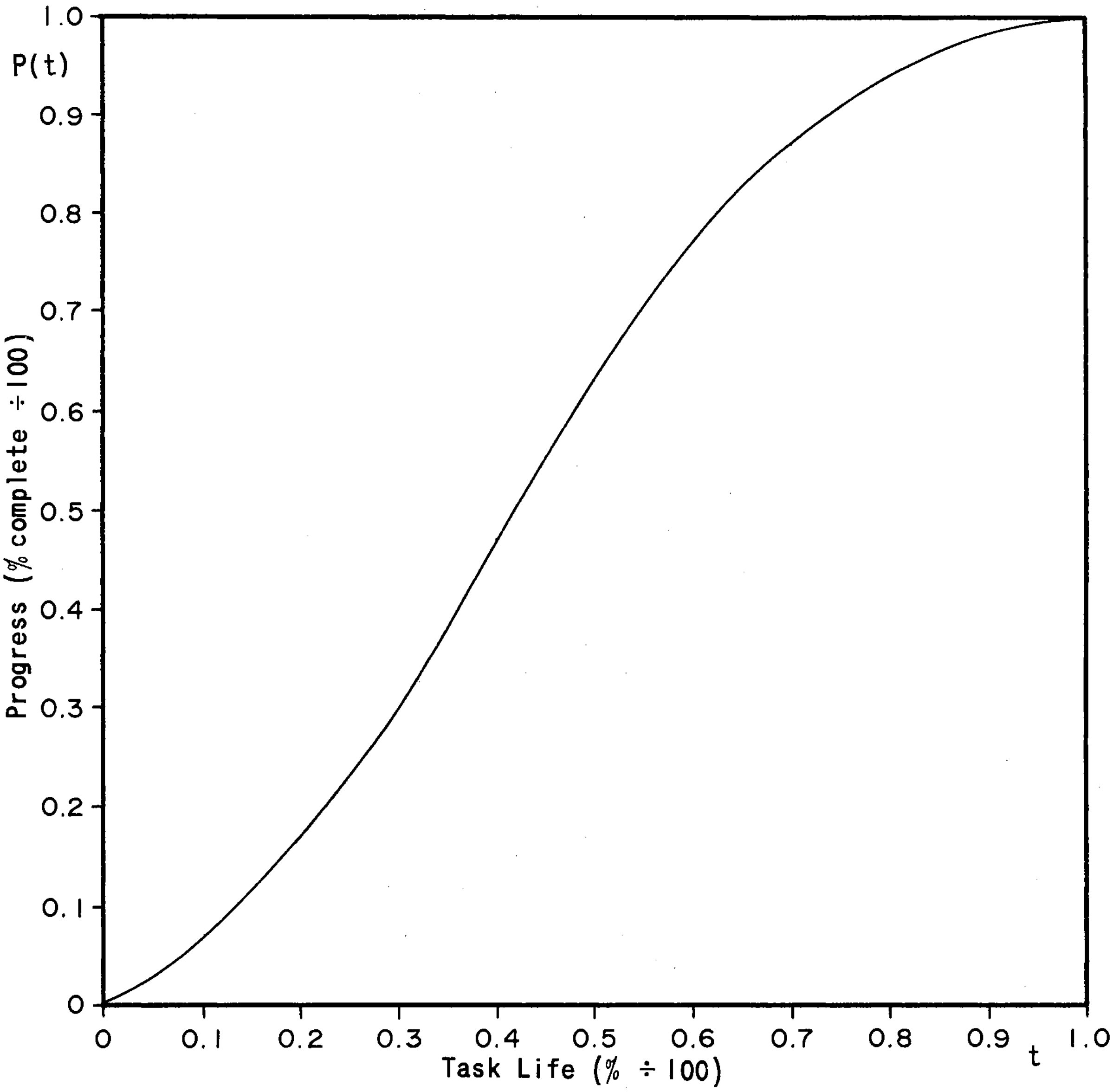

Figure 24. TOC Curve II

DATA FOR TOC CURVE III

ALPHA = 0.

DELTA = 0.

T	TOC	T	TOC	T	TOC	T	TOC	T	TOC
0.01	0.01	0.21	0.21	0.41	0.41	0.61	0.61	0.81	0.81
0.02	0.02	0.22	0.22	0.42	0.42	0.62	0.62	0.82	0.82
0.03	0.03	0.23	0.23	0.43	0.43	0.63	0.63	0.83	0.83
0.04	0.04	0.24	0.24	0.44	0.44	0.64	0.64	0.84	0.84
0.05	0.05	0.25	0.25	0.45	0.45	0.65	0.65	0.85	0.85
0.06	0.06	0.26	0.26	0.46	0.46	0.66	0.66	0.86	0.86
0.07	0.07	0.27	0.27	0.47	0.47	0.67	0.67	0.87	0.87
0.08	0.08	0.28	0.28	0.48	0.48	0.68	0.68	0.88	0.88
0.09	0.09	0.29	0.29	0.49	0.49	0.69	0.69	0.89	0.89
0.10	0.10	0.30	0.30	0.50	0.50	0.70	0.70	0.90	0.90
0.11	0.11	0.31	0.31	0.51	0.51	0.71	0.71	0.91	0.91
0.12	0.12	0.32	0.32	0.52	0.52	0.72	0.72	0.92	0.92
0.13	0.13	0.33	0.33	0.53	0.53	0.73	0.73	0.93	0.93
0.14	0.14	0.34	0.34	0.54	0.54	0.74	0.74	0.94	0.94
0.15	0.15	0.35	0.35	0.55	0.55	0.75	0.75	0.95	0.95
0.16	0.16	0.36	0.36	0.56	0.56	0.76	0.76	0.96	0.96
0.17	0.17	0.37	0.37	0.57	0.57	0.77	0.77	0.97	0.97
0.18	0.18	0.38	0.38	0.58	0.58	0.78	0.78	0.98	0.98
0.19	0.19	0.39	0.39	0.59	0.59	0.79	0.79	0.99	0.99
0.20	0.20	0.40	0.40	0.60	0.60	0.80	0.80	1.00	1.00

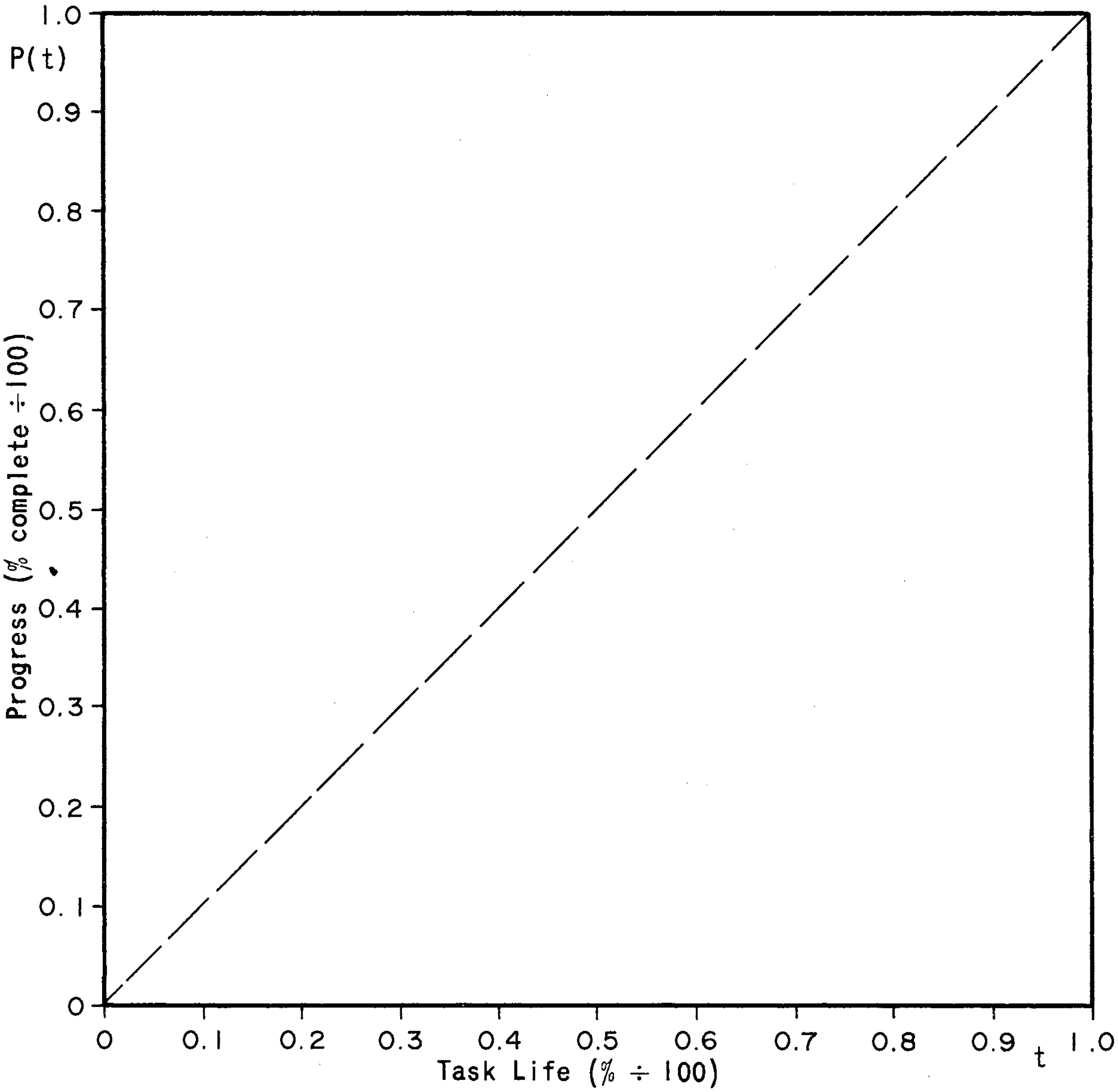

Figure 25. TOC Curve III

DATA FOR TOC CURVE IV

ALPHA = 2.0

DELTA =-0.1

T	TOC	T	TOC	T	TOC	T	TOC	T	TOC
0.01	0.00	0.21	0.12	0.41	0.31	0.61	0.57	0.81	0.82
0.02	0.01	0.22	0.13	0.42	0.33	0.62	0.58	0.82	0.83
0.03	0.01	0.23	0.14	0.43	0.34	0.63	0.60	0.83	0.84
0.04	0.02	0.24	0.14	0.44	0.35	0.64	0.61	0.84	0.85
0.05	0.02	0.25	0.15	0.45	0.36	0.65	0.62	0.85	0.87
0.06	0.03	0.26	0.16	0.46	0.37	0.66	0.64	0.86	0.88
0.07	0.03	0.27	0.17	0.47	0.39	0.67	0.65	0.87	0.89
0.08	0.04	0.28	0.18	0.48	0.40	0.68	0.66	0.88	0.90
0.09	0.04	0.29	0.19	0.49	0.41	0.69	0.68	0.89	0.91
0.10	0.05	0.30	0.20	0.50	0.42	0.70	0.69	0.90	0.92
0.11	0.05	0.31	0.21	0.51	0.44	0.71	0.70	0.91	0.92
0.12	0.06	0.32	0.22	0.52	0.45	0.72	0.71	0.92	0.93
0.13	0.07	0.33	0.23	0.53	0.46	0.73	0.73	0.93	0.94
0.14	0.07	0.34	0.24	0.54	0.48	0.74	0.74	0.94	0.95
0.15	0.08	0.35	0.25	0.55	0.49	0.75	0.75	0.95	0.96
0.16	0.08	0.36	0.26	0.56	0.50	0.76	0.76	0.96	0.97
0.17	0.09	0.37	0.27	0.57	0.52	0.77	0.78	0.97	0.98
0.18	0.10	0.38	0.28	0.58	0.53	0.78	0.79	0.98	0.98
0.19	0.11	0.39	0.29	0.59	0.54	0.79	0.80	0.99	0.99
0.20	0.11	0.40	0.30	0.60	0.56	0.80	0.81	1.00	1.00

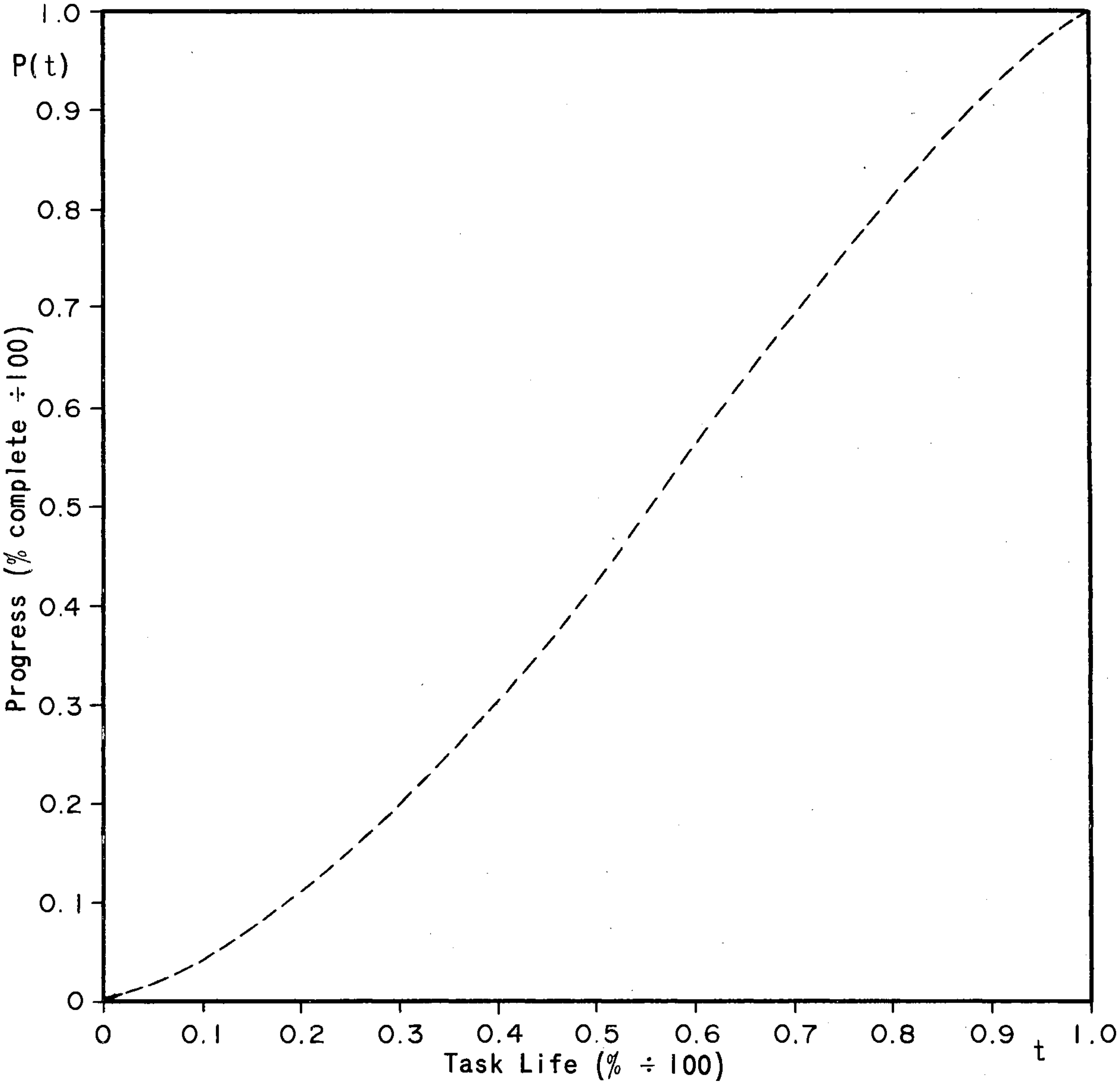

Figure 26. TOC Curve IV

DATA FOR TOC CURVE V

ALPHA = 3.0

DELTA =-0.2

T	TOC	T	TOC	T	TOC	T	TOC	T	TOC
0.01	0.00	0.21	0.04	0.41	0.16	0.61	0.42	0.81	0.76
0.02	0.00	0.22	0.05	0.42	0.17	0.62	0.44	0.82	0.78
0.03	0.00	0.23	0.05	0.43	0.18	0.63	0.45	0.83	0.80
0.04	0.00	0.24	0.05	0.44	0.19	0.64	0.47	0.84	0.81
0.05	0.01	0.25	0.06	0.45	0.20	0.65	0.49	0.85	0.83
0.06	0.01	0.26	0.06	0.46	0.21	0.66	0.50	0.86	0.84
0.07	0.01	0.27	0.07	0.47	0.22	0.67	0.52	0.87	0.85
0.08	0.01	0.28	0.07	0.48	0.23	0.68	0.54	0.88	0.87
0.09	0.01	0.29	0.08	0.49	0.24	0.69	0.56	0.89	0.88
0.10	0.01	0.30	0.08	0.50	0.26	0.70	0.58	0.90	0.89
0.11	0.02	0.31	0.09	0.51	0.27	0.71	0.59	0.91	0.91
0.12	0.02	0.32	0.09	0.52	0.28	0.72	0.61	0.92	0.92
0.13	0.02	0.33	0.10	0.53	0.30	0.73	0.63	0.93	0.93
0.14	0.02	0.34	0.11	0.54	0.31	0.74	0.65	0.94	0.94
0.15	0.02	0.35	0.11	0.55	0.33	0.75	0.66	0.95	0.95
0.16	0.03	0.36	0.12	0.56	0.34	0.76	0.68	0.96	0.96
0.17	0.03	0.37	0.13	0.57	0.36	0.77	0.70	0.97	0.97
0.18	0.03	0.38	0.13	0.58	0.37	0.78	0.71	0.98	0.98
0.19	0.04	0.39	0.14	0.59	0.39	0.79	0.73	0.99	0.99
0.20	0.04	0.40	0.15	0.60	0.40	0.80	0.75	1.00	1.00

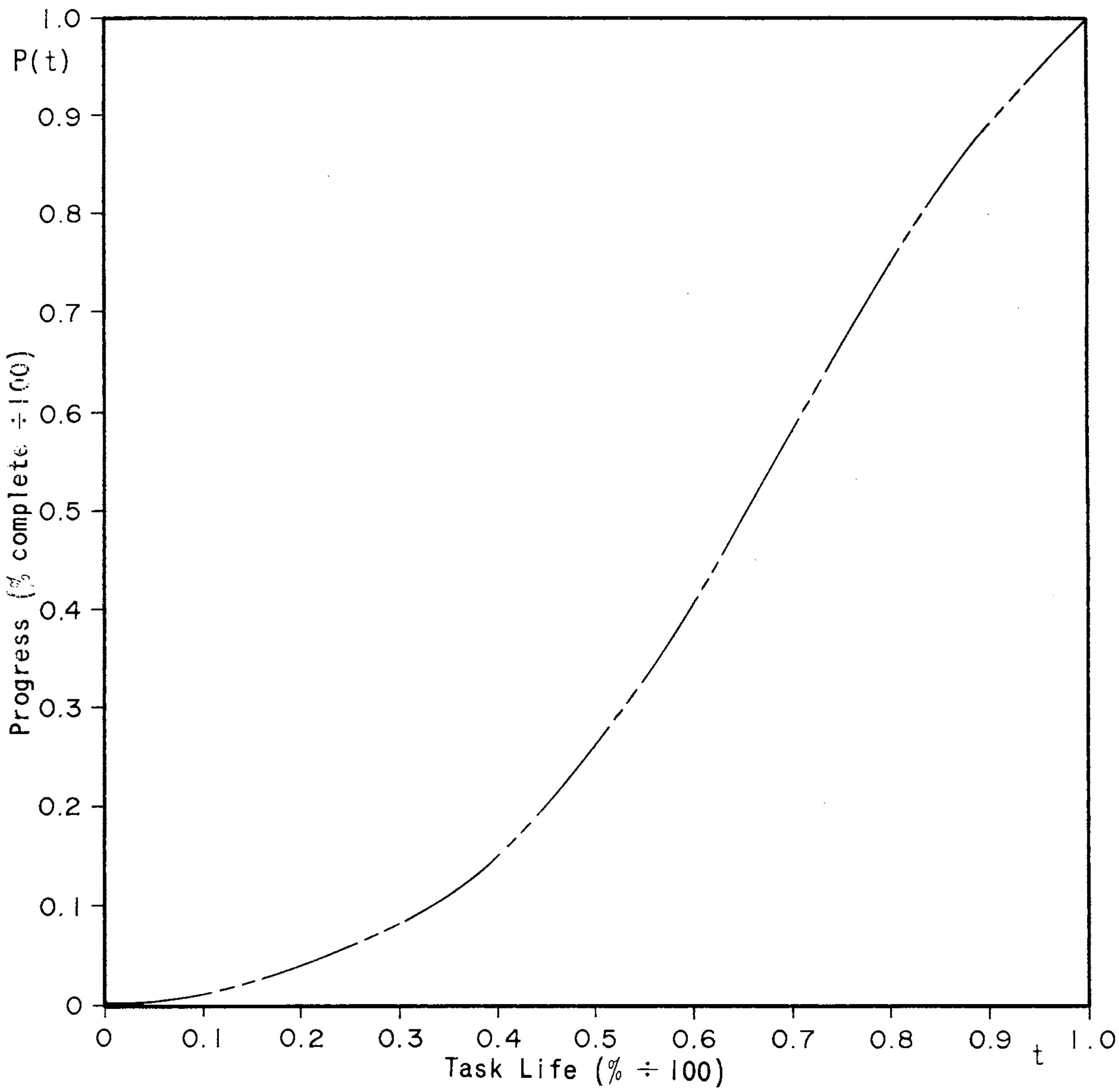

Figure 27. TOC Curve V

APPENDIX B-3

FORTRAN IV PROGRAM FOR IBM 7040 COMPUTER FOR SELECTED ROC CURVES

FORTAN IV PROGRAM LISTING OF ROC CURVE COORDINATES

```
  REAL K1,K2
  DIMENSION X(5,20),Y(5,20)
  DO8KK = 1,5
  GO TO (1,2,3,4,5),KK
1 ALP = 1.5
  DEL = .3
  GO TO 6
2 ALP = 2.5
  DEL =   .2
  GO TO 6
3 ALP = .01
  DEL = 0.
  GO TO 6
4 ALP = 1.5
  DEL = 0.
  GO TO 6
5 ALP = 2.5
  DEL = -.1
6 DO7I = 1,5
  DO 7 J = 1,20
  X(I,J) =FLOAT((I-1)*20+J)/100.
  T= X(I,J)
  K1=ALP*(1.-2.*DEL)
  K2=2.*ALP
  B=EXP(K1) + EXP(K2)
```

```
    C = EXP(K2) - 1.
    D = EXP(K2*T)  - 1.
    E = EXP(K2*T) + EXP(K1)
    Y(I,J)=((B)/C)*(D/(  E))
    Y(I,J) = 1. - Y(I,J)
  7 CONTINUE
    PRINT 10, ALP ,DEL
 10 FORMAT(1H1//// 40X,7HALPHA =F4.1//40X  7HDELTA = F4.1////
    14X,1HT 1 4X,3HROC,5X,1HT,4X,3HROC,5X,1HT,4X,3HROC,5X,1HT,
    4X,3HROC,5X,1HT, 24X,3HROC)
    DO 8 J = 1,20
  8 PRINT11, (X(I,J),Y(I,J),I =1,5)
 11 FORMAT(/10X, 5(F7.2,F6.2))
    STOP
    END
```

APPENDIX B-4

COMPUTATIONS AND GRAPHS FOR SELECTED ROC CURVES

DATA FOR ROC CURVE I

ALPHA = 1.5

DELTA = 0.3

T	ROC	T	ROC	T	ROC	T	ROC	T	ROC
0.01	0.99	0.21	0.73	0.41	0.47	0.61	0.25	0.81	0.10
0.02	0.98	0.22	0.71	0.42	0.46	0.62	0.24	0.82	0.09
0.03	0.96	0.23	0.70	0.43	0.45	0.63	0.24	0.83	0.09
0.04	0.95	0.24	0.69	0.44	0.43	0.64	0.23	0.84	0.08
0.05	0.94	0.25	0.67	0.45	0.42	0.65	0.22	0.85	0.07
0.06	0.93	0.26	0.66	0.46	0.41	0.66	0.21	0.86	0.07
0.07	0.91	0.27	0.65	0.47	0.40	0.67	0.20	0.87	0.06
0.08	0.90	0.28	0.63	0.48	0.39	0.68	0.19	0.88	0.06
0.09	0.89	0.29	0.62	0.49	0.38	0.69	0.18	0.89	0.05
0.10	0.87	0.30	0.61	0.50	0.37	0.70	0.18	0.90	0.05
0.11	0.86	0.31	0.60	0.51	0.36	0.71	0.17	0.91	0.04
0.12	0.85	0.32	0.58	0.52	0.34	0.72	0.16	0.92	0.04
0.13	0.83	0.33	0.57	0.53	0.33	0.73	0.15	0.93	0.03
0.14	0.82	0.34	0.56	0.54	0.32	0.74	0.15	0.94	0.03
0.15	0.81	0.35	0.54	0.55	0.31	0.75	0.14	0.95	0.02
0.16	0.79	0.36	0.53	0.56	0.30	0.76	0.13	0.96	0.02
0.17	0.78	0.37	0.52	0.57	0.29	0.77	0.12	0.97	0.01
0.18	0.77	0.38	0.51	0.58	0.28	0.78	0.12	0.98	0.01
0.19	0.75	0.39	0.49	0.59	0.27	0.79	0.11	0.99	0.00
0.20	0.74	0.40	0.48	0.60	0.26	0.80	0.10	1.00	0.00

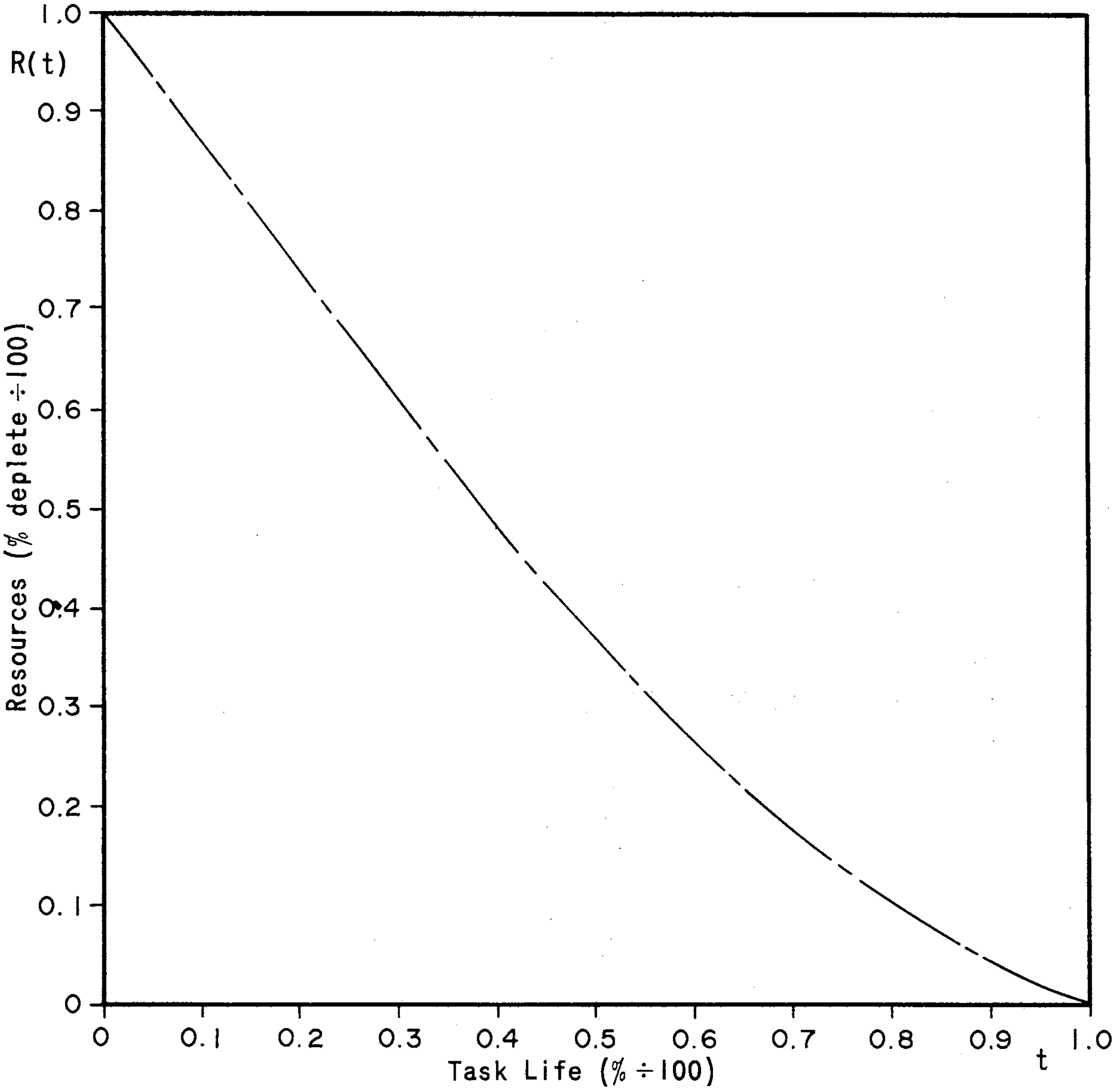

Figure 28. ROC Curve I

DATA FOR ROC CURVE II

ALPHA = 2.5

DELTA = 0.2

T	ROC	T	ROC	T	ROC	T	ROC	T	ROC
0.01	0.99	0.21	0.74	0.41	0.43	0.61	0.18	0.81	0.05
0.02	0.98	0.22	0.72	0.42	0.41	0.62	0.18	0.82	0.05
0.03	0.97	0.23	0.71	0.43	0.40	0.63	0.17	0.83	0.05
0.04	0.96	0.24	0.69	0.44	0.38	0.64	0.16	0.84	0.04
0.05	0.95	0.25	0.68	0.45	0.37	0.65	0.15	0.85	0.04
0.06	0.94	0.26	0.66	0.46	0.36	0.66	0.14	0.86	0.04
0.07	0.93	0.27	0.64	0.47	0.34	0.67	0.14	0.87	0.03
0.08	0.91	0.28	0.63	0.48	0.33	0.68	0.13	0.88	0.03
0.09	0.90	0.29	0.61	0.49	0.32	0.69	0.12	0.89	0.03
0.10	0.89	0.30	0.60	0.50	0.30	0.70	0.11	0.90	0.02
0.11	0.88	0.31	0.58	0.51	0.29	0.71	0.11	0.91	0.02
0.12	0.86	0.32	0.57	0.52	0.28	0.72	0.10	0.92	0.02
0.13	0.85	0.33	0.55	0.53	0.27	0.73	0.10	0.93	0.01
0.14	0.84	0.34	0.53	0.54	0.26	0.74	0.09	0.94	0.01
0.15	0.82	0.35	0.52	0.55	0.25	0.75	0.08	0.95	0.01
0.16	0.81	0.36	0.50	0.56	0.23	0.76	0.08	0.96	0.01
0.17	0.80	0.37	0.49	0.57	0.22	0.77	0.07	0.97	0.01
0.18	0.78	0.38	0.47	0.58	0.21	0.78	0.07	0.98	0.00
0.19	0.77	0.39	0.46	0.59	0.20	0.79	0.06	0.99	0.00
0.20	0.75	0.40	0.44	0.60	0.19	0.80	0.06	1.00	0.00

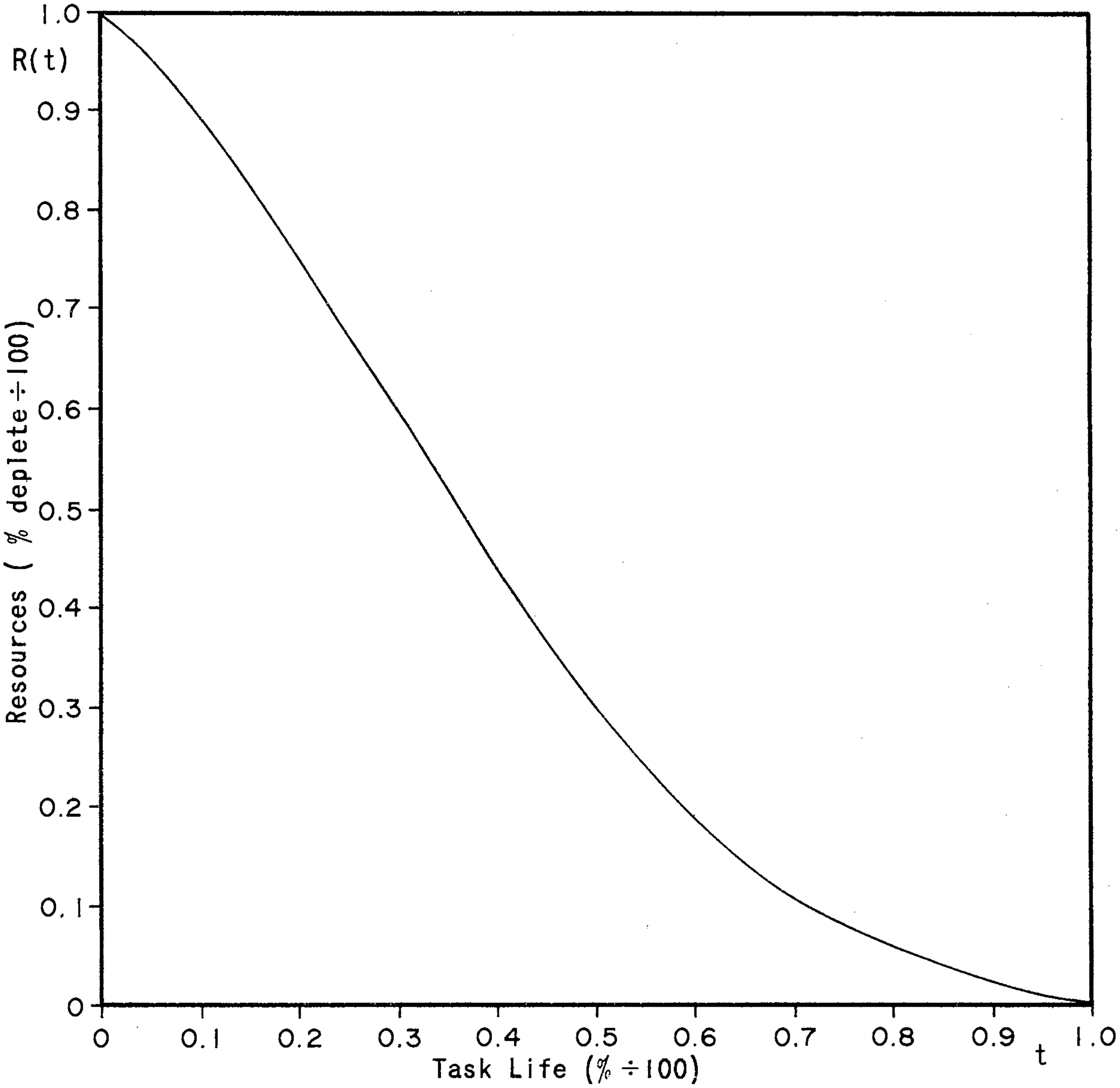

Figure 29. ROC Curve II

DATA FOR ROC CURVE III

ALPHA = 0.0

DELTA = 0.

T	ROC	T	ROC	T	ROC	T	ROC	T	ROC
0.01	0.99	0.21	0.79	0.41	0.59	0.61	0.39	0.81	0.19
0.02	0.98	0.22	0.78	0.42	0.58	0.62	0.38	0.82	0.18
0.03	0.97	0.23	0.77	0.43	0.57	0.63	0.37	0.83	0.17
0.04	0.96	0.24	0.76	0.44	0.56	0.64	0.36	0.84	0.16
0.05	0.95	0.25	0.75	0.45	0.55	0.65	0.35	0.85	0.15
0.06	0.94	0.26	0.74	0.46	0.54	0.66	0.34	0.86	0.14
0.07	0.93	0.27	0.73	0.47	0.53	0.67	0.33	0.87	0.13
0.08	0.92	0.28	0.72	0.48	0.52	0.68	0.32	0.88	0.12
0.09	0.91	0.29	0.71	0.49	0.51	0.69	0.31	0.89	0.11
0.10	0.90	0.30	0.70	0.50	0.50	0.70	0.30	0.90	0.10
0.11	0.89	0.31	0.69	0.51	0.49	0.71	0.29	0.91	0.09
0.12	0.88	0.32	0.68	0.52	0.48	0.72	0.28	0.92	0.08
0.13	0.87	0.33	0.67	0.53	0.47	0.73	0.27	0.93	0.07
0.14	0.86	0.34	0.66	0.54	0.46	0.74	0.26	0.94	0.06
0.15	0.85	0.35	0.65	0.55	0.45	0.75	0.25	0.95	0.05
0.16	0.84	0.36	0.64	0.56	0.44	0.76	0.24	0.96	0.04
0.17	0.83	0.37	0.63	0.57	0.43	0.77	0.23	0.97	0.03
0.18	0.82	0.38	0.62	0.58	0.42	0.78	0.22	0.98	0.02
0.19	0.81	0.39	0.61	0.59	0.41	0.79	0.21	0.99	0.01
0.20	0.80	0.40	0.60	0.60	0.40	0.80	0.20	1.00	0.00

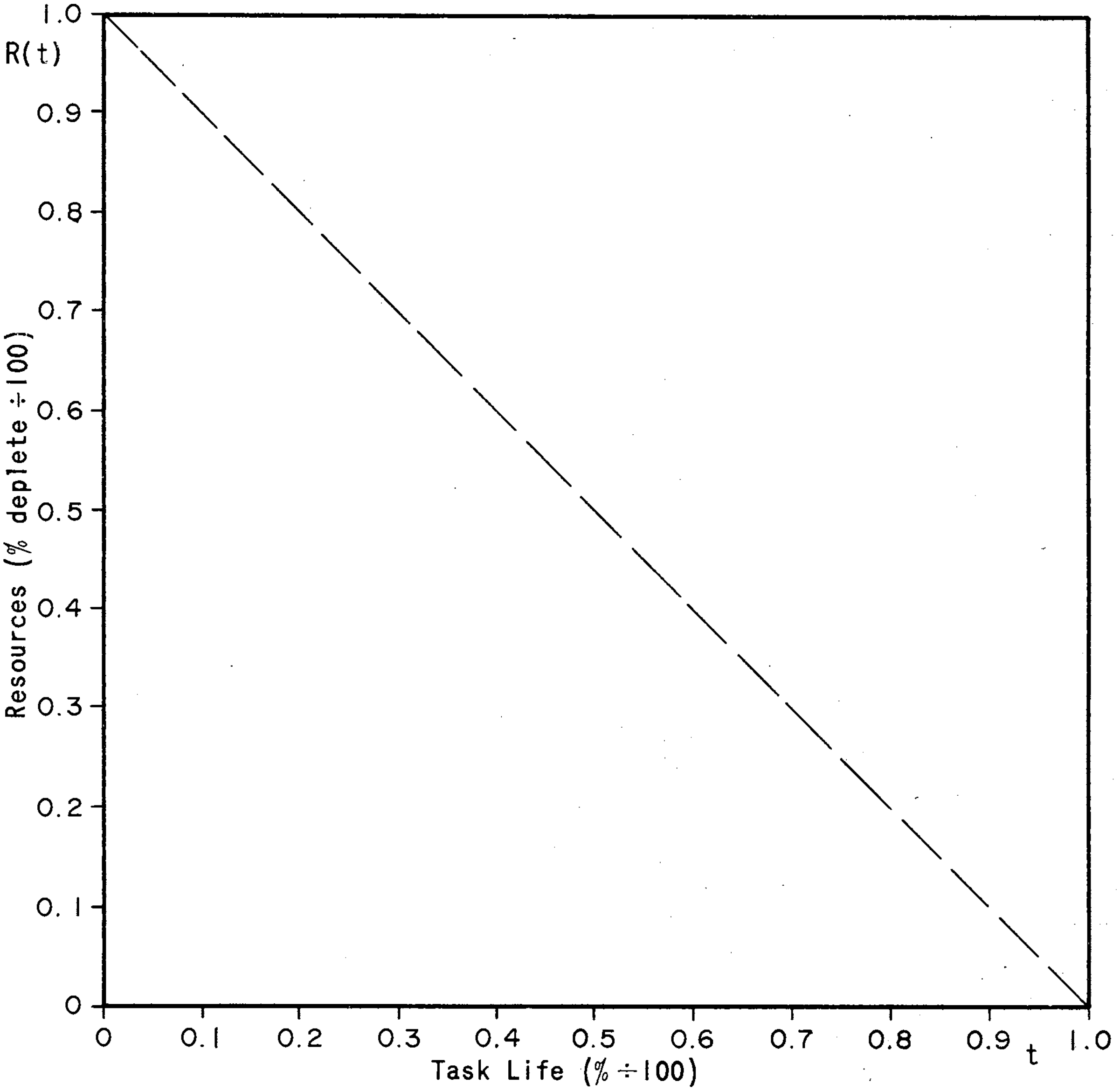

Figure 30. ROC Curve III

DATA FOR ROC CURVE IV

ALPHA = 1.5

DELTA = 0.

T	ROC	T	ROC	T	ROC	T	ROC	T	ROC
0.01	0.99	0.21	0.82	0.41	0.61	0.61	0.37	0.81	0.16
0.02	0.99	0.22	0.81	0.42	0.59	0.62	0.36	0.82	0.15
0.03	0.98	0.23	0.80	0.43	0.58	0.63	0.35	0.83	0.14
0.04	0.97	0.24	0.79	0.44	0.57	0.64	0.34	0.84	0.13
0.05	0.96	0.25	0.78	0.45	0.56	0.65	0.33	0.85	0.12
0.06	0.96	0.26	0.77	0.46	0.55	0.66	0.31	0.86	0.11
0.07	0.95	0.27	0.76	0.47	0.54	0.67	0.30	0.87	0.10
0.08	0.94	0.28	0.75	0.48	0.52	0.68	0.29	0.88	0.09
0.09	0.93	0.29	0.74	0.49	0.51	0.69	0.28	0.89	0.09
0.10	0.92	0.30	0.73	0.50	0.50	0.70	0.27	0.90	0.08
0.11	0.91	0.31	0.72	0.51	0.49	0.71	0.26	0.91	0.07
0.12	0.91	0.32	0.71	0.52	0.48	0.72	0.25	0.92	0.06
0.13	0.90	0.33	0.70	0.53	0.46	0.73	0.24	0.93	0.05
0.14	0.89	0.34	0.69	0.54	0.45	0.74	0.23	0.94	0.04
0.15	0.88	0.35	0.67	0.55	0.44	0.75	0.22	0.95	0.04
0.16	0.87	0.36	0.66	0.56	0.43	0.76	0.21	0.96	0.03
0.17	0.86	0.37	0.65	0.57	0.42	0.77	0.20	0.97	0.02
0.18	0.85	0.38	0.64	0.58	0.41	0.78	0.19	0.98	0.01
0.19	0.84	0.39	0.63	0.59	0.39	0.79	0.18	0.99	0.01
0.20	0.83	0.40	0.62	0.60	0.38	0.80	0.17	1.00	0.00

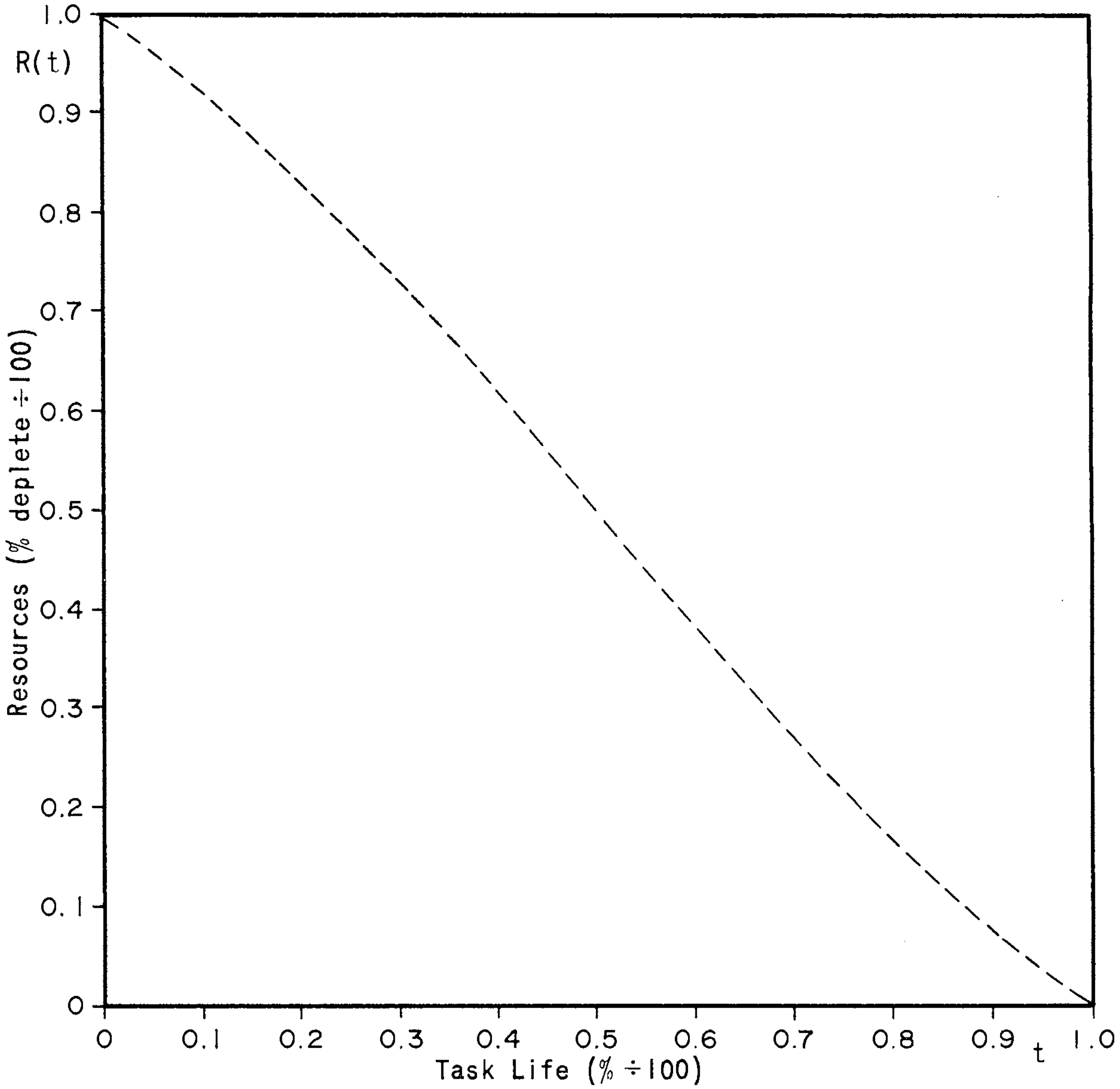

Figure 31. ROC Curve IV

DATA FOR ROC CURVE V

ALPHA = 2.5

DELTA =-0.1

T	ROC	T	ROC	T	ROC	T	ROC	T	ROC
0.01	1.00	0.21	0.91	0.41	0.72	0.61	0.44	0.81	0.17
0.02	0.99	0.22	0.90	0.42	0.71	0.62	0.43	0.82	0.16
0.03	0.99	0.23	0.89	0.43	0.70	0.63	0.41	0.83	0.15
0.04	0.99	0.24	0.89	0.44	0.68	0.64	0.40	0.84	0.13
0.05	0.98	0.25	0.88	0.45	0.67	0.65	0.38	0.85	0.12
0.06	0.98	0.26	0.87	0.46	0.66	0.66	0.37	0.86	0.11
0.07	0.98	0.27	0.86	0.47	0.65	0.67	0.35	0.87	0.10
0.08	0.97	0.28	0.86	0.48	0.63	0.68	0.34	0.88	0.09
0.09	0.97	0.29	0.85	0.49	0.62	0.69	0.32	0.89	0.08
0.10	0.97	0.30	0.84	0.50	0.60	0.70	0.31	0.90	0.08
0.11	0.96	0.31	0.83	0.51	0.59	0.71	0.30	0.91	0.07
0.12	0.96	0.32	0.82	0.52	0.58	0.72	0.28	0.92	0.06
0.13	0.95	0.33	0.81	0.53	0.56	0.73	0.27	0.93	0.05
0.14	0.95	0.34	0.80	0.54	0.55	0.74	0.26	0.94	0.04
0.15	0.94	0.35	0.79	0.55	0.53	0.75	0.24	0.95	0.03
0.16	0.94	0.36	0.78	0.56	0.52	0.76	0.23	0.96	0.03
0.17	0.93	0.37	0.77	0.57	0.50	0.77	0.22	0.97	0.02
0.18	0.93	0.38	0.76	0.58	0.49	0.78	0.20	0.98	0.01
0.19	0.92	0.39	0.75	0.59	0.47	0.79	0.19	0.99	0.01
0.20	0.91	0.40	0.73	0.60	0.46	0.80	0.18	1.00	0.00

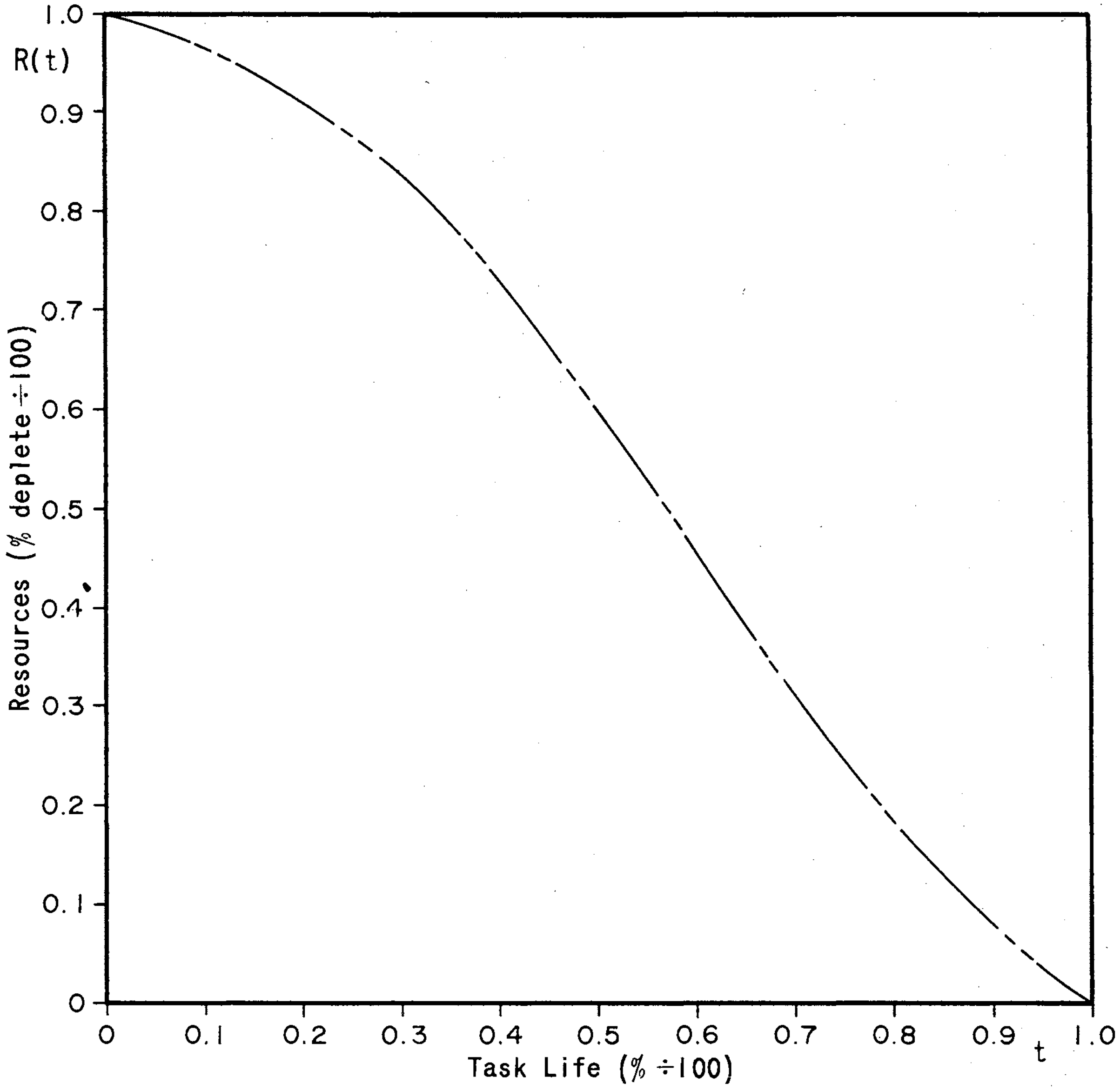

Figure 32. ROC Curve V

APPENDIX C

COMPUTATIONAL ALGORITHMS AND COMPARISONS OF $P'(t)$ AND $|R'(t)|$ SELECTED CURVES

APPENDIX C-I

FORTRAN IV PROGRAM FOR IBM 7040 COMPUTER AND COMPUTATIONS FOR P'(t)

FORTAN IV PROGRAM LISTING OF P'(T) COORDINATES

```
  REAL K1,K2
  DIMENSION X(5,20),Y(5,20)
  DO8KK = 1,5
  GO TO (1,2,3,4,5),KK
1 ALP = 2.
  DEL =   .2
  GO TO 6
2 ALP = 3.
  DEL = .1
  GO TO 6
3 ALP = .1
  DEL = 0.
  GO TO 6
4 ALP = 2.
  DEL = -.1
  GO TO 6
5 ALP = 3.
  DEL = -.2
6 DO7I = 1,5
  DO 7 J = 1,20
  X(I,J) =FLOAT((I-1)*20+J)/100.
  T= X(I,J)
  K1=ALP*(1.-2.*DEL)
  K2=2.*ALP
  B=EXP(K1) + EXP(K2)
```

```
      C = EXP(K2) - 1.
      D = EXP(K1) + 1.
      E = EXP(K2*T) + EXP(K1)
      F = K2*EXP(K2*T)
      Y(I,J)=((B)/C)*(D/(E**2)) * F
    7 CONTINUE
      PRINT 10, ALP ,DEL
   10 FORMAT(1H1//// 40X,7HALPHA =F4.1//40X  7HDELTA = F4.1////
     14X,1HT 1 4X,4HP'(T)4X,1HT,4X,4HP'(T)4X,1HT,4X,4HP'(T)4X,
     1HT,4X,4HP'(T)4X,1HT, 24X,4HP'(T))
      DO 8 J = 1,20
    8 PRINT11, (X(I,J),Y(I,J),I =1,5)
   11 FORMAT(/10X, 5(F7.2,F6.2))
      STOP
      END
```

APPENDIX C-2

FORTRAN IV PROGRAM FOR IBM 7040 COMPUTER AND COMPUTATIONS FOR $\left|R'(t)\right|$

FORTAN IV PROGRAM LISTING OF |R'(t)| COORDINATES

```
  REAL K1,K2
  DIMENSION X(5,20),Y(5,20)
  DO8KK = 1,5
  GO TO (1,2,3,4,5),KK
1 ALP = 1.5
  DEL = .3
  GO TO 6
2 ALP = 2.5
  DEL =   .2
  GO TO 6
3 ALP = .01
  DEL = 0.
  GO TO 6
4 ALP = 1.5
  DEL = 0.
  GO TO 6
5 ALP = 2.5
  DEL = -.1
6 DO7I = 1,5
  DO 7 J = 1,20
  X(I,J) =FLOAT((I-1)*20+J)/100.
  T= X(I,J)
  K1=ALP*(1.-2.*DEL)
  K2=2.*ALP
  B=EXP(K1) + EXP(K2)
```

```
      C = EXP(K2) - 1.
      D = EXP(K1) + 1.
      E = EXP(K2*T) + EXP(K1)
      F = K2*EXP(K2*T)
      Y(I,J)=((B)/C)*(D/(E**2)) * F
    7 CONTINUE
      PRINT 10, ALP ,DEL
   10 FORMAT(1H1//// 40X,7HALPHA =F4.1//40X  7HDELTA = F4.1////
     14X,1HT  1 4X,3HRAF*,5X,1HT,4X,3HRAF,5X,1HT,4X,3HRAF,5X,1HT,
    4X,3HRAF,5X,1HT, 24X,3HRAF)
      DO 8 J = 1,20
    8 PRINT11, (X(I,J),Y(I,J),I =1,5)
   11 FORMAT(/10X, 5(F7.2,F6.2))
      STOP
      END
```

* RAF = $|R'(t)|$

APPENDIX C-3

GRAPHIC COMPARISONS OF P'(t) WITH $|R'(t)|$

DATA FOR P'(T) CURVE I

ALPHA = 2.0

DELTA = 0.2

T	P'(T)	T	P'(T)	T	P'(T)	T	P'(T)	T	P'(T)
0.01	1.02	0.21	1.36	0.41	1.34	0.61	0.98	0.81	0.57
0.02	1.04	0.22	1.37	0.42	1.33	0.62	0.96	0.82	0.56
0.03	1.06	0.23	1.38	0.43	1.32	0.63	0.94	0.83	0.54
0.04	1.09	0.24	1.39	0.44	1.30	0.64	0.91	0.84	0.52
0.05	1.11	0.25	1.39	0.45	1.29	0.65	0.89	0.85	0.51
0.06	1.13	0.26	1.40	0.46	1.27	0.66	0.87	0.86	0.49
0.07	1.15	0.27	1.40	0.47	1.26	0.67	0.85	0.87	0.47
0.08	1.17	0.28	1.40	0.48	1.24	0.68	0.83	0.88	0.46
0.09	1.18	0.29	1.41	0.49	1.22	0.69	0.81	0.89	0.44
0.10	1.20	0.30	1.41	0.50	1.20	0.70	0.79	0.90	0.43
0.11	1.22	0.31	1.41	0.51	1.18	0.71	0.77	0.91	0.41
0.12	1.24	0.32	1.40	0.52	1.17	0.72	0.74	0.92	0.40
0.13	1.26	0.33	1.40	0.53	1.15	0.73	0.72	0.93	0.39
0.14	1.27	0.34	1.40	0.54	1.13	0.74	0.70	0.94	0.37
0.15	1.29	0.35	1.39	0.55	1.11	0.75	0.68	0.95	0.36
0.16	1.30	0.36	1.39	0.56	1.09	0.76	0.67	0.96	0.35
0.17	1.32	0.37	1.38	0.57	1.06	0.77	0.65	0.97	0.34
0.18	1.33	0.38	1.37	0.58	1.04	0.78	0.63	0.98	0.33
0.19	1.34	0.39	1.36	0.59	1.02	0.79	0.61	0.99	0.31
0.20	1.35	0.40	1.35	0.60	1.00	0.80	0.59	1.00	0.30

DATA FOR $|R'(t)|$ CURVE I

ALPHA = 1.5

DELTA = 0.3

T	RAF	T	RAF	T	RAF	T	RAF	T	RAF
0.01	1.23	0.21	1.33	0.41	1.21	0.61	0.93	0.81	0.64
0.02	1.24	0.22	1.33	0.42	1.20	0.62	0.92	0.82	0.62
0.03	1.25	0.23	1.33	0.43	1.19	0.63	0.90	0.83	0.61
0.04	1.26	0.24	1.33	0.44	1.17	0.64	0.89	0.84	0.59
0.05	1.27	0.25	1.33	0.45	1.16	0.65	0.87	0.85	0.58
0.06	1.28	0.26	1.32	0.46	1.15	0.66	0.86	0.86	0.57
0.07	1.28	0.27	1.32	0.47	1.14	0.67	0.84	0.87	0.56
0.08	1.29	0.28	1.31	0.48	1.12	0.68	0.83	0.88	0.54
0.09	1.30	0.29	1.31	0.49	1.11	0.69	0.81	0.89	0.53
0.10	1.30	0.30	1.30	0.50	1.10	0.70	0.80	0.90	0.52
0.11	1.31	0.31	1.30	0.51	1.08	0.71	0.78	0.91	0.51
0.12	1.31	0.32	1.29	0.52	1.07	0.72	0.77	0.92	0.49
0.13	1.32	0.33	1.28	0.53	1.05	0.73	0.75	0.93	0.48
0.14	1.32	0.34	1.28	0.54	1.04	0.74	0.74	0.94	0.47
0.15	1.33	0.35	1.27	0.55	1.02	0.75	0.72	0.95	0.46
0.16	1.33	0.36	1.26	0.56	1.01	0.76	0.71	0.96	0.45
0.17	1.33	0.37	1.25	0.57	0.99	0.77	0.69	0.97	0.44
0.18	1.33	0.38	1.24	0.58	0.98	0.78	0.68	0.98	0.43
0.19	1.33	0.39	1.23	0.59	0.96	0.79	0.66	0.99	0.42
0.20	1.33	0.40	1.22	0.60	0.95	0.80	0.65	1.00	0.41

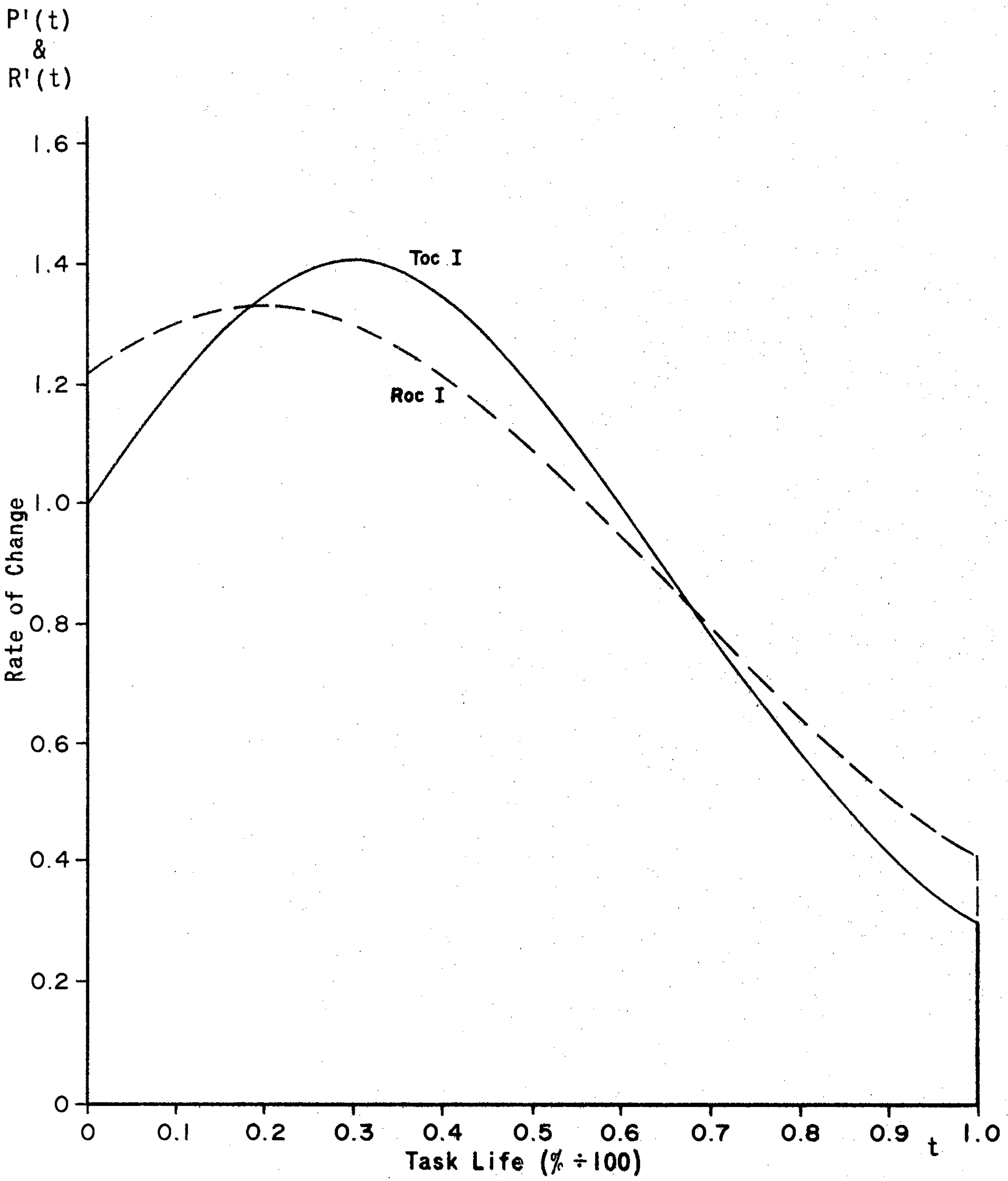

Figure 33. Graphic Comparisons of Absolute Derivatives for TOC and ROC Curves I

DATA FOR P'(T) CURVE II

ALPHA = 3.0

DELTA = 0.1

T	P'(T)	T	P'(T)	T	P'(T)	T	P'(T)	T	P'(T)
0.01	0.54	0.21	1.24	0.41	1.68	0.61	1.16	0.81	0.49
0.02	0.57	0.22	1.28	0.42	1.68	0.62	1.12	0.82	0.46
0.03	0.60	0.23	1.31	0.43	1.67	0.63	1.08	0.83	0.44
0.04	0.62	0.24	1.35	0.44	1.66	0.64	1.04	0.84	0.42
0.05	0.66	0.25	1.39	0.45	1.65	0.65	1.01	0.85	0.40
0.06	0.69	0.26	1.42	0.46	1.63	0.66	0.97	0.86	0.38
0.07	0.72	0.27	1.45	0.47	1.61	0.67	0.93	0.87	0.36
0.08	0.75	0.28	1.48	0.48	1.59	0.68	0.89	0.88	0.34
0.09	0.79	0.29	1.51	0.49	1.57	0.69	0.86	0.89	0.32
0.10	0.82	0.30	1.54	0.50	1.54	0.70	0.82	0.90	0.30
0.11	0.86	0.31	1.57	0.51	1.51	0.71	0.79	0.91	0.29
0.12	0.89	0.32	1.59	0.52	1.48	0.72	0.75	0.92	0.27
0.13	0.93	0.33	1.61	0.53	1.45	0.73	0.72	0.93	0.26
0.14	0.97	0.34	1.63	0.54	1.42	0.74	0.69	0.94	0.24
0.15	1.01	0.35	1.65	0.55	1.39	0.75	0.66	0.95	0.23
0.16	1.04	0.36	1.66	0.56	1.35	0.76	0.62	0.96	0.22
0.17	1.08	0.37	1.67	0.57	1.31	0.77	0.60	0.97	0.21
0.18	1.12	0.38	1.68	0.58	1.28	0.78	0.57	0.98	0.20
0.19	1.16	0.39	1.68	0.59	1.24	0.79	0.54	0.99	0.18
0.20	1.20	0.40	1.68	0.60	1.20	0.80	0.51	1.00	0.17

DATA FOR |R'(t)| CURVE II

ALPHA = 2.5

DELTA = 0.2

T	RAF	T	RAF	T	RAF	T	RAF	T	RAF
0.01	0.98	0.21	1.51	0.41	1.47	0.61	0.92	0.81	0.43
0.02	1.01	0.22	1.52	0.42	1.45	0.62	0.89	0.82	0.41
0.03	1.04	0.23	1.54	0.43	1.43	0.63	0.86	0.83	0.39
0.04	1.07	0.24	1.55	0.44	1.41	0.64	0.83	0.84	0.37
0.05	1.10	0.25	1.56	0.45	1.38	0.65	0.80	0.85	0.36
0.06	1.13	0.26	1.57	0.46	1.36	0.66	0.77	0.86	0.34
0.07	1.16	0.27	1.58	0.47	1.33	0.67	0.74	0.87	0.33
0.08	1.19	0.28	1.58	0.48	1.30	0.68	0.72	0.88	0.31
0.09	1.22	0.29	1.58	0.49	1.28	0.69	0.69	0.89	0.30
0.10	1.25	0.30	1.59	0.50	1.25	0.70	0.67	0.90	0.29
0.11	1.28	0.31	1.58	0.51	1.22	0.71	0.64	0.91	0.27
0.12	1.30	0.32	1.58	0.52	1.19	0.72	0.62	0.92	0.26
0.13	1.33	0.33	1.58	0.53	1.16	0.73	0.59	0.93	0.25
0.14	1.36	0.34	1.57	0.54	1.13	0.74	0.57	0.94	0.24
0.15	1.38	0.35	1.56	0.55	1.10	0.75	0.55	0.95	0.23
0.16	1.41	0.36	1.55	0.56	1.07	0.76	0.53	0.96	0.22
0.17	1.43	0.37	1.54	0.57	1.04	0.77	0.50	0.97	0.21
0.18	1.45	0.38	1.52	0.58	1.01	0.78	0.48	0.98	0.20
0.19	1.47	0.39	1.51	0.59	0.98	0.79	0.46	0.99	0.19
0.20	1.49	0.40	1.49	0.60	0.95	0.80	0.44	1.00	0.18

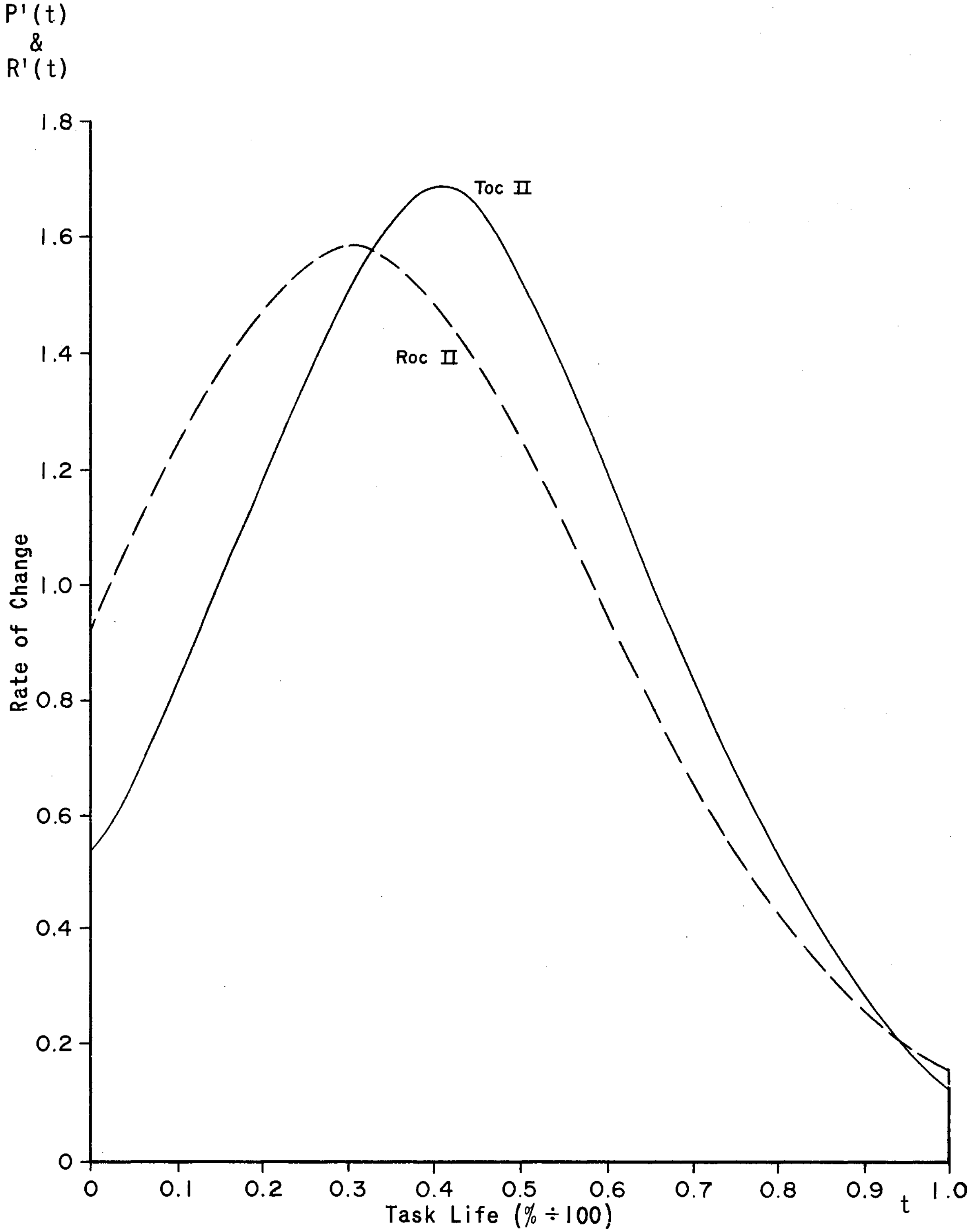

Figure 34. Graphic Comparisons of Absolute Derivatives for TOC and ROC Curves II

DATA FOR P'(T) CURVE III

ALPHA = 0.

DELTA = 0.

T	P'(T)	T	P'(T)	T	P'(T)	T	P'(T)	T	P'(T)
0.01	1.00	0.21	1.00	0.41	1.00	0.61	1.00	0.81	1.00
0.02	1.00	0.22	1.00	0.42	1.00	0.62	1.00	0.82	1.00
0.03	1.00	0.23	1.00	0.43	1.00	0.63	1.00	0.83	1.00
0.04	1.00	0.24	1.00	0.44	1.00	0.64	1.00	0.84	1.00
0.05	1.00	0.25	1.00	0.45	1.00	0.65	1.00	0.85	1.00
0.06	1.00	0.26	1.00	0.46	1.00	0.66	1.00	0.86	1.00
0.07	1.00	0.27	1.00	0.47	1.00	0.67	1.00	0.87	1.00
0.08	1.00	0.28	1.00	0.48	1.00	0.68	1.00	0.88	1.00
0.09	1.00	0.29	1.00	0.49	1.00	0.69	1.00	0.89	1.00
0.10	1.00	0.30	1.00	0.50	1.00	0.70	1.00	0.90	1.00
0.11	1.00	0.31	1.00	0.51	1.00	0.71	1.00	0.91	1.00
0.12	1.00	0.32	1.00	0.52	1.00	0.72	1.00	0.92	1.00
0.13	1.00	0.33	1.00	0.53	1.00	0.73	1.00	0.93	1.00
0.14	1.00	0.34	1.00	0.54	1.00	0.74	1.00	0.94	1.00
0.15	1.00	0.35	1.00	0.55	1.00	0.75	1.00	0.95	1.00
0.16	1.00	0.36	1.00	0.56	1.00	0.76	1.00	0.96	1.00
0.17	1.00	0.37	1.00	0.57	1.00	0.77	1.00	0.97	1.00
0.18	1.00	0.38	1.00	0.58	1.00	0.78	1.00	0.98	1.00
0.19	1.00	0.39	1.00	0.59	1.00	0.79	1.00	0.99	1.00
0.20	1.00	0.40	1.00	0.60	1.00	0.80	1.00	1.00	1.00

DATA FOR $|R'(t)|$ CURVE III

ALPHA = 0.0

DELTA = 0.

T	RAF	T	RAF	T	RAF	T	RAF	T	RAF
0.01	1.00	0.21	1.00	0.41	1.00	0.61	1.00	0.81	1.00
0.02	1.00	0.22	1.00	0.42	1.00	0.62	1.00	0.82	1.00
0.03	1.00	0.23	1.00	0.43	1.00	0.63	1.00	0.83	1.00
0.04	1.00	0.24	1.00	0.44	1.00	0.64	1.00	0.84	1.00
0.05	1.00	0.25	1.00	0.45	1.00	0.65	1.00	0.85	1.00
0.06	1.00	0.26	1.00	0.46	1.00	0.66	1.00	0.86	1.00
0.07	1.00	0.27	1.00	0.47	1.00	0.67	1.00	0.87	1.00
0.08	1.00	0.28	1.00	0.48	1.00	0.68	1.00	0.88	1.00
0.09	1.00	0.29	1.00	0.49	1.00	0.69	1.00	0.89	1.00
0.10	1.00	0.30	1.00	0.50	1.00	0.70	1.00	0.90	1.00
0.11	1.00	0.31	1.00	0.51	1.00	0.71	1.00	0.91	1.00
0.12	1.00	0.32	1.00	0.52	1.00	0.72	1.00	0.92	1.00
0.13	1.00	0.33	1.00	0.53	1.00	0.73	1.00	0.93	1.00
0.14	1.00	0.34	1.00	0.54	1.00	0.74	1.00	0.94	1.00
0.15	1.00	0.35	1.00	0.55	1.00	0.75	1.00	0.95	1.00
0.16	1.00	0.36	1.00	0.56	1.00	0.76	1.00	0.96	1.00
0.17	1.00	0.37	1.00	0.57	1.00	0.77	1.00	0.97	1.00
0.18	1.00	0.38	1.00	0.58	1.00	0.78	1.00	0.98	1.00
0.19	1.00	0.39	1.00	0.59	1.00	0.79	1.00	0.99	1.00
0.20	1.00	0.40	1.00	0.60	1.00	0.80	1.00	1.00	1.00

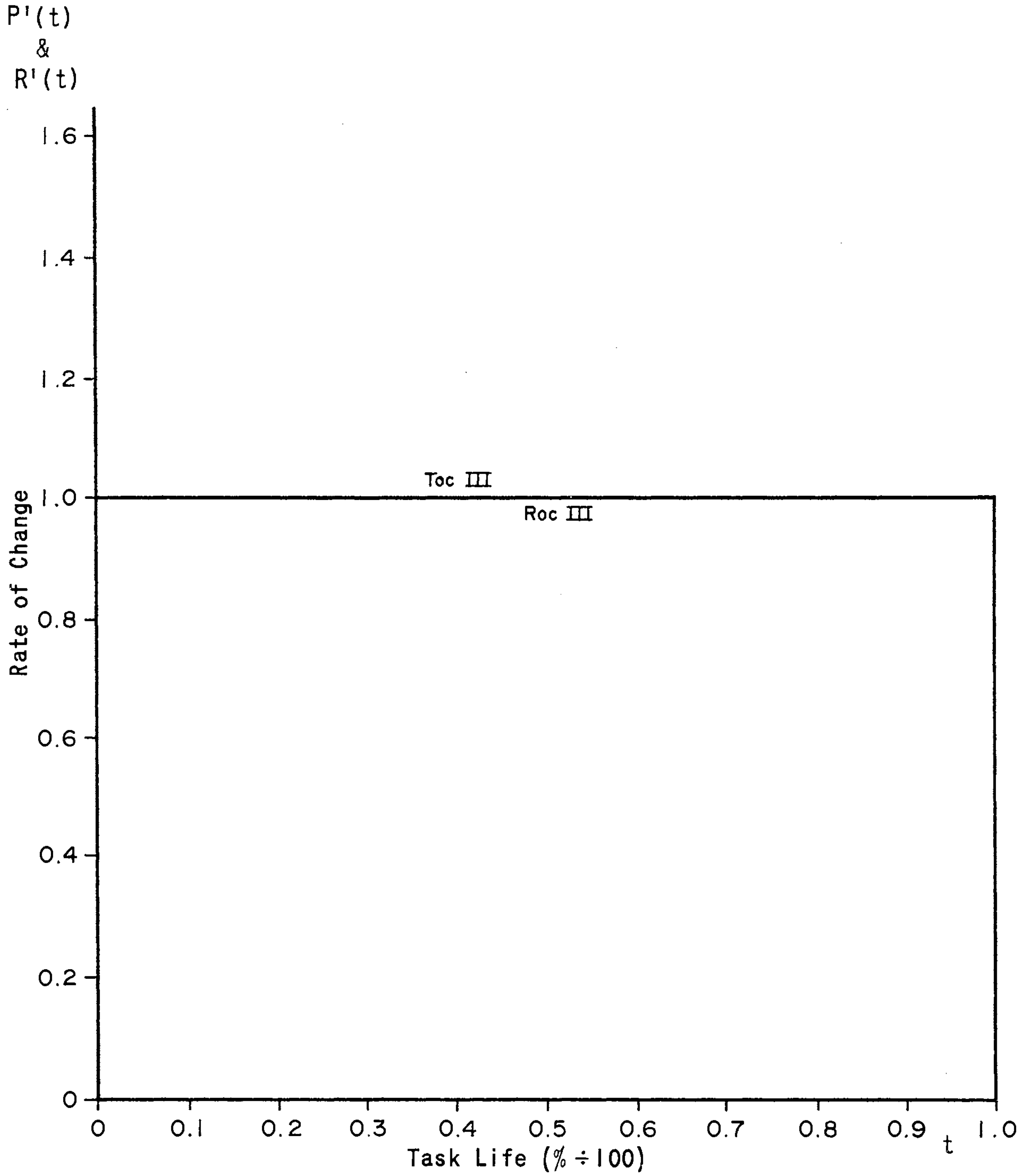

Figure 35. Graphic Comparisons of Absolute Derivatives for TOC and ROC Curves III

DATA FOR P'(T) CURVE IV

ALPHA = 2.0

DELTA =-0.1

T	P'(T)	T	P'(T)	T	P'(T)	T	P'(T)	T	P'(T)
0.01	0.42	0.21	0.77	0.41	1.16	0.61	1.33	0.81	1.12
0.02	0.44	0.22	0.79	0.42	1.18	0.62	1.33	0.82	1.11
0.03	0.45	0.23	0.81	0.43	1.19	0.63	1.33	0.83	1.09
0.04	0.46	0.24	0.83	0.44	1.21	0.64	1.33	0.84	1.07
0.05	0.48	0.25	0.85	0.45	1.22	0.65	1.32	0.85	1.05
0.06	0.50	0.26	0.87	0.46	1.24	0.66	1.32	0.86	1.03
0.07	0.51	0.27	0.89	0.47	1.25	0.67	1.31	0.87	1.01
0.08	0.53	0.28	0.91	0.48	1.26	0.68	1.30	0.88	0.99
0.09	0.54	0.29	0.93	0.49	1.27	0.69	1.29	0.89	0.97
0.10	0.56	0.30	0.95	0.50	1.28	0.70	1.28	0.90	0.95
0.11	0.58	0.31	0.97	0.51	1.29	0.71	1.27	0.91	0.93
0.12	0.60	0.32	0.99	0.52	1.30	0.72	1.26	0.92	0.91
0.13	0.61	0.33	1.01	0.53	1.31	0.73	1.25	0.93	0.89
0.14	0.63	0.34	1.03	0.54	1.32	0.74	1.24	0.94	0.87
0.15	0.65	0.35	1.05	0.55	1.32	0.75	1.22	0.95	0.85
0.16	0.67	0.36	1.07	0.56	1.33	0.76	1.21	0.96	0.83
0.17	0.69	0.37	1.09	0.57	1.33	0.77	1.19	0.97	0.81
0.18	0.71	0.38	1.11	0.58	1.33	0.78	1.18	0.98	0.79
0.19	0.73	0.39	1.12	0.59	1.33	0.79	1.16	0.99	0.77
0.20	0.75	0.40	1.14	0.60	1.34	0.80	1.14	1.00	0.75

DATA FOR $|R'(t)|$ CURVE IV

ALPHA = 1.5

DELTA = 0.

T	RAF	T	RAF	T	RAF	T	RAF	T	RAF
0.01	0.72	0.21	0.98	0.41	1.16	0.61	1.15	0.81	0.96
0.02	0.73	0.22	0.99	0.42	1.16	0.62	1.14	0.82	0.95
0.03	0.74	0.23	1.01	0.43	1.17	0.63	1.14	0.83	0.93
0.04	0.76	0.24	1.02	0.44	1.17	0.64	1.13	0.84	0.92
0.05	0.77	0.25	1.03	0.45	1.17	0.65	1.12	0.85	0.91
0.06	0.79	0.26	1.04	0.46	1.18	0.66	1.12	0.86	0.89
0.07	0.80	0.27	1.05	0.47	1.18	0.67	1.11	0.87	0.88
0.08	0.81	0.28	1.06	0.48	1.18	0.68	1.10	0.88	0.87
0.09	0.83	0.29	1.07	0.49	1.18	0.69	1.09	0.89	0.85
0.10	0.84	0.30	1.08	0.50	1.18	0.70	1.08	0.90	0.84
0.11	0.85	0.31	1.09	0.51	1.18	0.71	1.07	0.91	0.83
0.12	0.87	0.32	1.10	0.52	1.18	0.72	1.06	0.92	0.81
0.13	0.88	0.33	1.11	0.53	1.18	0.73	1.05	0.93	0.80
0.14	0.89	0.34	1.12	0.54	1.18	0.74	1.04	0.94	0.79
0.15	0.91	0.35	1.12	0.55	1.17	0.75	1.03	0.95	0.77
0.16	0.92	0.36	1.13	0.56	1.17	0.76	1.02	0.96	0.76
0.17	0.93	0.37	1.14	0.57	1.17	0.77	1.01	0.97	0.74
0.18	0.95	0.38	1.14	0.58	1.16	0.78	0.99	0.98	0.73
0.19	0.96	0.39	1.15	0.59	1.16	0.79	0.98	0.99	0.72
0.20	0.97	0.40	1.15	0.60	1.15	0.80	0.97	1.00	0.70

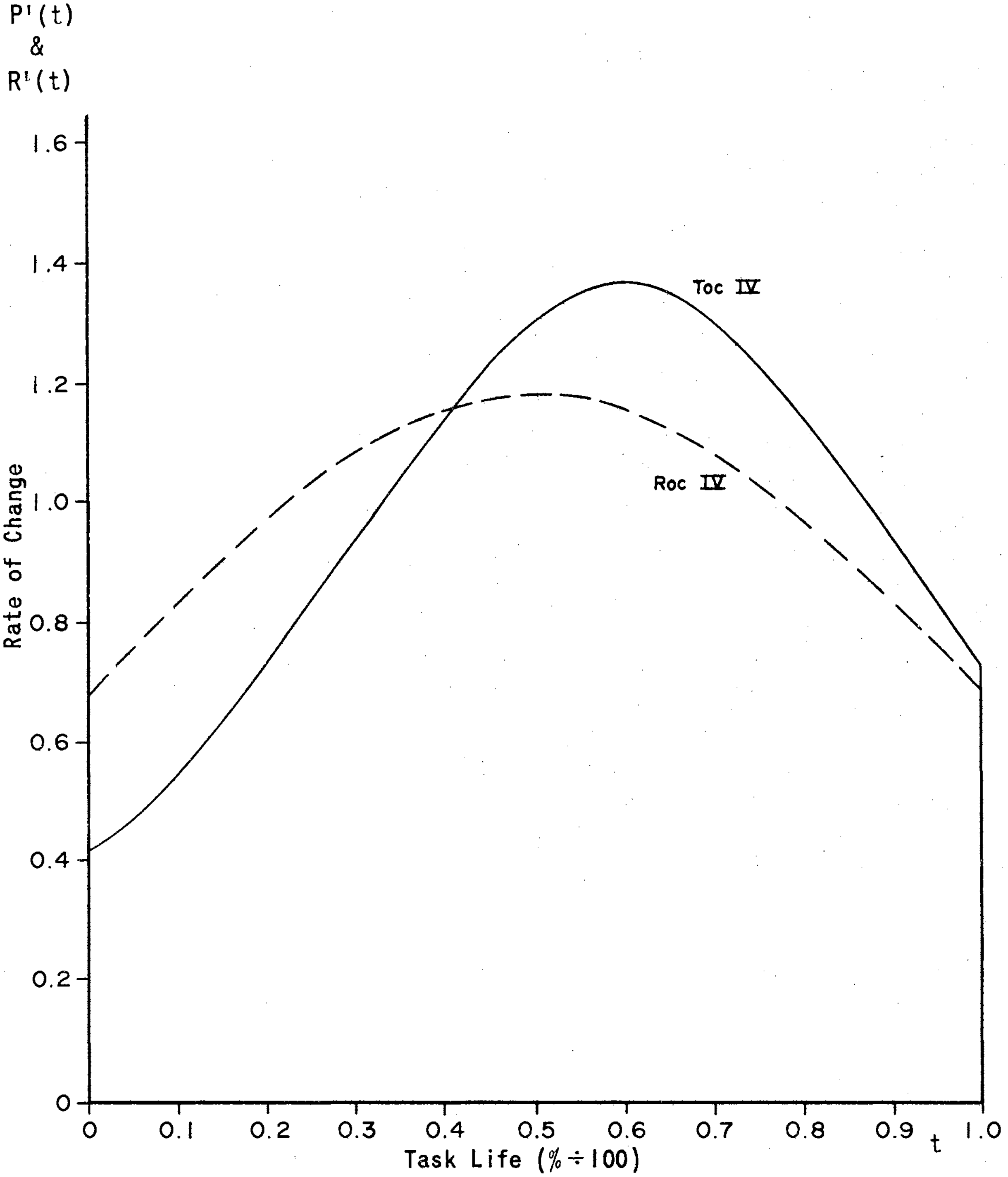

Figure 36. Graphic Comparisons of Absolute Derivatives for TOC and ROC Curves IV

DATA FOR P'(T) CURVE V

ALPHA = 3.0

DELTA =-0.2

T	P'(T)	T	P'(T)	T	P'(T)	T	P'(T)	T	P'(T)
0.01	0.11	0.21	0.34	0.41	0.90	0.61	1.65	0.81	1.60
0.02	0.12	0.22	0.36	0.42	0.94	0.62	1.68	0.82	1.57
0.03	0.12	0.23	0.38	0.43	0.98	0.63	1.70	0.83	1.53
0.04	0.13	0.24	0.40	0.44	1.02	0.64	1.72	0.84	1.50
0.05	0.14	0.25	0.42	0.45	1.06	0.65	1.74	0.85	1.46
0.06	0.15	0.26	0.44	0.46	1.10	0.66	1.75	0.86	1.42
0.07	0.16	0.27	0.47	0.47	1.14	0.67	1.76	0.87	1.39
0.08	0.16	0.28	0.49	0.48	1.18	0.68	1.77	0.88	1.35
0.09	0.17	0.29	0.52	0.49	1.22	0.69	1.78	0.89	1.31
0.10	0.18	0.30	0.54	0.50	1.27	0.70	1.78	0.90	1.27
0.11	0.19	0.31	0.57	0.51	1.31	0.71	1.78	0.91	1.22
0.12	0.21	0.32	0.60	0.52	1.35	0.72	1.77	0.92	1.18
0.13	0.22	0.33	0.63	0.53	1.39	0.73	1.76	0.93	1.14
0.14	0.23	0.34	0.66	0.54	1.42	0.74	1.75	0.94	1.10
0.15	0.24	0.35	0.69	0.55	1.46	0.75	1.74	0.95	1.06
0.16	0.26	0.36	0.72	0.56	1.50	0.76	1.72	0.96	1.02
0.17	0.27	0.37	0.76	0.57	1.53	0.77	1.70	0.97	0.98
0.18	0.29	0.38	0.79	0.58	1.57	0.78	1.68	0.98	0.94
0.19	0.30	0.39	0.83	0.59	1.60	0.79	1.65	0.99	0.90
0.20	0.32	0.40	0.87	0.60	1.63	0.80	1.63	1.00	0.87

DATA FOR $|R'(t)|$ CURVE V

ALPHA = 2.5

DELTA =-0.1

T	RAF	T	RAF	T	RAF	T	RAF	T	RAF
0.01	0.28	0.21	0.65	0.41	1.21	0.61	1.50	0.81	1.15
0.02	0.30	0.22	0.68	0.42	1.23	0.62	1.50	0.82	1.12
0.03	0.31	0.23	0.70	0.43	1.26	0.63	1.49	0.83	1.10
0.04	0.32	0.24	0.73	0.44	1.28	0.64	1.49	0.84	1.07
0.05	0.34	0.25	0.76	0.45	1.31	0.65	1.48	0.85	1.04
0.06	0.35	0.26	0.78	0.46	1.33	0.66	1.47	0.86	1.01
0.07	0.37	0.27	0.81	0.47	1.35	0.67	1.45	0.87	0.98
0.08	0.39	0.28	0.84	0.48	1.37	0.68	1.44	0.88	0.95
0.09	0.40	0.29	0.87	0.49	1.39	0.69	1.43	0.89	0.92
0.10	0.42	0.30	0.89	0.50	1.41	0.70	1.41	0.90	0.89
0.11	0.44	0.31	0.92	0.51	1.43	0.71	1.39	0.91	0.87
0.12	0.46	0.32	0.95	0.52	1.44	0.72	1.37	0.92	0.84
0.13	0.48	0.33	0.98	0.53	1.45	0.73	1.35	0.93	0.81
0.14	0.50	0.34	1.01	0.54	1.47	0.74	1.33	0.94	0.78
0.15	0.52	0.35	1.04	0.55	1.48	0.75	1.31	0.95	0.76
0.16	0.54	0.36	1.07	0.56	1.49	0.76	1.28	0.96	0.73
0.17	0.56	0.37	1.10	0.57	1.49	0.77	1.26	0.97	0.70
0.18	0.58	0.38	1.12	0.58	1.50	0.78	1.23	0.98	0.68
0.19	0.61	0.39	1.15	0.59	1.50	0.79	1.21	0.99	0.65
0.20	0.63	0.40	1.18	0.60	1.50	0.80	1.18	1.00	0.63

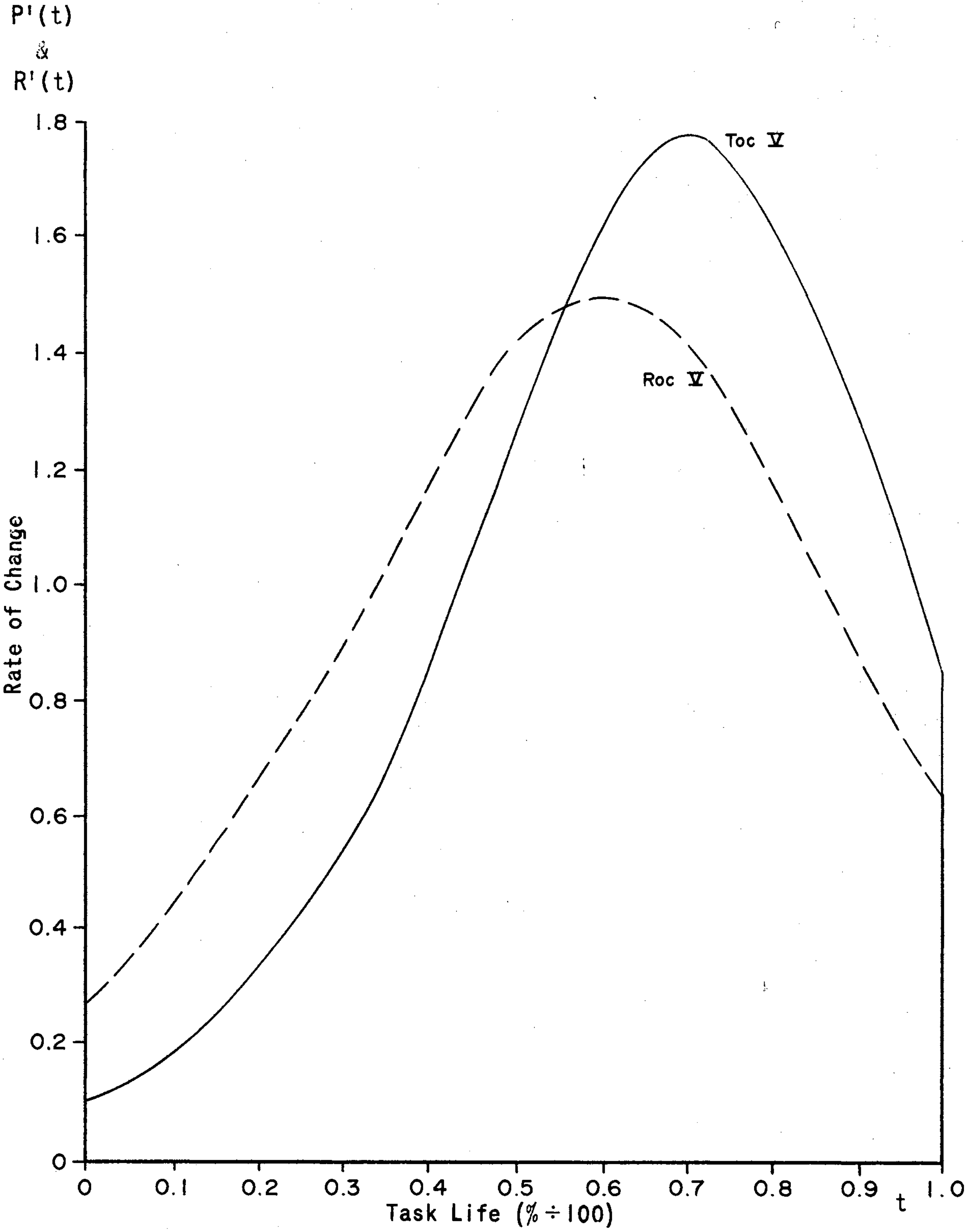

Figure 37. Graphic Comparisons of Absolute Derivatives for TOC and ROC Curves V

APPENDIX D

COMPOSITE ALGORITHM FOR SYSTEMS SIMULATION

APPENDIX D-I

COMPUTER LOGIC FLOW CHART

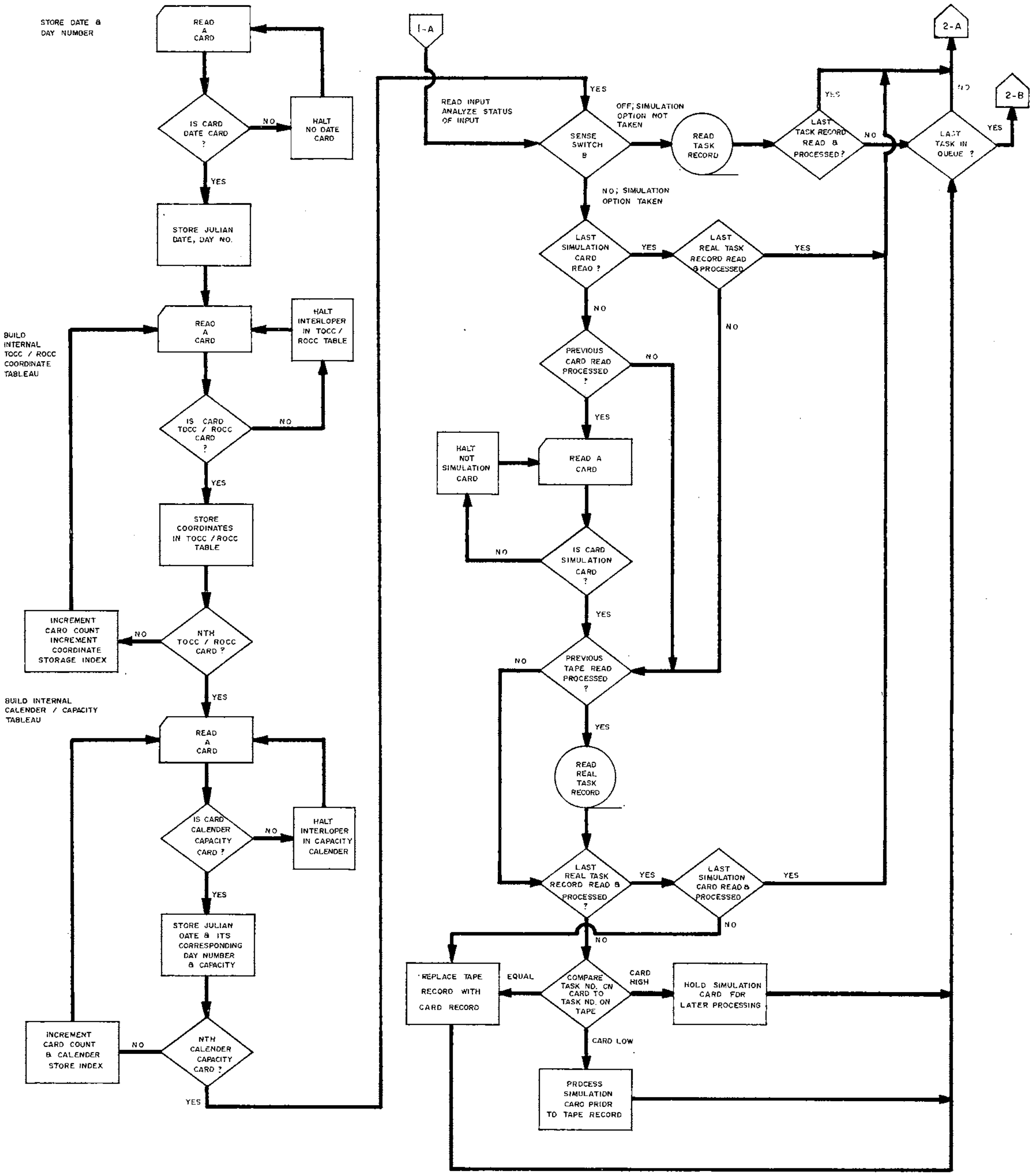

Figure 38a. Composite Algorithm Computer Logic Flow Chart

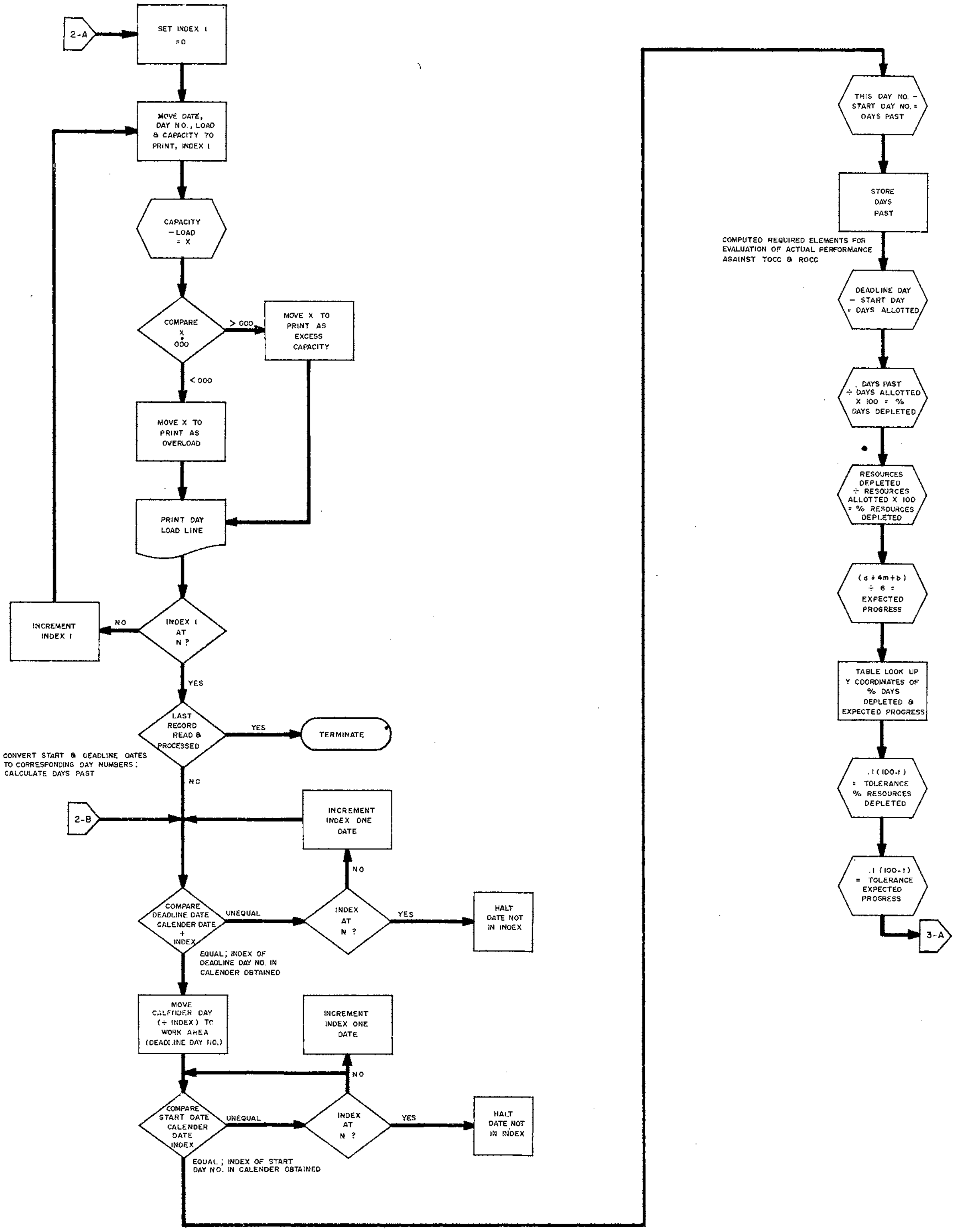

Figure 38b. Composite Algorithm Computer Logic Flow Chart

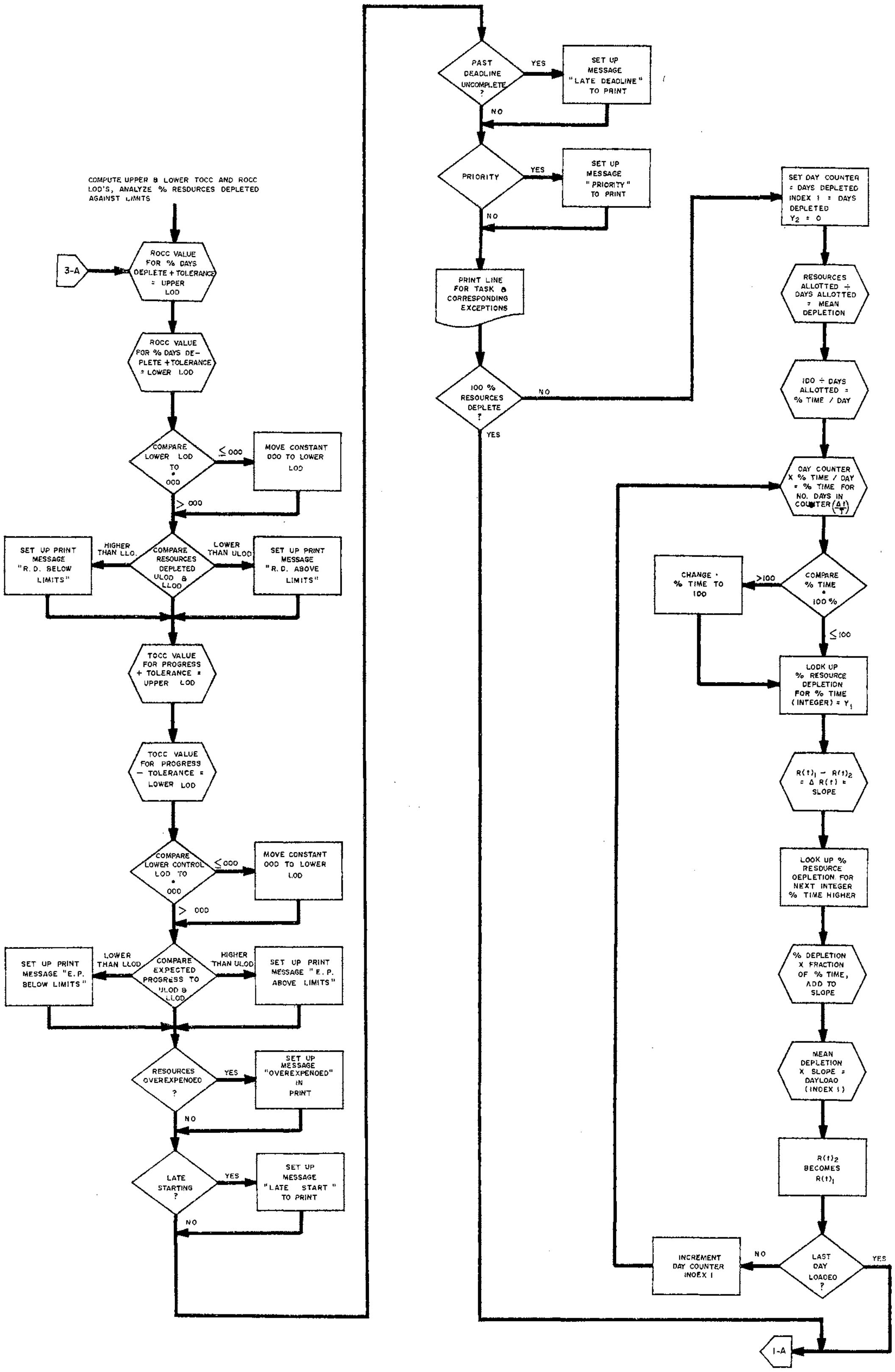

Figure 38c. Composite Algorithm Computer Logic Flow Chart

APPENDIX D-2

IBM 1401 COMPUTER PROGRAM

```
CLEAR STORAGE 1      ,008015,022026,030037,044,049,053053N000000N00001026                                              1
CLEAR STORAGE 2      L068116,105106,110117B101/I9I#071029C029056B026/B001/0991,001/001117I0&                           2
BOOTSTRAP            ,008015,022029,036040,047054,061068,072/061039                   ,0010011040                      3

                                                                                      TOCC                PAGE      1

SEQ PG LIN LABEL  OP    OPERANDS                                              SFX CT  LOCN  INSTRUCTION   TYPE   CARD

101  1 010 001    JOB
102  1 020        CTL   661
103  1 021 ANSW10 DCW   #10                                                       10  0342                          4
104  1 022 ANSW14 DCW   #14                                                       14  0356                          4
105  1 023 INDEX  DCW   #3                                                         3  0359                          4
106  1 024 MAR6   DCW   #6                                                         6  0365                          4
107  1 025 DVAR11 DCW   #11                                                       11  0376                          5
108  1 026 MAR8   DCW   #8                                                         8  0384                          5
109  1 027 MAR5   DCW   #5                                                         5  0389                          5
110  1 028 MAR10  DCW   #10                                                       10  0399                          5
111  1 030 MASIN  DA    1X80,‡                                                        0400  0480                    5
112  1 040 TASKND       1,4                                                           0403                FIELD     5
113  1 050 DESC         5,14                                                          0413                FIELD     5
114  1 060 RESALL       15,19                                                         0418                FIELD     6
115  1 070 RESDEP       20,24                                                         0423                FIELD     6
116  1 080 START        25,30                                                         0429                FIELD     6
117  1 090 DEAD         31,35                                                         0435                FIELD     6
118  1 100 TOCCRV       37,37                                                         0436                FIELD     6
119  1 105 ROCCRV       38,38                                                         0437                FIELD     6
120  1 110 A            39,41                                                         0440                FIELD     7
121  1 120 M            42,44                                                         0443                FIELD     7
122  1 130 B            45,47                                                         0446                FIELD     7
123  1 140 POS          48,48                                                         0447                FIELD     7
124  1 150 PRI          49,49                                                         0448                FIELD     7
                  DC    @‡@                                                        1  0480                RMARK     8
125  1 160 SWA    DC    @A@                                                        1  0481                          8
126  1 170 SWB    DC    @B@                                                        1  0482                          8
127  1 180 SWC    DC    @C@                                                        1  0483                          8
128  1 190 SWD    DC    @D@                                                        1  0484                          8
129  1 200 SWE    DC    @E@                                                        1  0485                          8
130  1 210 TABLE  DA    1000X3                                                        0486  3485                  174
131  1 220 CALEND DA    100X19                                                        3486  5385                  191
132  1 230 CDATE        1,6                                                           3491                FIELD   191
133  1 240 CDAY         7,9                                                           3494                FIELD   208
134  1 250 CCAPAC       10,14                                                         3499                FIELD   225
135  2 010 CLOAD        15,19                                                         3504                FIELD   241
136  2 020 X1     EQU   89                                                            0089
137  2 030 X2     EQU   94                                                            0094
138  2 040 X3     EQU   99                                                            0099
139  2 300 HEAD1  DCW   @ACTUAL RESOURCE DEPLETION & EXPECTED PROGRESS@           45  5430                        259
140  2 320 HEAD2  DCW   @VS. TOCC PROGRESS & ROCC RESOURCE DEPLETION@             43  5473                        261
141  2 330 HEAD3  DCW   @WITHIN TIME DEPLETION@                                   21  5494                        261
142  2 340 HEAD4  DCW   @TASKS IN QUEUE@                                          14  5508                        261
143  2 345 HEAD5  DCW   @TASKS IN FACILITY@                                       17  5525                        262
144  2 350        DCW   @TASK           START DEAD DAYS DAYS P.C. RESOR RES@      50  5575                        264
145  2 351        DC    @OR P.C. ROCC TOCC EXP   SELECTED     TOCC       RO@      50  5625                        266
146  2 360 HEAD6  DC    @CC@                                                       2  5627                        266
147  2 370        DCW   @NO.  DESCRIPTION  DAY  LINE ALTD DEPL DEPL ALTD  @       49  5676                        268
148  2 380        DC    @DEPL  DEPL REMG PROG PROG   CURVE      UCL  LCL  @       49  5725                        270
149  2 390 HEAD7  DC    @UCL  LCL  MESSAGES@                                      18  5743                        270
150        STARTP SW    87,92                                                      7  5744  , 087 092             270
151  3 006        SW    97                                                         4  5751  , 097                 270
152  3 010        R                                                                1  5755  1                     271
153  3 020        MLC   5,DATE#6                                                   7  5756  M 006 /8K             271
154  3 030        MLC   9,DAY#3                                                    7  5763  M 009 /8N             271
155  3 035        B     SKIP                                                       4  5770  B GOV                 271
156  3 040        BCE   B3,80,D                                                    8  5774  B X8W 080 D           271
157  3 050        H     START                                                      4  5782  . 429                 271
158  3 060 B3     R                                                                1  5786  1                     271
159  3 070        C     2,LAST                                                     7  5787  C 002 /9P             272
160  3 080        BL    B3A                                                        5  5794  B YOT T               272
161  3 090        NOP   B3                                                         4  5799  N X8W                 272
162  3 100 B3A    MLC   5&X1,TABLE&2&X2                                            7  5803  M 0‡5 4Q8             272
163  3 110        C     X1,@057@                                                   7  5810  C 089 /8Q             272
164  3 120        BE    B3B                                                        5  5817  B Y4‡ S               272
165  3 120        A     @3@,X1                                                     7  5822  A /8R 089             273
166  3 125        A     @3@,X2                                                     7  5829  A /8R 094             273
167  3 140        B     B3A                                                        4  5836  B YOT                 273
168  3 150 B3B    C     COUNT#3,@49@                                               7  5840  C /9K /9M             273
169  3 160        BE    B3C                                                        5  5847  B Y8/ S               273
170  3 165        A     @3@,X2                                                     7  5852  A /8R 094             273
171  3 170        A     &1,COUNT                                                   7  5859  A /9N /9K             274
172  3 175        MLC   2,LAST#2                                                   7  5866  M 002 /9P             274
173  3 175        S     X1&1                                                       4  5873  S 090                 274
174  3 180        B     B3                                                         4  5877  B X8W                 274
175  3 190 B3C    C     2,@55@                                                     7  5881  C 002 /9R             274
176  3 200        BE    B4                                                         5  5889  B Y9X S               274
177  3 210        H     B3                                                         4  5893  . X8W                 274
178  3 220 B4     S     X1&1                                                       4  5897  S 090                 275
179  3 225        S     X2&1                                                       4  5901  S 095                 275
180  3 230 B4A    R                                                                1  5905  1                     275
181  3 235        BCE   B4B,80,C                                                   8  5906  B Z1Y 080 C           275
182  3 236        H     B4                                                         4  5914  . Y9X                 275
183  3 240 B4B    MLC   5,CDATE&X1                                                 7  5918  M 006 DZ1             275
184  3 250        MLC   9,CDAY&X1                                                  7  5925  M 009 DZ4             275
185  4 010        MLC   14,CCAPAC&X1                                               7  5932  M 014 DZ9             276
186  4 020        C     X1,@Y81@                                                   7  5939  C 089 SOK             276
187  4 030        BE    B5                                                         5  5946  B Z6S S               276
188  4 040        A     @19@,X1                                                    7  5951  A SOM 089             276
189  4 050        B     B4A                                                        4  5958  B ZOV                 276
190  4 060 B5     BSS   B40,C                                                      5  5962  B H4X C               276
191  4 061        BSS   RDCARD,D                                                   5  5967  B Z7W D               277
192  4 062        B     RDTAPE                                                     4  5972  B -0‡                 277
193  4 063 RDCARD BLC   B33                                                        5  5976  B E7X A               277
194  4 064        R                                                                1  5981  1                     277
195  4 065        MLC   @‡@,81                                                     7  5982  M SON 081             277
196  4 066        MCM   1,MASIN                                                    7  5989  P 001 400             277
```

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SEQ PG LIN  LABEL  OP    OPERANDS                       SFX CT  LOCN  INSTRUCTION TYPE  CARD
197  4 067         B     B5A                                4   5996  B -6‡             277
198  4 069  RDTAPE NOP                                      1   6000  N                 278
199  4 070         RDTAP TAPE1,MASIN,B33                                      MACRO
200                MLC   99,H%IR                            7   6001  M 099 /5R   GEN   278
201                CALL  CTAPE                                                GEN
202                B     CTAPE                              4   6008  B 620       GEN   278
203                DSA   B33                                3   6014  E7X         GEN   278
204                RT    TAPE1,MASIN                        8   6015  M %U1 400 R GEN   278
205  4 080         C     POS,PREPOS#1                       7   6023  C 447 S00         278
206  4 090         BH    B5A                                5   6030  B -6‡ U           278
207  4 100         C     PRI,PREPRI#1                       7   6035  C 448 S0P         279
208  4 110         BH    B5A                                5   6042  B -6‡ U           279
209  4 120         C     TASKNO,PRENO#4                     7   6047  C 403 S1J         279
210  4 130         BL    B5A                                5   6054  B -6‡ T           279
211  4 140         H                                        1   6059  .                 279
212  4 150  B5A    MLC   POS,PREPOS                         7   6060  M 447 S00         279
213  4 160         MLC   PRI,PREPRI                         7   6067  M 448 S0P         279
214  4 170         MLC   TASKNO,PRENO                       7   6074  M 403 S1J         280
215  4 180  B5D    BCE   B5B,POS,2                          8   6081  B -9T 447 2       280
216  4 190         B     B6A                                4   6089  B J0U             280
217  4 200  B5B    MLC   @N@,B5D                            7   6093  M S1K -8/         280
218  4 210         B     B34                                4   6100  B E8/             280
219  4 220  B6A    S     X1&1                               4   6104  S 090             280
220  4 230  B6C    C     DEAD,CDATE&X1                      7   6108  C 435 DZ1         281
221  4 240         BE    B6B                                5   6115  B J4X S           281
222  4 250         C     X1,@Y81@                           7   6120  C 089 S0K         281
223  5 010         BE    B6D                                5   6127  B J4T S           281
224  5 020         A     @19@,X1                            7   6132  A S0M 089         281
225  5 030         B     B6C                                4   6139  B J0Y             281
226  5 040  B6D    H     B6A                                4   6143  . J0U             281
227  5 050  B6B    MLC   CDAY&X1,DEADD#3                    7   6147  M DZ4 S1N         282
228  5 060  B6E    S     X1&1                               4   6154  S 090             282
229  5 070  B6H    C     START,CDATE&X1                     7   6158  C 429 DZ1         282
230  5 080         BE    B6F                                5   6165  B J9X S           282
231  5 090         C     X1,@Y81@                           7   6170  C 089 S0K         282
232  5 100         BE    B6G                                5   6177  B J9T S           282
233  5 110         A     @19@,X1                            7   6182  A S0M 089         283
234  5 120         B     B6H                                4   6189  B J5Y             283
235  5 130  B6G    H     B6E                                4   6193  . J5U             283
236  5 140  B6F    MLC   CDAY&X1,STARTD#3                   7   6197  M DZ4 S1Q         283
237  5 150  B9     MLC   DAY,WORK3#3                        7   6204  M /8N S2J         283
238  5 160         S     STARTD,WORK3                       7   6211  S S1Q S2J         283
239  5 170         MLC   WORK3,DAPAST#3                     7   6218  M S2J S2M         284
240  5 180         BWZ   B10A,DAPAST,K                      8   6225  V K3X S2M K       284
241  5 182         B     B10D                               4   6233  B K5Z             284
242  5 183  B10A   MLC   @000@,DAPAST                       7   6237  M S2P S2M         284
243  5 184  B10B   MLC   @000@,PCDDEP                       7   6244  M S2P S3Q         284
244  5 185         SW    SWB                                4   6251  , 482             284
245  5 186         B     B10C                               4   6255  B L4/             285
246  5 190  B10D   MZ    DAPAST-1,DAPAST                    7   6259  Y S2L S2M         285
247  5 200         C     DAPAST,@000@                       7   6266  C S2M S2P         285
248  5 210         BE    B10A                               5   6273  B K3X S           285
249  5 220         MLC   DEADD,WORK3                        7   6278  M S1N S2J         285
250  5 230         S     STARTD,WORK3                       7   6285  S S1Q S2J         285
251  5 240         MLC   WORK3,DAALLO#3                     7   6292  M S2J S3-         286
252  5 250         ZA    DAPAST,ANSW10-3                    7   6299  & S2M 339         286
253  5 255         MLC   &000,ANSW10                        7   6306  M S3L 342         286
254  5 260         MZ    @ @,ANSW10-3                       7   6313  Y S3M 339         286
255  6 010         D     DAALLO,ANSW10-5                    7   6320  % S3- 337         286
256  6 015         A     @5@,ANSW10-4                       7   6327  A S3N 338         287
257  6 020         MLC   ANSW10-5,PCDDEP#3                  7   6334  M 337 S3Q         287
258  6 025  B10C   NOP                                      1   6341  N                 287
259  6 030         ZA    RESDEP,ANSW14-3                    7   6342  & 423 353         287
260  6 040         MLC   &000,ANSW14                        7   6349  M S3L 356         287
261  6 042         MZ    @ @,ANSW14-3                       7   6356  Y S3M 353         287
262  6 045         D     RESALL,ANSW14-7                    7   6363  % 418 349         288
263  6 046         A     @5@,ANSW14-6                       7   6370  A S3N 350         288
264  6 050         MLC   ANSW14-7,PCRDEP#3                  7   6377  M 349 S4J         288
265  6 D60         ZA    M,WORK3                  B13       7   6384  & 443 S2J         288
266  6 070         A     WORK3                              4   6391  A S2J             288
267  6 080         A     WORK3                              4   6395  A S2J             288
268  6 090         A     A,WORK3                            7   6399  A 440 S2J         289
269  6 100         A     B,WORK3                            7   6406  A 446 S2J         289
270  6 110         ZA    WORK3,ANSW5#5                      7   6413  & S2J S40         289
271  6 120         D     &6,ANSW5-2                         7   6420  % S4P S4M         289
272  6 130         MLC   ANSW5-2,EXPPRO#3                   7   6427  M S4M S5-         289
273  7 010         MLC   @000@,INDEX                        7   6434  M S2P 359         290
274  7 020         BW    B14B,SWB          PCDDEP IS ZERO   8   6441  V 05V 482 1       290
275  7 022         MZ    @ @,PCDDEP                         7   6449  Y S3M S3Q         290
276  7 023         C     PCDDEP,@099@                       7   6456  C S3Q S5L         290
277  7 024         BL    B14Q                               5   6463  B 03X T           290
278  7 030         MLC   ROCCRV,WORK2#2                     7   6468  M 437 S5N         291
279  7 040         S     &1,WORK2                           7   6475  S /9N S5N         291
280  7 050         MN    WORK2,INDEX-2                      7   6482  D S5N 357         291
281  7 060         A     PCDDEP,INDEX                       7   6489  A S3Q 359         291
282  7 095         A     @5@,INDEX-2                        7   6496  A S3N 357         291
283  7 065         S     X1&1                               4   6503  S 090             291
284  7 07          A     INDEX,X1                           7   6507  A 359 089         292
285  7 08          A     INDEX,X1                           7   6514  A 359 089         292
286  7 09          A     INDEX,X1                           7   6521  A 359 089         292
287  7 100         MLC   TABLE&X1&2,YCOOR#3                 7   6528  M 4Y8 S5Q         292
288  7 110         MLC   YCOOR,WORK4                        7   6535  M S5Q S7M         292
289  7 140         A     &5,WORK4                           7   6542  A S5R S7M         293
290  7 150         ZA    YCOOR,WORK3                        7   6549  & S5Q S2J         293
291  7 160         A     WORK4-1,WORK3                      7   6556  A S7L S2J         293
292  7 170         MZ    WORK3-1,WORK3                      7   6563  Y S2- S2J         293
293  7 180         C     WORK3,@099@                        7   6570  C S2J S5L         293
294  7 190         BL    B14C                               5   6577  B N9T T           294
295  7 200         MLC   WORK3,UCL#3                        7   6582  M S2J S6K         294
296  7 210         B     *&8                                4   6589  B 00‡             294
```

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SEQ PG LIN  LABEL  OP    OPERANDS                 SFX CT  LOCN· INSTRUCTION TYPE  CARD

297  7 220  B14C   MLC   @100@,UCL                    7  6593  M S6N S6K          294
298  7 240          ZA   YCOOR,LCL#3                  7  6600  & S5Q S6Q          294
299  7 250         S     WORK4-1,LCL                  7  6607  S S7L S6Q          294
300  8 010         BWZ   B14E,LCL,K                   8  6614  V O2W S6Q K        295
301  8 020         B     B14M                         4  6622  B POV              295
302  8 030  B14E   MLC   @000@,LCL                    7  6626  M S2P S6Q          295
303  8 040         B     B17                          4  6633  B Q7Y              295
304  8 045  B14Q   MLC   @000@,YCOOR                  7  6637  M S2P S5Q          295
305  8 046         MLC   @100@,YCOOR2                 7  6644  M S6N S7P          295
306  8 047         B     B14B&14                      4  6651  B O6Z              296
307  8 050  B14B   MLC   @000@,YCOOR                  7  6655  M S2P S5Q          296
308  8 055         MLC   @000@,YCOOR2                 7  6662  M S2P S7P          296
309  8 056         MLC   @000@,LCL2                   7  6669  M S2P S8L          296
310  8 057         MLC   @000@,UCL2                   7  6676  M S2P S8-          296
311  8 060         MLC   @000@,LCL                    7  6683  M S2P S6Q          296
312  8 070         MLC   @000@,UCL                    7  6690  M S2P S6K          297
313  8 071         CW    SWB                          4  6697  ¤ 482              297
314  8 072         B     B17                          4  6701  B Q7Y              297
315  8 073  B14M   MLC   TOCCRV,WORK02#2              7  6705  M 436 S7-          297
316  8 074         S     &1,WORK02                    7  6712  S /9N S7-          297
317  8 075         MLC   @000@,INDEX                  7  6719  M S2P 359          297
318  8 076         MN    WORK02,INDEX-2               7  6726  D S7- 357          298
319  8 077         A     PCDDEP,INDEX                 7  6733  A S3Q 359          298
320  8 077         S     X1&1                         4  6740  S 090              298
321  8 078         A     INDEX,X1                     7  6744  A 359 089          298
322  8 079         A     INDEX,X1                     7  6751  A 359 089          298
323  8 080         A     INDEX,X1                     7  6758  A 359 089          298
324  8 081         MLC   TABLE&X1-1,YCOOR2            7  6765  M 4Y5 S7P          299
325  8 082         ZA    @100@,WORK4#4                7  6772  & S6N S7M          299
326  8 083         S     YCOOR2#3,WORK4               7  6779  S S7P S7M          299
327  8 085         A     &5,WORK4                     7  6786  A S5R S7M          299
328  8 086         ZA    YCOOR2,WORK3                 7  6793  & S7P S2J          299
329  8 087         A     WORK4-1,WORK3                7  6800  A S7L S2J          300
330  8 088         MZ    WORK3-1,WORK3                7  6807  Y S2- S2J          300
331  8 089         C     WORK3,@099@                  7  6814  C S2J S5L          300
332  8 090         BL    B14W                         5  6821  B Q3X T            300
333  8 091         MLC   WORK3,UCL2#3                 7  6826  M S2J S8-          300
334  8 092         B     B14Y                         4  6833  B Q4U              300
335  8 093  B14W   MLC   @100@,UCL2                   7  6837  M S6N S8-          301
336  8 094  B14Y   ZA    YCOOR2,LCL2#3                7  6844  & S7P S8L          301
337  8 095         S     WORK4-1,LCL2                 7  6851  S S7L S8L          301
338  8 096         BWZ   B14Z,LCL2,K                  8  6858  V Q7‡ S8L K        301
339  8 097         B     B14K                         4  6866  B Q7X              301
340  8 098  B14Z   MLC   @000@,LCL2                   7  6870  M S2P S8L          302
341  8 099  B14K   NOP                                1  6877  N                  302
342  8 100  B17    S     X1&1                         4  6878  S 090              302
343  8 101         A     RESALL,TOTRES#6              7  6882  A 418 S8R          302
344  8 102         A     RESDEP,TOTDEP#6              7  6889  A 423 S9N          302
345  8 103         MLC   @100@,PCRREM#3               7  6896  M S6N S9Q          302
346  8 104         S     PCRDEP,PCRREM                7  6903  S S4J S9Q          303
347  8 105         MZ    UCL,PCRREM                   7  6910  Y S6K S9Q          303
348  8 105         C     PCRREM,UCL                   7  6917  C S9Q S6K          303
349  8 106         BL    B18                          5  6924  B R7‡ T            303
350  8 109         MZ    LCL,PCRREM                   7  6929  Y S6Q S9Q          303
351  8 110         C     PCRREM,LCL                   7  6936  C S9Q S6Q          304
352  8 120         BH    B19                          5  6943  B R5S U            304
353  8 130         B     B20                          4  6948  B R8Y              304
354  8 140  B19    MLC   @RD HI,@,314&X2              7  6952  M TOM 3J4          304
355  8 150         A     @6@,X1                       7  6959  A TON 089          304
356  8 160         B     B20                          4  6966  B R8Y              304
357  8 170  B18    MLC   @RD LO,@,314&X1              7  6970  M T1J 3/4          305
358  8 180         A     @6@,X1                       7  6977  A TON 089          305
359  8 190         B     B20                          4  6984  B R8Y              305
360  8 200  B20    C     EXPPRO,UCL2                  7  6988  C S5- S8-          305
361  8 210         BL    B21                          5  6995  B &1W T            305
362  8 220         C     EXPPRO,LCL2                  7  7000  C S5- S8L          305
363  8 230         BH    B22                          5  7007  B &3U U            306
364  8 240         B     B23                          4  7012  B &4Y              306
365. 8 250  B21    MLC   @EP HI,@,314&X1              7  7016  M T1P 3/4          306
366  9 010         A     @6@,X1                       7  7023  A TON 089          306
367  9 020         B     B23                          4  7030  B &4Y              306
368  9 030  B22    MLC   @EP LO,@,314&X1              7  7034  M T2L 3/4          306
369  9 040         A     @6@,X1                       7  7041  A TON 089          307
370  9 050  B23    C     RESALL,RESDEP                7  7048  C 418 423          307
371  9 060         BH    B24                          5  7055  B &6U U            307
372  9 070         B     B25                          4  7060  B &7Y              307
373  9 080  B24    MLC   @OVERX,@,314&X1              7  7064  M T2R 3/4          307
374  9 090         A     @6@,X1                       7  7071  A TON 089          307
375  9 100  B25    C     START,DATE                   7  7078  C 429 /8K          308
376  9 110         BH    B25A                         5  7085  B &9U U            308
377  9 120         B     B27                          4  7090  B A2‡              308
378  9 130  B25A   BCE   B26,POS,2                    8  7094  B AOW 447 2        308
379  9 140         B     B27                          4  7102  B A2‡              308
380  9 150  B26    MLC   @LATES,@,314&X1              7  7106  M T3N 3/4          308
381  9 160         A     @6@,X1                       7  7113  A TON 089          309
382  9 170  B27    C     DEAD,DATE                    7  7120  C 435 /8K          309
383  9 180         BH    B28                          5  7127  B A3W U            309
384  9 190         B     B29                          4  7132  B A5‡              309
385  9 200  B28    MLC   @LATED,@,314&X1              7  7136  M T4J 3/4          309
386  9 210         A     @6@,X1                       7  7143  A TON 089          309
387  9 220  B29    BCE   B30,PRI,1                    8  7150  B A6S 448 1        310
388  9 230         B     B31                          4  7158  B A7‡              310
389  9 235  B30    NOP                                1  7162  N                  310
390  9 240         MLC   @PRIOR,@,314&X1              7  7163  M T4P 3/4          310
391  9 245  B31    NOP                                1  7170  N                  310
392  9 250         MLC   @ @,308&X1                   7  7171  M S3M 3‡8          310
393 10 005         MLC   TASKNO,204                   7  7178  M 403 204          310
394 10 010         MLC   DESC,216                     7  7185  M 413 216          311
395 10 020         MCS   STARTD,221                   7  7192  Z S1Q 221          311
396 10 030         MCS   DEADD,227                    7  7199  Z S1N 227          311
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SEQ PG LIN  LABEL  OP    OPERANDS                    SFX CT  LOCN  INSTRUCTION TYPE CARD

397 10 040         MCS   DAALLO,232                        7  7206  Z S3- 232         311
398 10 050         MCS   DAPAST,237                        7  7213  Z S2M 237         311
399 10 060         MCS   PCDDEP,241                        7  7220  Z S3Q 241         312
400 10 070         MLC   @%@,242                           7  7227  M T4Q 242         312
401 10 080         MCS   RESALL,248                        7  7234  Z 418 248         312
402 10 090         MCS   RESDEP,254                        7  7241  Z 423 254         312
403 10 100         MCS   PCRDEP,258                        7  7248  Z S4J 258         312
404 10 110         MLC   @%@,259                           7  7255  M T4Q 259         313
405 10 120         MCS   YCOOR,263                         7  7262  Z S5Q 263         313
406 10 125         MLC   @%@,264                           7  7269  M T4Q 264         313
407 10 130         MCS   YCOOR2,268                        7  7276  Z S7P 268         313
408 10 135         MLC   @%@,269                           7  7283  M T4Q 269         313
409 10 137         MCS   EXPPRO,273                        7  7290  Z S5- 273         314
410 10 138         MLC   @%@,274                           7  7297  M T4Q 274         314
411 10 140         BCE   CURT1,TOCCRV,1                    8  7304  B C8W 436 1       314
412 10 142         BCE   CURT2,TOCCRV,2                    8  7312  B C9X 436 2       314
413 10 144         BCE   CURT3,TOCCRV,3                    8  7320  B D0Y 436 3       314
414 10 146         BCE   CURT4,TOCCRV,4                    8  7328  B D1Z 436 4       315
415 10 148         MLC   @V@,278                           7  7336  M T4R 278         315
416 10 150  CKCRV2 BCE   CURR1,ROCCRV,1                    8  7343  B D3‡ 437 1       315
417 10 152         BCE   CURR2,ROCCRV,2                    8  7351  B D4/ 437 2       315
418 10 154         BCE   CURR3,ROCCRV,3                    8  7359  B D5S 437 3       315
419 10 156         BCE   CURR4,ROCCRV,4                    8  7367  B D6T 437 4       316
420 10 158         MLC   @V@,284                           7  7375  M T4R 284         316
421 10 160         B     OUTCRV                            4  7382  B D7‡             316
422 10 162  CURT1  MLC   @I@,278                           7  7386  M T5- 278         316
423 10 164         B     CKCRV2                            4  7393  B C4T             316
424 10 166  CURT2  MLC   @II@,278                          7  7397  M T5K 278         316
425 10 168         B     CKCRV2                            4  7404  B C4T             317
426 10 170  CURT3  MLC   @III@,278                         7  7408  M T5N 278         317
427 10 172         B     CKCRV2                            4  7415  B C4T             317
428 10 174  CURT4  MLC   @IV@,278                          7  7419  M T5P 278         317
429 10 176         B     CKCRV2                            4  7426  B C4T             317
430 10 178  CURR1  MLC   @I@,284                           7  7430  M T5- 284         317
431 10 180         B     OUTCRV                            4  7437  B D7‡             317
432 10 182  CURR2  MLC   @II@,284                          7  7441  M T5K 284         318
433 10 190         B     OUTCRV                            4  7448  B D7‡             318
434 10 200  CURR3  MLC   @III@,284                         7  7452  M T5N 284         318
435 10 210         B     OUTCRV                            4  7459  B D7‡             318
436 10 220  CURR4  MLC   @IV@,284                          7  7463  M T5P 284         318
437 10 230  OUTCRV NOP                                     1  7470  N                 318
438 10 235         MLC   @   @,284                         7  7471  M T6- 284         318
439 10 236         MLC   278,KEEP#3                        7  7478  M 278 T6L         319
440 10 237         MLC   @   @,278                         7  7485  M T6- 278         319
441 10 238         MLC   KEEP,281                          7  7492  M T6L 281         319
442 10 240  *
443 10 290         MCS   UCL,300                           7  7499  Z S6K 300         319
444 10 300         MLC   @%@,301                           7  7506  M T4Q 301         319
445 10 310         MCS   LCL,305                           7  7513  Z S6Q 305         320
446 10 320         MLC   @%@,306                           7  7520  M T4Q 306         320
447 10 322         MCS   UCL2,290                          7  7527  Z S8- 290         320
448 10 324         MLC   @%@,291                           7  7534  M T4Q 291         320
449 10 326         MCS   LCL2,295                          7  7541  Z S8L 295         320
450 10 328         MLC   @%@,296                           7  7548  M T4Q 296         321
451 10 330         CC    S                                 2  7555  F S               321
452 10 340         W                                       1  7557  2                 321
453 10 350         CS    332                               4  7558  / 332             321
454 10 360         CS                                      1  7562  /                 321
455 10 370         BSS   B50,B                             5  7563  B 10K B           321
456 10 380         BCV   SKIP                              5  7568  B G0V @           321
457 10 390         B     B5                                4  7573  B Z6S             322
458 11 010  B33    SW    SWA                               4  7577  , 481             322
459 11 020  B34    ZA    TOTDEP,ANSW13#13                  7  7581  & S9N T70         322
460 11 030         D     TOTRES,ANSW13-5                   7  7588  % S8R T7J         322
461 11 035         MLC   ANSW13-7,STOR#7                   7  7595  M T6R T8L         322
462 11 040         MCS   STOR,265                          7  7602  Z T8L 265         322
463 11 050         MLC   @%@,266                           7  7609  M T4Q 266         323
464 11 060         MCS   TOTDEP,260                        7  7616  Z S9N 260         323
465 11 070         MCS   RESDEP,253                        7  7623  Z 423 253         323
466 11 080         BW    B33A,SWA                          8  7630  V F4Z 481 1       323
467 11 090         MLC   @FACILITY TOTALS@,215             7  7638  M T9Q 215         323
468 11 100         B     B33B                              4  7645  B F5W             324
469 11 110  B33A   MLC   @FACILITY & QUEUE TOTALS @,223    7  7649  M U2K 223         324
470 11 120  B33B   CC    J                                 2  7656  F J               324
471 11 130         CS    332                               4  7658  / 332             324
472 11 140         CS                                      1  7662  /                 324
473 11 150         BSS   B100,B                            5  7663  B I9T B           324
474 11 160         BW    HALT,SWA                          8  7668  V F8U 481 1       324
475 11 170         B     SKIP                              4  7676  B G0V             325
476 11 180         B     B6A                               4  7680  B J0U             325
477 11 181  HALT   BSS   HLT,D                             5  7684  B F9U D           325
478 13 XXX         RWD   1                                 5  7689  U %U1 R           325
479 11 190  HLT    H     9999,999                          7  7694  . Z9R 999         325
480 11 200         B     HLT                               4  7701  B F9U             325
481 12 010  SKIP   SBR   BACK&3                            4  7705  H H4V             325
482 12 015         CC    1                                 2  7709  F 1               326
483 12 020         MLC   HEAD1,284                         7  7711  M U3‡ 284         326
484 12 030         W                                       1  7718  2                 326
485 12 040         CS    332                               4  7719  / 332             326
486 12 050         CS                                      1  7723  /                 326
487 12 060         MLC   HEAD2,283                         7  7724  M U7T 283         326
488 12 070         W                                       1  7731  2                 326
489 12 080         CS    332                               4  7732  / 332             327
490 12 090         CS                                      1  7736  /                 327
491 12 100         MLC   HEAD3,272                         7  7737  M U9U 272         327
492 12 110         W                                       1  7744  2                 327
493 12 120         CS    332                               4  7745  / 332             327
494 12 130         CS                                      1  7749  /                 327
495 12 140         MLC   HEAD5,270                         7  7750  M V2V 270         327
496 12 150         MLC   @N@,*-13                          7  7757  M S1K G5‡         328
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SEQ PG LIN  LABEL  OP    OPERANDS                                            SFX CT  LOCN  INSTRUCTION TYPE    CARD

497 12 200  SKIPA  NOP   HEAD4,268                                                7  7764  N V0Y 268           328
498 12 202         MLC   @M@,SKIPA                                                7  7771  M U2L G6U           328
499 12 204         MLC   DATE,ROTATE-2                                            7  7778  M /8K U5-           328
500 12 205         MLC   DATE-4,ROTATE                                            7  7785  M /7Q U5K           328
501 12 206         LCA   @ / / @,209                                              7  7792  L U3J 209           329
502 12 207         MCE   ROTATE,209                                               7  7799  E U5K 209           329
503 12 210         W                                                              1  7806  2                   329
504 12 220         CS    332                                                      4  7807  / 332               329
505 12 230         CS                                                             1  7811  /                   329
506 12 240  SKIP8  CC    K                                                        2  7812  F K                 329
507 13 010         MLC   HEAD6,304                                                7  7814  M W2X 304           329
508 13 020         W                                                              1  7821  2                   330
509 13 030         CS    332                                                      4  7822  / 332               330
510 13 040         CS                                                             1  7826  /                   330
511 13 050         MLC   HEAD7,316                                                7  7827  M X4T 316           330
512 13 060         W                                                              1  7834  2                   330
513 13 070         CS    332                                                      4  7835  / 332               330
514 13 080         CS                                                             1  7839  /                   330
515 13 090         CC    J                                                        2  7840  F J                 331
516 13 100  BACK   B     0                                                        4  7842  B 000               331
517 13 110         NOP                                                            1  7846  N                   331
518 13 117  B40    NOP                                                            1  7847  N                   331
519 14 01   HEAD8  DCW   @INTERMITTENT SYSTEM LOAD ANALYSIS BY DAY@              40  7887                      333
520 14 02          DCW    DAY    TASKS    RESO ALTD   CAPACITY   EXCESS     DVER  4  7891                      333
521 14 03   HEAD9  DC    @LOAD@                                                   4  7895                      333
522 14 04   SKIP2  SBR   BACK2&3                                                  4  7896  H I9S               333
523 14 05          CC    1                                                        2  7900  F 1                 333
524 14 06          MLC   HEAD8,245                                                7  7902  M H8X 245           333
525 14 07          W                                                              1  7909  2                   334
526 14 08          CS    332                                                      4  7910  / 332               334
527 14 09          CS                                                             1  7914  /                   334
528 14 10          CC    J                                                        2  7915  F J                 334
529 14 101         MLC   @FACILITY@,228                                           7  7917  M U3R 228           334
530 14 102  NOPER  NOP   @& QUEUE@,235                                            7  7924  N U40 235           334
531 14 103         MLC   @M@,NOPER                                                7  7931  M U2L I2U           334
532 14 104         W                                                              1  7938  2                   335
533 14 105         CS    332                                                      4  7939  / 332               335
534 14 106         CS                                                             1  7943  /                   335
535 14 107         CC    K                                                        2  7944  F K                 335
536 14 108         MLC   DATE-4,ROTATE#6                                          7  7946  M /7Q U5K           335
537 14 109         MLC   DATE,ROTATE-2                                            7  7953  M /8K U5-           335
538 14 110  *
539 14 11          MLC   HEAD9,254                                                7  7960  M H9V 254           335
540 14 111         LCA   @ / / @,255                                              7  7967  L U6- 255           336
541 14 112         MCE   ROTATE,255                                               7  7974  E U5K 255           336
542 14 12          W                                                              1  7981  2                   336
543 14 13          CS    332                                                      4  7982  / 332               336
544 14 14          CS                                                             1  7986  /                   336
545 14 15          CC    K                                                        2  7987  F K                 336
546 14 16   BACK2  B     0                                                        4  7989  B 000               336
547 15 01   B100   B     SKIP2                                                    4  7993  B H9W               337
548 15 02          S     X1&1                                                     4  7997  S 090               337
549 15 03          MCS   CDAY&X1,203                                              7  8001  Z DZ4 203           337
550 15 04          LCA   @ / / @,213                                              7  8008  L U6Q 213           337
551 15 05          MCE   CDATE&X1,213                                             7  8015  E DZ1 213           337
552 15 06          MCS   CLOAD&1,221                                              7  8022  Z E05 221           337
553 15 07          MCS   CCAPAC,233                                               7  8029  Z D99 233           338
554 15 08          MLC   CCAPAC&X1,WORK05#5                                       7  8036  M DZ9 U7L           338
555 15 09          S     CLOAD&X1,WORK05                                          7  8043  S E‡4 U7L           338
556 15 10          BWZ   OVRLOD,WORK05,K                                          8  8050  V 06R U7L K         338
557 15 11          MCS   WORK05,243                                               7  8058  Z U7L 243           338
558 15 12          B     PRINTL                                                   4  8065  B 070               339
559 15 13   OVRLOD MCS   WORK05,253                                               7  8069  Z U7L 253           339
560 15 14   PRINTL W                                                              1  8076  2                   339
561 15 15          CS    332                                                      4  8077  / 332               339
562 15 16          CS                                                             1  8081  /                   339
563 15 17          CC    J                                                        2  8082  F J                 339
564 15 18          BCV   SKIP2                                                    5  8084  B H9W @             339
565 15 19          BW    HALT,SWA                                                 8  8089  V F8U 481 1         340
566 15 20          B     B6A                                                      4  8097  B J0U               340
567 15 21          NOP                                                            1  8101  N                   340
568 16 01   B50    MZ    @ @,PCRDEP                                               7  8102  Y S3M S4J           340
569 16 02          C     PCRDEP,@100@                                             7  8109  C S4J S6N           340
570 16 03          BE    B5                                                       5  8116  B Z6S S             340
571 16 04          MLC   @000@,Y2                                                 7  8121  M S2P V3K           340
572 16 05          MLC   DAPAST,DAYCNT#3                                          7  8128  M S2M U70           341
573 16 055         S     MAR6                                                     4  8135  S 365               341
574 16 060         ZA    DAYCNT,MAR6-3                                            7  8139  & U70 362           341
575 16 070         M     @19@,MAR6                                                7  8146  @ S0M 365           341
576 16 08          MLC   MAR6,CHOP#4                                              7  8153  M 365 U8-           341
577 16 09          MZ    @ @,CHOP                                                 7  8160  Y S3M U8-           341
578 16 10          A     CHOP,X1                                                  7  8167  A U8- 089           342
579 16 110         ZA    RESALL,DVAR11-2                                          7  8174  & 418 374           342
580 16 120         MLC   &00,DVAR11                                               7  8181  M U8K 376           342
581 16 125         MZ    @ @,DVAR11-2                                             7  8188  Y S3M 374           342
582 16 13          D     DAALLO,DVAR11-6                                          7  8195  % S3- 370           342
583 16 14          A     @5@,DVAR11-4                                             7  8202  A S3N 372           343
584 16 150         MLC   DVAR11-5,MEANDR#6                                        7  8209  M 371 U8Q           343
585 16 16          ZA    @10000@,DVAR9#9                                          7  8216  & U9L V0K           343
586 16 17          D     DAALLO,DVAR9-4                                           7  8223  % S3- U9Q           343
587 16 180         A     @5@,DVAR9-4                                              7  8230  A S3N U9Q           343
588 16 190         MLC   DVAR9-5,PCTDAY#4                                         7  8237  M U9P V00           344
589 16 195         S     MAR8                                                     4  8244  S 384               344
590 16 200         ZA    PCTDAY,MAR8-4                                            7  8248  & V00 380           344
591 16 21          M     DAYCNT,MAR8                                              7  8255  @ U70 384           344
592 16 22          MLC   MAR8,TIME#4                                              7  8262  M 384 V1-           344
593 16 221         S     WRK04#4          6                                       4  8269  S V1M               344
594 16 222         MLC   TIME-1,WRK04-1                                           7  8273  M V0R V1L           345
595 16 223         A     @1@,WRK04-1                                              7  8280  A V1N V1L           345
596 16 224         S     TIME,WRK04                                               7  8287  S V1- V1M           345
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SEQ PG LIN  LABEL  OP     OPERANDS                                          SFX CT  LOCN  INSTRUCTION TYPE   CARD

597 16 225         ZA     TIME-1,DEXO                                           7  8294  & VOR V20          345
598 16 226         A      ROCCRV,DEXO-2                                         7  8301  A 437 V2M          345
599 16 227         S      @1@,DEXO-2                                            7  8308  S V1N V2M          346
600 16 227         S      X2&1                                                  4  8315  S 095              346
601 16 228         A      DEXO,X2                                               7  8319  A V20 094          346
602 16 229         A      DEXO,X2                                               7  8326  A V20 094          346
603 16 230         A      DEXO,X2                                               7  8333  A V20 094          346
604 16 231         MLC    TABLE&X2-1,WRK03                                      7  8340  M 4Q5 V1Q          346
605 16 232         S      TABLE&2&X2,WRK03#3                                    7  8347  S 4Q8 V1Q          347
606 16 233         S      MAR8                                                  4  8354  S 384              347
607 16 234         ZA     WRK04,MAR8-4      3                                   7  8358  & V1M 380          347
608 16 235         M      WRK03,MAR8                                            7  8365  @ V1Q 384          347
609 16 236         A      @5@,MAR8                                              7  8372  A S3N 384          347
610 16 237         MLC    MAR8-1,Y2                                             7  8379  M 383 V3K          347
611 16 237         A      TABLE&X2&2,Y2                                         7  8386  A 4Q8 V3K          348
612 16 238  B50C   MZ     @ @,TIME                                              7  8393  Y S3M V1-          348
613 16 24          C      TIME,@1000@                                           7  8400  C V1- V2K          348
614 16 25          BL     B50A                                                  5  8407  B 410 T            348
615 16 255         B      B50B                                                  4  8412  B 42L              348
616 17 01   B50A   MLC    @1000@,TIME                                           7  8416  M V2K V1-          348
617 17 02   B50B   ZA     TIME-1,DEXO#4                                         7  8423  & VOR V20          349
618 17 03          A      ROCCRV,DEXO-2                                         7  8430  A 437 V2M          349
619 17 04          S      @1@,DEXO-2                                            7  8437  S V1N V2M          349
620 17 045         S      X2&1                                                  4  8444  S 095              349
621 17 05          A      DEXO,X2                                               7  8448  A V20 094          349
622 17 060         A      DEXO,X2                                               7  8455  A V20 094          349
623 17 07          A      DEXO,X2                                               7  8462  A V20 094          350
624 17 080         MLC    TABLE&X2-1,Y1#3                                       7  8469  M 4Q5 V2R          350
625 17 09          S      Y2#3,Y1                                               7  8476  S V3K V2R          350
626 17 10          ZA     Y1,SLOPE#3                                            7  8483  & V2R V3N          350
627 17 11          MLC    TABLE&5&X2,NEXTHI#3                                   7  8490  M 4R1 V3Q          350
628 17 12          MLC    TIME,FRACTN#1                                         7  8497  M V1- V3R          351
629 17 125         S      MAR5                                                  4  8504  S 389              351
630 17 130         ZA     FRACTN,MAR5-4                                         7  8508  & V3R 385          351
631 17 14          M      NEXTHI,MAR5                                           7  8515  @ V3Q 389          351
632 17 15          A      @5@,MAR5                                              7  8522  A S3N 389          351
633 17 16          A      MAR5-1,SLOPE                                          7  8529  A 388 V3N          351
634 17 165         S      MAR10                                                 4  8536  S 399              352
635 17 170         ZA     MEANDR,MAR10-5                                        7  8540  & U8Q 394          352
636 17 18          M      SLOPE,MAR10                                           7  8547  @ V3N 399          352
637 17 19          A      @5@,MAR10-1                                           7  8554  A S3N 398          352
638 17 200         MLC    MAR10-2,LOADAY#5                                      7  8561  M 397 V4M          352
639 17 21          A      LOADAY,CLOAD&X1                                       7  8568  A V4M E‡4          352
640 17 220         MLC    TABLE&X2-1,Y2                                         7  8575  M 4Q5 V3K          353
641 17 225         MZ     DAYCNT,DAALLO                                         7  8582  Y U70 S3-          353
642 17 23          C      DAYCNT,DAALLO                                         7  8589  C U70 S3-          353
643 17 24          BE     B5                                                    5  8596  B Z6S S            353
644 17 25          A      @1@,DAYCNT                                            7  8601  A V1N U70          353
645 17 255         A      @3@,X1                                                7  8608  A /8R 089          354
646 17 256         A      PCTDAY,TIME                                           7  8615  A V00 V1-          354
647 17 257         B      B50C                                                  4  8622  B 39L              354
648         *                                                                                       GEN
649         *        READ/WRITE   ROUTINE                                                           GEN
650         *                                                                                       GEN
651         CTAPE  SBR    99                          SETTING                   4  8626  H 099          GEN    354
652                SBR    CCONPR&3                    UP LINKAGE                4  8630  H 76Q          GEN    354
653                MA     C%11,CCONPR&3                                         7  8634  # /50 76Q      GEN    354
654                MLC    10&X3,CTAPEC&7              READ/WRITE                7  8641  M 0A0 71Q      GEN    355
655                MLC    2&X3,CEORC&3                COMMAND                   7  8648  M 0&2 73M      GEN    355
656                MLC    2&X3,CEORC1&3                                         7  8655  M 0&2 76L      GEN    355
657                SBR    CCOMPR&6,0                  SETTING UP                7  8662  H 74K 000      GEN    355
658                MA     9&X3,CCOMPR&6               NOISE RECORD              7  8669  # 0&9 74K      GEN    355
659                MA     C%12,CCOMPR&6               TEST                      7  8676  # /6P 74K      GEN    356
660                MLCWA  H%IR,99                     RESTORE INDEX             7  8683  L /5R 099      GEN    356
661                A      C%1,K%CON                   NOISE REC CNT             7  8690  A /7- /6M      GEN    356
662         CRESTR MLC    C%9,CERASC                  ERASE COUNT               7  8697  M /7J /7M      GEN    356
663                MLC    C%9,CERRCT                                            7  8704  M /7J /6R      GEN    356
664         CTAPEC RT     0,0                         READ/WRITE CMD            8  8711  M %U0 000 R    GEN    357
665                SBR    CCLEAR&6                                              4  8719  H 86Q          GEN    357
666                BCE    CORKS,CTAPEC&7,W            WRITE CMD                 8  8723  B 75N 71Q W    GEN    357
667         CEORC  BEF    0                           EOR/EOF TEST              5  8731  B 000 K        GEN    357
668         CCOMPR BCE    CCLEAR,0,   GROUP MARK      TEST FOR                  8  8736  B 86K 000      GEN    357
669                CHAIN 11                           NOISE RECORD                                      GEN
670                BCE                                                          1  8744  B              GEN    357
671                BCE                                                          1  8745  B              GEN    357
672                BCE                                                          1  8746  B              GEN    358
673                BCE                                                          1  8747  B              GEN    358
674                BCE                                                          1  8748  B              GEN    358
675                BCE                                                          1  8749  B              GEN    358
676                BCE                                                          1  8750  B              GEN    358
677                BCE                                                          1  8751  B              GEN    358
678                BCE                                                          1  8752  B              GEN    358
679                BCE                                                          1  8753  B              GEN    359
680                BCE                                                          1  8754  B              GEN    359
681         CORKS  BER    CRWRED                      ERROR TEST                5  8755  B 76R L        GEN    359
682         CEORC1 BEF    0                           EOF/EOR TEST              5  8760  B 000 K        GEN    359
683         CCONPR B      0                           CONTINUE PROGRAM          4  8765  B 000          GEN    359
684         *        READ/WRITE ROUTINE REDUNDANCY SECTION                                              GEN
685         CRWRED BCE    CADDRR,CERRCT,9                                       8  8769  B 81D /6R 9    GEN    359
686         CCONRR S      C%1,CERRCT                  SUB 1 FR ERR CNT          7  8777  S /7- /6R      GEN    359
687                MN     CTAPEC&3,*&4                BACKSPACE                 7  8784  D 71M 79M      GEN    360
688                BSP    0                                                     5  8791  U %U0 B        GEN    360
689                BCE    CTROW,CERRCT,G              BR IF 2 WRITES            8  8796  B 88J /6R G    GEN    360
690         CTSTVC BM     CCLEAN&4,CERRCT             BR IF 10 REREADS          8  8804  V 92N /6R K    GEN    360
691                B      CTAPEC                                                4  8812  B 71J          GEN    360
692         CADDRR BCE    CTSTTM,CTAPEC&7,R           IF WRITE                  8  8816  B 84L 71Q R    GEN    361
693                S      C%1,W%29                    SUB 1 FROM                7  8824  S /7- /6L      GEN    361
694                BM     CPERR2,W%29                 TOTAL ERRORS              8  8831  V ‡7L /6L K    GEN    361
695                B      CCONRR                                                4  8839  B 77P          GEN    361
696         *        STATISTICS                                                                     GEN
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SEQ PG LIN  LABEL  OP     OPERANDS                                          SFX CT LOCN  INSTRUCTION TYPE  CARD

697         CTSTTM S      C%1,R%49                          SUB 1 FROM          7  8843  S /7- /6J   GEN    361
698                BM     CPERR1,R%49                       TOTAL READ          8  8850  V ‡5M /6J K GEN    362
699                B      CCONRR                            ERRORS              4  8858  B 77P       GEN    362
700         CCLEAR MN     C%1,0                             IF NOISE REC        7  8862  D /7- 000   GEN    362
701                MN                                       CLEAR GM            1  8869  D           GEN    362
702                ZS     C%1,K%CON                         READ NEXT           7  8870  - /7- /6M   GEN    362
703                B      CTAPEC                            RECORD              4  8877  B 71J       GEN    362
704         CTROW  BCE    CTSTVC,CTAPEC&7,R                 IF WRITE, EOR       8  8881  B 80M 71Q R GEN    362
705                BEF    CHEOR                             TEST                5  8889  B /1J K     GEN    363
706                S      C%1,CERASC                        CHECK IF            7  8894  S /7- /7M   GEN    363
707                BM     CPERR3,CERASC                     10 ERASES           8  8901  V ‡9K /7M K GEN    363
708                MN     CTAPEC&3,*&4                      IF NOT,             7  8909  D 71M 91R   GEN    363
709         CRASE  SKP    0                                 ERASE TAPE          5  8916  U %U0 E     GEN    363
710         CCLEAN B      CTAPEC-7                                              4  8921  B 70M       GEN    363
711         *        VACUUM CLEANING                                                                 GEN
712                BM     CPERR0,K%CON                      IF PERMANENT        8  8925  V ‡1R /6M K GEN    364
713                MN     CTAPEC&3,*&4                      READ ERROR          7  8933  D 71M 94L   GEN    364
714         CBSPC  BSP    0                                 BACKSPACE           5  8940  U %U0 B     GEN    364
715                S      C%1,CNT%2                         3 RECORDS           7  8945  S /7- /6Q   GEN    364
716                BWZ    CBSPC,CNT%2,B                     AND REREAD          8  8952  V 94- /60 8 GEN    364
717                MLC    CTAPEC&6,*&7                      THREE RECORDS       7  8960  M 71P 97L   GEN    365
718         CREROW RT     0,0                                                   8  8967  M %U0 000 R GEN    365
719                MN     C%1                                                   4  8975  D /7-       GEN    365
720                MN                                                           1  8979  D           GEN    365
721                A      C%1,CNT%2                                             7  8980  A /7- /6Q   GEN    365
722                BM     CREROW,CNT%2                      IF STILL            8  8987  V 96P /6Q K GEN    365
723                MLC    CTAPEC&6,*&7                      REDUNDANT           7  8995  M 71P ‡0Q   GEN    366
724                RT     0,0                               BRANCH TO           8  9002  M %U0 000 R GEN    366
725                BER    CPERR0&15                         PERMANENT           5  9010  B ‡3M L     GEN    366
726                B      CCONPR                            ERROR               4  9015  B 76N       GEN    366
727         CPERR0 MLC    CTAPEC&6,*&7                      REREAD RECORD       7  9019  M 71P ‡3K   GEN    366
728                RT     0,0                                                   8  9026  M %U0 000 R GEN    366
729         *MODIFIED TO PROCESS UNREADABLE RECORD                                                   GEN
730                MLC    C%9,CERRCT                                            7  9034  M /7J /6R   GEN    367
731                BSS    CTAPEC,D                                              5  9041  B 71J D     GEN    367
732                H      CCONRR                                                4  9046  . 77P       GEN    367
733                B      CCONPR                                                4  9050  B 76N       GEN    367
734         *        FIFTY READ REDUNDANCIES                                                         GEN
735         CPERR1 MLC    C%49,R%49                         RESTORE COUNT       7  9054  M /7L /6J   GEN    367
736                NOP    850,850                           AFTER 50 READ       7  9061  N 850 850   GEN    367
737                H                                        ERRORS AND          1  9068  .           GEN    367
738                B      CCONRR                            HALT                4  9069  B 77P       GEN    368
739         *     THIRTY WRITE REDUNDANCIES                                                          GEN
740         CPERR2 MLC    C%29,W%29                         RESTORE             7  9073  M /70 /6L   GEN    368
741                NOP    830,830                           REDUNDANCY          7  9080  N 830 830   GEN    368
742                H                                        COUNT AND           1  9087  .           GEN    368
743                B      CCONRR                            HALT                4  9088  B 77P       GEN    368
744         *     TEN ERASES                                                                         GEN
745         CPERR3 MLC    C%9,CERASC                        RESTORE             7  9092  M /7J /7M   GEN    368
746                NOP    810,810                           ERASE               7  9099  N 810 810   GEN    368
747                H                                        COUNT AND           1  9106  .           GEN    369
748                B      CRASE                             HALT                4  9107  B 910       GEN    369
749         *     END OF REEL REDUNDANCY WHILE WRITING                                               GEN
750         CHEOR  MLC    C%29,W%29                         RESTORE COUNT       7  9111  M /70 /6L   GEN    369
751                MN     CTAPEC&3,*&4                      WRITE               7  9118  D 71M /2Q   GEN    369
752                WTM    0                                 TAPE MARK           5  9125  U %U0 M     GEN    369
753                MN     CTAPEC&3,*&4                      MODIFIED TO         7  9130  D 71M /4-   GEN    369
754                RWU    0                                 UNLOAD DRIVE        5  9137  U %U0 U     GEN    369
755                NOP    888,888                                               7  9142  N 888 888   GEN    370
756                H                                        HALT                1  9149  .           GEN    370
757                B      CRESTR                                                4  9150  B 69P       GEN    370
758         *     CONSTANTS                                                                          GEN
759         C%11   DCW    @011@                                                 3  9156              GEN    370
760         H%IR   DCW    @000@                                                 3  9159              GEN    370
761         R%49   DCW    @49@                                                  2  9161              GEN    370
762         W%29   DCW    @29@                                                  2  9163              GEN    370
763         K%CON  DCW    @K@                                                   1  9164              GEN    371
764         C%12   DCW    @012@                                                 3  9167              GEN    371
765         CNT%2  DCW    @1@                                                   1  9168              GEN    371
766         CERRCT DCW    @9@                                                   1  9169              GEN    371
767         C%1    DCW    @1@                                                   1  9170              GEN    371
768         C%9    DCW    @9@                                                   1  9171              GEN    371
769         C%49   DCW    @49@                                                  2  9173              GEN    371
770         CERASC DCW    @9@                                                   1  9174              GEN    372
771         C%29   DCW    @2I@                                                  2  9176              GEN    372
772         TAPE1  EQU    %U1                                                      %U1               GEN
773         TAPE2  EQU    %U2                                                      %U2               GEN
774         TAPE3  EQU    %U3                                                      %U3               GEN
775         TAPE4  EQU    %U4                                                      %U4               GEN
776         TAPE5  EQU    %U5                                                      %U5               GEN
777         TAPE6  EQU    %U6                                                      %U6               GEN
       153  DATE   DCW    #06                                                   6  9182              AREA   372
       154  DAY           #03                                                   3  9185              AREA   372
                          @057@                                                 3  9188              LIT    372
                          @3@                                                   1  9189              LIT    372
       168  COUNT         #03                                                   3  9192              AREA   372
                          @49@                                                  2  9194              LIT    373
                          &1                                                    1  9195              LIT    373
       172  LAST          #02                                                   2  9197              AREA   373
                          @55@                                                  2  9199              LIT    373
                          @Y81@                                                 3  9202              LIT    373
                          @19@                                                  2  9204              LIT    373
                          @‡@                                                   1  9205              LIT    373
       205  PREPOS        #01                                                   1  9206              AREA   374
       207  PREPRI        #01                                                   1  9207              AREA   374
       209  PRENO         #04                                                   4  9211              AREA   374
                          @N@                                                   1  9212              LIT    374
       227  DEADD         #03                                                   3  9215              AREA   374
       236  STARTO        #03                                                   3  9218              AREA   374
       237  WORK3         #03                                                   3  9221              AREA   374
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SEQ PG LIN  LABEL   OP      OPERANDS                              SFX CT  LOCN  INSTRUCTION TYPE  CARD

       239  DAPAST          #03                                        3  9224              AREA  375
                            @000@                                      3  9227              LIT   375
       251  DAALLO          #03                                        3  9230              AREA  375
                            &000                                       3  9233              LIT   375
                            @ @                                        1  9234              LIT   375
                            @5@                                        1  9235              LIT   375
       257  PCDDEP          #03                                        3  9238              AREA  375
       264  PCRDEP          #03                                        3  9241              AREA  376
       270  ANSW5           #05                                        5  9246              AREA  376
                            &6                                         1  9247              LIT   376
       272  EXPPRO          #03                                        3  9250              AREA  376
                            @099@                                      3  9253              LIT   376
       278  WORK2           #02                                        2  9255              AREA  376
       287  YCOOR           #03                                        3  9258              AREA  376
                            &5                                         1  9259              LIT   377
       295  UCL             #03                                        3  9262              AREA  377
                            @100@                                      3  9265              LIT   377
       298  LCL             #03                                        3  9268              AREA  377
       315  WORK02          #02                                        2  9270              AREA  377
       325  WORK4           #04                                        4  9274              AREA  377
       326  YCOOR2          #03                                        3  9277              AREA  377
       333  UCL2            #03                                        3  9280              AREA  378
       336  LCL2            #03                                        3  9283              AREA  378
       343  TOTRES          #06                                        6  9289              AREA  378
       344  TOTDEP          #06                                        6  9295              AREA  378
       345  PCRREM          #03                                        3  9298              AREA  378
       354                  @RD HI,@                                   6  9304              LIT   378
                            @6@                                        1  9305              LIT   378
       357                  @RD LO,@                                   6  9311              LIT   379
       365                  @EP HI,@                                   6  9317              LIT   379
       368                  @EP LO,@                                   6  9323              LIT   379
       373                  @OVERX,@                                   6  9329              LIT   379
       380                  @LATES,@                                   6  9335              LIT   379
       385                  @LATED,@                                   6  9341              LIT   379
       390                  @PRIOR,@                                   6  9347              LIT   380
                            @%@                                        1  9348              LIT   380
                            @V@                                        1  9349              LIT   380
                            @I@                                        1  9350              LIT   380
                            @II@                                       2  9352              LIT   380
                            @III@                                      3  9355              LIT   380
                            @IV@                                       2  9357              LIT   380
                            @   @                                      3  9360              LIT   381
       439  KEEP            #03                                        3  9363              AREA  381
       459  ANSW13          #13                                       13  9376              AREA  381
       461  STOR            #07                                        7  9383              AREA  381
       467                  @FACILITY TOTALS@                         15  9398              LIT   382
       469                  @FACILITY & QUEUE TOTALS @                24  9422              LIT   382
                            @M@                                        1  9423              LIT   383
       501                  @  /  /  @                                 8  9431              LIT   383
       529                  @FACILITY@                                 8  9439              LIT   383
       530                  @& QUEUE@                                  7  9446              LIT   383
       536  ROTATE          #06                                        6  9452              AREA  383
       540                  @  /  /  @                                 8  9460              LIT   383
       550                  @  /  /  @                                 8  9468              LIT   384
       554  WORK05          #05                                        5  9473              AREA  384
       572  DAYCNT          #03                                        3  9476              AREA  384
       576  CHOP            #04                                        4  9480              AREA  384
                            &00                                        2  9482              LIT   384
       584  MEANDR          #06                                        6  9488              AREA  384
       585                  @10000@                                    5  9493              LIT   384
       585  DVAR9           #09                                        9  9502              AREA  385
       588  PCTDAY          #04                                        4  9506              AREA  385
       592  TIME            #04                                        4  9510              AREA  385
       593  WRK04           #04                                        4  9514              AREA  385
                            @1@                                        1  9515              LIT   385
       605  WRK03           #03                                        3  9518              AREA  385
                            @1000@                                     4  9522              LIT   385
       617  DEXO            #04                                        4  9526              AREA  386
       624  Y1              #03                                        3  9529              AREA  386
       625  Y2              #03                                        3  9532              AREA  386
       626  SLOPE           #03                                        3  9535              AREA  386
       627  NEXTHI          #03                                        3  9538              AREA  386
       628  FRACTN          #01                                        1  9539              AREA  386
       638  LOADAY          #05                                        5  9544              AREA  386
778 13 120          END     STARTP                                                  / X4U 080         387
```

APPENDIX D-3

SIMULATION OF ACTUAL VS. PLANNED PROGRESS AND RESOURCE BEHAVIOR

```
                              ACTUAL RESOURCE DEPLETION & EXPECTED PROGRESS
                               VS. TOCC PROGRESS & ROCC RESOURCE DEPLETION
                                          WITHIN TIME DEPLETION
 04/01/64                                 TASKS IN FACILITY

  TASK               START DEAD DAYS DAYS P.C. RESOR RESOR P.C. ROCC TOCC EXP   SELECTED     TOCC       ROCC
 NO.  DESCRIPTION    DAY  LINE ALTD DEPL DEPL ALTD  DEPL  DEPL REMG PROG PROG    CURVE     UCL  LCL  UCL  LCL  MESSAGES

 1111  AIRPORT EX     18    38   20   10  50%  1000   500  50%  51%  64%  50%      I        68%  60%  56%  46%  EP LO PRIOR,

 0002  SCHED MFG      18    38   20   10  50%  1000   500  50%  29%  63%  50%      II       67%  59%  32%  26%  RD LO,EP LO

 0003  CONT 399       18    38   20   10  50%  1000   600  60%  49%  50%  60%     III       55%  45%  54%  44%  RD HI,EP HI

 0004  TELEPH SYS     18    38   20   10  50%  1000   400  40%  49%  42%  81%      IV       48%  36%  54%  44%  RD LO,EP HI

 0005  RAMP DSIGN     18    38   20   10  50%  1000   700  70%  59%  26%  50%      V        33%  19%  65%  53%  RO HI,EP HI

 0006  STEEL POST     18    38   20   10  50%  1000   300  30%  49%  64%  50%      I        68%  60%  54%  44%  RD LO,EP LO

 0007  3 AMP MTRS     18    38   20   10  50% 10000  5000  50%  49%  63%  50%      II       67%  59%  54%  44%  EP LO

 0008  PAINT HATS     18    38   20   10  50% 10000  6000  60%  29%  50%  60%     III       55%  45%  32%  26%  RD LO,EP HI

 0009  DESIGN VAB     18    38   20   10  50% 10000  4000  40%  51%  42%  40%      IV       48%  36%  56%  46%  RD LO

 0010  COMP FEASB     18    38   20   10  50% 10000  4500  45%  59%  26%  70%      V        33%  19%  65%  53%  EP HI

 0011  MFG CLIPS      18    38   20   10  50% 10000  5500  55%  49%  64%  40%      I        68%  60%  54%  44%  EP LO

 0014  LOGIS SYS      24    32    8    4  50% 10000 10001 100%  51%  50%  50%     III       55%  45%  56%  46%  RD HI,OVERX

 0015  PHOTO CONT     25    37   12    3  25% 10000  2500  25%  87%  15%  25%      IV       24%   6%  96%  78%  RD HI

 0016  EVAL JCB12     25    37   12    3  25% 10000  2000  20%  77%   6%  25%      V        15%    %  85%  69%  EP HI

 0017  CUT FRAMES     25    37   12    3  25% 10000  3000  30%  77%  31%  25%      I        38%  24%  85%  69%

 0018  TRANS ANAL     25    37   12    3  25% 10000  1500  15%  74%  23%  25%      II       31%  15%  81%  67%  RD LO
 04/01/64                                   )    TASKS IN QUEUE

  TASK               START DEAD DAYS DAYS P.C. RESOR RESOR P.C. ROCC TOCC EXP   SELECTED     TOCC       ROCC
 NO.  DESCRIPTION    DAY  LINE ALTD DEPL DEPL ALTD  DEPL  DEPL REMG PROG PROG    CURVE     UCL  LCL  UCL  LCL  MESSAGES

 0012  CRCT DESIG     25    37   12    3  25% 10000              66%  25%         III       33%  17%  73%  59%  RD LO,EP LO,LATES

 0019  CK VACUUMS     25    37   12    3  25% 10000              66%  15%          IV       24%   6%  73%  59%  RD LO,EP LO,LATES

 0020  ION PUMPS      25    37   12    3  25% 10000              87%   6%          V        15%    %  96%  78%  RD LO,EP LO,LATES

 0021  SEQ RELAY      25    37   12    3  25% 10000              77%  15%          IV       24%   6%  85%  69%  RD LO,EP LO,LATES

 0022  Q TRANSPRT     25    37   12    3  25% 10000              77%  23%          II       31%  15%  85%  69%  RD LO,EP LO,LATES

 0023  PYROMETERS     25    37   12    3  25% 10000              66%  25%         III       33%  17%  73%  59%  RD LO,EP LO,LATES

 0024  VISICORDER     19    31   12    9  75% 10000              23%  75%          IV       78%  72%  25%  21%  RD LO,EP LO,LATES

 0025  CRYOGEN PR     19    31   12    9  75% 10000              24%  66%          V        69%  63%  26%  22%  RD LO,EP LO,LATES

 0039  MAGLAMP        19    31   12    9  75% 10000              13%  88%          I        89%  87%  14%  12%  RD LO,EP LO,LATES

 0102  LIGHT SHLD     19    31   12    9  75% 10000              23%  91%          II       92%  90%  25%  21%  RD LO,EP LO,LATES

 0103  RADIO ISOT     19    31   12    9  75% 10000              21%  75%         III       78%  72%  23%  19%  RD LO,EP LO,LATES

 0104  SS CIRCUIT     19    31   12    9  75% 10000              24%  75%          IV       78%  72%  26%  22%  RD LO,EP LO,LATES

 0113  TACK EVALU     19    31   12    9  75% 10000               8%  66%          V        69%  63%   9%   7%  RD LO,EP LO,LATES

 0129  RH SENSOR      19    31   12    9  75% 10000              13%  88%          I        89%  87%  14%  12%  RD LO,EP LO,LATES

 0182  EXPLODE AS     19    31   12    9  75% 10000              23%  91%          II       92%  90%  25%  21%  RD LO,EP LO,LATES

 1110  DETONATE H     19    31   12    9  75% 10000              21%  75%         III       78%  72%  23%  19%  RD LO,EP LO,LATES

 1113  SETUP M/P      19    31   12    9  75% 10000               8%  75%         III       78%  72%   9%   7%  RD LO,EP LO,LATES

 1114  OPTICS,C39     19    31   12    9  75% 10000              13%  66%          V        69%  63%  14%  12%  RD LO,EP LO,LATES

 1115  DESIGN PUL     19    31   12    9  75% 10000              13%  88%          I        89%  87%  14%  12%  RD LO,EP LO,LATES
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APPENDIX D-4

SIMULATION OF INTERMITTENT SYSTEM ALLOCATION BY DAY-INCREMENTS

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          INTERMITTENT SYSTEM LOAD ANALYSIS BY DAY
                         FACILITY              04/01/64


DAY    DATE     RESO LOAD    CAPACITY    EXCESS    OVERLOAD

 29  04/02/64     9690        13000       3310
 30  04/03/64    10394        13000       2606
 31  04/06/64    10492        13000       2508
 32  04/07/64    11080        13000       1920
 33  04/08/64     9518        13000       3482
 34  04/09/64     9010        13000       3990
 35  04/10/64     9273        13000       3727
 36  04/11/64     6805        13000       6195
 37  04/12/64     5899        13000       7101
 38  04/13/64     1450        13000      11550
                         FACILITY & QUEUE      04/01/64


DAY    DATE     RESO LOAD    CAPACITY    EXCESS    OVERLOAD

 29  04/02/64    23530        13000                  10530
 30  04/03/64    22240        13000                   9240
 31  04/06/64    21140        13000                   8140
 32  04/07/64    14330        13000        617
 33  04/08/64    12380        13000        620
 34  04/09/64    11701        13000       1299
 35  04/10/64    11630        13000       1370
 36  04/11/64     8630        13000       4370
 37  04/12/64     7620        13000       5380
 38  04/13/64     1450        13000      11550
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VITA

Robert Neil Braswell

Candidate for the Degree of

Doctor of Philosophy

Thesis: A HEURISTIC RESOURCE ALLOCATION AND CONTROL ALGORITHM FOR INTERMITTENT SYSTEMS

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Biographical:

Personal Data: Born near Boaz, Alabama, July 23, 1932, the son of Homer W. and Irene Wright Braswell.

Education: Graduated from Douglas High School, Douglas, Alabama, in May, 1950; graduated from Snead Junior College, Boaz, Alabama, in June, 1956, with a major in engineering; received the degree of Bachelor of Science in Industrial Engineering from the University of Alabama in August, 1957; received the degree of Master of Science in Engineering from the University of Alabama in May, 1959; attended the University of California at Los Angeles in 1958 and Arizona State University in 1961; completed the requirements for the degree of Doctor of Philosophy in May, 1964.

Professional Experience: Principal Engineer, Brown Engineering Company, Inc. since September, 1962; Chairman, Operations Research Department, Brevard Engineering College, since December, 1963; Senior Project Engineer, Brown Engineering Company, Inc. from June, 1959 to September, 1962; part-time Assistant Professor of Engineering, University of Alabama from September, 1959 to June, 1961; U. S. Steel Research Fellow, University of Alabama from September, 1957 to May, 1959; Engineer, Hughes Aircraft Company from June, 1958 to September, 1958; Engineer, Southern Bell Telephone Company from May, 1957 to September, 1957; served on active duty in the U. S. Air Force from May, 1950 to September, 1953; registered as a Professional Engineer; member of Tau Beta Pi, Omicron Delta Kappa, Alpha Pi Mu, Sigma Xi, Pi Mu Epsilon, Phi Theta Kappa, Chi Alpha Phi, ORSA, AIIE, ASEE, and NSPE.