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SIMULATION AND EVALUATION OF MANUFACTURING
LEAD TIME ESTIMATION EQUATIONS IN
COMBINATION WITH VARIOUS PRIORITY
RULES IN A MATERIAL REQUIREMENTS
PLANNING SYSTEM

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CHAPTER I

INTRODUCTION AND DEFINITION OF THE PROBLEM

1.0 Problem Statement

1.1.1 In any reasonable production-inventory control system, some estimate of the time required to produce the desired parts must be made. This time span is generally known as manufacturing lead time, flow time or span time. The conformance of this lead time estimate to the actual lead time experienced has a direct impact on the three major production-inventory related costs. These costs are: order lateness costs, facilities utilization costs, and work-in-process inventory costs.

1.1.2 Businessmen have long been aware of the costs associated with order lateness and under utilization of facilities. As Gere (6) states, "When a job is not completed by the due date certain costs are incurred. These costs include: (1) direct dealings with the customer - paper work, telephone calls, executive time taken up, (2) penalty clause in the contract, if there is one, (3) loss of goodwill resulting in an increased probability of losing the customer for some or all of his future jobs, or perhaps a damaged reputation which will turn other customers away."

1.1.3 Facilities costs are fixed in the short run. Thus, the utilization of facilities represents the degree to which these fixed costs are taken advantage of. It is to the investor's advantage to make the best use of this fixed cost by maximizing output, thus increasing the return on investment.

1.1.4 Unlike lateness costs and facilities utilization costs, businessmen are just now beginning to see the true costs associated with excessively large work-in-process inventories. As Alley (1) states "Recently businesses have put increased emphasis on proper control of inventory. Reducing inventory frees working capital that can be used to purchase new equipment or support an expansion program. It can also reduce the interest cost for the borrowed money to finance a large inventory. Tight inventory control can improve the rate of return on an asset."

1.1.5 An efficient production-inventory control system should attempt to minimize these production-inventory related costs. These costs, however, should not be reduced independently. The sum of these three costs should be minimized in order to obtain the lowest total production-inventory cost. The control of these costs is, in part, determined by the method used to estimate manufacturing lead time. An estimate which is too long will reduce late orders, but at the same time will increase work-in-process inventory. An estimate which is too short will reduce work-in-process

inventory but will also increase order lateness. Finally, an estimate which is either too long or too short will not allow proper production planning to take place and will result in less than optimal utilization of facilities.

1.1.6 Due to the more widespread concern over late orders than work-in-process inventory, lead times are generally set longer than necessary in order to assure that due dates will be met. As Rowe (15) points out "Exact factory performance is difficult to predict as a result of queueing effects and job sequence interaction. Present shop scheduling methods simply allow sufficient time between operations to circumvent the problem." By setting planned lead times longer than required, work-in-process inventory becomes inflated, leading to increased production-inventory related costs.

1.2.1 Having shown the importance of accurately estimating manufacturing lead time, the lack of pertinent research in this area is surprising. As noted by Malstrom and Moodie (10) "Documented research in the area of job cost and throughput time forecasting is extremely limited. Most research has dealt with the effects of various dispatching rules on job flow time rather than on flow time itself."

As Rochette and Sadowski (3), and Jones and Jucker (9) point out: most research in the area of job shop scheduling has dealt with the performance of various dispatching rules.

Two measures of performance of these rules were used in the majority of past research. Performance was measured by either mean flow time, or order lateness.

1.2.3 Typical of researchers using mean flow time as a measure of performance, Manne (11) states, "by minimizing the flow time it is possible to; (1) lower the work-in-process inventory, (2) reduce 'average' customer delay, and (3) increase facilities utilization." With this type of model, manufacturing lead time was not estimated in advance; a job was simply released into production and left to rely on processing time and queue discipline rules (to govern queue time) to determine the job's completion date.

1.2.4 The other main vein of research was concerned with order lateness as the measure of performance. In research of this type a start date was established and flow time was estimated either randomly, or with some respect to the order's work content. Orders would enter the shop on the prescribed start date and would rely on the order's work content and the queue discipline rule to determine the order's actual flow time. When the job was completed, its actual completion date would be compared to its prescribed due date to determine order lateness. The ability of a queue discipline rule to meet due dates was taken as the measure of performance.

2.0 Past Research

2.1.1 Much of the research in Job Shop Scheduling has been hampered by the use of unrealistic models and limited scope. Simplifying assumptions made in constructing the models with which past research has been conducted severely limit the general application of the results obtained. The use of random operation times, random job routings, regular order arrivals, etc. restricts these models from being used to characterize a particular situation.

2.1.2 In the work of Gere (6), Baker and Dzielinski (2), Eilon and Chowdhury (4), and Elvers (5) for example, standard operation times came from random distributions. In some cases these randomly generated operation times were used as generated as with Gere's (6) work. In other work such as Elver's (5), noise was added to the random operation times in order to better reflect the real life situation of variation from standard times.

2.1.3 Operation times were generally obtained from either a uniform distribution as in Gere's (6) work, or a Normal distribution as was used by Eilon and Chowdhury (4). In the case of Eilon and Chowdhury (4) all operation times for all jobs on all machines came from the same Normal distribution. Rochette and Sadowski (14) improved this situation by generating operation times from probability density functions which could be different for each machine center.

2.1.4 In some cases, such as the work of McLintock (12), fixed standard times for each operation served as the basis for determining processing times used in the model. This represented a great improvement over randomly generated operation times used in earlier research. McLintock did not, however, introduce noise to the standard times, but instead assumed that fluctuations from standards were insignificant.

2.1.5 Another common assumption concerning operation times was to ignore setup time or assume setup time to be contained in the operation time. This was the case with Rochette and Sadowski (14) and Baker and Dzielinski (2) for example. This assumption may not be detrimental if simple hand operations are involved, but can have a significant effect if complex machines requiring long setup times are being simulated.

2.2.1 Similar to the methods used for producing operation times, much of the research in Job Shop Scheduling has used randomly generated job routings. This method was employed by Rochette and Sadowski (14), Baker and Dzielinski (2), Eilon and Chowdhury (4), and Elvers (5) for example.

2.2.2 Random job routings were generally either determined in advance of the experiment as in the work of Baker and Dzielinski (2) or determined upon the job's arrival, as with Eilon and Chowdhury's (4) work. The number of operations on a job would also be determined from

either uniform or non-uniform probability distributions. Once the number of operations had been set, the machine required for each operation would then be determined randomly. In most cases, all machines, except the machine just left would have equal probabilities of being chosen for the next operation. Jobs could have several, but not consecutive, operations on the same machine,

2.2.3 The use of random job routings as discussed above has two main shortcomings. First, by assuming that upon leaving one machine, all other machines have an equal probability of being chosen for the next operation, the assumption is made that all machines will have the same expected utilization. This is not generally the case. Machine utilizations vary widely from very low utilization, to a maximum utilization of one hundred percent. With widely varying utilizations, widely varying queue lengths are also encountered, adding greatly to the scheduling problem.

2.2.4 The second major shortcoming of past research employing random job routings is that the assumption is also made that machines do not have innate sequence limitations. This assumption implies that a shear, for example, has an equal probability of being used on the first operation as it has of being used on the last operation. In real life this is not the case. Machines such as shears and saws are

used in early operations, while machines such as grinders and paint facilities are used on later operations.

2.3.1 Another area where simplifying assumptions in past research have led to results which are not generally applicable is in the area of order arrivals. Rather than to use a continuous or near continuous time frame for order arrivals, some models have used a discrete time frame with orders arriving at regular intervals. The degree to which this assumption affects results depends upon the time interval used. Elvers (5) used an interval of one week between order arrivals. This causes load fluctuations in production and also requires jobs to be released either earlier or later than actually required. Rochette and Sadowski (14) and Eilon and Chowdhury (4) used a time interval of one day between order arrivals. This shorter time interval reduces the affects on shop load and early or late order release. The use of a discrete time frame causes order arrivals, which normally follow a continuous time frame, to be shifted either forward or backward in time to fit the discrete time periods.

2.3.2 Eilon and Chowdhury (4) also made the assumption that jobs arrived in regular batches of ten as well as being released at regular intervals. This assumption leads to a shop load which is more stable than generally found thus limiting the application of the results obtained.

2.4.1 In McLintock's (12) work it was assumed that raw materials were available in perfect supply and with zero lead time. These assumptions represent a significant departure from the normal situation. An imperfect supply of raw materials with lead times greater than zero presents additional problems which can delay order starts and add to the scheduling problem. To reduce these problems, raw material must be ordered far enough in advance to avoid most of the delays that may be caused by fluctuations in raw material supply. Delays caused by raw materials still occur and do cause problems with order start dates, and therefore order completion dates. This problem must be recognized when formulating a total production-inventory control policy.

2.5.1 In summary it can be seen that the simplifying assumptions used in developing previous models represent significant departures from the real-life situation. These departures from real-life in model construction place serious doubt on application of the results obtained to real-life situations.

2.6.1 In addition to simplifying assumptions, past research is also hampered by the criteria used to evaluate results. The criteria fall into two major categories; order tardiness and order flow time. In Elvers' (5) work, the number and percentage of orders completed late was used as the basic measure of performance. Gere (6) used the amount of tardiness at order completion as a measure of performance.

The amount of tardiness was equal to the sum of lateness of orders completed after their due dates. Consideration was not given to orders which were completed early. Rochette and Sadowski (14) and McLintock (12) used mean job tardiness as a criterion for evaluating results. The added costs of orders completed early was also considered by Eilon and Chowdhury (4) with notational cost functions of the forms:

$$(i) \quad C_1 = 10 L + E$$

$$(ii) \quad C_2 = L + E$$

where C_i = order completion costs, L = the number of orders completed late and E = the number of orders completed early. Here an arbitrary weighting factor of ten was employed when computing C_1 indicating that orders completed late had a cost ten times as great as orders completed early.

2.6.2 Tardiness is indeed something to be avoided, but generally should not be eliminated. In order to eliminate tardiness, finished goods inventory would have to be tremendous in order to deal with all the problems that can delay production.

2.6.3 The other main evaluation criterion used in past research was mean job flow time. Rochette and Sadowski (14) and McLintock (12) used mean flow time as a measure of performance, relating flow time to work-in-process inventory levels. It was believed that by minimizing flow time, work-in-process inventory would also be reduced. The

problem here is that utilization of facilities is ignored as well as order lateness. Facilities utilization and product throughput will have to be reduced if mean flow time is to be minimized.

2.7.1 Using lateness as a criterion for evaluating performance requires that both order due dates and start dates be set. Start date was usually determined by when an order arrived for processing. The due date was left to be determined by estimating order flow time. Machine processing time, plus transportation time, plus time spent waiting in queues makes up an order's flow time.

2.7.2 One approach to estimating flow time has been to use a multiple of machine processing time. Gere (6) estimated flow time as the sum of the expected machine processing times multiplied by a factor selected at random between specified upper and lower bounds. Elvers (5) estimated six sets of flow times for each job by multiplying the expected machine processing times by 1.0, 3.0, 4.0, 5.0, 6.0, and 7.0. Both of these methods make the assumption that queue time is dependent upon machine processing time, which is not the case. Queue time is dependent on arrival rate and service time.

2.7.3 Another method for estimating flow times has been to use an estimate of machine processing times together with an estimate of queue time. Rochette and Sadowski (14) estimated flow time as a time proportional to the sum of the

expected processing times plus a uniformly distributed random time. The component of flow time proportional to processing time represents the efficiency to standard times. The component of flow time drawn from a uniform distribution is used to represent queue time. Here the estimate of queue time is independent of order routing and machine loading, a highly questionable method.

2.7.4 Jackson (8) disregarded any information available, such as machine processing times, and used only a random number to estimate flow time. This method can hardly be expected to yield practical results since all jobs, regardless of routing or expected processing time, will have random flow times drawn from the same distribution.

2.8.1 In addition to the problems already mentioned, past research in the area of Job Shop Scheduling has not investigated the problems associated with Material Requirements Planning (MRP) systems. No research dealing with an MRP model could be found. Past research has dealt primarily with traditional production-control systems which merely release an order to the shop and wait for it to be completed.

2.8.2 Material Requirements Planning is a relatively new production-inventory control method that places great emphasis on reducing inventories and meeting delivery dates. The method and timing of order releases under an MRP system sets it off from traditional production-inventory systems

and also creates new areas of emphasis when dealing with production-inventory control problems.

2.8.3 Traditional systems turn an order loose with excessive planned flow time and rely on the priority rule to attempt to get an order completed on time. An MRP system can plan the production of the order level by level and operation by operation to reduce the flow time while still achieving satisfactory results in meeting due dates. The difference here is that an MRP system starts with order due dates and plans order release dates. Once an order is released, the MRP system follows the status of the order and attempts to keep the order on the planned schedule.

2.8.4 An MRP system still relies upon priority rules to try to meet due dates, but since an MRP system plans better than traditional production-inventory systems, the responsibility of the priority rule is reduced. The priority rule that minimizes mean flow time may not be ideal in an MRP system. An MRP system does not have to allow extra work-in-process inventory to make up for the lack of planning in traditional production-inventory systems.

3.0 Research Goals

3.1.1 The purpose of this research is to construct a realistic MRP production-inventory control model which will be used to investigate the effects of various lead time equation-priority rule combinations on total production-

inventory related costs. In order to create a realistic model the simplifying assumptions cited in previous research will not be employed, instead, these problems will be dealt with at a detailed and realistic level. As Hunter and Naylor (7) point out, "a simulation model is constructed in the hope that it will successfully mimic a real world system. The model may, as a consequence, become very complicated and involved. However, our comprehension proceeds only when we are able to synthesize the system in terms of simpler explanations." Instead of over simplifying the production-inventory relationships as in past research, a more detailed model will be constructed in hopes of more successfully mimicking a real world system.

3.1.2 Determination of the actual job processing times will be based on standards by operation, including setup and run times. Standard times will be multiplied by a factor drawn from a truncated normal distribution with mean = 1, standard deviation = 0.03, minimum = 0.94, and maximum = 1.06. This multiplier will be used to introduce noise into the processing times to more realistically reproduce situations actually encountered.

3.1.3 Job routings will be determined by detailed operation sheets for each part. Operation sheets will give operation sequences, and will identify the machine required for each operation. Operation sheets may be different for each part number. No alternate sequences or machines will

be allowed. All information concerning sequencing and machine requirements will be determined external to the model.

3.1.4 Orders will arrive in the shop as determined by the MRP order release system. Release dates will be determined by order due dates and calculated part number lead times which will be dynamic. Order quantities will be determined by the least unit cost lotting method.

3.1.5 Raw material delivery will be based on normally distributed lead times. Five normal distributions will be used to approximate lead times for the various raw materials used. A 95% safety level will be used when calculating release dates for raw material orders.

3.1.6 Labor used in the model will be fixed in both quantity and skill. The number of workers available and the machines which the workers can operate will be stated in advance of the simulation.

3.2.1 Rather than using lead time or lateness alone as a criterion for judging the systems performance, total production-inventory related costs will be used. Those costs affected by the production-inventory system are: work-in-process inventory, order completion with respect to due date (either early or late), and facilities utilization.

TOTAL COST = WORK-IN-PROCESS COST + LATENESS COST + FACILITY
UTILIZATION COST

3.2.2 In order to compare different systems it is essential that total costs be compared. It is possible that one system may do very well at meeting due dates, but only at the expense of low facilities utilization. Facilities utilization may be maintained at near full capacity in another system, but only at the expense of a high work-in-process inventory. If results are to be meaningful the total production-inventory costs must be compared in order to find a system which minimizes total cost.

3.2.3 As Jones and Jucker (5) point out, "The cost of having too much work-in-process inventory are the traditional inventory carrying costs (space, insurance, capital costs, risk of damage or obsolescence, taxes, etc.) plus the confusion, extra handling, and clerical costs occurring when production area is over-crowded with material plus the sales connected costs associated with long lead times." As Orlicky (13) states, "A minimum inventory investment consistent with production objectives and constraints imposed on the manufacturing process is always the goal." What we desire is the minimum work-in-process level which will enable order due dates to be met while maintaining facilities utilization.

3.2.4 The second main component of production-inventory related costs is the cost of discrepancies between planned and actual order completion dates. If an order is completed after its planned due date costs due to expediting,

communications with the customer, special handling or shipping, and the generation of illwill may be incurred. It is generally considered good to complete orders prior to the planned due date, but this too acts to keep costs above the minimum. When goods are completed before their planned due dates, Finished Goods inventory is inflated and again, as with work-in-process inventory, excessive inventory related costs are incurred. Orders should be completed at the exact moment of need in order to minimize inventory costs.

3.2.5 The third major component of production-inventory related costs is the cost incurred due to under utilization of facilities. Investments in machines and buildings are fixed in the short run. Under utilization of these facilities acts to reduce the return on investment, and thus increases opportunity costs. Labor is also fixed in the short run, but not to the extent of machinery and building investments. Here again, under utilization brings about an increase in opportunity costs.

3.2.6 Jones and Jucker (9) made a reasonable attempt at minimizing production-inventory related costs, but they considered only work-in-process costs plus the cost of idle resources. Order lateness costs were not considered. Expected total variable costs defined as the cost of idle resources plus work-in-process inventory cost, was the cost which Jones and Jucker attempted to minimize.

3.3.1 Due to the way an MRP system starts with a part's due date and works backwards in time, lead time estimating is very important if parts are to be completed near their due dates. As Orlicky (13) states, "What should planned lead times be in a given situation? Excessive planned lead times inflate the investment in work in process - this we know, but we do not know what their optimum values should be and by what method to arrive at them. It seems clear that optimum lead time values cannot be constant, as they are a function of capacity and the load pattern resulting from a particular product mix that is in production at a given time. The precise relationship remains to be discovered and defined."

3.3.2 Lead time is made up of three components; processing time, queue time, and move time. If lead time is to be accurately estimated, all of these components must be considered. Processing time can be estimated from standards, applying a performance factor if need be, to make standards more accurately reflect actual times to be encountered. Queue time must be estimated in a dynamic manner since it reacts to shop load. Exponential smoothing should provide a reasonable estimate of queue time. Transportation time will be included in the queue time estimate in this model.

3.3.3 In order to control the system a priority rule or queue discipline must be employed. A reasonable priority

rule should work with lead time in an attempt to complete orders within the lead time planned. As Gere (6) states, "we desire both predictability (because we would like to set due dates correctly) and control (because we want to meet the due dates)." In this work Gere was starting with a start date and projecting a due date. In an MRP system, a due date is given and the start date is backed into. In either case the lead time to be estimated is the same. Lead times must be estimated accurately so that due dates will be met and a reasonable priority rule must be used in order to control order completions.

3.4.1 In summary, the task at hand is to construct a realistic model which will employ reasonable and hopefully accurate estimates of actual lead times. The results obtained from experimentation conducted with this model will be evaluated on the basis of the total costs produced by the experimental conditions.

CHAPTER II

DESCRIPTION OF THE MODEL

1.0 General Model Description

1.1.1 Products produced in the simulated machine shop represent the type of products commonly manufactured by job shops. Final products are made up of purchased parts, machined parts, and sheet metal parts which are combined into assemblies and weld assemblies. Three end item products were used in the model simulated.

1.2.1 Purchased parts may be: raw material such as bar stock or sheetmetal; hardware such as screws, bolts, and washers; or other items such as valves, bearings, or seals. Machined parts are those parts which have been turned, milled, drilled, ground, or otherwise machined. Examples of machined parts include: shafts, cylinders, and manifolds. Sheet metal parts are parts which are generally sheared, bent, stamped, or punched. Sheet metal parts include covers, channels, straps, and plates. Twenty-four parts of six levels were used in the model.

1.3.1 Fifteen machines or processes were simulated in the model used. Operations simulated included: shearing, punching, bending, welding, drilling, turning, inspection,

painting, and assembly. Some operations such as drilling and painting could be performed in more than one operation center (machine) while others, such as inspection and welding were limited to one operation center.

1.4.1 Nine workers were used in the model simulated, with each worker being capable of operating every machine. This situation is considered to be representative of the typical job shop.

1.5.1 As stated above, every worker was assumed to be able to operate every machine. In addition, it is further assumed that all workers are of uniform ability and that they are fixed in number.

1.5.2 Purchased parts are assumed to follow the normally distributed lead times as given in the model input. Actual deviations from standard times for processing operations are also assumed to be normally distributed, following the distribution given.

1.5.3 Scrapped parts or orders are assumed to be negligible or non-existent. Machines are assumed to operate at a constant level of efficiency and never break down. The number of machines available is fixed during the course of the simulation.

1.5.4 Further assumptions are that: operation sequences are fixed and that alternate routings do not exist; two operations cannot be executed simultaneously on

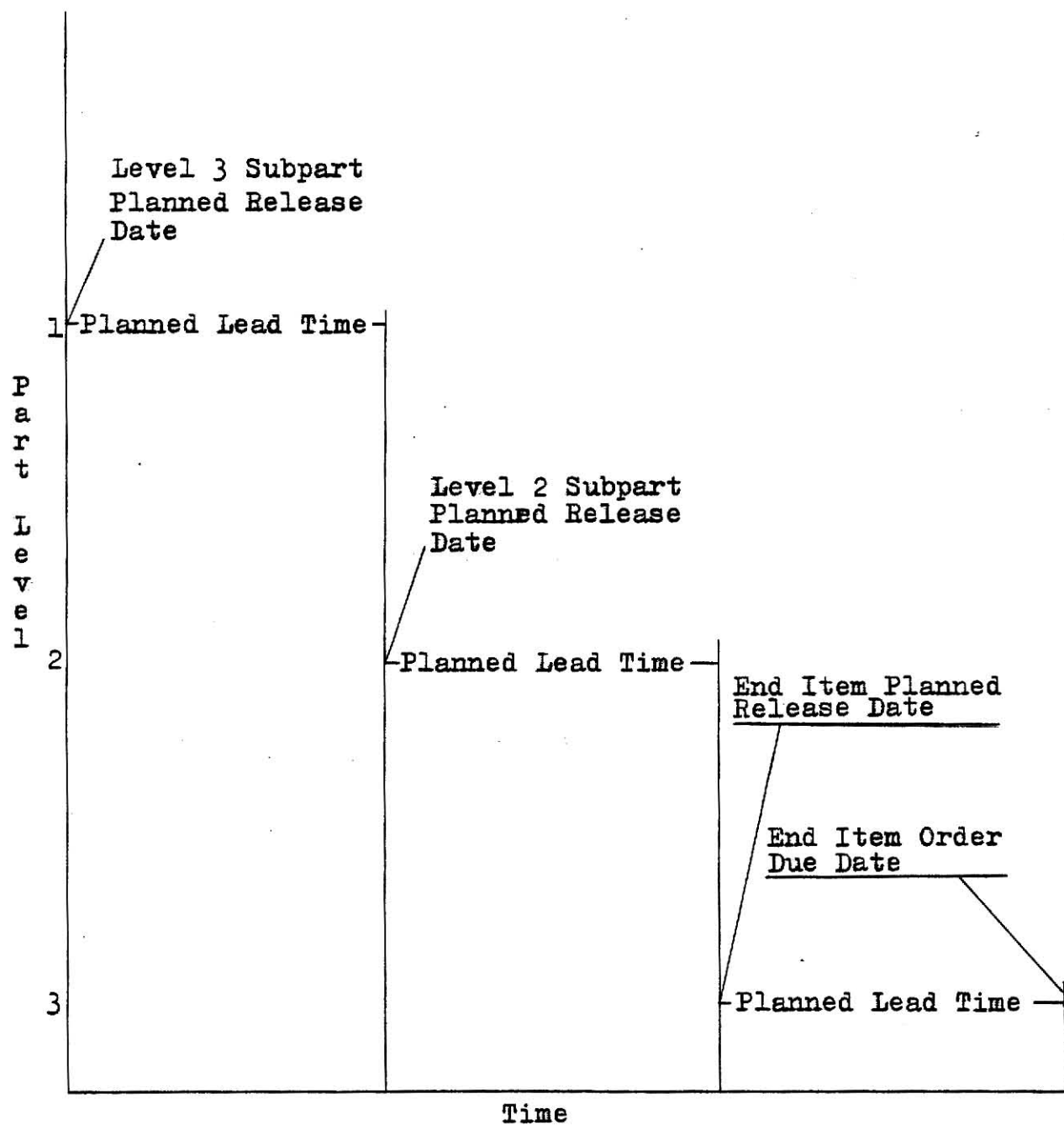


FIGURE 1

The Material Requirements Planning Process

the same machine, no order cancellations are allowed; no lap phasing is allowed; and demand is known and fixed.

2.0 Material Requirements Planning

2.1.1 Material Requirements Planning is a relatively new production-inventory control technique that is a common sense approach to the problem made possible through the use of computers. MRP makes it possible to use more of the available information than was possible with earlier techniques such as the Reorder Point, or Reorder Period techniques.

2.1.2 With MRP it is possible to schedule shop load based on estimated lead times and demand which is assumed to be known. With MRP a specific order will be generated to meet a known demand, rather than keeping goods on hand in the event that an order comes about. By working to known demands with estimated lead times it is possible to reduce inventories, meet demands, and plan facilities utilization.

2.2.1 As stated above, an MRP system works on the assumption that demand is known. Estimated demand is summarized in the master production schedule which is then treated as a known demand. "The first prerequisite is the existence of a master production schedule, i.e., an authoritative statement of how many end items are to be produced and when." Orlicky (13).

2.2.2 Demand in the real world generally is not known

for certain but this does not preclude the use of MRP. Whenever production is to take place some forecast of future demand must be made in order to establish production quantities. "Requirements for end items are stated in the master production schedule, and they are derived from forecasts, customer orders, field warehouse requirements, interplant orders, etc. Requirements for all component items (including raw materials), and their timing are derived from this schedule by the MRP system" (Orlicky (13)). When an MRP system is used, this forecast is assumed to be correct and is used as if demand were known until the forecast is revised. When the demand forecast changes, the master production schedule also changes, causing orders to be cancelled, added, or realigned.

2.3.1 Once a master production schedule has been established, the next step is to determine the part levels, from prime parts up to the end items included in the master production schedule. The bill of material defines which subparts and in what quantities join together to make the next higher level part: "Thus the bill of material is expected to specify not only the composition of a product but also the process stages in that product's manufacture. It must define product structure in terms of levels of manufacture, each of which represents the completion of a step in the buildup of the product. This is vital for material requirements planning because it establishes, in

conjunction with the item lead times, the precise timing of requirements, order releases, and other priorities" (Orlicky (13)).

2.3.2 To demonstrate part levels, consider a simple nut and bolt assembly. Both the nut and bolt are purchased parts and are therefore of the lowest part level (prime). When these two parts are combined to form an assembly, the assembly is not prime since it has gone through one stage in production. The assembly is now a level two part since it is made solely up of level one (prime) subparts.

2.4.1 Before the master production schedule can be exploded by part levels to determine subpart requirements timing, lead times must be estimated for each part. End item subpart due dates cannot be determined until the lead time required to process the end item, once the subparts are available, is known. "The timing of the planned-order release is arrived at by offsetting for lead time, i.e., by subtracting the value of the lead time (expressed in shop calendar units) from the shop calendar date of order completion" (Orlicky (13)).

2.4.2 If the end item we are concerned with is a motor home which requires two days to assemble, all subparts for the motor home must be available two days before the end item's due date. The two days required to assemble the motor home is said to be its lead time. Lead times must

be estimated for each subpart, level by level, in order that all subpart requirements can be determined.

2.5.1 The situation with the motor home discussed above represented exploding the end item demand one level down. That is, all part numbers making up the end item were determined and their need date estimated based on the time required to assemble the motor home. Suppose that the end item, the motor home, was required on January 30th, with the two day lead time required, all subparts would be required on January 28th. Suppose one of the end items subparts was the motor home frame, to explode another level down it would be necessary to know what subparts join together to make the frame.

2.5.2 To determine what parts join together to form the frame it is necessary to consult the frame's bill of material. "The bill of material file guides the explosion process. Product structure data are not operated on but merely consulted by the system to determine component identities, quantities 'per', and addresses." Orlicky (13). The frame's bill of material would show the subparts to be two channels, six cross members, and two axle assemblies. All of these parts would be lower level parts than the frame assembly which is a lower level part than the end item motor home.

2.5.3 This explosion process would continue through to the prime parts, such as the wheels, tires, and the

bearings on the axle assemblies. It is this explosion process, coupled with lead time estimates that determines when subpart requirements occur.

2.6.1 The final point in determining subpart requirements is the lotting rule. A lotting rule is used to combine the individual subpart demands into larger, more economical orders. If the master production schedule called for one motor home every day, this would in turn generate a requirement for a frame for each of the motor homes. Rather than to setup the tooling and generate an order daily for each frame it may be more economical to combine the frame requirements for several days production and weld several frames with only one setup.

2.6.2 The question to be answered now is how many frames to build at one time? Should a year's supply of frames be manufactured at one time, or should they be manufactured one per day as they are required? To answer this question it is necessary to know the cost to setup to weld a frame as well as the cost of carrying a completed frame in inventory for a given period of time.

2.6.3 Once the setup and carrying costs have been determined it is possible to group or lot individual part orders in an economical manner. Several lotting techniques are available: least unit cost, Wilson's Economic Order Quantity, least total cost, etc. but most have the same goal.

The goal is to balance the cost of setting up against the cost of holding completed goods in inventory until their time of need.

2.7.1 To summarize the operation of an MRP inventory system: demand is forecast and put into the form of a master production schedule, telling what and how many are required when. Part levels must be determined next in order for bill of material exploding to take place in a logical sequence. Once part levels have been determined, end item requirements are exploded downward via their bills of material, level by level to determine subpart demands. Lead times are applied at each level of explosion to all subpart demands to determine the timing of these demands. Once individual part demands have been determined they are lotted in an economical manner and actual part orders are determined.

3.0 General Model Input Data

3.1.1 Master production schedule requirements were determined in advance of the simulation and were entered period by period at the start of the experiment. Specific input data included a prefix card which identified the period number and gave the number of part numbers demanded in the period shown. The Demand Card followed, showing the specific part numbers and associated quantities required.

3.2.1 Bills of material were determined in advance of the simulation and were entered part number by part number

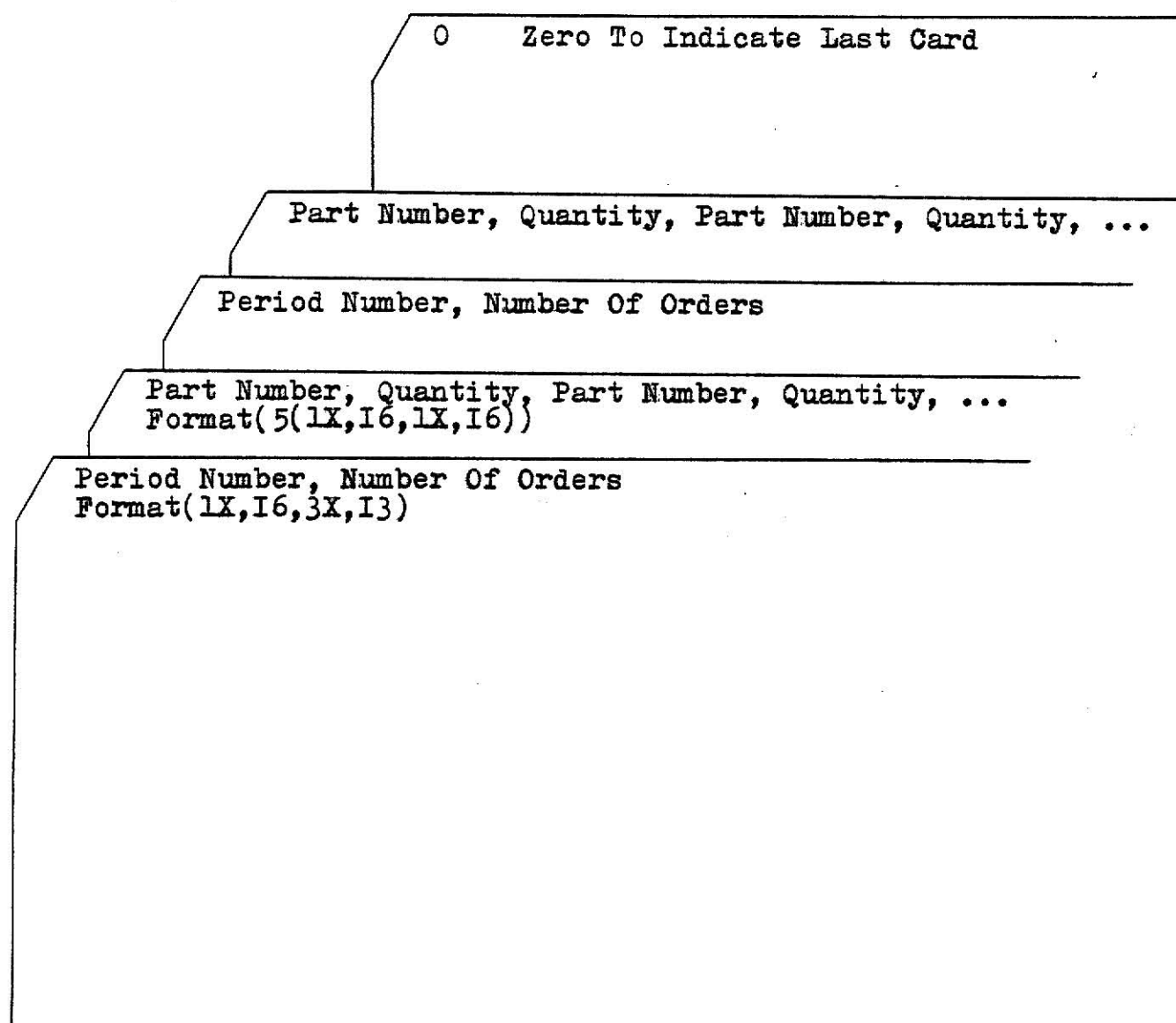


FIGURE 2

Master Production Schedule Organization

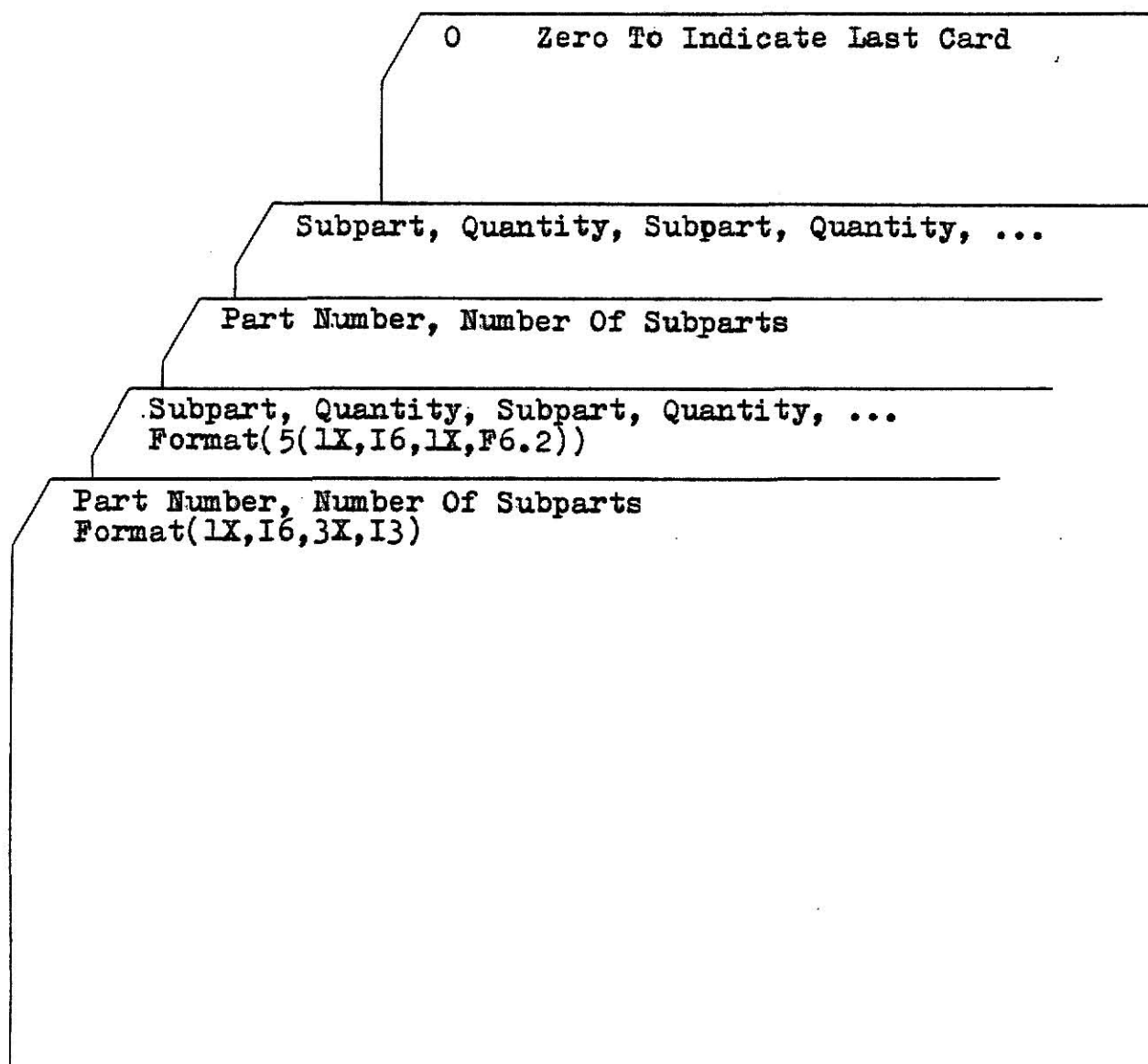


FIGURE 3
Bills Of Material

for all but prime parts. Bill of material input data included a prefix card identifying the part number and the number of subpart numbers required. The subpart card followed identifying the subpart numbers and quantity of each going into the next assembly.

3.3.1 Operation sheet data: operation sequences, machines required, and standard setup and run times, were determined in advance of the simulation and entered part number by part number for all but prime parts. A prefix card was read first, identifying the part number and the number of operations required. An operations data card was read next, giving (in order of operation) the machine required, standard setup time and standard run time.

3.4.1 Worker ability was read for each worker to be used in the model. This data was read worker by worker with one input card representing the ability of each worker. If a worker had the ability to operate a particular machine a one was placed in the column corresponding to the machine in question. If the worker was unable to operate the machine a zero was placed in the corresponding column. A prefix card indicating the number of workers available preceeded the worker ability cards.

3.5.1 Prime part cost and lead time distribution information was determined in advance of the simulation and entered by prime part number. A data card indicating prime part number, lead time distribution number and unit cost

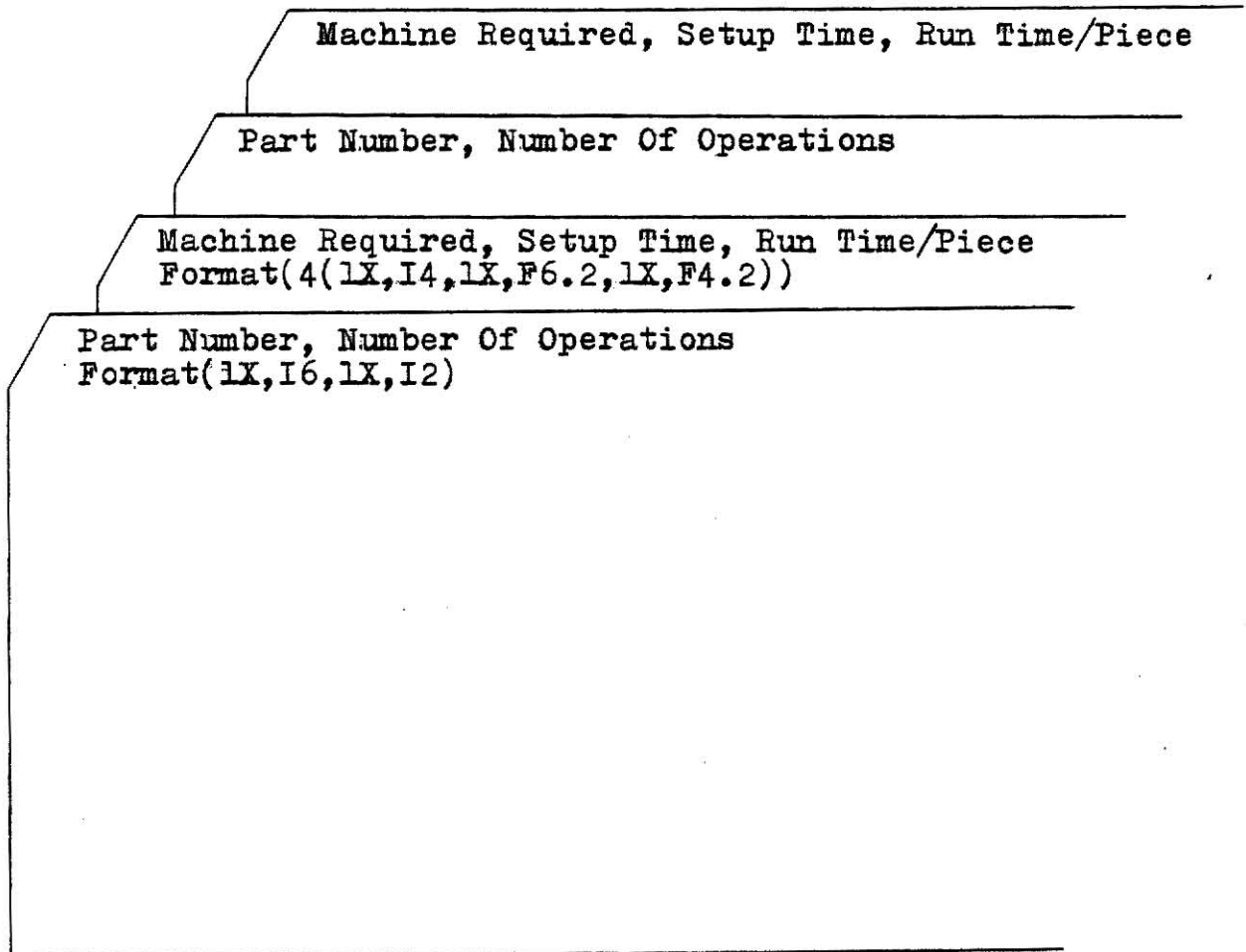


FIGURE 4
Operation Sheets

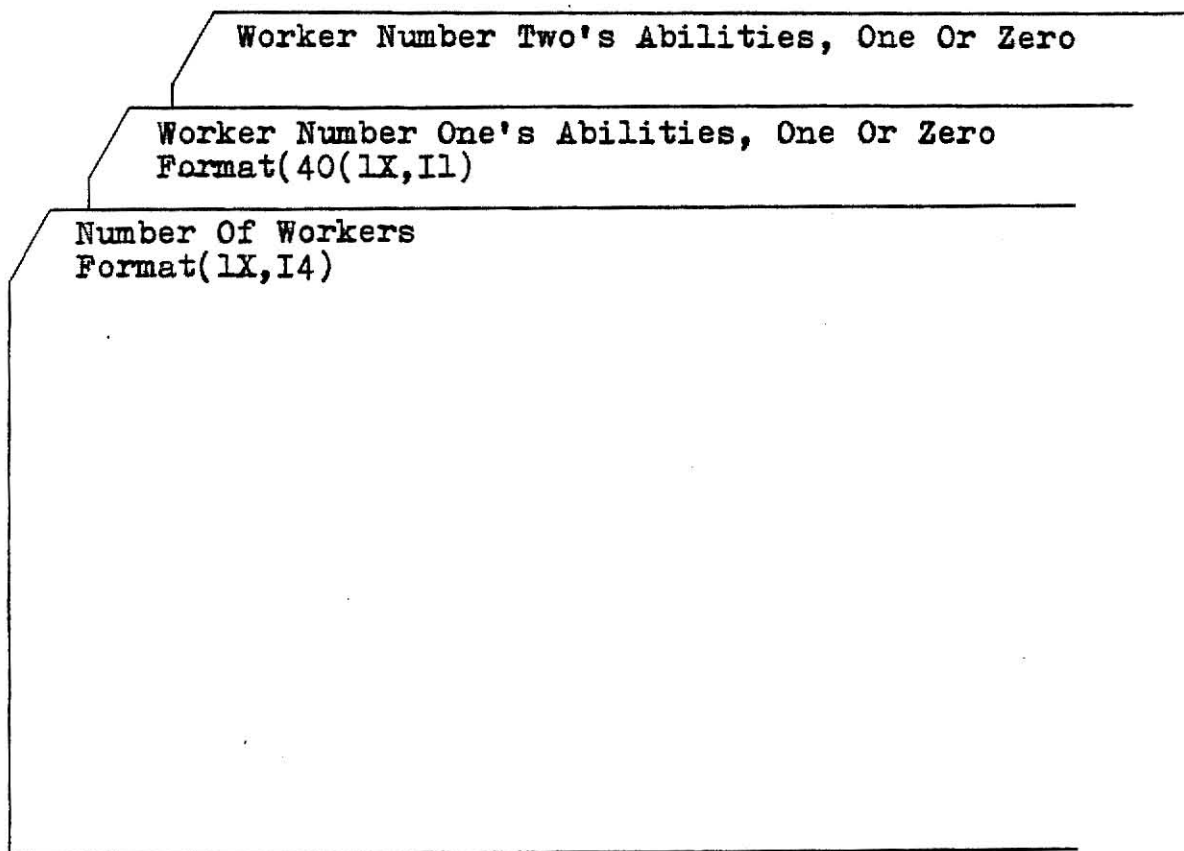


FIGURE 5
Worker Ability

Part Number, Lead Time Distribution Number, Unit Cost

Part Number, Lead Time Distribution Number, Unit Cost
Format(1X,I6,1X,I3,1X,F8.2)

FIGURE 6

Prime Part Information

was read for each prime part. Five different prime part lead time distributions were available and were identified on the prime part data cards by distribution number only.

3.6.1 Machine operating data was determined in advance of the simulation and sequenced by machine number. A prefix card indicating the machine number was read first, followed by a card indicating machine operating data. Machine operating data included cost per minute including labor, and operating efficiency to standard times. All machines were assumed to operate at 100% of standard.

3.7.1 MRP operating parameters including: percentage inventory cost per year, scheduling period length in minutes, maximum number of open orders allowed at one time, number of periods included in the firm horizon, and the fixed ordering cost, were each read separately. The number of parts in the system and an alpha for smoothing machine queue estimates were also entered.

3.8.1 Initial estimates of machine queues were determined in advance of the simulation and included for each machine in an effort to speed attainment of a steady state condition. An estimate of machine queue time in minutes was entered for each machine simulated.

4.0 System Design

4.1.1 The master production schedule was read first; the next step in the operation of an MRP system was to

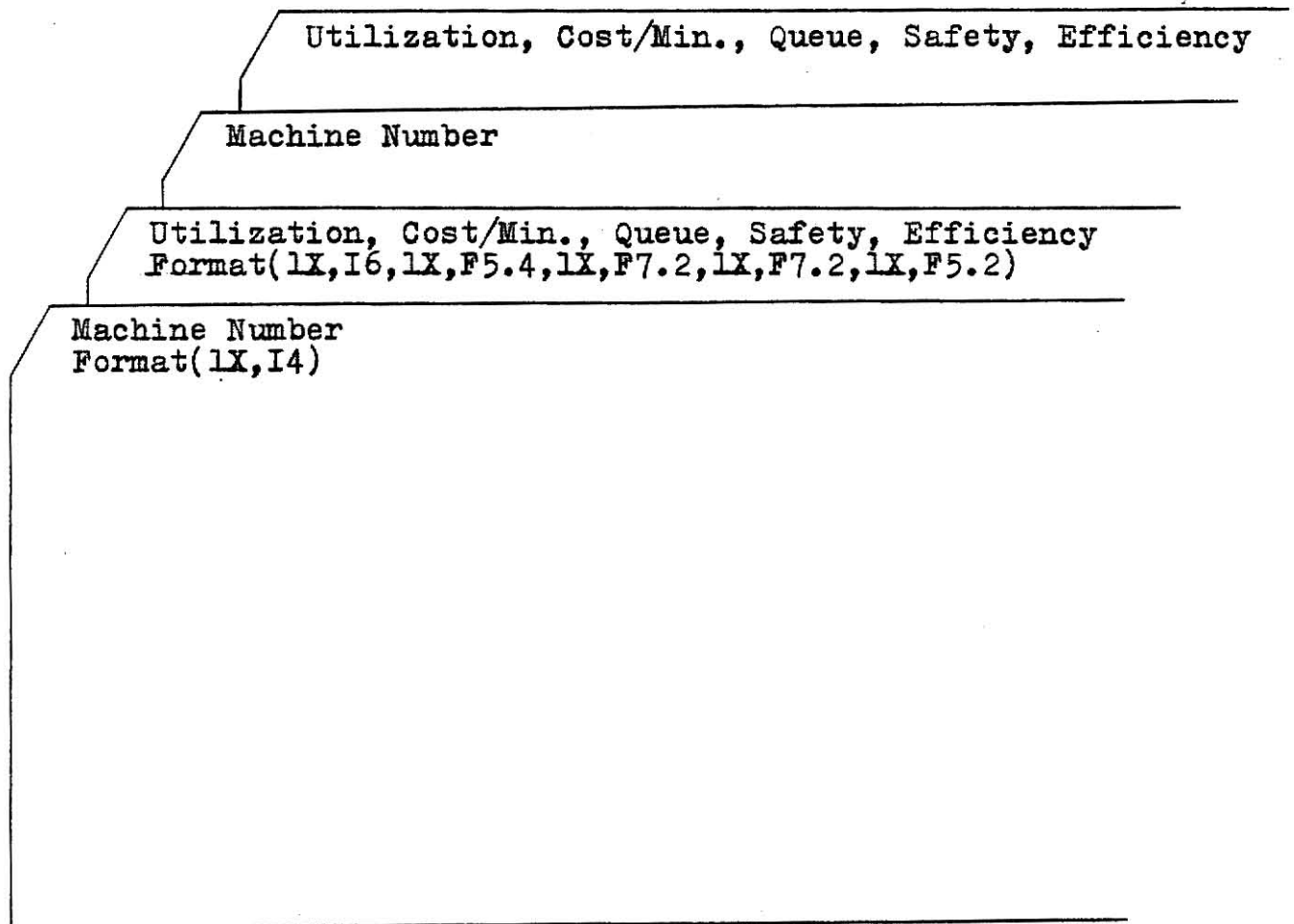


FIGURE 7
Machine Operating Data

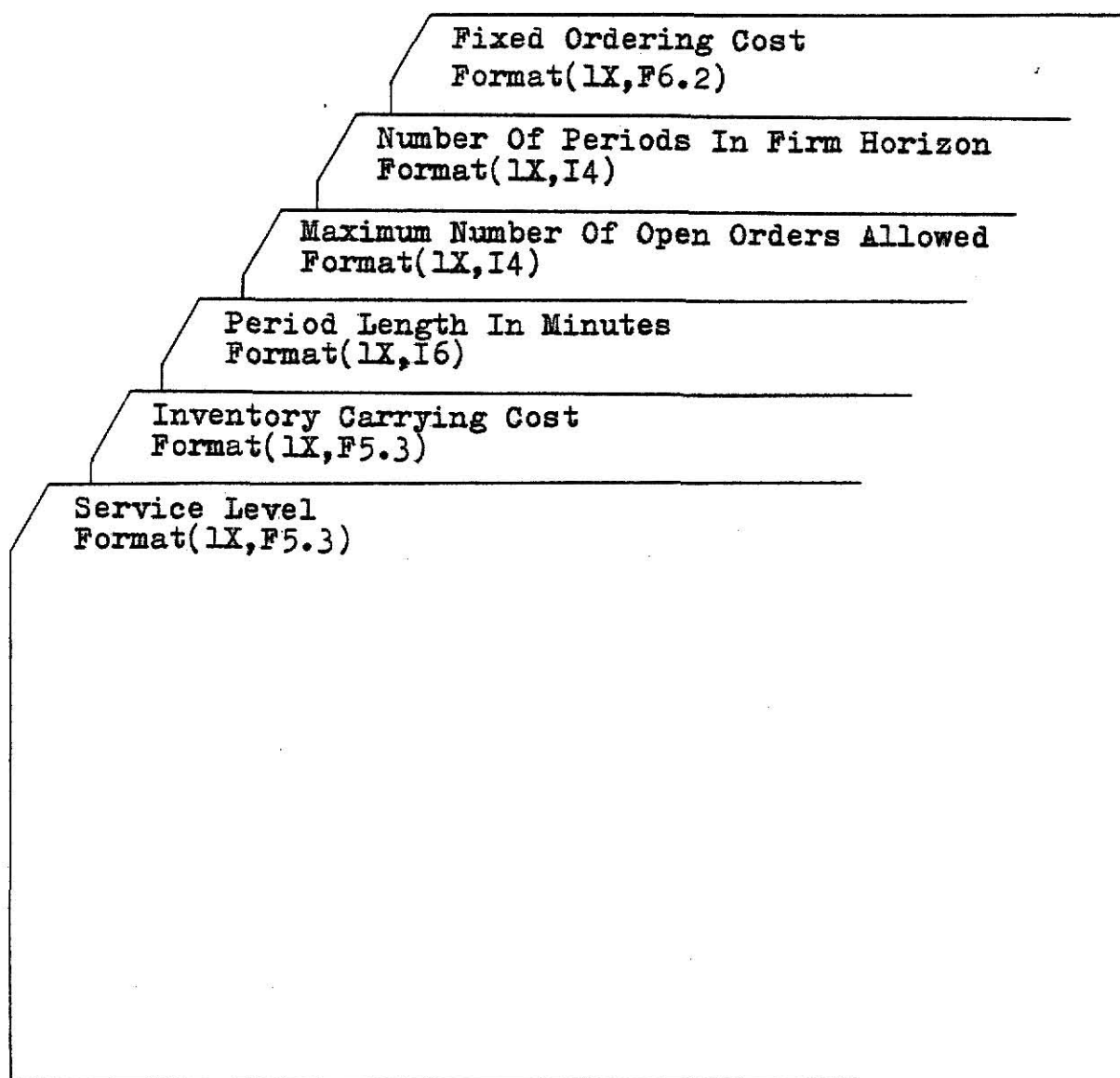


FIGURE 8

MRP Operating Parameters

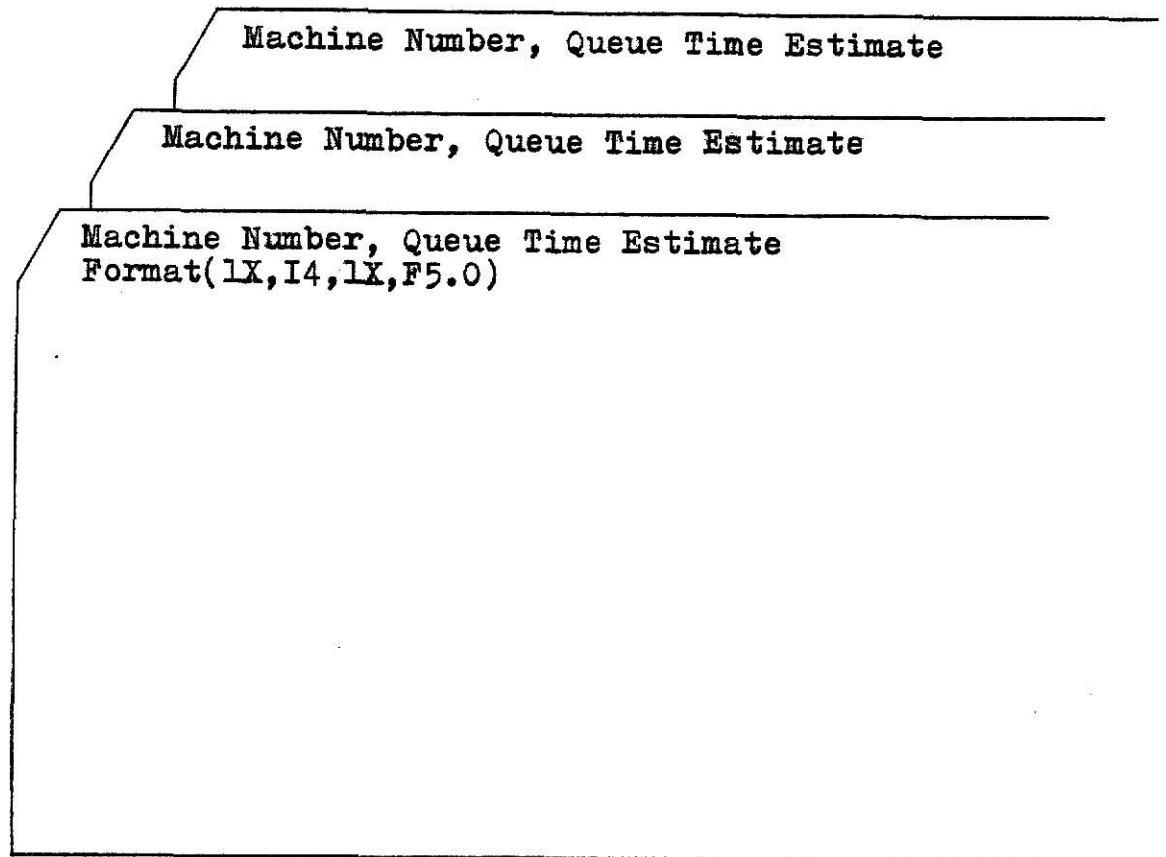


FIGURE 9
Initial Machine Queue Estimates

determine part level. As stated in section 3.2.1, bills of material were entered for all but prime parts. This served as the basis for determining which parts were prime. Any part number without a bill of material was determined to be prime and given a part level of one. All bills of material were then consulted to see if the part number in question was made up strictly of prime parts. Any part meeting these requirements was given a part level of two.

4.1.2 Once all parts of levels one and two had been determined, the other part numbers were checked one by one to determine if they were made up of only level one or two parts. Any part meeting these requirements was assigned a part level of three. This system was continued level by level until all part numbers, from prime parts to end items, had part levels established.

4.2.1 Once part levels had been determined it was necessary to explode the end item requirements given in the firm horizon in order to determine subpart demand. It is desirable to keep the firm horizon as short as possible, while allowing sufficient lead time allowance for prime part orders, in order to keep the ordering system as flexible as possible. A firm horizon which is too short will not allow low level part orders to be released on time, while a firm horizon which is too long will make for a very rigid system which is slow to react to changes in demand.

4.2.2 After firm horizon requirements had been

C o s t P e r U n i t	Order A	
	Total Cost	
	Order A	
	Ordering Cost	Orders A+B+C
	Orders A+B	Total Cost
	Total Cost	Orders A+B+C
		Carrying Cost
	Orders A+B	
	Ordering Cost	
	Orders A+B	Orders A+B+C
	Carrying Cost	Ordering Cost
	Order A	
	Carrying Cost	
Units Included In Lot		

FIGURE 10

The Least Unit Cost Process

determined, lotting of end item demands was to take place. The Least Unit Cost lotting method was used because it uses specific demand points to balance inventory carrying costs against fixed ordering costs. Demands are added to a lot as long as the unit ordering cost decreases. When the least unit cost is found, the lot size is set and the process starts again to form the next lot.

$$\text{Unit Cost} = \frac{(\text{Fixed Ordering Cost} + \text{Inventory Carrying Cost})}{\text{Lot Quantity}}$$

4.2.3 Lotting of a particular part number would continue for all orders in the firm horizon. Lotting begins with the highest level part numbers and continues level by level until the prime parts are lotted.

4.3.1 As stated in section 4.2.2, inventory carrying costs are incurred as differently timed orders are combined. Demand timing is determined by the master production schedule, part level explosion, lotting, and estimated lead times. Going back to the motor home example in section 2.4.2, the lead time required to assemble the end item was estimated at two days. This two day lead time made the demand for the motor home frame come two days prior to the demand for the motor home. Lead time estimates play an important part in determining planned order release dates in an MRP system.

4.3.2 Lead time estimates fall into two categories: those that can be directly controlled and those that cannot. Lead times which can be directly controlled are those of

manufactured or non-prime parts. In this case it is the organization which is making and using the parts that can control lead time to a high degree.

4.3.3 Purchased parts, on the other hand, are made and shipped by an entity outside the direct control of the manufacturer. Parts of this type must generally be ordered earlier, with more safety stock kept on hand, in order to allow for the relative lack of control in receiving these parts.

4.3.4 When estimating manufactured parts lead time it is essential to use all of the available information in order to accurately estimate lead time. Manufactured parts lead time is made up of two main components: processing time and queue time. Processing time can be easily estimated from standard times, applying a performance factor if necessary.

4.3.5 Queue time estimates are not as readily available as processing times and therefore must be estimated in a more complicated manner. The method used was to start with an initial estimate of queue time in order to hasten reaching steady state. Each time an actual queue time observation was taken it was combined with the old estimated value by the use of the exponential smoothing technique. In this technique an alpha of 0.05 was used in order not to over-react.

Estimate = (Old Estimate)(1 - α) + (Observation) (α)

4.3.6 Since queue times and estimates of queue time varied, this method for estimating lead time gave a dynamic estimate which varied with the level of congestion in the shop. As shop load increased, queue times increased and therefore lead time estimates increased in an effort to accurately mimic the actual situation to be encountered.

4.3.7 Purchased parts lead times were assumed to follow one of five different normal distributions. The means were: four, six, seven, eight, and nine days, with standard deviations of: 0.75, 1.0, 1.0, 1.25, and 1.5 days respectively. Since purchased parts were assumed to follow normal distributions it was easy to employ a safety level to help insure that purchased parts would be on hand when required. A 95% service level was used in the model. By using a 95% service level it is insured that purchased part orders will arrive on or before the required need date 95% of the time. The remaining 5% of the orders would arrive late.

4.4.1 As stated in section 4.2.2 lotting of demands included in the firm horizon was accomplished using the Least Unit Cost method. When using a lotting technique such as the Least Unit Cost method it may be possible to come to the end of the firm horizon demand and still be experiencing a decreasing unit cost for the lot in question. This situation poses a problem. Should these last demands be made into a lot of their own, or should these demands be

left as they are until future scheduling periods are included in the firm horizon? If the last demands are made into a lot of their own, least unit cost is not assured, and problems arise when future buckets are, in time, added to the firm horizon and the lotting process starts again.

4.5.1 The solution to this problem is to maintain a file of unlotted demands. This file represents demands which are in limbo between demands created by the Master Production Schedule, and lots created by the lotting plan. When demands are created by the Master Production Schedule or by the explosion process, these demands are entered into the File of Unlotted Demands. When lotting takes place, orders are removed from the File of Unlotted Demands one by one and combined into lots. If the end of the firm horizon is reached and unit cost is still decreasing, those yet unlotted demands are simply left in the File of Unlotted Demands. When time progresses and the firm horizon is expanded one more period, more demands are added to the File of Unlotted Demands and the lotting process starts again.

4.6.1 The firm horizon is a dynamic time span which is updated as each scheduling period is passed in time. The firm horizon represents that fixed distance into the future which can be forecast with reasonable accuracy. As one period of time passes, the distance into the future which can be accurately forecast simultaneously increases by one period.

4.6.2 When the simulation first starts, demands in the periods corresponding to the firm horizon are transferred to the File of Unlotted Demands and lotting takes place. As the simulation progresses and time passes, additional periods are included in the firm horizon as successive periods are passed in time. All demand is determined in advance of the simulation, but real life situations are reproduced by only allowing the model to work with the demand contained in the fixed horizon.

4.7.1 When the master production schedule has been exploded, lotting has taken place, and order release dates have been set, it is time for the actual simulation process to begin. When an order's planned release time comes about, that order is released to production. If the proper subparts are available, the order is ready to begin its path through the production facility. If the proper subparts are not available, the order is placed in a queue pending the arrival of the required subparts. When the subparts become available the order will be released to the shop.

4.7.2 Once several orders have entered the production facility, conflicts may occur when several orders are vying for the same resources, either men or machines. To resolve these conflicts in a logical manner a priority rule is established. The priority rule is used to evaluate contending orders and to determine which order is most urgent.

Three priority rules were examined in this experiment: First Come-First Served, Shortest Operation time, and Critical Ratio. These priority rules will be discussed in more detail in a later section.

4.7.3 In order to insure that the highest priority order was put into work first, all orders in the queue were assigned priorities and then evaluated step by step. The first step in the evaluation was to determine the machine required for the highest priority order. If the machine required was in a busy state, the highest priority order would be removed from the evaluation and the next highest priority order would be considered.

4.7.4 If the machine required was in a free state the next step in the evaluation would take place. The second step was to determine what workers were able to operate the machine required. All workers would be checked one by one to see if they could operate the required machine. If a worker was able to operate the machine in question, the next step in the evaluation took place.

4.7.5 The third step was to determine if the worker able to operate the required machine was in a busy or free state. If the worker was in a busy state, all other workers' abilities were checked to see if any other workers could operate the machine in question. If other workers were able they would be checked for availability.

4.7.6 If both a worker and machine were available, both would be set to the busy state and the order would be processed. If a worker could not be found, the evaluation would move to the next highest priority order and begin again by checking machine requirements. Worker and machine assignments would continue until all orders in the queue had been evaluated and all possible assignments made.

4.8.1 Once orders had been released to the shop and work had begun, it was necessary to keep track of these orders. Inventory records were kept for each part number showing the quantity on hand, the quantity allocated, and the average part cost. Records were also kept for each open order, showing order number, part number, order quantity, due date, current operation, worker in use, priority, and order cost.

4.8.2 When an order for purchased parts arrived, or an order for manufactured parts was completed, the quantity of this part number on hand was updated. Likewise, when parts were removed from inventory to go into assemblies or to meet the master production schedule demands, the quantity on hand was again updated.

4.8.3 Parts were removed from the on hand inventory and transferred to an allocated status when a master production schedule demand came due and there was an insufficient quantity on hand to meet this demand. When subsequent orders for the parts in demand were completed they would be

combined with the parts already allocated. If the new quantity available was sufficient to meet the master production schedule demand, the demand would be filled, and any excess would be placed in on-hand inventory. If the new quantity available still was not sufficient to meet the demand it, too, would be placed on an allocated status to await additional orders.

4.8.4 Only parts required to meet master production schedule demands were transferred to the allocated status. The master production schedule demands had priority over demands of subparts for assemblies. Unfilled master production schedule demands represented deliveries to the customer which were already late and could not regain schedule. Assembly demands on subparts represented orders which were not yet complete and therefore had a chance to regain their schedule position.

4.8.5 When the simulation began estimates of part costs were required in order to carry out the lotting process. At the start of the simulation, standard part costs were determined based on the material and standard labor hours required to produce the part in question. Setup costs were omitted from standard part costs since lot sizes had not yet been determined. As the simulation progressed it was possible to collect actual part costs as orders were completed. Average part cost was recomputed with each completed order. An average, weighted by part quantity, was

used to combine the cost of parts already in inventory with the cost of the newly completed order. Once available, the weighted average part costs took the place of the standard costs for use in determining lot sizes.

4.9.1 During the course of the simulation statistics were kept in order to allow the various conditions simulated to be compared. Statistics were kept on: machine and worker utilization, machine queues, raw material and work-in-process inventories, timeliness in meeting master production schedule demands, manufactured part lateness, purchased parts lateness, and delays in order releases caused by the lack of subparts. Statistics kept included: averages based on observations, time weighted averages, and histograms.

4.9.2 Machine and worker utilization statistics were kept by time weighted averages. Machine utilization records allowed visibility as to where bottlenecks were taking place and made it possible to keep these bottlenecks from getting out of hand and causing meaningless results in the experiment. By plotting machine and worker utilization it was also possible to determine when steady state had been reached in the model.

4.9.3 Measures of worker utilization made it possible to simulate real life situations. A worker utilization level of about 95% was desired as this level of utilization would provide some constraints, and yet would not promote a degenerate experiment.

4.9.4 As stated in Chapter One, facilities utilization - both men and machines, is one of the costs directly affected by any production-inventory control system. In order to measure the impact of the various conditions simulated on facilities costs, it was necessary to measure the utilization of these facilities. Specific statistics kept were: mean, standard deviation, minimum, and maximum values.

4.9.5 Statistics were also kept on the queue lengths for each machine in order to allow estimates for queue time to be included in the lead time estimates. These statistics were based on observations. Each time an order moved out of a machine's queue and into processing on the machine, the time spent in the queue was included with the observations for the particular machine's queue length. Specific statistics kept included: mean, standard deviation, standard deviation of the mean, minimum, maximum, and a count of the number of observations made. Histograms were also developed for machine queues showing observed frequency, relative frequency, and cumulative frequency.

4.9.6 Work-in-process and raw material inventory records were kept on a time weighted basis. It is generally a time weighted average inventory which is used in computing inventory carrying costs. Statistics kept on the work-in-process inventory helped in determining when steady state had been attained as well as giving a measure to the

performance of the various conditions simulated. Work-in-process inventory is another cost which is directly affected by the production-inventory control system employed.

4.9.7 Raw material inventory is also directly affected by the production-inventory control system used. Raw material inventory, however, is outside the main area of concern in this experiment. Statistics were kept on raw material inventory only to track conformance to the raw material service level desired and its affect on the manufacturing process.

4.9.8 Statistics kept on work-in-process and raw material inventory included mean, standard deviation, minimum, maximum, and current value.

4.9.9 Statistics kept on the timeliness of meeting master production schedule demands were broken into three groups: early orders only, late orders only, and average orders - both early and late. Within each group statistics were kept based on observations for the days early or late and the order dollar value multiplied by the days early or late. Orders were separated into the early or late categories so that it would be possible to determine which type of order, if any, was generally early or late. Order value was applied to the due date discrepancy because it was felt that more weight should be placed on a \$10,000 order three days late than on a \$100 order five days late.

4.9.10 Whenever an order for a master production schedule demand is met, its time of completion is noted as well as the order's value. When the completed order is applied against the master production schedule demand, the difference between the order's time of completion and its due date is determined and added to the observations of this type. Specific statistics kept include: mean, standard deviation, standard deviation of the mean, minimum, maximum, and the number of observations. Histograms were also compiled giving: observed frequency, relative frequency, and cumulative frequency.

4.9.11 As with delays in meeting the master production schedule demands, delays in meeting demands for subparts were also recorded. Since subpart delays cause problems which are still internal to the production entity, it was decided to keep these statistics separate from the master production schedule demand delay statistics. A subpart delay was caused when a scheduled assembly requirement for a given subpart was not covered. The time span from when the scheduled assembly requirement occurred to the time when the requirement was filled was recorded as an observation of subpart delay. Subpart delay statistics kept included: mean, standard deviation, standard deviation of the mean, minimum, maximum, and the number of observations made. In addition, the observations were used to form histograms

giving: observed frequency, relative frequency, and cumulative frequency.

4.9.12 In an MRP system, subpart delays are caused by delays in the receipt into inventory of the subpart in question. As stated earlier, subparts are of two types, purchased subparts and manufactured subparts. Different factors are responsible for the delays in the two types of subparts, and therefore, statistics were collected separately for each type of subpart.

4.9.13 Purchased parts delivery is the responsibility of the vendor. Delays in the receipt of purchased parts can be caused by delays in manufacture or delays while in transit. Each time an order for purchased parts arrived, its actual arrival date was compared with its planned delivery date and the difference was recorded as an observation in purchased parts arrival. Note that every order received, whether early or late, contributed an observation to the statistics kept on purchased parts arrival. These statistics were kept to show how the purchased parts ordering system performed and to insure that purchased parts delays did not become excessive: excessive purchased parts delays were interpreted to indicate that the firm horizon was too short to allow adequate lotting and lead time for purchased part orders. Specific statistics kept included mean, standard deviation, standard deviation of the mean, minimum, maximum, and the number of observations made.

A histogram, based on the subpart delay observations was also kept showing observed frequency, relative frequency, and cumulative frequency.

4.9.14 The other cause of subpart delay is the delay in completion of manufactured subparts. Delays of this type can be brought about by poor lead time estimation, an unresponsive priority rule, delays in still other subparts going into the subpart in question, poor capacity planning, etc.

4.9.15 Each time an order for a manufactured part was completed its actual completion date was compared to its planned completion date and the difference was entered as an observation in manufactured parts completion. Here, as with purchased parts arrival, every completion was recorded. Statistics kept included: mean, standard deviation, standard deviation of the mean, minimum, maximum, and the number of observations. In addition, a histogram was kept showing the observed, relative, and cumulative frequencies.

5.0 Model Flexibility

5.1.1 In order to make the application of the model as general as possible, many of the design parameters were left flexible so that the model could be tailored to fit many situations. By allowing for flexibility, the model created can be used to test effects produced by many

situations; changes in the firm horizon length, inventory carrying cost, worker ability, etc.

5.2.1 The main areas to be investigated with the model were the estimation of lead time for manufactured parts, and the use of various priority rules in an MRP production-inventory system. Each of these parameters was somewhat complex and therefore a separate subroutine was used for each. By using separate subroutines to compute lead time or priority, it was quite easy to substitute one method for another. Subroutines for several lead time equations were developed as well as one for each of the three priority rules tested.

5.3.1 Other model parameters were much simpler and therefore were used as either a model operating parameter or as model input data. Model operating parameters were those parameters that affected the way in which the model functioned. Model input data did not determine how the model operated but instead was operated on by the model.

5.4.1 Variable model operating parameters included: the number of machines available, number of workers available, ability of the workers, service level for purchased parts ordered, inventory holding costs, fixed ordering cost, scheduling period length, firm horizon length, and the smoothing constant to be used in estimating machine queues.

5.4.2 The number of machines used in the model was determined internally directly from the operation sheets.

If the operation sheets used in the model called for 100 different machines, then the model would set up to simulate a factory of 100 machines. Other machine information such as operating cost and efficiency to standards is considered model input data and had to be entered explicitly.

5.4.3 Worker quantity and ability were under the control of the experimenter and could be easily varied. This information was entered explicitly as described in section 3.4.1.

5.4.4 Purchased parts service level could be altered by the experimenter to observe the problems experienced in production caused by purchased parts delays. By varying the service level, it would be possible to form a relationship between service level, purchased parts inventory, and downstream delays caused by purchased parts shortages. The service level concept is based on normally distributed purchases part lead times although other distributions may be used. The value entered was the number of standard deviations to be added to the mean purchased part lead time in order to develop the planned purchased part lead time.

5.4.5 Costs related to the determination of lot sizes; inventory holding cost and fixed ordering cost, were also under the direct control of the experimenter. Inventory holding cost was used as a percentage. In computing the holding cost, the yearly average inventory is multiplied by the percentage given to determine the cost of holding that

amount of inventory for one year. This figure includes the cost of capital, insurance, obsolescence, warehouses, etc. The fixed ordering cost, expressed as a dollar value, includes those fixed costs directly associated with ordering. These costs include, labor to write the order, the cost of the ordering forms, record keeping costs, etc.

5.4.6 Associated with the estimation of lead time is the alpha used in the exponential smoothing of machine queue times. A large alpha causes the queue time estimate used in lead time estimation to vary rapidly as conditions change. A smaller value of alpha produces gradual changes in the queue times used to estimate lead time. The value of alpha chosen depends upon how fast actual conditions change.

5.4.7 Scheduling period length is used to group end item demands into time periods in the master production schedule. When demand is low and unpredictable, longer buckets may be warranted than when demand is high and very predictable.

5.4.8 The firm horizon length depends upon the accuracy in long or medium range forecasting, the number of part levels dealt with, lotting rules used, and lead times required. If demand forecasting is not very accurate, a firm horizon as short as possible should be used. If demand forecasting is fairly reliable a longer firm horizon may be used to allow more stable planning to take place.

The firm horizon must not be allowed to become too short and therefore cause problems in lotting and scheduling order releases.

5.5.1 Variable model input parameters included: master production schedule, bills of material, operation sheets, purchased part lead time distributions, prime parts cost, machine operating costs, machine efficiency to standards, and initial machine queue estimates.

5.5.2 The master production schedule, bills of material, and operation sheet input data were discussed in sections 3.3.3, 3.2.1, and 3.3.1 of this chapter, respectively. The master production schedule determined what end items were to be delivered and when. The composition of the items demanded was determined by the bills of material, and the methods for producing all parts involved was determined by the operation sheets.

5.5.3 For each purchased part represented in the model, the lead time distribution used, and cost were entered. The quantity and parameters of the purchased part lead time distributions were under the control of the experimenter. Normal lead time distributions were used for prime parts although other distributions were possible. Purchased part cost was entered by the experimenter as discussed in section 3.5.1 of this chapter. This information, along with standard times from the operation sheets, was used to calculate the standard costs of the manufactured parts. Prime part costs

and standard part costs were used in the initial lotting procedure.

5.5.4 Machine operating costs including labor and machine efficiency to standards were entered as described in section 3.6.1 of this chapter. Initial estimates of machine queues were entered as described in section 3.8.1 of this chapter. Machine operating costs and efficiency to standards were used in developing the costs of non-prime parts. Initial machine queue estimates were developed from early simulation runs and were input in order to speed attainment of steady state.

6.0 Interesting Facets

6.1.1 In order to be able to use part numbers and machine numbers as pointers it was required that the external part numbers and machine numbers be given consecutive internal counterparts. External numbers are those used in real life, external to the model, such as part number 2416 or machine number 943. It can easily be seen that if the external numbers were used as file pointers that the files would be of tremendous size and of very low density. In order to solve this problem external numbers were given internal counterparts. The first part number entered was given an internal number of one. When additional external part numbers were entered through the bills of material they were first checked against those part numbers already

entered to see if an internal part number had already been assigned. If an internal part number had not yet been assigned, an assignment took place and the external part number was added to the list of part numbers converted.

6.1.2 Machine numbers were converted in much the same way as part numbers except that external machine numbers were obtained from the operation sheets. When an operation sheet was entered, the machine numbers called out would be checked to see if an internal counterpart had already been assigned. If an assignment had not yet taken place, the machine in question would receive the next consecutive number as its internal machine number.

6.1.3 Through the above process, parts were numbered internally from one to the number of parts being considered. Likewise, machines were numbered internally from one to the number of machines being simulated. Once the conversion had taken place, external part numbers were recorded in the Master Parts List File only, with internal part numbers being substituted in all other records. External machine numbers were stored in the Internal Machine Number File only, with internal machine numbers being substituted elsewhere.

6.2.1 In order to have the ability to easily change file dimensions as the size of the model parameters changed, Block Data was used to dimension all varying files. Parameters that change with the size of the model include: machine quantity, number of master production schedule

periods, number of part levels, number of parts, etc. The dimensions of many variables changed as these parameters changed. In order to avoid the necessity of changing the dimension of each affected variable in each subroutine every time the model size changed a Block Data Subroutine was employed. By using the Block Data Subroutine, it was possible to change the dimension of a variable in every subroutine simply by making one change in the Block Data Subroutine. This flexibility made it easy to tailor the storage capacity required to the model being tested rather than to simply allow excess storage space.

6.2.2 Unlike most simulation models, the model described in this paper can be stopped and then restarted at a later time without losing that time period already simulated. It is quite often the case in simulation, that the time period just simulated was insufficient to produce the desired results. When this situation occurs, it is generally required that the simulation be re-started from the very beginning and simply run for a longer period of time. This requires that the results from the first run be simply repeated and extended in time.

6.2.3 In order to avoid this costly repetition, the model used here has the ability to dump all records in the form of punched cards when the model is terminated. If it is desired that the model run time be extended, the results

of the previous run are simply entered as the initial conditions of the subsequent run.

6.2.4 The experimenter had the option of either dumping the files via punched cards at the simulation's termination, or printing selected files for observation. Four subroutines were written to allow this flexibility. User supplied information could be dumped via punched cards by using one version of the UDUMP subroutine, or selected files could be printed by using another version of UDUMP. GASP files would be dumped via punched cards by using one version of GDUMP. If data was not to be dumped a dummy version of GDUMP was substituted.

6.3.1 The timing of all scheduling activities except the master production schedule demands followed a continuous time frame. It was felt that master production schedule demands were not known exactly and therefore should be grouped into time periods for ease in manipulation. Other scheduling activities, on the other hand, assumed that the master production schedule posed the exact requirement times. Scheduling, therefore, operated on a continuous time frame, with subpart order due dates, scheduled release dates, scheduled completion dates, etc. being planned on a continuous time scale.

6.3.2 The continuous time scale allowed events to take place at the exact time estimated, and did not require events to be shifted either forward or backward in time to

correspond to discrete time intervals. Deviations from estimated times would require additional handling and would necessitate that most events take place earlier or later than actually required.

CHAPTER THREE

DESCRIPTION OF WORK DONE

1.0 How Questions Were Answered

1.1.1 The question of which priority rule to use depends to some extent on the method by which lead time is estimated. Priority rules must be tested in combination with lead time equations in order to arrive at the best overall solution. When evaluating priority rule-lead time equation combinations, it is necessary to consider all affected costs. Affected costs are: work-in-process holding costs, lateness costs, and costs related to facilities utilization. These costs are interrelated and therefore must be evaluated in total rather than independently.

1.1.2 Work-in-process holding cost as a percentage of inventory value must be specified in advance of the simulation in order to perform the lotting operation. This same holding cost should be used in computing the work-in-process costs associated with any priority rule-lead time equation combination since work-in-process inventory is determined, to a high degree, by the lotting rule and the associated holding cost employed.

1.1.3 Model output does not yield the cost of holding work-in-process inventory over a particular time period.

In order for the model output to be of greater value the work-in-process dollar value is given. The same holding cost as that used in lotting can be used, or any other holding cost rate may be applied.

1.2.1 Lateness costs are also not given explicitly by the model. Model output includes values for days late and for the dollar amount of the order multiplied by the number of days late. As with the work-in-process costs, direct costs are not given for lateness in order to increase flexibility.

1.3.1 Utilization costs are not given explicitly in the model's output. These costs can, however, be computed using the utilization values for the workers and machines and the associated costs per unit time. In addition, values for overhead must also be added to arrive at a total opportunity cost due to the underutilization of facilities.

1.4.1 Assigning particular values to each of the production-inventory related costs merely acts to weight each as a component of the total cost. By not applying weights to each of the production-inventory costs, each may be evaluated independently and then combined later by applying specific costs.

1.5.1 In this analysis, each production-inventory cost component will be evaluated separately in order to allow individual reactions to be observed. The affect of each priority rule-lead time equation combination on

work-in-process, lateness, and utilization will be noted. If one combination is superior in all areas there is no need to apply weights to each cost component in order to determine which combination is best. If no one combination is best overall, estimates of the weights of these components will be applied to determine a total cost. Caution must be exercised in evaluating results based on total cost, since relative production-inventory cost component weights vary from company to company. Relative weights will have a direct impact on total cost, and therefore on the merit of each combination tested. A company with low storage capacity will probably have a relatively high work-in-process carrying cost, a company in a highly competitive market will probably have a relatively high lateness related costs.

1.6.1 Whether the production-inventory related costs are assigned relative weights or not is not the main point. The important point is that these three costs must be evaluated together when making a determination as to which priority rule-lead time equation combination is superior.

1.7.1 Three priority rules were evaluated in the model described: First Come First Served, Shortest Operation Time, and Critical Ratio. With the First Come First Served rule the order which entered the queue earliest will be elected first. The Shortest Operation Time rule chooses that job from the queue which has the shortest operation time on the machine in question. The Critical Ratio rule

selects the job with the lowest critical ratio. The critical ratio is simply the estimated time required to complete the order divided by the actual time remaining to complete the order.

1.7.2 The First Come First Served rule was tested due to its simplicity and extensive treatment in queuing theory. "The familiar priority rules - first-come-first-served, earliest due-date - are examples of the simplest type of dispatching procedure for which the information requirements are minimal and the mechanics of computation and implementation are trivial. More complicated rules can certainly be used if it can be demonstrated that their superior performance justifies the increased difficulty of implementation" (Conway and Maxwell (17)).

1.7.3 The priority rule which has been researched most is probably the Shortest Operation Time (SOT) rule. This rule has been tested in a great many job shop type simulations with very favorable results with respect to the criteria employed (6) (3) (14). The criteria generally applied when the SOT rule was tested were: average flow time, average lateness, average number of jobs in process, and average waiting time.

1.7.4 A major flaw in the testing of the SOT rule was the evaluation criteria employed. Rather than looking at the actual costs of work-in-process inventory or lateness, the evaluations of the SOT rule generally looked at average

flow time or average lateness. When using the SOT rule it is possible for some jobs to be in process a very long time (3) or to become very late when due dates are imposed (6).

1.7.5 The last rule evaluated is the Critical Ratio rule. The First Come First Served rule took advantage of only one piece of the information available, the order's arrival time in the queue. The next higher level rule was the Shortest Operation Time rule which took into consideration the estimated processing time on the next machine. The Critical Ratio rule is the most complex rule tested. This rule considers the order's due date, future expected processing time, and future expected queue time, as well as the current time.

1.7.6 "It is reasonable to expect that effective priority rules will take into account due dates or processing times or both. Furthermore, since each operation is another opportunity for delay as the job waits in the queue at the machine, the number of operations appears to be relevant. Also the machine loading should be a significant factor, expected delays are greater on heavily loaded machines" (Gere (6)).

1.7.7 A Critical Ratio rule which uses a dynamic estimate of queue times meets all of the specifications set forth in the paragraph above. As machine loading varies, queue time estimates would vary, thus giving a good reflection of the actual situation to be encountered.

1.7.8 "Although the dispatching function is not in itself the complete scheduling procedure, it is an essential phase of any scheduling procedure. It is a function that must be performed, by intent or by default, and it might as well be performed well" (Conway and Maxwell (3)).

1.8.1 The basic lead time equation used in this model was of the form put forth by Vazsonyi (16). Lead time is estimated to be the sum of the expected queue time for each operation plus the expected processing time for each operation.

1.8.2 Expected queue time was developed for each machine by using an exponentially smoothed value of queue times actually experienced for each machine. An initial estimate of the queue time for each machine was employed in order to speed attainment of steady state. Each time a job moved from a queue and onto a machine, the value of the job's queue time was used to update the queue time estimate for the machine in question.

1.8.3 By updating estimated queue time with each observation, the queue time estimate changed to reflect current shop load. By developing estimates of queue time for each machine it was possible to more nearly predict the actual flow time a particular job would experience. Since queue time is related to the utilization of the facility involved it is imperative that queue time be estimated for

each machine due to the wide variations in loading experienced.

1.8.4 Expected processing time for each operation was estimated based on standard times. Standard times could be factored to represent performance-to-standards which was other than 100%, although factoring was not required in this experiment.

1.8.5 The lead time estimation equations used in this model fulfill the requirements for a good estimate as set forth by Eilon and Chowdhury (4) and Gere (6). In general, these requirements are that lead time estimates consider: job routing, operation times, machine loads, and job arrival time. Job routing is considered by estimating queue time and processing time separately for each machine shown on the operation sheet. Operation times are estimated based on standard times for each operation on each machine shown on the job's operation sheet. Machine loading is considered through the use of dynamic queue time estimates for each machine being simulated. Queue time estimates will change to reflect changing levels of machine utilization. Job completion time, or due date as opposed to the job's arrival time, is used in this model to act as a baseline. The simulation models of the type described by Eilon and Chowdhury (4) and Gere (6) simply let jobs arrive randomly and then tried to predict a completion time. In the model described here, the completion date is considered to be fixed and the lead

time estimate is subtracted from the completion date to arrive at the job's planned release date. The logic is the same in either case, only the starting points differ.

1.8.6 A variation of the original lead time equation which added a constant times the standard deviation of the queue time estimates was also tested. The constant used was the same as that used in determining raw material lead times. It was thought that by adding this constant times the standard deviation of the queue times it would be possible to obtain a sort of "service level," similar to that used in determining raw material lead times. This alternate lead time equation makes the assumption that queue times for each particular machine are normally distributed.

1.8.7 Another lead time variation was the addition of the average subpart delay to the lead time used for determining release dates. It was hoped that this addition to the lead time would offset the delays caused by inadequate subpart inventories. Inadequate subpart inventories caused significant delays in the early simulation periods due to congestion in the shop which delayed subpart completions.

2.0 Detailed Model Working

2.1.1 In an attempt to better duplicate actual situations, standard times for processing were multiplied by a random deviate to introduce noise into the model. The random deviate was drawn from a normal distribution with a

mean of one and a standard deviation of 0.03. This multiplier would cause actual times experienced to vary from standards in a random manner as is normal in real-life situations.

2.1.2 Randomly varying processing times also introduced random variation into the queue times which made for job flow times that varied randomly. Random variation is normal for flow times in job shop environments and greatly adds to the scheduling problem. By including this random variation in the model it was hoped that generally applicable results could be obtained.

2.1.3 Raw material lead times also varied randomly. Lead times for raw materials were drawn from one of the five available lead time distributions. All lead time distributions used were normal, with varying means and standard deviations. Service levels for raw materials were less than 100%, leading to shortages of raw materials which delayed the planned start of orders.

2.1.4 Service levels less than 100% and randomly varying raw material lead times were additional attempts to duplicate the scheduling problems encountered in real-life. With a supply of raw materials which was less than perfect, the ability of the priority rule to "catch up" an order could be tested.

2.2.1 In order to make the best possible use of limited resources, priority rules were established to

allocate these resources. When multiple orders were vying for limited resources, such as; labor, raw material, or detail parts, priorities were assigned to each order in competition. By following the priority rules it was insured that the limited resources would be put to use where needed most. This system put the highest priority jobs into work first and also worked the highest priority jobs first. The same priority rule was used for all selections including machine loading and subpart and raw material allocation.

2.2.2 In order to make timely decisions when determining which order to supply with raw material or to work next, etc., order priorities were updated prior to each decision. With dynamic priority rules it is possible for the order ranking to change with time. Static priority rules, such as First Come-First Served, need not be updated.

2.2.3 The mechanism for establishing and updating priorities was the subroutine SEARCH. This subroutine was used in three modes corresponding to each of the priority rules tested: First Come-First Served, Shortest Operation Time, and Critical Ratio. The subroutine was the same in all cases except for the criteria used to establish the priority of orders.

2.2.4 SEARCH was called whenever it might be possible to increment an order towards completion. Three events enabled orders to progress; completion of an operation on a

specific order, the addition of subparts (including raw material) to inventory, and the release of new orders.

2.2.5 SEARCH also operated in two different sub-modes regardless of the priority rule in use. The first mode was used for orders vying for machines and workers, and the second mode was used for orders vying for subparts or raw material.

2.2.6 When SEARCH was operating in the machine selection mode it would start by examining every valid order number. The order number would be checked to see if that number was currently in use, if the order had been released, and if the order was waiting on a machine. If all of these conditions were met, the next test would be whether or not the required machine was in use. If the machine required was unavailable, the order in question would not be tested further. If the required machine was free the order's priority would be calculated. Once all orders pending machine assignment had their priorities calculated, they would be ranked from high to low.

2.2.7 With all pending orders ranked, the assignment process would start. Beginning with the highest priority job, machine availability would be rechecked to make sure that the machine required was still available. The next step was to see which workers were capable of running the machine required. When a capable worker was located, his availability would be checked. If the worker was busy a

check on the capabilities of the remaining workers would take place. If the worker was free, both that worker and the machine in question would be assigned to the order under consideration. This procedure would then be repeated with the next highest priority job until all possible assignments had been made.

2.2.8 When SEARCH was operating in the mode used to assign subparts and raw material to pending orders the initial procedure was the same as in the machine selection mode. Only the appropriate orders would have their priorities calculated and would then be ranked. Starting with the highest priority order, a check would be made to see if all of the required subparts were available. If all of the required subparts were not available, no assignment would be made and the next highest priority order would be tested. If all of the required subparts were available, they would be transferred from inventory to the order under consideration and SEARCH would be called in the machine selection mode in order to attempt to start on the first operation of the newly released order. This subpart and raw material procedure would continue until all possible assignments had been made.

2.3.1 SEARCH provided a mechanism for making decisions as the orders moved through production. This section will discuss the step by step movement of these orders. The method for lotting orders and determining release dates was

discussed in Chapter Two. When an order reached its release date different actions would occur depending on whether the order was for purchased or manufactured parts.

2.3.2 When the release date for a purchased parts order came, the order would be released to the supplier and the arrival date would be randomly selected from the ordered part's lead time distribution. The actual arrival date could come before or after the scheduled need date. When the purchased parts actually arrived, they would be added to inventory and SEARCH would be called to make any possible subpart assignments.

2.3.3 Orders for manufactured parts went through a much more complicated procedure. When a manufactured part's order reached its release date a check of the assignment of the required raw material or subparts would first take place in SEARCH. Raw material and subpart assignment would take place as previously described. Once an order had the required subparts and/or raw materials it would begin vying for machine time.

2.3.4 The orders waiting for a machine would rely on SEARCH to determine priority and make the machine assignments when the order's priority became high enough. Until the machine required for the first operation became available and was assigned to an order, the order would be held in queue and its waiting time recorded. When a machine was assigned to an order, the order would be removed from the

queue and work on the order would progress. The standard time allowed for the operation would be computed and then altered by a normal random deviate, discussed in section 2.2.1 of this chapter, to arrive at the actual operation completion time.

2.3.5 Upon completion of an operation a check of the order's operation sheet would be made to see if the operation just completed was the last required. If the operation just completed was the last, the finished parts would be added to inventory. If the order was still unfinished, it would enter the queue of the machine required for its next operation. The queue selection process would then take over and the order would progress in this way until its completion.

2.4.1 End item demand shown in the Master Production Schedule could not be met until all related orders had been completed and the end items were added to inventory. Whenever a Master Production Schedule demand came due, a check of the inventory on hand would be made to see if sufficient goods were on hand. If sufficient goods were available, the demand would be filled and removed from the Master Production Schedule. When insufficient goods were available to fill the demand completely, the goods that were available would be transferred to an allocated status. These goods were allocated to meet a due, but as yet unmet, Master Production Schedule demand. By putting these goods on an

allocated status they were unavailable to meet any other demand.

2.4.2 The purpose of this allocation system was to insure that the most crucial demands, the Master Production Schedule demands, were met first. The remaining demand for subparts was more forgiving and therefore received less attention. Master Production Schedule demands represent customer demands and the penalty for missing customer due dates is high. Internal demands for subparts infers that further processing was required on these orders, leaving time to catch up if these subparts were not immediately available.

3.0 Problems Encountered

3.1.1 In the initial stages of writing and running the simulation model several problems were encountered. The use of pointers and multiple uses for storage locations required extra consideration when writing and debugging. The lotting subroutine became very complex in an effort to consider and allow for all possible circumstances. Since the model was completely new, problems were also encountered in determining when steady state had been reached. Lead time equation-priority rule combinations also lead to problems since some combinations took longer to reach steady state than others and some simply degenerated. The final major problem was that of selecting a firm horizon for planning purposes.

3.2.1 When working with pointers to locate storage locations, special care had to be taken to see that the pointers as well as the storage locations were correct. It was very easy to point to an incorrect location and retrieve erroneous information, or store information in the wrong location. If the information being stored was a pointer to yet more information, the problem became complex very rapidly.

3.2.2 Another method used to reduce the required storage space was to use the same storage location for multiple uses. The "Worker in Use" location in the "Open Order File" is an example of the multiple use of storage space. If the order actually was in work, the number of the worker involved would be entered in this location. If the order was not in work but was waiting on a machine, the entry in the "Worker in Use" location would be one more than the total number of workers available. If the order was waiting on subparts, a zero would be shown in the "Worker in Use" location. This system allowed useful information to be stored in a location which would otherwise be idle.

3.2.3 The use of a storage location for multiple purposes created problems in that great care had to be taken. If an inquiry as to the worker in use was made of an order which was not in work, a meaningless response would be given. Problems also occurred when a storage location was not cleared between uses in different modes. When an

operation on an order was completed, the "Worker in Use" would have to be cleared or set to a new state. If this was not done and an inquiry was made as to whether this order was waiting for subparts or a machine, an erroneous condition would be reported.

3.3.1 The major problems with the lotting subroutine "LOT" were in keeping orders from becoming too large and therefore not allowing sufficient time to complete them by the required due dates. If an order was allowed to become too large its manufacturing span time would become longer than the time remaining until the order's due date. When this situation came about, the Least Unit Cost lotting mechanism would be overruled and a reduced lot size with a planned manufacturing lead time less than the time remaining until the order's due date would be generated.

3.4.1 Since this model had never been run before and started with the shop empty and no inventory on hand, problems were encountered in determining when steady state had been reached. Due to the complexities created by using six part levels, a long time span was required before the pipeline filled and end item demands finally started to be met.

3.4.2 End item requirements were determined so that they could be met within shop capacity. However, when the first orders started to appear in the shop considerable overloading occurred and queue problems became evident on the primary machines such as saws and shears. These

bottlenecks did not disappear rapidly and therefore delayed attainment of steady state.

3.5.1 Lead time-priority rule combinations also presented problems in that some combinations did not function well, with the extreme cases causing the simulation to degenerate. Once these combinations were found to function poorly, they were excluded from further testing. The more liberal lead time equations, such as those which allowed for subpart delay, coupled with an unresponsive priority rule, such as First Come First Served, proved to be the worst combinations.

3.5.2 A poor lead time-priority rule combination led to results which were erratic and which could not support a production-inventory control system as demanding as an MRP system. These poor combinations did not produce a system which was consistent enough and led to a high work-in-process inventory, long customer delays, and poor utilization of facilities.

3.6.1 The final major problem was the selection of a firm planning horizon. In order to make the model responsive to change, the original firm horizon was quite short. This short horizon caused severe problems in that it did not allow enough time for higher part level lotting and exploding to take place. The result of this condition was that purchased parts orders were being released late and in small quantities.

3.6.2 The firm horizon was gradually lengthened until it allowed sufficient time for lotting of the lowest level parts. In lengthening the firm horizon much of the responsiveness of the model was sacrificed. With a long firm horizon, lead times for parts demanded twenty weeks into the future would be calculated using the present queue time estimates. Until steady state was reached and queue time estimates became more constant this long firm planning horizon contributed to the instability problems.

CHAPTER FOUR

CONCLUSIONS AND RECOMMENDATIONS

1.0 Lead Time Equation Results

1.1.1 The first lead time equation tested was similar to that proposed by Vazsonyi (16). This equation consisted simply of the sum of the expected processing and queue times for each operation required. The only problem encountered in the use of this equation was with the queue time estimates.

1.1.2 Queue estimates did not become reliable until steady state was achieved. Prior to the achievement of steady state, the load in the shop was getting progressively greater. This increase in load meant that queues would as a general rule, become longer. With significant changes in the queues occurring, it was impossible to accurately estimate the queue time that an order would experience in the future. As a general rule, early queue time estimates were short, leading to short lead time estimates and therefore a high number of late orders.

1.1.3 Once steady state was achieved, this problem with queue time estimates was eliminated. Without the queue time estimate problem the Vazsonyi equation produced very satisfactory results. The number of late orders decreased,

work-in-process was not unreasonable, and utilization of facilities was at a high level.

1.1.4 In an attempt to speed the achievement of steady state and reduce the problems encountered with early queue time estimates, initial estimates of queue times were employed. The values used for the initial estimates were the current smoothed values when steady state was reached. By starting with the steady state values, rather than zero queue times, early disturbances caused by poor queue time estimates were reduced.

1.2.1 In an attempt to obtain the service level benefits of the raw material ordering system, a modification was made to the original lead time equation. The modification involved the addition of the raw material service level factor times the standard deviation of the queue time for each machine considered. The concept was that with this value added to the original lead time equation value, manufactured parts orders should be completed when required approximately 95% of the time.

1.2.2 This modification reduced the number of late orders somewhat but only at the expense of a high work-in-process inventory. When this modified lead time equation was used in conjunction with the Critical Ratio priority rule, facilities utilization and order completions both suffered. Since the Critical Ratio priority rule makes use of the lead time estimate in computing priority, a longer

than necessary estimate of lead time produces poor queue selection decisions. These poor decisions caused jobs to be worked in an inefficient manner.

1.2.3 Due to the problems encountered with this modified service level lead time equation it was abandoned early in the experimental period.

1.3.1 Another attempt was made to modify the original lead time equation, to compensate for the delays caused by the lack of required subparts. This modification involved the addition of the average subpart delay time to the original lead time equation value.

1.3.2 The problem with this modification, as with the modification mentioned above, was that it circumvented the built-in lead time adjustment system. If subparts were not available when required it was because the estimated lead time for the subparts had been too short. The lead time estimate had been too short because queue time estimates were inadequate. Queue time estimates were updated dynamically and should have adjusted themselves to produce good results if simply left alone.

1.3.3 The subpart delay modification was also abandoned. The number of late orders had been reduced, but again, only at the price of a high work-in-process inventory.

1.4.1 After the failure of the two modified lead time equations the original equation was restored. With the initial queue time estimates and allowance of time for the

system to reach steady state, the original equation produced satisfactory results.

2.0 Results Obtained

2.1.0 All of the following discussion of the results obtained excludes the observations made during the first twenty weeks simulated. This period was required for the attainment of steady state. The exclusion of these observations is to limit the results obtained to the steady state period only.

2.1.1 Work-in-process inventory dollar value was lowest on the average for the Critical Ratio rule. Average steady state work-in-process inventory values were \$328,000, \$256,200, and \$209,500 for the FCFS, SOT, and CR priority rules respectively. The FCFS rule was shown to be significantly higher than the SOT and CR rules at the 0.05 alpha level. The SOT rule was also found to be significantly higher than the CR rule at the 0.05 level, making the CR rule best overall.

2.1.2 The standard deviations of the work-in-process inventories were found to be \$51,870, \$18,070 and \$12,800 for the FCFS, SOT, and CR priority rules, respectively. These values were found to be significantly different from one another at the 0.05 level. This difference indicates the higher volatility of the FCFS and SOT rules as compared to the Critical Ratio rule.

2.2.1 On the average, orders for Master Production Schedule demands were found to be completed 21.44, 9.574, and 3.943 days late with the FCFS, SOT, and CR rules respectively. This is the average of orders completed early as well as those completed late. At the 0.05 level the FCFS orders are significantly later than the SOT and CR orders. The SOT orders are also significantly later than the CR orders, again making the CR performance best overall.

2.2.2 If only Master Production Schedule (end item) demand orders which were completed after their due dates are considered, the CR rule still produces the best results. Average days late for those late orders were 21.87, 16.41, and 5.603, respectively, for the FCFS, SOT, and CR priority rules tested. At the 0.05 level, the FCFS rule proves to be significantly later than the SOT and CR rules, and the SOT rule significantly later than the CR rule.

2.2.3 When the dollar value of an order is multiplied by the number of days an order's actual completion deviates from its planned completion, an indication is given as to which value orders are affected most. If only the end item orders which passed their due dates are considered, the average dollar-time values as described above are \$322,200 for the FCFS rule, \$392,200 for the SOT rule, and \$85,810 dollar days for the CR rule. In terms of the order lateness and value the CR rule was found to be significantly better

than the FCFS and SOT rules at the 0.05 level. No significant difference was found between the FCFS and SOT rules.

2.2.4 By dividing the above average dollar-time values by the average lateness given in section 2.2.2, the average value of a late order can be determined for each of the three rules tested. These average late order values are \$14,734, \$23,898, and \$15,313 for the FCFS, SOT, and CR rules respectively. These values highlight one of the major shortcomings of the SOT rule: it may produce good results on the average, but the larger orders are generally very late.

2.2.5 When examining only subpart orders, looking at both early and late completions, orders were late an average of 15.28, 6.818, and 5.073 days under the FCFS, SOT, and CR rules, respectively. Here also, the FCFS orders were significantly later than the SOT and CR orders at the 0.05 level. The SOT orders were also significantly later than orders under the CR priority rule, making the CR rule best overall in this area also.

2.3.1 Worker utilization was highest for the FCFS rule at 97.19%, followed by the CR rule at 96.12%, and the SOT rule at 94.31%. At the 0.05 level, utilization under the FCFS rule was found to be significantly higher than either the SOT or CR rules, making the FCFS rule highest overall. Worker utilization under the CR rule was found to be significantly higher than under the SOT rule at the 0.05 level.

2.3.2 Average machine utilization was found to be 58.32%, 56.59%, and 57.68% for the FCFS, SOT, and CR rules, respectively. Under the FCFS rule, individual machine utilizations ranged from 2.52% to 94.80%. For the SOT rule, utilization of machines ranged from 2.32% to 90.47%. Machine utilization under the CR rule ranged from 2.45% to 91.53%. As with worker utilization, these values ranged high enough to provide serious constraints as desired in the simulation.

2.3.3 When comparing individual machine utilizations under the three rules tested, no significant differences were found at the 0.05 level for 13 of the 15 machines modelled. For one machine tested, the utilization was found to be 69.93%, 74.58%, and 75.93% under the FCFS, SOT, and CR rules respectively. No significant differences were found at the 0.05 level when comparing the FCFS rule to the SOT rule and the SOT rule to the CR rule. The CR rule was shown to produce significantly higher utilization than the FCFS rule, however.

2.3.4 For the remaining machine, the utilization was 94.80%, 83.26%, and 88.11% under the FCFS, SOT, and CR rules, respectively. Here no significant differences were found at the 0.05 level when comparing the SOT rule to the CR rule, or the FCFS rule to the CR rule. The FCFS rule was shown to produce a significantly higher utilization on this machine than did the SOT rule, however.

2.4.1 In order to fully evaluate how well resources were utilized it is also necessary to examine the total throughput under each priority rule. The total throughput is made up of Master Production Schedule demands met, completed parts in inventory, and work-in-process. Throughput evaluations are made in terms of standard costs.

2.4.2 On part number one, Master Production Schedule demand was met through periods 42, 45, and 45 under the FCFS, SOT, and CR rules, respectively. For part number nine, demand was met through periods 39, 42, and 45, under the FCFS, SOT, and CR rules, respectively. All rules met the demand for part number seventeen through period 45. The dollar value of the Master Production Schedule demands met were \$1,503,844.80, \$1,607,493.00 and \$1,691,451.00 under the FCFS, SOT, and CR rules respectively.

2.4.3 The value of completed parts on hand was \$277,078.24, \$156,974.07, and \$41,586.90 under the FCFS, SOT, and CR rules, respectively. When the above mentioned values are added to the work-in-process values shown in section 2.1.1, the total throughput for the three rules was found to be \$2,185,830.10, \$2,006,860.95, and \$1,949,574.90 for the FCFS, SOT, and CR rules, respectively.

2.5.1 To summarize the above results; the Critical Ratio rule was shown to have the lowest work-in-process inventory, the best ability to meet due dates, and the lowest inventory of completed parts on hand. The First

Come-First Served rule was shown to have the highest worker utilization and the highest throughput. The SOT rule did not stand out in any of the areas tested.

2.5.2 The Critical Ratio rule was found to be superior overall to the other two rules tested. The high worker utilization and throughput of the First Come-First Served rule, are actually shown as detriments when examined further. The poor functioning of the First Come-First Served rule in meeting end item demands, its high level of work-in-process inventory, and its high level of completed parts on hand shows that this rule was causing work to be performed on the wrong parts. With the FCFS rule \$423,861, or 164% more inventory was required than with the CR rule and yet \$187,606, or 11% less in end item demand was met. Clearly the First Come-First Served rule is inefficient when compared to the Critical Ratio rule.

2.5.3 Since the Critical Ratio rule excelled overall in the areas tested, no specific costs for inventory, lateness, and utilization need be employed in order to determine which rule functions best.

2.5.4 It is believed that this paper has set forth a realistic model and an improved method of evaluation of results. The lead time equation presented, although not perfect, provides a very workable and efficient system when combined with the Critical Ratio priority rule. It is recommended that the system developed should be refined

further in future research, and that attempts be made to apply this system to real life situations.

2.6.1 Since much of the historical job shop research was concerned with the queues themselves, queues will be discussed here briefly. For 13 of the 15 machines simulated, the average queues under the FCFS rule were found to be significantly longer than under the other two rules.

2.6.2 When comparing the SOT rule to the CR rule, no significant difference at the 0.05 level was found for eight of the fifteen machines. The SOT rule was found to produce significantly shorter queues in five out of the fifteen machines, and the CR rule produced significantly shorter queues for two of the fifteen machines. The SOT rule has long been acclaimed for its ability to produce short average queues but does not appear to operate much better than the CR rule.

TABLE I

STEADY STATE OUTPUT SUMMARY

From Time = 80,640 min. until Time = 201,600 min.

ITEM MEASURED	<u>FCFS</u> Value	n	<u>SOT</u> Value	n	<u>CR</u> Value	n
Average Work-in-Process Inventory (\$)	328,000	1,491	256,200	1,416	209,500	1,457
Standard Deviation, Work-in-Process Inventory (\$)	51,870	1,491	18,070	1,416	12,800	1,457
End Item Order Lateness, Average Orders (days)	21.44	102	9.574	108	3.943	108
End Item Order Lateness, Late Orders (days)	21.87	100	16.41	63	5.603	76
End Item Order Lateness x Order Value, Average Orders (\$-days)	315,900	102	228,800	108	60,380	108
End Item Order Lateness x Order Value, Late Orders (\$-days)	322,200	100	392,200	63	85,810	76
Manufactured Subpart Average Order Lateness (days)	15.28	378	6.818	366	5.073	380
Average Worker Utilization (%)	97.19	2,778	94.31	2,616	96.12	2,698
Average Machine Utilization (%)						
Machine 1	88.74	173	90.47	183	91.53	183
Machine 2	47.22	277	50.91	297	51.78	307
Machine 3	69.93	463	74.58	467	75.93	489
Machine 4	84.08	241	85.10	239	87.93	257
Machine 5	42.14	175	40.03	163	38.46	167
Machine 6	52.66	137	47.04	133	50.63	143
Machine 7	34.07	167	34.14	163	32.73	165
Machine 8	42.26	153	39.45	123	39.92	125
Machine 9	74.67	187	72.27	175	75.52	181
Machine 10	75.19	141	71.08	133	70.44	129

TABLE I - Continued

ITEM MEASURED	<u>FCFS</u> <u>Value</u>	n	<u>SOT</u> <u>Value</u>	n	<u>CR</u> <u>Value</u>	n
Machine 11	17.17	157	15.09	129	16.66	129
Machine 12	2.52	215	2.32	185	2.45	187
Machine 13	60.79	141	59.53	128	59.86	133
Machine 14	88.59	85	82.94	57	83.29	59
Machine 15	94.80	81	83.26	55	88.11	59
Average	58.32	2,793	56.59	2,630	57.68	2,713
End Item Demand Met (bucket number)						
Part #1	42		45		45	
Part #9	39		42		45	
Part #17	45		45		45	
Finished Parts on Hand (\$)	277,078.24		156,974.07		41,586.90	
Average Queue Lengths (minutes)						
Machine 1	10,180	86	10,160	91	5,957	91
Machine 2	3,484	138	354	148	749	153
Machine 3	4,717	231	1,571	233	1,618	244
Machine 4	5,602	120	3,713	119	4,379	128
Machine 5	4,044	87	1,556	81	2,458	83
Machine 6	5,775	68	2,270	66	2,404	71
Machine 7	3,487	83	1,118	81	1,466	82
Machine 8	3,274	76	424	61	2,227	62
Machine 9	6,379	93	2,864	87	3,512	90
Machine 10	7,073	70	3,584	66	3,317	64
Machine 11	3,159	78	54	64	482	64
Machine 12	3,183	107	0	92	78	93
Machine 13	4,621	70	1,474	64	2,084	66
Machine 14	7,253	42	20,570	28	7,944	29
Machine 15	15,780	40	11,120	27	5,128	29
Average	5,867	1,389	4,055	1,308	2,920	1,349

TABLE II
TESTS OF SIGNIFICANCE

$\alpha = 0.05$

ITEM TESTED	FCFS vs. SOT	SOT vs. CR	FCFS vs. CR	Summary
Average Work-in-Process Inventory	FCFS > SOT	SOT > CR	FCFS > CR	FCFS > SOT > CR
Std. Dev., Work-in-Process Inventory	FCFS > SOT	SOT > CR	FCFS > CR	FCFS > SOT > CR
End Item Order Lateness				
Average Orders	FCFS > SOT	SOT > CR	FCFS > CR	FCFS > SOT > CR
Late Orders	FCFS > SOT	SOT > CR	FCFS > CR	FCFS > SOT > CR
End Item Order Lateness x Order Value				
Average Orders	FCFS = SOT	SOT > CR	FCFS > CR	FCFS = SOT > CR
Late Orders	FCFS = SOT	SOT > CR	FCFS > CR	FCFS = SOT > CR
Manufactured Subpart Order Lateness	FCFS > SOT	SOT > CR	FCFS > CR	FCFS > SOT > CR
Average Worker Utilization	FCFS > SOT	SOT < CR	FCFS > CR	FCFS > CR > SOT
Average Machine Utilizations				
Machine 1	FCFS = SOT	SOT = CR	FCFS = CR	FCFS = SOT = CR
Machine 2	FCFS = SOT	SOT = CR	FCFS = CR	FCFS = SOT = CR
Machine 3	FCFS = SOT	SOT = CR	FCFS < CR	--
Machine 4	FCFS = SOT	SOT = CR	FCFS = CR	FCFS = SOT = CR
Machine 5	FCFS = SOT	SOT = CR	FCFS = CR	FCFS = SOT = CR
Machine 6	FCFS = SOT	SOT = CR	FCFS = CR	FCFS = SOT = CR
Machine 7	FCFS = SOT	SOT = CR	FCFS = CR	FCFS = SOT = CR
Machine 8	FCFS = SOT	SOT = CR	FCFS = CR	FCFS = SOT = CR
Machine 9	FCFS = SOT	SOT = CR	FCFS = CR	FCFS = SOT = CR
Machine 10	FCFS = SOT	SOT = CR	FCFS = CR	FCFS = SOT = CR
Machine 11	FCFS = SOT	SOT = CR	FCFS = CR	FCFS = SOT = CR
Machine 12	FCFS = SOT	SOT = CR	FCFS = CR	FCFS = SOT = CR
Machine 13	FCFS = SOT	SOT = CR	FCFS = CR	FCFS = SOT = CR
Machine 14	FCFS = SOT	SOT = CR	FCFS = CR	FCFS = SOT = CR
Machine 15	FCFS > SOT	SOT = CR	FCFS = CR	--

TABLE II - Continued

ITEM TESTED	FCFS vs. SOT	SOT vs. CR	FCFS vs. CR	SUMMARY
Average Queue Lengths				
Machine 1	FCFS = SOT	SOT = CR	FCFS > CR	--
Machine 2	FCFS > SOT	SOT < CR	FCFS > CR	FCFS > CR > SOT
Machine 3	FCFS > SOT	SOT = CR	FCFS > CR	FCFS > SOT = CR
Machine 4	FCFS > SOT	SOT = CR	FCFS > CR	FCFS > SOT = CR
Machine 5	FCFS > SOT	SOT < CR	FCFS > CR	FCFS > CR > SOT
Machine 6	FCFS > SOT	SOT = CR	FCFS > CR	FCFS > SOT = CR
Machine 7	FCFS > SOT	SOT = CR	FCFS > CR	FCFS > CR = SOT
Machine 8	FCFS > SOT	SOT < CR	FCFS > CR	FCFS > CR > SOT
Machine 9	FCFS > SOT	SOT = CR	FCFS > CR	FCFS > SOT = CR
Machine 10	FCFS > SOT	SOT = CR	FCFS > CR	FCFS > SOT = CR
Machine 11	FCFS > SOT	SOT < CR	FCFS > CR	FCFS > CR > SOT
Machine 12	FCFS > SOT	SOT < CR	FCFS > CR	FCFS > CR > SOT
Machine 13	FCFS > SOT	SOT = CR	FCFS > CR	FCFS > SOT = CR
Machine 14	FCFS < SOT	SOT > CR	FCFS = CR	SOT > FCFS = CR
Machine 15	FCFS > SOT	SOT > CR	FCFS > CR	FCFS > SOT > CR

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APPENDICES

APPENDIX A
Model Input Data

ILLEGIBLE DOCUMENT

**THE FOLLOWING
DOCUMENT(S) IS OF
POOR LEGIBILITY IN
THE ORIGINAL**

**THIS IS THE BEST
COPY AVAILABLE**

**THE FOLLOWING
PAGES ARE BADLY
SPECKLED DUE TO
BEING POOR
QUALITY
PHOTOCOPIES.**

**THIS IS AS
RECEIVED FROM
CUSTOMER.**

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100	3	60	801	100	1529	40	
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418	3	002	IPAR-COST	100			MACHINE DATA
937	4	006	IPAR-COST	100			MACHINE DATA
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2329	1	011	IPAR-COST	100			MACHINE DATA
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285	03167		MACHINE DATA	100			MACHINE DATA
419	07000		MACHINE DATA	100			MACHINE DATA
114	02667		MACHINE DATA	100			MACHINE DATA
267	05333		MACHINE DATA	100			MACHINE DATA
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181			MACHINE DATA	100			MACHINE DATA

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1445	INCST												
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10080	LIMIT												
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20	ORDER												
30.00	ORDER												
05	ALPHA												
HUR BASCOM													
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3	115UE MCH115												
3	116UE MCH116												

4	17MIP INVT	0.0							
4	18MPL TAV	0.0							
5	ILATNESS	4C							1.0
5	21P LATE	24							2000.0
5	301P LATE	11							20.0
5	4NCRML RD	2							0.005
5	5MFD LCIS	30							1.0
5	GP-P LCIS	30							1.0
5	70P7 WAIT	10							1440.
5	80ELAY 1	20							1440.
5	90ELAY 2	20							1440.
5	100ELAY 3	20							1440.
5	110ELAY 4	20							1440.
5	120ELAY 5	20							1440.
5	130ELAY 6	20							1440.
5	140ELAY 7	20							1440.
5	150ELAY 8	20							1440.
5	160ELAY 9	20							1440.
5	170ELAY 10	20							1440.
5	180ELAY 11	20							1440.
5	190ELAY 12	20							1440.
5	200ELAY 13	20							1440.
5	210ELAY 14	20							1440.
5	220ELAY 15	20							1440.
1									
1									
10	1	10080.	7200.						1440.
10	2	11520.	7920.						1800.
10	3	12960.	8640.						2160.
10	4	8640.	5760.						1440.
10	5	5760.	3600.						1080.
10	6	1.	0.94						0.030
1	1	10080.	0.0						15324178563
12	1	10080.	7.						
12	1	10080.0	3.0						
12	1	40321.00	-2.						40320.
12	1	80641.00	-2.						40320.
12	1	120541.00	-2.						40320.
12	1	161281.00	-2.						40320.
12	1	201601.00	-2.						40320.
2880.	HOLD								
300	3401.	MACHINE QUEUE							
848	577.	MACHINE QUEUE							
419	639.	MACHINE QUEUE							
401	3100.	MACHINE QUEUE							
114	2372.	MACHINE QUEUE							
943	1682.	MACHINE QUEUE							
181	1088.	MACHINE QUEUE							
222	1181.	MACHINE QUEUE							
267	1484.	MACHINE QUEUE							
367	1994.	MACHINE QUEUE							
209	47.	MACHINE QUEUE							
146	34.	MACHINE QUEUE							
796	1528.	MACHINE QUEUE							
285	7472.	MACHINE QUEUE							
748	3550.	MACHINE QUEUE							

APPENDIX B
Model Source Listing

```

BLICK DATA
REAL LEOTN
REAL INCST
REAL PCST
PIAL LCYSZ
REAL MCH10,NMK10
INTEGER NPST
EQUIVALENCE (MPL(11),CMPL(11),INUM(11),QUOM(11),
11NRDR(11),QDRDR(11),NNLCT(11),UNLCT(11),UPST(11),QPST(11)
COMMON /UCOM4/ EFFC(15)
COMMON /UCOM5/ IPNC(15)
COMMON /UCOM6/ LRMES(104)
COMMON /UCOM7/ LEVST(8)
COMMON /UCOM8/ LCYST(24)
COMMON /UCOM9/ MCH10(15)
COMMON /UCOM10/ NCST(15)
COMMON /UCOM11/ MPL(200)
COMMON /UCOM12/ MPST(28)
COMMON /UCOM13/ NABLC(135)
COMMON /UCOM14/ NBCM(100)
COMMON /UCOM15/ NML(115)
COMMON /UCOM16/ NMLCT(800)
COMMON /UCOM17/ NNDR(3200)
COMMON /UCOM18/ NMKT(9)
COMMON /UCOM19/ CPST(1225)
COMMON /UCOM20/ QTIME(15)
COMMON /UCOM21/ SAFE(15)
COMMON /UCOM22/ NEIPA(5)
COMMON /UCOM23/ NMACH(6)
COMMON /UCOM24/ NQTE(15)
COMMON /UCOM25/ NSUR(7)
COMMON /UCOM26/ QSUR(7)
COMMON /UCOM27/ RUATP(6)
COMMON /UCOM28/ SETIME(6)
COMMON /UCOM29/ WAITM(400)
COMMON /UCOM30/ QUEUE(15)
COMMON /UCOM31/ UTILZ(15)
DIMENSION CMPL(11),QDRDR(11),UNLCT(11),QPST(11)
DATA NRGCH/100*0/,NPST/225*0/,MPL/200*0/,NNLCT/320*0/
END

```


SUBROUTINE EVENTS (1)
GO TO (101,102,103,104,105,106,107) , 1
101 CALL INVTY
GO TO 500
102 CALL PLSPP
GO TO 500
103 CALL PELL
GO TO 500
104 CALL FINISH
GO TO 500
105 CALL CIPUT
GO TO 500
106 CALL CHECK
GO TO 500
107 CALL STATUS
500 RETURN
END


```

SUBROUTINE GRUMP
  COMMON QSFT(2000)
  DIMENSION NSET(2000)
  EQUIVALENCE (NSET(1),QSET(1))
  CMMCA /GCCMI/ ATR(125),JEVT,NEA,NFE(100),MLE(100),NSTOP,ACKOP,NGCTH
  INAPQ,NNAPT,MATR,NFE(1),NN(100),NNTRY,NPRNT,PPRNT(50,4),TNOM,TIMEGCLM
  2,TICLR,TIEIN,TIR(125),TSET
  CMMCA /GCCM5/ IEVT,IISED(6),JJREG,JJCLR,MNIT,MNOM,MNAME(3),MNCF
  11,MNDAY,MNPT,MNSET,MNPRJ,MNPRM,MNRS,MNRUN,MNSTR,MNTR,SSEF(16)
  ***** GROUP TO BE USED IF SIMULATION IS TO BE RESTARTED
  WRITE(6,3075) (J,SEED(J),J=1,MNSTR)
  3075 FORMAT(1X,'NEW SEED FOR 1STRM',I2,'I=',F10.4)
  3080 FORMAT(1X,I2,I5,F10.0,F10.0,F10.0)
  KXX=1
  N=12
  ANAPQ=ANATR+1
  LINE=NFF(1)
  IXX=0
  103 IXX=IXX+1
  DO 114 I=1,MNATR
    NSISA=I+LINE
  114 TIR(I)=QSET(NSISA)
  WRITE(7,3060) N,KXX,(TTR(I),I=1,MNATR)
  NSISA=ANAPQ+LINE
  LINE=NSET(NSISA)
  IF(LINE) 105,116,113
  105 CALL ERROR(541)
  116 RETURN
  END

```

SUBROUTINE GUMP
C*** DUMMY SUBROUTINE
C*** GUMP TO BE USED IF SIMULATION IS NOT TO BE RESTARTED
1-1
RETURN
END


```

LHM=1
IHM7=-1
C*** ENTER FIRST FIRM HORIZEN BUCKETS INTO FILE OF UNLOTTED DEMANDS
DO 595 J=1,NFIRM
  NORD=MP(SLORDMPS(J))
  IF(NORD.EQ.0) GO TO 595
  DO 595 I=1,NORD
    IHM7=IHM7+2
    KHM2=IHM7
    C*** ENTER PART NUMBER DEMANDED
    NMLT(IHM7)-MPS(LDMFSL(J))*(I-1)*2+1
    IHM7=IHM7+1
    C*** ENTER QUANTITY DEMANDED
    NMLT(IHM7)-MPS(LDMFSL(J))*(I-1)*2+2
    IHM7=IHM7+1
    C*** ENTER DUE DATE OF DEPART
    NMLT(IHM7)-(LJ-1)*LRUM
    TIME=VALG(IHM7)
    C*** SET POINTER TO NEXT DEMAND FOR SAME PART NO. IN SEQUENCE
    CALL SEQNCE
    595 CONTINUE
    KHM8=IHM7-2
    DO 605 J=1,NOPRT
      LOTST(J)=C
      IHM9=0
      DO 600 I=1,KHM8+4
        IF(NMLT(I).NE.J) GO TO 600
        IF(LOTST(J).EQ.0) GO TO 610
        NMLT(IHM9)=1
        IHM9=I+3
        GO TO 600
      610 LOTST(J)=1
      IHM9=I+3
      600 CONTINUE
      IF(IHM9.EQ.0) GO TO 605
      NMLT(IHM9)=0
      605 CONTINUE
      KHM4=NFIRM
      CALL LCT
      RETURN
      END

```

```

SUBROUTINE INITC
  COMMON QSEI(7000)
  DIMENSION NSET(1000)
  11000,110004,11001,1004,MAX,MAXP,NCHCK,NCHM,NCHM4,NCHM4,NEHPL,UCUMH
  2N1RM,NCHM,NOPRT,NUMRK,URDEN,TYPE,SERVL,RPTINV,WIP
  3COPMCA/GCCM1/ATR1B(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,NCRDP,NGCUM
  1NAPC,NNAPT,NNAIR,NANIL,NNO(100),NNTPY,NPRT,PPARM(50,4),TNVU,TTBEGGCM
  2,TCLP,TTER,TTR1B(25),TSET
  3COMMON/GCFA/DTPL(125),MILM(125),MINI(125),IICRD,IITAP(10),JJCELGCM4
  15000,LLABIC(25,2),LLABH(25,2),LLARP(11,2),LLARI(25,2),LLPHI(10),LLGCM4
  21010,LLPLT,LLSUP(125),LLSYH(10),MMPT5,MNCELL(25),MNCLT,MNMLS,MNPLGCM4
  3T,MPT15(10),MNSTA,NVAR(10),PPH(10),PPLU(10)
  4COMMON/GCMM6/EENQ(100),FINNE(100),KRNK(100),HMAXQ(100),QOTIME(100GCM6
  1),SSOBV(25,5),SSTPV(25,6),VYNQ(100)
  2,SIMON5M,QMPL(11),QEM(11),QORR(11),VALUT(11),QPST(11)
  3INTEGER QPST
  4REAL PCHIU,NMKTU
  5REAL LOTSZ
  6REAL PCST
  7REAL TMCST
  8EQUIVALENCE (NSET(11),QSE(11))
  9EQUIVALENCE (MPL(11),CMPL(11)),(INROM(11),QROM(11))
  11NHROR(11),QORR(111),UNLOT(11),UNLOT(11),OPST(11),QPST(11)
  2COMMON/UCOM4/EFFC(11)
  3COMMON/UCPC5/TPHC(11)
  4COMMON/UCOM6/LBMP(11)
  5COMMON/UCOM7/LEVT(11)
  6COMMON/UCOM8/LOTST(11)
  7COMMON/UCOM9/MCHU(11)
  8COMMON/UCOM10/PCST(11)
  9COMMON/UCOM11/MPL(11)
  10COMMON/UCOM12/MPST(11)
  11COMMON/UCOM13/NABLE(11)
  12COMMON/UCOM14/NROM(11)
  13COMMON/UCOM15/AMLT(11)
  14COMMON/UCOM16/NMLT(11)
  15COMMON/UCOM17/NORD(11)
  16COMMON/UCOM18/NKTL(11)
  17COMMON/UCOM19/OPST(11)
  18COMMON/UCOM20/QTIME(11)
  19COMMON/UCOM21/SAFE(11)
  20COMMON/UCOM22/NEIPN(11)
  21COMMON/UCOM23/APACH(11)
  22COMMON/UCOM24/NOIE(11)
  23COMMON/UCOM25/MSUB(11)
  24COMMON/UCOM26/QSUB(11)
  25COMMON/UCOM27/RUNTM(11)
  26COMMON/UCOM28/SETIM(11)
  27COMMON/UCOM29/WAITM(11)
  28COMMON/UCOM30/QUEUE(11)
  29COMMON/UCOM31/UTLZ(11)
  30COMMON/UCOM32/HOLD
  31COMMON/UCOM33/ALPHA
  32COMMON/UCOM34/ALPHA
  33COMMON/UCOM35/ALPHA
  34COMMON/UCOM36/ALPHA
  35COMMON/UCOM37/ALPHA
  36COMMON/UCOM38/ALPHA
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  221COMMON/UCOM221/ALPHA
  222COMMON/UCOM222/ALPHA
  223COMMON/UCOM223/ALPHA
 
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1DRKUM6*8-1)QPL(NPIND*8-2)+QPL(NPIND*8-1)+QURUR(KUM6*8-6-1)
CALL CALCULATE,(KPC*7)
CALL HISTOGRAM
C***
515 CANCEL CPEN ORDER
MURDR(KUM6*8-7)=0
CURDR(KUM6*8-6)=0
QURDR(KUM6*8-5)=0
NURDR(KUM6*8-4)=0
MURDR(KUM6*8-3)=0
NURDR(KUM6*8-2)=0
QURUR(KUM6*8-1)=0
CURUR(KUM6*8)=0
WAITIKUM61=0
MUM5=0
GO TO 520
C*** CHECK FOR MASTER PRODUCTION SCHEDULE DEMAND
500 NPIND=0
645 NPTNC=NPTND*1
IF(NPIND.EQ.NPNT) GO TO 650
MUM5=1
GO TO 520
650 MUM5=C
C*** SET HIGHEST BUCKET TC RE CHECKED FOR DEMAND
520 MURUK-TMUR/LURM*1
530 IF(MS(LBPPS(LUM))=0) GO TO 535
C*** SET LCW TO LOWEST BUCKET WITH UNPET DEMAND
LOW-LUM*1
IF(LOW.GT.MURUK) GO TO 525
GO TO 530
535 L=LUM
540 J=0
545 J=J+1
MUM1=NPTAD*8-1
MUM2=NPTM*8-2
IF(L.GT.MS(LBPPS(LUM))) GO TO 550
MUM3=LAMP(L*J-1)*2*1
IF(MS(MUM3)=0) GO TO 555
IF(MS(MUM3)=NPTM) GO TO 545
GO TO 560
555 K=K+1
IF(MS(LBPPS(LUM))=GT.K) GO TO 545
C*** IF ALL DEMANDS IN THIS BUCKET HAVE BEEN MET, SET DEMANDS TO ZERO
MPS(LBPPS(LUM))=0
550 IF(QPL(MUM1)+QPL(MUM2))=0 GO TO 525
I=I+1
IF(I.GT.ACUBK) GO TO 525
GO TO 540
C*** CHECK TO SEE IF QTY ALLOCATED IS SUFFICIENT TO MEET MPS DEMAND
560 IF(QPL(MUM1)+Q.LUM).GE.MPS(MUM3)) GO TO 565
C*** CHECK IF ALLOCATED HAND SUFFICIENT TO MEET MPS DEMAND
IF(QPL(MUM1)+QPL(MUM2)+Q.LUM).GE.MPS(MUM3)) GO TO 570
C*** IF NOT SUFFICIENT,TRANSFER CN HAND TO ALLOCATED
QPL(MUM1)=QPL(MUM1)+QPL(MUM2)
QPL(MUM2)=0
GO TO 525
C*** REMOVE MPS DEMAND FROM ALLOCATED+ON HAND, LEAVE REMAINDER IN CN
570 QPL(MUM2)=QPL(MUM2)+QPL(MUM1)-MPS(MUM3)+1
QPL(MUM1)=0
IF(QPL(MUM2).GE.0.100) GO TO 575

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```

OMPL(PDUM2)=0.0
GO TO 575
C*** REMOVE MPS DEMAND FROM ALLOCATED
565 OMPL(MIN1)-OMPL(MIN1)-MPS(MCUM3+1)
IF(CMPL(PDUM1).GE.0.100) GO TO 575
OMPL(PDUM1)=0.0
575 IF(MPL(MIN1)-GT.1) GO TO 580
C*** REDUCE RAW MATERIAL INVENTORY BY MPS DEMAND VALUE
MINV=MINV-MPS(MIN1)*CMPL(MIN1)
CALL TIMST(MINV,INCH,INCH+3)
GO TO 585
C*** REDUCE WORK IN PROCESS INVENTORY BY MPS DEMAND VALUE
580 WIP=WIP-MPS(MIN1)*CMPL(MIN1)
CALL TIMST(WIP,INCH,INCH+2)
585 MPS(MIN1)=0
C*** CALCULATE LATENESS IN MEETING MPS DEMAND
WENT=(1-1)*WENT
LAT=INCH-WENT/1440.
LOTSZ=PPS(MIN1)
DATE=DATE+OMPL(MIN1)*LOTSZ
IF(LATE-LE.0) GO TO 590
CALL COLCT(LATE,INCH+2)
CALL COLCT(LATE,INCH+4)
GO TO 595
590 CALL COLCT(LATE,INCH+1)
CALL COLCT(LATE,INCH+3)
LOTSZ=LOTSZ
595 CALL HISTO(LATE,1)
CALL HISTO(LATE,2)
CALL HISTO(LATE,3)
CALL COLCT(LATE,INCH+5)
CALL COLCT(LATE,INCH+6)
GO TO 590
525 IF(MIN1-FQ.1) GO TO 645
IF(LDUM4.NE.1) GO TO 600
LDUM4=C
RETURN
600 IF(OMPL(PDUM2).GT.0.100) GO TO 505
RETURN
C*** CALL SEARCH TO RANK ORDERS WAITING FOR SUBPARTS
505 LDUM1=NONRK+1
665 MINOR(LDUM4+8-4)=1
CALL SEARCH
IF(MAP.NE.0) GO TO 66C
RETURN
660 CONTINUE
LDUM1=C
LDUM2=C
C*** CHECK FOR ADEQUATE SLOPES
605 HPARN=MINOR(MAP+8-7)
MSP=NC(MPL(MAP+8-6))
J=0
610 J=J+1
IF(J.GT.NCSP) GO TO 615
NSUB(J)=NONMPL(MAP+8-6)*(J-1)+2+1
OSUB(J)=QCM(MPL(MAP+8-6)*(J-1)+2+1)*QORD(MAP+8-6)
IF(100*NSUB(J)+8-2)<0.100).GE.OSUB(J)) GO TO 610
GO TO 620
615 LDUM2=1
DELAY=TIME-WAIT(MAP)

```

```

WAITP(PAXP)=0.0
HOLD=ALPHA*DELAY(1,-ALPHA)*HOLD
CALL COLCT(DELAY,(INCRCH+9))
CALL F1STC(DELAY,7)
C**** SUFFICIENT SUPPARTS, RELEASE ORDER
NRDR(PAXP+8-4)=1
NRDR(MAXP+8-3)=0
C**** REMOVE SUPPARTS FROM INVENTORY
ON 625 I=1,NUSP
  QPLNSUB(1)+8-21=QPLNSUB(1)+8-21-QSUB(1)
  IF(QPLNSUB(1)+8-21).GE.-0.100) GO TO 655
  CMLTASUB(1)+8-21=0.0
  655 IF(PLNSUB(1)+8-4).GT.1) GO TO 630
  C**** TRANSFER RAW MATERIALS DEMANDED FROM RAW MAIL TO WORK IN PROCESS INVENTORY
  RMNV=RMNV-QSUB(1)*QPLNSUB(1)+8
  WIP=WIP+QSUB(1)*QPLNSUB(1)+8
  CALL TIMSTIMNV,TACW,(INCRCH+3))
  CALL TIMSTIP,TACW,(INCRCH+2))
  C**** INCREASE ORDER COST BY SUPPART COST
  630 QDRDR(PAXP+8)-QDRDR(PAXP+8)+QSUB(1)*CMLNSUB(1)+8
  625 CONTINUE
  C**** CHECK NEXT HIGHEST PRIORITY ORDER
  620 MAXP=NRDR(MAXP+8-2)
  IF(MAXP.NE.0) GO TO 605
  C**** IF LDR2=1, CALL SEARCH TO ATTEMPT TO START ON NEWLY RELEASED ORDERS
  IF(LDR2=1, CALL SEARCH TO ATTEMPT TO START ON NEWLY RELEASED ORDERS
  CALL SEARCH
  635 RETURN
  END

```



```

SUBROUTINE LENTIM
COMMON /COUN6/ CENCL(100), IENH(100), KRNK(100), MKAQ(100), QOT(14), LUDG(14),
1, SSNPV(25,1), SSPV(25,61), VVNO(100)
COMMON /COUN4/ IDUR4, ICOUN4, IDUM4, IDUM5, IDUM6, IDUM7, IDUM8, IDUM9, IDUM10, IDUM11, IDUM12, IDUM13, IDUM14, IDUM15, IDUM16, IDUM17, IDUM18, IDUM19, IDUM20, IDUM21, IDUM22, IDUM23, IDUM24, IDUM25, IDUM26, IDUM27, IDUM28, IDUM29, IDUM30, IDUM31, IDUM32, IDUM33, IDUM34, IDUM35, IDUM36, IDUM37, IDUM38, IDUM39, IDUM40, IDUM41, IDUM42, IDUM43, IDUM44, IDUM45, IDUM46, IDUM47, IDUM48, IDUM49, IDUM50, IDUM51, IDUM52, IDUM53, IDUM54, IDUM55, IDUM56, IDUM57, IDUM58, IDUM59, IDUM60, IDUM61, IDUM62, IDUM63, IDUM64, IDUM65, IDUM66, IDUM67, IDUM68, IDUM69, IDUM70, IDUM71, IDUM72, IDUM73, IDUM74, IDUM75, IDUM76, IDUM77, IDUM78, IDUM79, IDUM80, IDUM81, IDUM82, IDUM83, IDUM84, IDUM85, IDUM86, IDUM87, IDUM88, IDUM89, IDUM90, IDUM91, IDUM92, IDUM93, IDUM94, IDUM95, IDUM96, IDUM97, IDUM98, IDUM99, IDUM100
COMMON /COUN3/ LCU3, LCU4, LCU5, LCU6, LCU7, LCU8, LCU9, LCU10, LCU11, LCU12, LCU13, LCU14, LCU15, LCU16, LCU17, LCU18, LCU19, LCU20, LCU21, LCU22, LCU23, LCU24, LCU25, LCU26, LCU27, LCU28, LCU29, LCU30, LCU31, LCU32, LCU33, LCU34, LCU35, LCU36, LCU37, LCU38, LCU39, LCU40, LCU41, LCU42, LCU43, LCU44, LCU45, LCU46, LCU47, LCU48, LCU49, LCU50, LCU51, LCU52, LCU53, LCU54, LCU55, LCU56, LCU57, LCU58, LCU59, LCU60, LCU61, LCU62, LCU63, LCU64, LCU65, LCU66, LCU67, LCU68, LCU69, LCU70, LCU71, LCU72, LCU73, LCU74, LCU75, LCU76, LCU77, LCU78, LCU79, LCU80, LCU81, LCU82, LCU83, LCU84, LCU85, LCU86, LCU87, LCU88, LCU89, LCU90, LCU91, LCU92, LCU93, LCU94, LCU95, LCU96, LCU97, LCU98, LCU99, LCU100
COMMON /COUN2/ NUPAT, NUMK, ORDER, TIME, SERVL, RMINV, NIP
COMMON /COUN1/ EFFC(11)
COMMON /COUN0/ MPL(11)
COMMON /COUN-1/ NML(11)
COMMON /COUN-2/ NML(11)
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COMMON /COUN-190/ NML(11)
COMMON /COUN-191/ NML(11)
COMMON /COUN-192/ NML(11)
COMMON /COUN-19
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145 FORMAT(IX,F6.2)
DO 600 I=1,LIMIT
  NORDR(I)=B-71-0
600 CONTINUE
  DO 610 J=1,NIPRT
    LOTST(J)=0
610 CONTINUE
  REAR(5,160) ALPHA
C**** PRINT FILE CHECK
  WRITE(6,1145)
1145 FORMAT(IX,7IX,'MINKER ABILITY MATRIX',7IX,111,'MCH1 MCH2 MCH3 MC
114 MCH5 MCH6 MCH7 MCH8 MCH9 MC10 MC11 MC12 MC13 MC14 MC15')
  WRITE(6,1150) (1,NABLE(I*15-14),NABLE(I*15-13),NABLE(I*15-12),NABL
1E(I*15-11),NABLE(I*15-10),NABLE(I*15-9),NABLE(I*15-8),NABLE(I*15-7
2),NABLE(I*15-6),NABLE(I*15-5),NABLE(I*15-4),NABLE(I*15-3),NABLE(I*
315-2),NABLE(I*15-1),NABLE(I*15),I=1,NMWRK)
1150 FORMAT(IX,T2,'MINKER',19,12,113,11,118,11,123,11,128,11,133,11,138
1,11,4X,11,148,11,153,11,158,11,163,11,168,11,173,11,178,11,183,11)
  WRITE(6,1000)
1000 FORMAT(IX,'MACHINE DATA',7IX,T2,'INTERNAL EXTERNAL UTILIZAT
1ION COST PER QUEUE AT SAFETY STANDARD',7IX,T2,'MACH. NO.
2 MACH. NO. FACTOR MINUTE 100% FACTOR EFFICI
3ENCY')
  WRITE(6,1005) (1,IMNU(I),NMLT(I),MCST(I),QTIME(I),SAFE(I),EFFIC(I)
1,1-1,NMCH)
1005 FORMAT(IX,15,14,115,16,128,16,142,15,4,152,17,2,162,17,2,174,15,2)
  WRITE(6,1020)
1020 FORMAT(IX,7IX,'MASTER PARTS LIST FILE')
  WRITE(6,1025)
1025 FORMAT(IX,T2,'INTERNAL EXTERNAL',T25,'DOM',T34,'OPST',T44,'PART
1 SEQUENCE OM',T73,'NUMBER AVERAGE',7IX,T2,'PART NO. PART
2 NO. POINTER POINTER LEVEL POINTER HAND ALLOCATED
3 COST')
  WRITE(6,1030) (1,MPL(I*8-7),MPL(I*8-6),MPL(I*8-5),MPL(I*8-4),MPL(I
18-3),OMPL(I*8-2),OMPL(I*8-1),OMPL(I*8),I=1,NEMPL)
1030 FORMAT(IX,14,14,113,17,125,16,135,16,145,14,153,16,161,16,169,2,171,19
1,2,183,19,2)
  WRITE(6,1035)
1035 FORMAT(1H1,'BILL OF MATERIAL FILE')
  WRITE(6,1050)
1050 FORMAT(IX,T23,'SUBPART',T43,'SUBPART',T63,'SUBPART',T83,'SUBPART',
1T103,'SUBPART',7IX,T23,'NUMBER QUANTITY NUMBER QUANTITY N
2NUMBER QUANTITY NUMBER QUANTITY NUMBER QUANTITY')
  DO 630 J=1,NEMPL
    WRITE(6,1040) J
1040 FORMAT(IX,7IX,'PART NUMBER',IX,16,'
1-----')
    IF IMPL(J*8-4).NE.11 GO TO 635
  WRITE(6,1045)
1045 FORMAT(IX,'PRIME PART, NO BILL OF MATERIAL')
  GO TO 630
635 JDOM=NOC(EMPL(J-1)*8+21)
  WRITE(6,1055) (NOC(EMPL(J-1)*8+21)+2*I-1),ORGM(MPL(IJ-1)*8+2)+2*I)
1,1-1,JDOM)
1055 FORMAT(IX,20X,513X,16,3X,F8.211)
630 CONTINUE
  WRITE(6,1060)
1060 FORMAT(1H1,'OPERATION SHEET FILE')
  WRITE(6,1070)
1070 FORMAT(IX,T22,'MACHINE SETUP RUN MACHINE SETUP

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1 RUN      MACHINE      SETUP      RUN*,//1X,T22,*REQUIRED      TIME
2 TIME     REQUIRED      TIME     TIME     REQUIRED      TIME     TIME
3,1
    ON 640 J-1,NEMPL
    WRITE(6,1040) J
    IF (NPL(J+8-61,NF.0) GO TO 645
    WRITE(6,1065)
    1065 FORMAT(1X,'PRIME PART, NO OPERATION SHEET')
    GO TO 640
    645 JUMP2=CSTIMPL((J-1)*8133)
    WRITE(6,1075) (OPSTIMPL((J-1)*8133)+1-2),OPSTIMPL((J-1)*8133)+
    13*1-1),OPSTIMPL((J-1)*8133)+1),1-1,JJUM2)
    1075 FORMAT(11X,10X,316X,14,4X,F8.2,4X,F5.21)
    640 CONTINUE
    WRITE(6,1080) NEMPL,NEMPL,NEBEM,16,2X,NEMDS=,16)
    1080 FORMAT(1X,1X,1X,NEMPL=,16,2X,NEMDS=,16)
    1085 FORMAT(1X,1X,1X,MASTER PRODUCTION SCHEDULE//1X)
    1090 FORMAT(1X,1X,1X,BUCKET PART NO. CNTY. PART NO. QNTY. PART NO.
    1 QNTY. PART NO. QNTY. PART NO. QNTY. PART NO. QNTY.)
    1-0
    620 1-14
    IF(1-GT.IJUM2) GO TO 625
    NIRD=MPS(LBMS(1))
    IF (NIRD.EQ.0) GO TO 615
    WRITE(6,1095) I,MPS(LBMS(1)),(J-1)*2+1),MPS(LBMS(1)),(J-1)*2+2),J
    1-1,NORD)
    1095 FORMAT(1X,15,16,11,16,120,16,129,16,138,16,147,16,156,16,1
    174,16,183,16,192,16)
    GO TO 620
    615 WRITE(6,1100) I
    1100 FORMAT(1X,15,14,* NO DEMAND IN THIS BUCKET*)
    GO TO 620
    625 CONTINUE
    WRITE(6,1115) SERVL
    1115 FORMAT(1X,1X,1X,SERVICE LEVEL-MEAN*,F5.2,*STD. DEV.*)
    WRITE(6,1120) INCS1
    1120 FORMAT(1X,1X,1X,INVENTORY COST=,F5.2,*TIMES INVENTORY VALUE*)
    WRITE(6,1125) LBUMK
    1125 FORMAT(1X,1X,1X,BUCKET LENGTH=,16,*MINUTES*)
    WRITE(6,1130) LIMIT
    1130 FORMAT(1X,1X,1X,LIMIT NO. OF OPEN ORDERS =,14)
    WRITE(6,1135) NFIRM
    1135 FORMAT(1X,1X,1X,FIRM HOFITCN=,14,*BUCKETS*)
    WRITE(6,1140) ORDER
    1140 FORMAT(1X,1X,1X,ORDERING COST =,F6.2)
    WRITE(6,1010) ALPHA
    1010 FORMAT(1X,1X,1X,ALPHA=,F5.2)
    CALL GASP
    STOP
    END

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SUBROUTINE LOT
DIMENSION QSET(7000)
FOURVALANCE INSETE(1),QSET(1)
COMMON /UCM1/ IODM1,INIM1,INCST,JJUMS,KIUMZ,KUUM6,LAUKH,
KUUM1,UDUM4,LIMIT,LCM,PAX,MXP,NCHC,NCMCH,NDUM3,NDUM4,NEMPL,
ZUFIRH,NEMCH,NPR1,NURK,CADER,TPE,SFRVL,RMLKV,WIP
CEPMON /UCD3/ NBDCH,NPTNO,LOTS,Z,NOP,ADD,XDUM5
COMMON /UCEN7/ LEVSI(1)
COMMON /UCOM8/ LOTS(1)
CEPMON /UCEM10/ PCST(1)
COMMON /UCOM11/ MPL(1)
CEPMON /UCEM14/ NBEM(1)
CIMMEN /UECM16/ ANLOT(1)
CIMMON /UCEN17/ NURDI(1)
CIMHEN /UCEN19/ OPST(1)
COMMON /UCUN32/ HCLD
DIMENSION QMPL(1),QDMH(1),QQDRP(1),UMLUT(1),QPST(1)
CIMCHN /GCCMI/ ATRID(25),JEVAT,HFA,MFE(100),MLET(100),NSTOP,NCRDR,MCCCH,
INAPD,NMAPT,NMATR,NACIL,ANGL(100),MNTRY,NPRNI,PPARH(50,4),TDNM,TFBFGCOM)
2,TTCLR,TTFIN,TTIRL(25),TTSET
COMMON /GCCG6/ EENQ(100),TIMH(100),MKRNK(100),MMARKQ(100),QQTIM(100GGCOM)
1),SSORV(25,5),SSIPV(25,6),VVNQ(100)
EQUIVALENCE IMPL(1),CMP(1),INBEH(1),QBOM(1),
(INMRDIR(1),QNDRP(1)),(INMLOT(1),UMLOT(1)),(OPST(1),QPST(1))
INTEGER OPST
REAL LOTSZ
REAL MCST
REAL INCGT
REAL LEDTM
LOT LOTS ORDERS, SETS RELEASE DATES, AND EXPLODES DEMANDS
LOT DOES NOT USE AVERAGE SUBPART DELAY IN COMPUTING RELEASE DATE
CALL FRSET(100,256,-1,0,0)
START LOTTING WITH HIGHEST LEVEL PARTS
JJUMS=PAX
C**** SET PART NUMBER TO BE LCITED
500 JJUMS=(LEVST(JJUM6)+7)/8
505 IF (LOTS(JJUM5).EQ.0) GC TO 510
C**** AND FIXER ORDERING COST
515 XDUMZ=CHDER
IF IMPL(JJUMS+0-4).EQ.1 GO TO 520
IMP=OPST(IMPL(JJUMS+0-5))
DO 520 I=1,NOP
XDUMZ=XDUMZ+OPST(IMPL(JJUMS+0-5))*(I-1)*3+2)+MCST(IUPSTIMPL(JJUMS+0-5)
1)+1-1-1)*3+1))
520 CONTINUE
XDUML=LCITST(JJUM5)
QUEDY=UMLST(LOTS(JJUM5)+2)
UNIT=1C00000.
CARRY=0.
LOTS=0.
XDUM5=0.
XDUM6=0.
XDUM7=C
KDUM8=0
KDUM9=0 TC INDICATE FIRST PASS FOR A LOT
525 IF(KDUM9.EQ.0) GO TO 645
ADMT INDICATES THAT A NEGATIVE LOT ALREADY EXISTS
IF(INNUMY.EQ.1) GO TO 670

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C***  LOTSZ IF ZERO INDICATES SECOND PASS FOR A LOT
      IF (LOTSZ.LE.0.001) GE TO 630
C***  CHECK TO SEE IF DUE DATE-LEAD TIME IS LESS THAN OR EQUAL TO THRU
      IF (DUE DT-KDUM5).LT.(TACM) GO TO 530
C***  CHECK TO SEE IF UNIT COST IS STILL DECREASING
      665 IF ((XDM2+CARRY)/(LOTSZ+UNLOT(KDUM1+1)))-OF.UNIT) GO TO 530
C***  INCREASE LOTSZ, AVE CARRYING CCST, SET NEW LOT LEAD TIME, AND UNIT COST
      650 LOTSZ=LOTSZ+UNLOT(KDUM1+1)
          XDM2=XDM2+CARRY
          560 LEDIN=XDUM5
          UNIT=XDM2/LOTSZ
          GO TO 615
C***  DIES AND MAKE THE RELEASE DATE EARLIER THAN THRU+BUKM
      630 IF (DUE DT-KDUM5).LT.(THRU+BUKM)) GO TO 635
          GO TO 650
C***  IS ADR'S RELEASE DATE GREATER THAN OR EQUAL TO THRU+BUKM
      670 IF (UNLOT(KDUM1+2)-XDM5).GT.(THRU+BUKM)) GO TO 625
C***  IS THIS THE FIRST DEPEND IN A NEGATIVE LOT?
      IF (XDM6.LE.0.001) GO TO 635
C***  INCREASE SIZE OF NEGATIVE LOT
          XDM6=XDM6+UNLOT(KDUM1+1)
          LOTSZ=0.
          GO TO 615
      635 NDUM7=1
C***  SET SIZE OF NEGATIVE LOT TO THAT OF FIRST DEMAND
          XDM6=UNLOT(LOTSZ+JDM5+1)
C***  IS THIS THE LAST UNLOTTED DEMAND FOR THIS PART NUMBER?
      IF (UNLOT(KDUM1+3)-EQ.0) GO TO 535
          KDUM1=UNLOT(KDUM1+3)
          LOTSZ=0.
          GO TO 645
C***  RELEASE NEGATIVE LOT
      625 NDUM7=0
          LOTSZ=XDM6
          ATR1811=THRU
          GO TO 570
C***  IS THIS THE LAST UNLOTTED DEMAND FOR THIS PART NUMBER?
      615 IF (UNLOT(KDUM1+3)-EQ.0) GO TO 535
C***  IS THIS THE FIRST PASS?
      605 IF (KDUM8.EQ.0) GO TO 645
          KDUM1=UNLOT(KDUM1+3)
C***  CALCULATE INCREMENTAL CARRYING CCST FOR ADDING ANOTHER DEMAND TO THE LOT
          CARRY=((UNLOT(KDUM1+2)-DUE DT)/525600.1)*INCS+QPL(JDUM5+8)*UNLOT(KDUM1+1)
      645 IF (MPL(JDUM5+8)-4).EQ.1) GO TO 550
C***  CALCULATE MANUFACTURED PART LEAD TIME
          LEDIN=XDUM5
          XDUM5=C.
          NDP=OPST(MPL(JDUM5+8-5))
          NPTND=XDUM5
          ACD=UNLOT(KDUM1+1)
          AM9CO=1
          CALL LEDTIM
          ATR18(2)=1.
          GO TO 580
      550 K=MPL(JDUM5+8-5)
C***  CALCULATE PURCHASED-PARTS LEAD TIME
          XMEAN=PPARM(K,1)
          SIGMA=PPARM(K,4)
          LEDIN=XPEAN+SERVL+SIGMA

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ATRI0121-2.
XJUMS-LEDIN
580 KJUM8-1
GO TO 525
C**** RELEASE POSITIVE LCT
655 LENTM-XJUMS
530 ATRIR11-EUENT-LEDIN
C**** SET ORDER NUMBER FOR LOT JUST RELEASED
570 KJUM6=C
565 KJUM6-KJUM6+1
IF(KJUM6-GLIMIT) CALL ERROR(3)
IF(NORR(KJUM6*B-7),NE.0) GO TO 565
ATRI(3)-KJUM6
CALL FILEM(1)
C**** PUT ORDER IN OPEN ORDER FILE
NORR(KJUM6*B-7)-JUMPS
QORR(KJUM6*B-6)-LOT52
QORR(KJUM6*B-5)-DUET
NORR(KJUM6*B-4)-0
NORR(KJUM6*B-3)-NORR+1
NORR(KJUM6*B-2)-0
QORR(KJUM6*B-1)-0.0
CORR(KJUM6*B)-0.0
GO TO 575
535 IF(NJUM),NE.1) GO TO 660
GO TO 625
680 IF(PL(JJUMS*B-3),NE.0) GO TO 545
GO TO 540
510 IF(PL(JJUMS-1)*B-5),EQ.0) GO TO 540
C**** SET NEXT PART NUMBER OF SAME LEVEL TO BE LOTTED
545 JJUMS=(PL(JJUMS*B-3)+7)/8
GO TO 505
C**** REDUCE LEVEL BEING LCTED
540 JUM4-JUM4-1
IF(JUM4,NE.0) GO TO 500
RETURN
C**** REMOVE LCTED DEMANDS FROM FILE OF UNLOTTED DEMANDS
575 XJUM3-LOT52
660 KJUM1-LCT(JJUMS)
IF(UNLCT(KJUM1),LE.0.001) CALL ERROR(4)
LOT52-LOT52-UNLCT(KJUM1)+1
SET NEW LOTTING START POINT
LOT52(JJUMS)-UNLCT(KJUM1)+3
UNLCT(KJUM1)-0
UNLCT(KJUM1+1)-0.0
UNLCT(KJUM1+2)-0.0
UNLCT(KJUM1+3)-0
IF(LOT52-1,LE.0.001) GC TC 675
IF(LOT52(JJUMS),EQ.0) CALL ERROR(5)
GO TO 660
675 IF(PL(JJUMS*B-4),EQ.1) GO TO 505
C**** EXPLODE SUBPART DEMANDS FOR LOT JUST CREATED
NOSP-NORR(PL(JJUMS*B-6))
DO 585 1-1,NOSP
KJUM2-1
555 IF(UNLCT(KJUM2),EQ.0) GC TO 590
KJUM2-KJUM2+4
GO TO 595
590 UNLCT(KJUM2)-NORR(PL(JJUMS*B-6))+(1-1)*2+1
UNLCT(KJUM2+1)-NORR(PL(JJUMS*B-6))+(1-1)*2+2)

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```
UNL(11KUN212)*ATRI(11)
C**** SET SEQUENCE PRINTERS IN FILE OF UNLCITED DEMANDS
TIME-ATRI(11)
CALL SEQNC
585 CONTINUE
GO TO 505
END
```

```

SUBORDINATE LOT
COMMON QSET(20000)
EQUIVALENCE INSET(1),QSET(1)
COMMON /UCOM1/ J0UM3,J0UM5,INCST,J0UP5,K0UM2,K0UM5,L0UKM,
110UP1,110UP4,11MIT,11UM,PAX,MAXP,ACIEK,NCMCH,HDUM,3,INDUM4,4,MEPPL,
2NF1B,MUMCH,NIPRT,ADNRK,CDEB,TYPE,SEVL,RMINV,MIP
COMMON /UCOM2/ NRACD,NPTND,LOTSZ,NUP,ADD,K0UM5
COMMON /UCOM7/ LEVST(1)
COMMON /UCOM8/ LOTS(1)
COMMON /UCOM10/ MCST(1)
COMMON /UCOM11/ PPL(1)
COMMON /UCOM14/ NRCH(1)
COMMON /UCOM16/ NKLOT(1)
COMMON /UCOM17/ NORPR(1)
COMMON /UCOM19/ OPST(1)
COMMON /UCOM32/ HELD
COMMON /GCOM1/ ATR1B25,JEVNT,MFA,MFEI100,MLET100,MSTDP,NCKDR,NGCOM1
2,ATCLR,TTFIN,TTRIR(25),JTSET
COMMON /GCOM6/ EEWQ(100),FINQ(100),KRNK(100),MNAHQ(100),QOTIM(100GCOM6
1),SSOBV25,51,SETPV25,61,VVHQ(100)
EQUIVALENCE IMPL(1),CHPL(1),INBOH(1),QBOM(1),
1,INDORD(1),QORDR(1),INMLD(1),UNLOT(1),LOPST(1),QPST(1)
INTEGER OPST
REAL LOTSZ
REAL MCST
REAL INCGT
REAL LEDTM
LOT LETS ORDERS, SETS RELEASE CATES, AND EXPLODES DEMANDS
LOT USES AVERAGE SUPRAT DELAY IN COMPUTING RELEASE DATE
CALL ERSET(208,256,-1,0,0)
START LOTTING WITH HIGHEST LEVEL PARTS
J0UM5-PAX
C**** SET PART NUMBER TO BE LCITED
500 J0UM5-(LEVST(J0UM4),7)/8
505 IF(LEST(J0UM5)-EQ,0) GC TO 510
C**** ADD FIXED ORDERING COST
515 J0UM2-CRDER
IF(OPST(J0UM5+8-4),EQ,1) GO TO 920
NUP-OPST(IMPL(J0UM5+8-5))
ADD OPERATION SETUP COSTS
DO 520 I=1,MWP
J0UM2=J0UM2+QPST(IMPL(J0UM5+8-5)*(I-1)+3) *MCST(OPST(IMPL(J0UM5+8-5
1)I-1)+3+1))
520 CONTINUE
J0UM1-LOST(J0UM5)
RUENT-UNLOT(J0UM5)+2)
UNIT=1C0BC00.
CARRY=0.
LOTSZ=0.
X0UM5=0.
X0UM6=0.
X0UM7=C.
X0UM8=0
X0UM9=0 TC INDICATE FIRST PASS FOR A LOT
C****
525 IF(K0UM8-EQ,0) GO TO 445
MINTP INDICATES THAT A NEGATIVE LOT ALREADY EXISTS
C**** IF(MINTP-EQ,1) GO TO 670

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C*** LOTSZ OF ZERO INITIATES SECOND PASS FOR A LOT
IF(LOTSZ.LE.0.001) GO TO 630
C*** CHECK TO SEE IF DUE DATE-LEAD TIME IS LESS THAN OR EQUAL TO INHIV
IF(DDEDI-XDUM5)-LT.TKCM) GO TO 530
C*** CHECK TO SEE IF UNIT COST IS STILL INCREASING
IF((XDUM2+CARRY)/LOTSZ<UNLOT(KDUM1+1)).GE.UNIT) GO TO 530
C*** INCREASE LOTSZ, AND CARRYING COST, SET NEW LOT LEAD TIME, AND UNIT COST
650 LOTSZ=LOTSZ+UNLOT(KDUM1+1)
XDUM2=XDUM2+CARRY
540 LEADI=XDUM5
UNIT=XDUM2/LOTSZ
GO TO 615
C*** DUES AND MAKE THE RELEASE DATE EARLIER THAN INHIV*LBUMK
630 IF((DUEINT-XDUM5)-LT.(INHIV*LBUMK)) GO TO 635
GO TO 650
C*** IS ADMS RELEASE DATE GREATER THAN OR EQUAL TO INHIV*LBUMK
670 IF((UNLOT(KDUM1+2)-XDUM5)-GT.(INHIV*LBUMK)) GO TO 625
C*** IS THIS THE FIRST DEMAND IN A NEGATIVE LOT?
IF(XDUM6-LE.0.001) GO TO 635
C*** INCREASE SIZE OF NEGATIVE LOT
XDUM6=XDUM6+UNLOT(KDUM1+1)
LOTSZ=0.
GO TO 615
635 NDUM7=1
C*** SET SIZE OF NEGATIVE LOT TO THAT OF FIRST DEMAND
XDUM6=UNLOT(LOTSZ(JDUM5)+1)
C*** IS THIS THE LAST UNLITTED DEMAND FOR THIS PART NUMBER?
IF(UNLOT(KDUM1+3).EQ.0) GO TO 535
KDUM1=UNLOT(KDUM1+3)
LOTSZ=0.
GO TO 645
C*** RELEASE NEGATIVE LOT
625 NDUM7=0
LOTSZ=XDUM6
ATRIB13=INHIV
GO TO 570
C*** IS THIS THE LAST UNLITTED DEMAND FOR THIS PART NUMBER?
615 IF(UNLOT(KDUM1+3).EQ.0) GO TO 535
C*** IS THIS THE FIRST PASS?
605 IF(XDUM6-ED.0) GO TO 645
KDUM1=UNLOT(KDUM1+3)
C*** CALCULATE INCREMENTAL CARRYING COST FOR ADDING ANOTHER DEMAND TO THE LOT
CARRY=((UNLOT(KDUM1+2)-DUEOT1)/525600.)*INCS*OMPL(JDUM5+6)*UNLOT(KDUM1+1)
645 IF(MPL(JDUM5+6)-4).EQ.1) GO TO 550
C*** CALCULATE MANUFACTURED PART LEAD TIME
LEDT=XDUM5
XDUM5=0.
NDP=OPST(MPL(JDUM5+6)-5)
NDINO=XDUM5
ADD=UNLOT(KDUM1+1)
AMBCO=1
CALL LEDTIM
XDUM5=XDUM5+NDINO
ATRIB13=1.
GO TO 580
550 F=MPL(JDUM5+6)-5)
C*** CALCULATE PURCHASED-PARTS LEAD TIME
XMEAN=PPARMK.1)
SIGMA=PPARMK.4)

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LEDIM=XMEAN+SERVL+SIGMA
ATR1(2)=2.
XJUMS=LEDIM
500 KJUM8=1
    GO TO 525
C*** RELEASE POSITIVE LOT
655 LEDIM=XJUMS
530 ATR1(1)=RNDYD-LEDIM
C*** SET ORDER NUMBER FOR LOT JUST RELEASED
570 KJUM6=0
565 KJUM6=KJUM6+1
    IF (KJUM6-GE.LIMIT) CALL ERROR(3)
    IF (NINOT(KJUM6+8-7).NE.0) GO TO 565
    ATR1(3)=KJUM6
    CALL FILE(1)
C*** PUT ORDER IN OPEN ORDER FILE
NINOT(KJUM6+8-7)=JUMS
CINOT(KJUM6+8-6)=LOTSZ
QINOT(KJUM6+8-5)=QUDET
NINOT(KJUM6+8-4)=0
NINOT(KJUM6+8-3)=ACWRK+1
NINOT(KJUM6+8-2)=0
CINOT(KJUM6+8-1)=0.0
QINOT(KJUM6+8)=0.0
    GO TO 575
535 IF (KJUM7.NE.1) GO TO 600
    GO TO 525
600 IF (MPL(JJUMS+8-3).NE.0) GO TO 545
    GO TO 540
510 IF (MPL(JJUMS-11+8+5).EQ.0) GO TO 540
C*** SET NEXT PART NUMBER OF SAME LEVEL TO BE LOTTED
545 JUMS=(MPL(JJUMS+8-3)+7)/8
    GO TO 505
C*** REDUCE LEVEL BEING LOTTEC
540 JUMS=JUMS-1
    IF (JUMS.NE.0) GO TO 500
    RETURN
C*** REMOVE LOTTED DEMANDS FROM FILE OF UNLOTTED DEMANDS
575 XJUM3=LOTSZ
660 KJUM1=LOTST(JJUMS)
    IF (UNLOT(KJUM1+1).LE.0.001) CALL ERROR(4)
    LOTST=LOTST-UNLOT(KJUM1+1)
C*** SET NEW LOTTING START PCINT
    LOTST(JJUMS)=NNLOT(KJUM1+3)
    NNLOT(KJUM1)=0
    UNLOT(KJUM1+1)=0.0
    UNLOT(KJUM1+2)=0.0
    NNLOT(KJUM1+3)=0
    IF (LOTST.LT.0.001) GO TO 675
    IF (LOTST(JJUMS).EQ.0) CALL ERROR(5)
    GO TO 660
675 IF (MPL(JJUMS+8-4).EQ.1) GO TO 505
C*** EXPLODE SUPPORT DEMANDS FOR LCT JUST CREATED
NINOT(KJUM1)=MPL(JJUMS+8-6)
    DO 505 I=1,NOSP
        KJUM2=1
595 IF (NNLOT(KJUM2).EQ.0) GO TO 590
        KJUM2=KJUM2+4
        GO TO 545
590 NNLOT(KJUM2)=NINOT(MPL(JJUMS+8-6))+1-11+2+1

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UNLIT(KDUM2+1)=XDU3*QRC/MPL(JOUMS+8-6)*(1-1)*2+2)
UNLIT(KDUM2+2)=ATRIB(1)
C***) SET SEQUENCE POINTERS IN FILE OF UNLOTTED DEMANDS
TIME=ATRIB(1)
CALL SECNCE
505 CONTINUE
GO TO 505
END

[illegible]

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110 FORMAT(1X,16,1X,F6.2)
IF (INPPL.EQ.0) GO TO 510
NCHK=NPARN
CALL SERMPL
GO TO 515
510 NNUM3=1
NEMPL=NEMPL+1
515 MPL(NDUM3)=NPARK
NEMM=NEMM+1
NBM(NEMM)=NOSP
MPL(NDUM3+1)=NEMM
DO 500 J=1,NOSP
NCHK=NSUB(J)
CALL SERMPL
MPL(NDUM3)=NSUB(J)
NEMM=NEMM+1
NBM(NEMM)=(NDUM3+1)/8
NEMM=NEMM+1
QROM=NEMM+1
500 CONTINUE
GO TO 502
503 CONTINUE
C*** SET PRIME PARTS, PARTS W/O NBCH POINTERS, TO LEVEL ONE
NDUM2=(NEMPL-1)*8+2
NDUM4=0
DO 520 I=2,NDUM2,8
IF (PPL(I).NE.0) GO TO 520
MPL(I+2)=1
NDUM4=NDUM4+1
520 CONTINUE
C*** ENTER OPERATION SHEETS, CONVERT TO INTERNAL MACH. NOS., SET OPST POINTER
NDUM5=NDUM4+1
NEMM=0
DO 525 N=1,NDUM5
READ(5,115) NPTMC,NOP
115 FORMAT(1X,16,1X,12)
READ(5,120) (NMACH(I),SETIM(I),RUNT(I),I=1,NOP)
120 FORMAT(1X,14,1X,F6.2,1X,F4.2)
NEOPS=NEOPS+1
OPST(NEOPS)=NOP
NCHK=NPTMC
CALL SERMPL
MPL(NDUM5+2)=NEOPS
DO 525 I=1,NOP
NEMM=NEMM+1
CALL SERMCH
530 NEOPS=NEOPS+1
OPST(NEOPS)=NDUM4
NEOPS=NEOPS+1
OPST(NEOPS)=SETIM(I)
NEOPS=NEOPS+1
OPST(NEOPS)=RUNT(I)
525 CONTINUE
C*** ASSIGN REMAINING PARTS TO CORRECT LEVEL
NDUM9=NEMPL-8-4
NDUM8=0
DO 540 I=4,NDUM9,8
IF (PPL(I).NE.0) GO TO 540
MACH=0

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MINIM7=C
MINIM1=NDOPIMPL(I-2)
J=0
550 J=J+1
IF(IJ.GT.NDUM1) GO TO 555
NDUM6=MPL((NONCH(I-2)+J-2-1)-1)*N44)
IF(NDUM6.EQ.0) GO TO 540
IF(NDUM6.LE.MAX) GC IC 550
MAX=NDUM6
545 GO TO 550
555 MPL(I)=MAX+1
NDUM8=NDUM8+1
540 CENTALE
IF(NDUM6.LY.NDUM5) GC IC 535
MAX=MAX+1
C*** READ WORKER ABILITY MATRIX
READ(5,100) NDWRK
DO 555 I=1,NDWRK
  READ(5,150) INABLE((I-1)*NONCH+J),J=1,NENCH1
555 CONTINUE
150 FORMAT(40IX,11)
C*** SET LEVEL SEQUENCE PCINTERS IN MPL
DO 560 L=1,MAX
  IDUM6=0
  IDUM8=NDOPIMPL*8-4
  DO 565 J=4, IDUM8,8
    IF(MPL(IJ).NE.L1) GC IC 565
    IF(IDUM6.NE.0) GO TO 570
    LCVST(L)=J-3
    IDUM6=J+1
  570 MPL(IIDUM6)=J-3
  IDUM6=J+1
  565 CONTINUE
  MPL(IIDUM6)=0
560 CONTINUE
  READ MASTER PRODUCTION SCHEDULE
  IDUM1=0
  IDUM2=0
585 READ(5,105) NOBOK,NORD
  IF(NOBOK.EQ.0) GO TO 575
  IF(NORD.EQ.0) GO TO 581
  READ(5,125) (NEIPM(I),NOTE1(I),I=1,NORD)
  125 FORMAT(5IX,16,1X,16)
  IDUM1=IDUM1+1
  IDUM2=IDUM2+1
  LAMP5(NOBOK)=IDUM1
  MP5(IDUM1)=NORD
  DO 580 J=1,NORD
    MCHEN=NEIPM(J)
    CALL SERMPL
    IDUM1=IDUM1+1
    MP5(IDUM1)=(IDUM3+7)/8
    IDUM1=IDUM1+1
    MP5(IDUM1)=NOTE1(J)
  580 CONTINUE
  GO TO 585
581 IDUM1=IDUM1+1
  IDUM2=IDUM2+1
  LAMP5(INGRUK1)=IDUM1
  MP5(IDUM1)=NORD

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GO TO 585
575 CONTINUE
C READ IPAR AND COST DATA FOR PRIME PARTS
DO 590 J=1,NDUM%
  READ(5,155) NPTRG,IPAR,NCUM1
  155 FORMAT(1X,16,1X,13,1X,1X,F6.2)
  NTRK=NPTRG
  CALL SERMPL
  IF (IPTRNDUM%+1).NE.0) CALL ERROR(1)
  MPL(NDUM%+2)=IPAR
  CMPL(NDUM%+7)=XNDUM1
590 CONTINUE
REAL MCST
REAL LEPTM
C READ MACHINE LEAD TIME STATISTICS
DO 650 I=1,NMCH
  READ(5,100) NMCH
  CALL SERMCH
  READ(5,130) (NMPL(I,NDUM%),MCST(I,NDUM%),OTIME(I,NDUM%),SAFE(I,NDUM%),EFFI
    1C(I,NDUM%))
  130 FORMAT(1X,16,1X,F5.4,1X,F7.2,1X,F7.2,1X,F5.2)
650 CONTINUE
C**** ESTIMATE MANUFACTURED PARTS COST FROM STANDARDS
J=1
J=J+1
665 K=LEVST(I)
680 NPNT=MPL(K+1)
  NOSP=ADOP(NPNT)
  DO 670 I=1,NOSP
    NPPT=NPNT*(I-1)+2+1
    QMPL(K+7)=QMPL(K+7)+CMPL(NMCH,NPPT)*B)*QROM(NPPT+1)
  670 CONTINUE
    NOSP=MPL(K+2)
    NOP=OPST(NOSP)
    DO 675 I=1,NOP
      NMPT=NCST*(I-1)+3+1
      MACH=OPST(NMPT)
      QMPL(K+7)=QMPL(K+7)+QPST(NMPT+2)*MCST(MACH)
    675 CONTINUE
      K=MPL(K+4)
      IF (K.NE.0) GO TO 680
    J=J+1
    IF (J.LE.MAX) GO TO 665
  C READ MATERIAL REQUIREMENTS PLANNING & COST PARAMETERS
  READ(5,140) SERV
  140 FORMAT(1X,F5.3)
    READ(5,140) INCS
    READ(5,105) LBUM
    READ(5,100) LIMIT
    READ(5,100) NTRM
    READ(5,145) ORDER
  145 FORMAT(1X,F6.2)
    IN 60C 1=1,LIMIT
    NORD(1+B-7)=0
  600 CONTINUE
    DO 610 I=1,NPRT
      LCST(I)=0
    610 CONTINUE
  C**** PRINT FILE ECHO CHECK

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645 JUMP2=OPST(MPL(IJ-1,J-1))
WRITE(6,1075) (OPST(MPL(IJ-1,J-1)),3*1-2),OPST(MPL(IJ-1,J-1))
13*1-1,OPST(MPL(IJ-1,J-1))
1075 FORMAT(11,10X,3(6X,14,4X,F8.2,4X,F5.2))
640 CONTINUE
WRITE(6,1080) NEPL,NECP,NECP5
1080 FORMAT(1X,7(1X,'NEPL-',16,2X,'NECP-',16,2X,'NECP5-',16)
WRITE(6,1085)
1085 WRITE(6,1085) MASTER PRODUCTION SCHEDULE//1X)
WRITE(6,1090)
1090 FORMAT(1X,13,'BUCKET PART NO. CATY. PART MI. QNTY. PART NO.
1 QNTY. PART NO. CATY. PART NO. QNTY. PART NO. QNTY.')
1-0
620 1-1:1
IF(1-GT.INUM2) GO TO 625
NMD=PPSILMPS(1)
IF(INOPD.EQ.0) GO TO 615
WRITE(6,1055) 1,(PPSILMPS(1)+(J-1)*2+1),MPS(LHMPST(1)+(J-1)*2+1),J
1-1,NORD)
1095 FORMAT(1X,15,14,11,16,120,16,129,16,138,16,147,16,156,16,165,16,1
174,16,183,16,192,16)
GO TO 620
615 WRITE(6,1100) 1
1100 FORMAT(1X,15,14,' NO DEMAND IN THIS BUCKET')
GO TO 620
625 CONTINUE
WRITE(6,1115) SERV
1115 FORMAT(1X,7(1X,'SERVICE LEVEL-MEAN',F5.2,'STD. DEV.',)
WRITE(6,1120) INCS
1120 FORMAT(1X,'YEARLY INVENTORY COST-',F5.2,'TIMES INVENTORY VALUE')
WRITE(6,1125) LBOKN
1125 FORMAT(1X,'BUCKET LENGTH-',16,'MINUTES')
WRITE(6,1130) LIMIT
1130 FORMAT(1X,'MAXIMUM NO. OF OPEN ORDERS ',14)
WRITE(6,1135) NFIRM
1135 FORMAT(1X,'FIRM HORIZON-',14,'BUCKETS')
WRITE(6,1140) ORDER
1140 FORMAT(1X,'FIXED ORDERING COST ',F6.2)
WRITE(6,1010) ALPHA
1010 FORMAT(1X,'ALPHA-',F5.2)
CALL GASP
STOP
END

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CFMHCN /GGCM1/ ATIN(25),JEVNT,MEA,NFF(100),MLE(100),MSTOP,NCORR,MCC(M1
INAPQ,NNAPT,MIAIR,NMF IL,NNQ(100),NNTRY,NPRINT,PPARM(50,4),TNDW,TTBEGGCCM1
2,TTLF,TTFIN,TIR(25),YTSET
C**** MAIN TO BE USED FOR STARTING AT TTBEGO.O
NCORR=5
NPRINT=6
CALL GASP
STOP
END
```

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SUBROUTINE INPUT
  COMMON CSET(2000)
  DIMENSION NSFT(2000)
  EQUIVALENCE (INSET(1),OSET(1))
  CCMCA /GCCM1/ ATRIM25,JEVNT,MFA,MFF(100),MLE(100),MSTUP,MCDUR,MCCDM
  IHAPG,MNAPT,MNATR,MNFTL,MNO(100),KNTRY,NPRNT,PPARH(50,4),TNDM,TTBEGGDM
  2,TTCLP,TTFIN,TTIR(125),TTSET
  COMMON ZUCOM1/IDUP3,IDUP4,IDUM5,INCST,JDUM5,KDUM5,LBUM5,UCOM1
  ILOUM1,LDUM5,LIMIT,LON,MAR,MAXP,NCHEK,MCH,NOUN3,MUM5,MEMPL,UCOM1
  ZNTRP,ACPCN,NOPRT,NORR,ORDER,TIME,SERV,RAINV,WIP
  COMMON ZUCM4/ EFFIC1
  COMMON ZUCM5/ INNO1
  COMMON ZUCM6/ LWP51
  COMMON ZUCM7/ LEVST1
  COMMON ZUCM8/ LOIST1
  COMMON ZUCM9/ MCHU1
  COMMON ZUCM10/ MCS1
  COMMON ZUCM11/ MPL1
  COMMON ZUCM12/ MPS1
  COMMON ZUCM13/ NABLE1
  COMMON ZUCM14/ NCM1
  COMMON ZUCM15/ NML1
  COMMON ZUCM16/ NMLT1
  COMMON ZUCM17/ NORR1
  COMMON ZUCM18/ NMLT1
  COMMON ZUCM19/ OPST1
  COMMON ZUCM20/ QTIME1
  COMMON ZUCM21/ SAFE1
  COMMON ZUCM22/ REPA1
  COMMON ZUCM23/ RMACH1
  COMMON ZUCM24/ NQTE1
  COMMON ZUCM25/ NSUB1
  COMMON ZUCM26/ QSUB1
  COMMON ZUCM27/ RUNT1
  COMMON ZUCM28/ SETIP1
  COMMON ZUCM29/ WAITM1
  COMMON ZUCM30/ QUEUE1
  COMMON ZUCM31/ UTILZ1
  COMMON ZUCM32/ HOLD
  DIMENSION OMPL(1),QBCK(1),QORD(1),UNLOT(1),OPST(1)
  EQUIVALENCE (MPL(1),OMPL(1)),(MCH(1),QBCK(1))
  IINORR(1),CORR(1),INLCT(1),UNLOT(1),OPST(1),OPST(1)
  REAL MCHU,MNKTU
  WRITE(6,2045)
2045 FORMAT(IX,'FILE OF UNLCITED DEMANDS',/IX,IS,'PART NUMBER',I25,'QU
  ANTITY',I45,'DUE DATE',I65,'POINTER TO',/IX,I65,'NEXT DEMAND')
  WRITE(6,2050) (UNLOT(1),UNLOT(1+2),UNLOT(1+3),I-1,200,4
  )
2050 FORMAT(IX,I5,I7,I25,F9.2,I45,F12.2,I65,I4)
2055 FORMAT(IX,'OPEN ORDER FILE',/IX,I3,'ORDER',I14,'PART
  1 ORDER CURRENT WORKER PRIORITY ORDER COST',/IX,I3,
  2 NUMBER NUMBER QUANTITY DUE DATE OPERATION IN USE POINTE
  3R PRIORITY COST WAIT)
  WRITE(6,2060) (I1,NORR(1+8-1),QORD(1+8-6),QORD(1+8-5),MCHU(1+8-
  14),NORR(1+8-3),NORR(1+8-2),QORD(1+8-1),QORD(1+8-1),I-1,
  2 LIMIT)
2060 FORMAT(IX,I3,I3,I12,I7,I20,F9.2,I30,F10.2,I44,I2,I54,I3,I64,I3,I71
  1,F9.5,I81,F11.2,I43,F9.0)
  WRITE(6,1020)

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1020 FORMAT(IX, //IX, 'MASTER PARTS LIST FILE')
WRITE(6, 1025)
1025 FORMAT(IX, T2, 'INTERNAL EXTERNAL', T25, 'BUN', T35, 'OPST', T44, 'PART
1 SEQUENCE ON', T73, 'NUMBER AVERAGE', //IX, T2, 'PART NO. PART
2 NO. PCINTER PCINTER LEVEL POINTER HAND ALLOCATED
3 COST')
WRITE(6, 1030) (I, MPL(I*5-T), MPL(I*5-6), MPL(I*5-5), MPL(I*5-4), MPL(I
1*5-3), CMPL(I*5-2), CMPL(I*5-1), CMPL(I*5), I=1, NEMPL)
1030 FORMAT(IX, T4, T5, T13, T17, T25, T6, T35, T6, T45, T53, T6, T61, T9, T2, T71, T9
1, 2, T83, T9, 2)
WRITE(6, 1000) (I, PCHUI(I), I=1, NCPCHI)
1000 FORMAT(IX, 'MACHINE NO.', T2, 'STATE', T3, 1)
WRITE(6, 1005) (I, WKKUI(I), I=1, NKKKI)
1005 FORMAT(IX, 'WORKER NO.', T2, 'STATE', T3, 1)
WRITE(6, 1010) TINI
1010 FORMAT(IX, //IX, 'CURRENT TIME', T2, T12, 2)
WRITE(6, 1035) HOLD
1035 FORMAT(IX, //IX, 'AVERAGE WAITING TIME ON SUBPARTS', T10, 0)
WRITE(6, 1040)
1040 FORMAT(IX, //IX, 'MACHINE QUEUE')
WRITE(6, 1045) (I, QUEUE(I), I=1, NQNGH)
1045 FORMAT(IX, T6, T12, T10, T10, 0)
IDIM2=97
WRITE(6, 1095)
1095 FORMAT(IX, 'MASTER PRODUCTION SCHEDULE', //IX)
WRITE(6, 1090)
1090 FORMAT(IX, T3, 'BUCKET PART NO. CNTY. PART NO. QNTY. PART NO.
1 QNTY. PART NO. QNTY. PART NO. QNTY. PART NO. CNTY.')
I=0
620 I=I+1
IF (I-61-ICUM2) GO TO 625
NORD=MPS(LBMP5(I))
IF (NORD-50.0) GO TO 615
WRITE(6, 1095) (I, J=1, 2, 3), MPS(LBMP5(I)), (J-1)*2+2), J
I=I+NCRD)
1095 FORMAT(IX, T5, T4, T11, T6, T20, T6, T25, T6, T38, T6, T47, T6, T56, T6, T65, T6, T
17, T6, T83, T6, T92, T6)
GO TO 620
615 WRITE(6, 1100) I
1100 FORMAT(IX, T5, T4, 'ALL DEMAND IN THIS BUCKET HAS BEEN MET')
GO TO 620
625 CONTINUE
RETURN
500 CALL UDUMP
CALL GRUMP
RETURN
END

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```

SUBROUTINE RI SPP
COMMON CSFT(2000)
DIMENSION NSFT(2000)
EQUIVALENCE (INSET(1),QSET(1))
COMMON /GCCM1/ ATR(125),JEVNT,MFA,MFE(100),MLE(100),MS TOP,MCRDR,MGCCOM1
INAPD,NWAPT,NWATR,NAFIL,NQC(100),NNTRY,NPRM1,PPARM(50,5),TNDW,TTBEGCOM1
2,TTCLR,TTFIN,TTTRIF(25),TYSET
COMMON /UCCM1/ ICUP3,ICUP4,ICDUM5,INCST,JDMMS,KOUN2,KOUN3,LBUKH,
ICDUM1,LOUN4,LIMIT,LUM,MAX,NAXP,NCHER,MCPCH,NDUM3,NDUM4,NEMPL,
2KFIRM,ACMCH,NOPRT,ACMRK,CORDER,TIME,SERVL,RMINV,NIP
COMMON /UCOM1/ MPL(1)
COMMON /UCCM14/ NRDM(1)
COMMON /UCCM16/ NKLOT(1)
COMMON /UCOM17/ NORDM(1)
COMMON /UCOM19/ DPST(1)
DIMENSION QMPL(1),QRCM(1),QORDR(1),UNLOT(1),QPST(1)
EQUIVALENCE (MPL(1),CMPL(1)),(INBOM(1),QBOM(1)),
1(NORDR(1),QORDR(1)),(ANALCT(1),UNLOT(1)),(QPST(1),QPST(1))
C*** RLSP RELEASES ORDERS FOR PRIME PARTS
KOUN6=ATR(13)+0.5
NPRM=PPL(NORDR,KOUN6+0-7)+0-5)
ATR(12)=1.
C*** SET OPERATION NUMBER TO ONE
NORDR(KOUN6+0-4)=1
C*** INCREMENT ORDER COST
QORDR(KOUN6+0-8)=QORDR(KOUN6+0-6)+QMPL(NORDR(KOUN6+0-7)+0)
CALL FILEN(1)
RETURN
END

```

[illegible]


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560 MACH=UPSTIMPL(NORDR(I*8-7)*8-5)*(NORDR(I*8-4)-(I*3+1)
IF(MCHUIPACH).GE.0.5) GO TO 500
C*** INCREMENT NUMBER OF CRODERS PENDING
505 MPEND=MPEND+1
C*** CALCULATE LEAD TIME
LEDTM=0.
AMRCC=ACROR(I*8-4)
IF(MRCCO.NE.0) GC TO 550
MRCCO=1
550 NOP=UPST(P/L(NORDR(I*8-7)*8-5))
ADD=0.
XDRMS=0.
CALL LEDTM
LEDTM=XDRMS
NPTMC=NORDR(I*8-7)
LOSTZ=CORDR(I*8-6)
C*** SET ORDER PRIORITY=(DUE DATE-INOR-LEAD TIME)/LEDTM
CORDR(I*8-1)=(NORDR(I*8-5)-(NOP-LEDTM)/LEDTM
C*** CHECK FOR HIGHEST PRIORITY ORDER
IF(CORDR(I*8-1).GE.HIGH) GO TO 500
HIGH=CORDR(I*8-1)
MAXP=1
500 CONTINUE
IF(MAXP.NE.0) GO TO 510
RETURN
C*** RANK PENDING ORDERS AND SET PRIORITY POINTERS
510 LHIGH=MAXP
515 TEST=HIGH
HIGH=1000000.
NORDR(LHIGH*8-2)=-1
I=1
520 IF(NORDR(I*8-7).EQ.0) GO TO 525
IF(NORDR(I*8-4).EQ.0) GO TO 525
IF(MPLINDR(I*8-7)*8-4).EQ.1) GO TO 525
IF(NORDR(I*8-3).NE.LDUM1) GO TO 525
IF(CORDR(I*8-1).LT.TEST) GO TO 525
IF(NORDR(I*8-2).NE.0) GO TO 525
IF(NORDR(I*8-1).GE.HIGH) GO TO 525
HIGH=CORDR(I*8-1)
LOCAT=I
525 CONTINUE
I=I+1
IF(I.LE.LIMIT) GO TO 520
MPEND=MPEND-1
IF(MPEND.EQ.0) GC TO 530
NORDR(LHIGH*8-2)=LCCAT
LHIGH=LOCAT
GO TO 515
530 NORDR(LHIGH*8-2)=0
IF(LDUM1.EQ.0) GO TO 535
RETURN
C*** DETERMINE MACHINE REQUIRED FOR HIGHEST PRIORITY ORDER
535 MACH=CPSTIMPL(NORDR(MAXP*8-7)*8-5)*(NORDR(MAXP*8-4)-(I*3+1)
C*** IS REQUIRED MACHINE IN USE?
IF(MCHUIPACH).GE.0.5) GO TO 540
I=0
545 I=I+1
IF(I.GT.NCMRK) GO TO 540
C*** CHECK MCRKR ABILITY
IF(INABLE(I-1)*NUNCH(MACH).NE.1) GO TO 545

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C**** CHECK WORKER AVAILABILITY
IF INKIU(1).GE.0.51 GO TO 545
C**** SET WORKER AND MACHINE TO BUSY STATE
NORDR(MAXP+8-3)-1
MCHU(MACH)-1
NWKU(1)-1
NWKU=NORKU-1./NORK
CALL TIMST(MRKU,TNOW,1)
CALL TIMST(MCHU(PAC),TNCW,(MACH+1))
C****CALCULATE QUEUE TIME FOR THIS ORDER
DELAY-TNM-WAIT(MAXP)
WAIT(MAXP)=0.0
CALL COLCT(DELAY,MACH)
CALL HISTC(DELAY,(MACH+7))
QUEUE(MACH)=ALPHA*DELAY*(1.-ALPHA)+QUEUE(MACH)
PDRN=NDRM(6,2)
CALL HISTO(DRN,4)
MIDM=MPL(NORDR(MAXP+8-7)+8-5)
C**** CALCULATE ACTUAL ORDER OPERATION TIME
ACTN=DRN*(10*PDRM)/(NORDR(MAXP+8-4)-1)+3*(1)/EFFC(MACH)
1PST(MDM)=NDRM(MAXP+8-4)-1)+3*(2))/(MCHST(MACH)
QORDR(PAC)=QORDR(MAXP+8)+ACTN*MCHST(MACH)
C**** INCREASE WORK IN PROCESS INVENTORY
WIP=WIP+ACTN*MCHST(MACH)
CALL TIMST(WIP,TNCW,INCPCH+2)
AIRB(1)=TNOW+ACTN
AIRB(2)=4.
AIRB(3)=MAXP
CALL FILE(1)
C**** SET NEXT ORDER TO BE CHECKED
540 MAXP=NORDR(MAXP+8-2)
IF (MAXP.NE.0) GO TO 535
RETURN
END

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SUBROUTINE SEARCH
COMMON QSET(2000)
DIMENSION NSET(2000)
EQUIVALENCE (NSET(1),QSET(1))
COMMON /GCOM1/ ATRO(25),JEVNT,MFA,MFE(100),MLF(100),MSTOP,MCRDR,MCCOM1
INAPD,AAAPT,MNATR,ANFIL,AKG(100),MNTRY,NPRMI,PPARM(50,4),TNDM,TTBEGCOM1
2,TICLR,TTEIN,TIRB(25),TISET
COMMON /GCOM2/ DEPL(10),MELUM(25),MMIUM(25),IICRD,IITAP(10),JJCELGCOM4
11500,LLADCT(25,2),LLABH(25,2),LLABP(11,2),LLABT(25,2),LLPHI(10),LLGCOM4
2FLDI(10),LLPLT,LLSUP(15),LLSYM(10),MPTTS,MNCEL(25),MNCLT,MNHTS,MNPLGCOM4
3T,MNPTS(10),MNSTA,MNVAR(10),PPT(10),PPLD(10)
COMMON /GCOM3/ EENQ(100),TIMM(100),KKRNC(100),MMAXQ(100),QOTINI,100GCOM6
11,SSORV(25,5),SSTPV(25,6),VMQ(100)
COMMON /UCOM1/ ICUP3,ICUP4,ICUP5,INCST,JOUM5,KOUM2,KOUM4,LBURN,UCOM1
ILDUM1,LDUM4,LIMIT,LON,MAX,MAXP,MCHEN,MCMCH,NMUM3,NMUM6,NEWPL,UCOM1
2NFTM,ACPCN,NOPRT,NOMRK,ORDER,TIME,SERV,MINV,MIP
COMMON /UCOM3/ MMBCH,NPTNO,LOST,NOP,ADD,XDIMS
DIMENSION QMPL(11),QRCM(11),QORDR(11),UNLOT(11),QPST(11)
CCPMGR /UCOM4/ EFFIC(11)
COMMON /UCOM5/ MCHTU(11)
COMMON /UCOM10/ MCST(11)
COMMON /UCOM11/ MPL(11)
COMMON /UCOM13/ NABLE(11)
COMMON /UCOM14/ NBCM(11)
COMMON /UCOM16/ NKLOT(11)
COMMON /UCOM17/ NORDR(11)
COMMON /UCOM18/ NKIU(11)
COMMON /UCOM19/ QPST(11)
COMMON /UCOM29/ WAITM(11)
COMMON /UCOM30/ CUEDE(11)
COMMON /UCOM33/ ALPHA
COMMON /UCOM34/ WGRKU
EQUIVALENCE (MPL(11),QMPL(11),QRCM(11),QORDR(11),UNLOT(11),QPST(11),
11NORDR(11),CONDR(11),QNKLOT(11),QNKLOT(11),TOPS(11),QPST(11))
REAL PCMU,MKIU
REAL LEDIN
INTEGER OPST
REAL INCST
REAL MCST
REAL LCT52
C**** SEARCH SETS PRIORITIES AND TRIES TO ASSIGN ORDERS TO BE WORKED ON
C**** SEARCH USES PRIORITY BASED ON FIRST COME, FIRST SERVED
555 NPEND=C
HIGH=1000000.
MAXP=0
DO 500 I=1,LIMIT
NORDR(I)=0
C**** IS THIS ORDER NUMBER IN USE?
IF(NORDR(I)=0) GO TO 500
C**** HAS IT IS ORDER BEEN RELEASED?
IF(NORDR(I)=0) GO TO 500
C**** IS THIS ORDER FOR A PRIME PART?
IF(MPL(I)=0) GO TO 500
C**** IS THIS ORDER RIGHT TYPE? WAITING CN PARTS OR WAITING ON MACHINE
IF(NORDR(I)=0) GO TO 500
C**** IS THIS ORDER WAITING ON A MACHINE
IF(LDUM1.EQ.INDMCK(1)) GO TO 505
IF(WAITM(1).GT.0) GO TO 505
WAITM(1)=TNCV
C**** IS REQUIRED MACHINE IN USE?

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560 MACH=CPST(AMPL(NCRR(1*8-7)*8-5)+(NDR(1*8-4)-(1)*3))
IF(MCHUI(MACH).GE.0.5) GO TO 500
C**** INCREMENT NUMBER OF CRCSERS PENDING
505 NPEND=NPEND+1
C**** SET ORDER PRIORITY FIRST COME, FIRST SERVE
QORDR(1*8-1)=WAITM(1)
C**** CHECK FOR HIGHEST PRIORITY ORDER
IF(QORDR(1*8-1).GE.HIGH) GO TO 500
HIGH=QORDR(1*8-1)
MAXP=1
500 CONTINUE
IF(MAXP.NE.0) GO TO 510
RETURN
C**** RANK PENDING ORDERS AND SET PRIORITY POINTERS
510 HIGH=MAXP
515 TEST=HIGH
HIGH=1000000
NDR(1*8-2)=1
I=1
520 IF(NDR(1*8-7).EQ.0) GO TO 525
IF(NDR(1*8-4).EQ.0) GO TO 525
IF(AMPL(NDR(1*8-7)*8-4).EQ.1) GO TO 525
IF(NDR(1*8-3).NE.LOUM) GO TO 525
IF(QORDR(1*8-1).LT.TEST) GO TO 525
IF(NDR(1*8-2).NE.0) GO TO 525
IF(QORDR(1*8-1).GE.HIGH) GO TO 525
HIGH=QORDR(1*8-1)
LOCAT=1
525 CONTINUE
I=I+1
IF(I.LE.LIMIT) GO TO 520
NPEND=NPEND-1
IF(NPEND.EQ.0) GO TO 530
NDR(1*8-2)=LOCAT
GO TO 515
530 NDR(1*8-2)=0
IF(LOUM.EQ.0) GO TO 535
RETURN
C**** DETERMINE MACHINE REQUIRED FOR HIGHEST PRIORITY ORDER
535 MACH=OPST(AMPL(NDR(MAXP*8-7)*8-5)+(NDR(MAXP*8-4)-(1)*3))
C**** IS REQUIRED MACHINE IN USE?
IF(MCHUI(MACH).GE.0.5) GO TO 540
I=0
545 I=I+1
IF(I.GT.NCWRK) GO TO 540
C**** CHECK WORKER ABILITY
IF(ABLE(1*8-1)*NDR(MACH).NE.1) GO TO 545
C**** CHECK WORKER AVAILABILITY
IF(MKUI(1).GE.0.5) GO TO 545
C**** SET WORKER AND MACHINE TO BUSY STATE
NDR(MAXP*8-3)=1
MCHUI(MACH)=1
MKUI(1)=1
MKRW=MKRW+1./NCWRK
CALL TIMST(MKRW,TIME)
C**** CALCULATE QUEUE TIME FOR THIS ORDER
DELAY=TIME-WAITM(MAXP)
WAITM(MAXP)=0.0

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CALL COLCTIDFLAY,MACF)
CALL HISTC(DELAY,INACH*7)
QUEUE(INACH)-ALPHA*DELAY*(1.-ALPHA)+QUEUE(INACH)
RORRN=RACRM16*2)
CALL HISTC(RORRN,4)
MINMI-MPL(INORRN(MAXP*8-2)+8-5)
C*** CALCULATE ACTUAL CPDR OPERATION TIME
ACTIM=RORRN*(QPSI(PDUMI+INORRN(MAXP*8-4)-1)+3+3)*QORRN(MAXP*8-4)+Q
IPST(MOPI+INORRN(MAXP*8-4)-1)+3+2)/EFFC(INACH)
QORRN(MAXP*8)-QORRN(MAXP*8)*ACTIM*NCST(INACH)
C*** INCREASE WORK IN PROCESS INVENTORY
WIP-WIP+ACTIM*NCST(INACH)
CALL TIMETWIP,INCH,INCPCH*2)
ATRI(1)=INCH+ACTIM
ATRI(2)=4.
ATRI(3)=MAXP
CALL FILEP(1)
C*** SET NEXT ORDER TO BE CHECKED
540 MAXP=INORRN(MAXP*8-2)
IF MAXP.EQ.0) GO TO 535
RETURN
END

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560 MACH=CPSI(MPL(MURDR(I*8-7)*8-5)*1000000*(I*8-4)-1)*3+1)
    IF(MCHT(MACH).GE.0.5) GO TO 500
C**** INCREMENT NUMBER OF ORDERS PENDING
505 NPEND=NPEND+1
C**** SET PRIORITY; SHORTEST OPERATION TIME
    MNC=C-NORDR(I*8-4)
    IF(MNCO.01.0) GO TO 565
    MNCO=1
565 NPINC=NORDR(I*8-7)
    NPST=MPL(MPND)*8-5)
    LOTSZ=CORDR(I*8-6)
    QURDR(I*8-1)=QPSI(NOSPT*(MNC)-1)*3+2)*LOT SZ*QPSI(NOSPT*(MNC)-1)*
    13+1)
C**** CHECK FOR HIGHEST PRIORITY ORDER
    IF(QURDR(I*8-1).GE.HIGH) GO TO 500
    HIGH=CORDR(I*8-1)
    MAXP=1
500 CONTINUE
    IF(MAXP.NE.0) GO TO 510
    RETURN
C**** RANK PENDING ORDERS AND SET PRIORITY PRINTERS
510 HIGH=MAXP
515 TEST=HIGH
    HIGH=1000000.
    NMDR(LHIGH*8-2)*=-1
    I=1
520 IF(NORDR(I*8-7).EQ.0) GO TO 525
    IF(QURDR(I*8-4).EQ.0) GO TO 525
    IF(MPL(NORDR(I*8-7)*8-4).EQ.1) GO TO 525
    IF(NORDR(I*8-3).NE.LOUM) GO TO 525
    IF(QURDR(I*8-1).LT.TEST) GO TO 525
    IF(NORDR(I*8-2).NE.0) GO TO 525
    IF(QURDR(I*8-1).GE.HIGH) GO TO 525
    HIGH=QURDR(I*8-1)
    LOCAT=1
525 CONTINUE
    I=I+1
    IF(I.LE.LIMIT) GO TO 520
    NPEND=NPEND-1
    IF(NPEND.EQ.0) GO TO 530
    NURDR(LHIGH*8-2)=LOCAT
    LGH=LOCAT
    GO TO 515
530 NURDR(LHIGH*8-2)=0
    IF(LDUM1.EQ.0) GO TO 535
    RETURN
C**** DETERMINE MACHINE REQUIRED FOR HIGHEST PRIORITY ORDER
535 MACH=UPST(MPL(MURDR(MAP*8-7)*8-5)*NORDR(MAP*8-4)-1)*3+1)
C**** IS REQUIRED MACHINE IN USE?
    I=0
545 I=I+1
    IF(I.GT.NWORK) GO TO 540
    CHECK WORKER ABILITY
    IF(MABLE(I)-1)*MPC(MACH).NE.1) GO TO 545
C**** CHECK WORKER AVAILABILITY
    IF(MKUT(I).GE.0.5) GO TO 545
C**** SET WORKER AND MACHINE TO BUSY STATE
    NORDR(MAP*8-3)=1
    MCHT(MACH)=1

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NURIN(1)=1
NURIN=WORKN(1)/NURPK
CALL TIMSTINORD(TNDB,1)
CALL TIMSTINCH(MACH),TNDB,(MACH,1)
C***CALCULATE CUL TIME FOR THIS ORDER
IFLAV=TNDB-WAIT(MNXP)
WAIT(MNXP)=0.0
CALL CCLCTINFLAY,MACH)
CALL HISTOINFLAY,(MACH,7)
QURIN(PACH)=ALPHA*OFLAY*(1.-ALPHA)*QUEIN(MACH)
PDNRN=RNCN(6,2)
CALL HISTOINFLAY,4)
MNP1=MPL(NORDR(MNXP-8-7)*8-5)
C*** CALCULATE ACTUAL ORDER OPERATION TIME
ACTIN=RDNRN+OPSTINORD(MNXP-8-4)-1)*3)*3)*QURIN(MNXP-8-6)*4)
IPSTINORD(MNXP-8)-QURIN(MNXP-8-4)-1)*3)*2)/EFFIC(MACH)
QURIN(MNXP-8)-QURIN(MNXP-8)*ACTIN*HCST(MACH)
C*** INCREASE WORK IN PROCESS INVENTORY
MIP=MIP+ACTIN*HCST(MACH)
CALL TIMSTINP,TNDB,(MACH,2)
ATIN(1)=TNDB+ACTIN
ATIN(2)=4.
ATIN(3)=MNP
CALL FILEIN(1)
C*** SET NEXT ORDER TO BE CHECKED
540 MAXP=NORDR(MNXP-2)
RETURN
END

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SURRCUTINE STATUS
COMMON /GCCN1/ ATR101251,JEVNT,MFA,MEE11001,MLE11001,MSTOP,NCRRD,NGCCM1
IHAPO,NNAT,NNAT,NNF1L,NNQ11001,NNTRY,NNPRI,PPARM150,51,INOH,TTWEGCCM1
2,ITGLP,ITFIN,ITRIC1251,ITSET
COMMON /GCCM6/ EENQ11001,ITAN11001,KRNRK11001,MHAKQ11001,QQTIM10JGC1M6
11,SSORV125,51,SSTPV125,61,VVWQ11001
COMMON /UCOM1/ TOUN3,TDUP3,TDUM5,INCST,JINHS,KOUN2,KOUN4,LBUKH,UCOM1
ILHUM1,LOUM4,LIMIT,LOH,MAX,NXP,ANCHER,NCPCN,NDUM3,NDUM4,NEMPL,UCOM1
2NFRM,MIPCH,HOPRT,NDWRK,ORDER,TIME,SERV1,RMINV,MIP
COMMON /UCOM10/ QUEUE11
COMMON /UCOH32/ HOLD
WRITE6,10001,INCH
1000 FORMAT11X,771X,'CURRENT TIME IS',F12.2)
WRITE6,10051,RMINV,MIP
1005 FORMAT11X,'RMINV=',F9.2,' MIP=',F12.2)
DHOLD=1010/1440.
WRITE6,10101,DHOLD
1010 FORMAT11X,'AVERAGE SUBPART DELAY=',F6.2,' DAYS')
WRITE6,10151(1,QUEUE11),1-1,NOMCH)
1015 FORMAT11X,'QUEUE1',12,1)-1,F8.0)
XT=INOH-TICLR
DO 505 J=1,NCMCH
XS=SSTPV1(J,11,11)*SSTPV1(J,11,6)+ITNON-SSTPV1(J,11,3))
AVG=XS/XT
WRITE6,10251 J,AVG
1025 FORMAT11X,'UTILIZATION OF MACHINE ',12,' =',F4.2)
505 CONTINUE
CALL TIMST(MIP,INOH,0)
CALL COLCT(HOLD,0)
ATR101251=INOH+LBUKH
ATR101251=7.
CALL FILEM11)
RETURN
END

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SUBROUTINE UDUMP
COMMON QSET(2000)
DIMENSION NSET(2000)
EQUIVALENCE (NSET(1),QSET(1))
COMMON /GCCOM1/ ATRIR(25),JEVNT,MFA,MEE(100),MLE(100),NSTOP,NCRDR,MGCCOM1
INAPC,NNAPT,NNAIR,NAFIL,NNO(100),NNTPV,NPRNT,PPARM(50,4),TNOH,TREGGCCOM1
2,TTCLR,TTFIN,TTIR(125),TTSET
COMMON /UCOM1/ IDUM3,ICUM4,ICUM5,INCEST,JDUM5,KDUM2,KDUM4,LBUK4,UCOM1
ILDUM1,LDUM4,LIMIT,LON,PAX,MAXP,NCHEK,NCHEG,NDUM3,NDUM4,NENPL,UCOM1
2NFIN,NMCH,NMPRT,NMRR,ORDER,TIME,SERVL,RNINV,WIP
COMMON /ZCCM4/ EFFIC(1)
COMMON /ZCCM5/ INNO(1)
COMMON /ZCCM6/ LBNPS(1)
COMMON /ZCCM7/ LEVST(1)
COMMON /ZCCM8/ LOTST(1)
COMMON /ZCCM9/ MCHIO(1)
COMMON /ZCCM10/ MCSST(1)
COMMON /ZCCM11/ MPL(1)
COMMON /ZCCM12/ PPS(1)
COMMON /ZCCM13/ NABLE(1)
COMMON /ZCCM14/ NRCM(1)
COMMON /ZCCM15/ NPLT(1)
COMMON /ZCCM16/ NNLO(1)
COMMON /ZCCM17/ NORDR(1)
COMMON /ZCCM18/ NNRK(1)
COMMON /ZCCM19/ OPST(1)
COMMON /ZCCM20/ QTIME(1)
COMMON /ZCCM21/ SAFE(1)
COMMON /ZCCM22/ NEIPN(1)
COMMON /ZCCM23/ ANACH(1)
COMMON /ZCCM24/ NOTE(1)
COMMON /ZCCM25/ NSUB(1)
COMMON /ZCCM26/ QSUB(1)
COMMON /ZCCM27/ RUNTR(1)
COMMON /ZCCM28/ SETTR(1)
COMMON /ZCCM29/ WAITM(1)
COMMON /ZCCM30/ QUEUE(1)
COMMON /ZCCM31/ UTILZ(1)
COMMON /ZCCM32/ HOLD
COMMON /ZCCM33/ ALPHA
DIMENSION QMPL(1),QRCM(1),UNLOT(1),OPST(1)
EQUIVALENCE (QMPL(1),QRCM(1),UNLOT(1),OPST(1))
1(NORDR(1),QORDR(1),INACCT(1),UNLOT(1),OPST(1),OPST(1))
INTEGER OPST
REAL INCSY
REAL MCST
REAL MCHIO,MNRKU
C*** UDUMP TO BE USED IF SIMULATION IS TO BE RESTARTED
WRITE(17,3000) IDUM3,LDUM4,LDUM5,JDUM5,KDUM2,KDUM4,LBUK4,LDUM1,
1LDUM4
3000 FORMAT(10I8)
WRITE(17,3001) LIMIT,LON,MAXP,NDUM3,NDUM4,NENPL,MFA,MEE,NCHEK
WRITE(17,3002) NMPRT,ADMPK
WRITE(17,3003) INCSY,ORDER,SERVL,RNINV,WIP,ALPHA,INNO
3003 FORMAT(F8.4,1X,F6.2,1X,F5.3,1X,F12.2,1X,F13.2,1X,F5.3,1X,F8.0)
WRITE(17,3004) (INNC(J),J=1,15)
WRITE(17,3010) (LMPST(J),J=1,104)
3010 FORMAT(20I4)
WRITE(17,3010) (LEVST(J),J=1,6)
WRITE(17,3010) (LOTST(J),J=1,24)

```



```

SUBCLTINE UOLUMP
  CUMHON QSE (120001)
  DIMENSION NSET(2000)
  FOLLOVANCE INSET(11),QSET(11)
  COMMON /GCOM1/ ATR1(25),JEVMT,PEA,MFE(100),MSE(100),MSTDP,NCRD,NGCGMI
  INAPD,MMAPT,MMATR,MMFL,MMFL,MMNO(100),MMTRY,MMPT,PPARM(50,5),TMMY,ITYBEGGCOM1
  GCOM1
  2,TICKL,TTFIN,TRTBL(25),TTYPE1
  COMMON /UCOM1/ IOUN3, IOUN4, IOUN5, INCS1, IOUN6, KOUN2, KOUN3, LBOUKH,
  UCUM1
  ILOUM1,LOUM5,LIMIT,LGM,PAK,MAP,KACHEK,MMCHN,NOUN3,NOUN4,NEMPL,
  UCUM1
  ZNFTR,AGCHN,NOPR,MMHMA,OMDER,TTYPE,SERVL,NPINV,WIP
  COMMON /UCCM1/ EFFIC(1)
  COMMON /UCCM2/ MPS(1)
  COMMON /UCCM3/ IMNO(1)
  COMMON /UCOM6/ LBWPS(1)
  COMMON /UCOM7/ LBWPS(1)
  COMMON /UCOM8/ LC1(1)
  COMMON /UCOM9/ MCHT(1)
  COMMON /UCCH10/ MEST(1)
  COMMON /UCCM11/ MPL(1)
  COMMON /UCCM12/ MPS(1)
  COMMON /UCOM13/ NABLE(1)
  COMMON /UCOM14/ NBOH(1)
  COMMON /UCCM15/ NHLT(1)
  COMMON /UCOM16/ NMLT(1)
  COMMON /UCCM17/ NOROR(1)
  COMMON /UCCM18/ NAKT(1)
  COMMON /UCOM19/ OPS(1)
  COMMON /UCOM20/ QTME(1)
  COMMON /UCOM21/ SAFE(1)
  COMMON /UCOM22/ NETPN(1)
  COMMON /UCCM23/ NPACP(1)
  COMMON /UCOM24/ NOTET(1)
  COMMON /UCOM25/ NSUB(1)
  COMMON /UCCM26/ QSL(1)
  COMMON /UCOM27/ RUNTP(1)
  COMMON /UCOM28/ SETIME(1)
  COMMON /UCOM29/ WAITP(1)
  COMMON /UCOM30/ QUEUE(1)
  COMMON /UCCM31/ UTILZ(1)
  DIMENSION QMPL(1),QRCM(1),QCROR(1),UNLO(11),OPST(1)
  EQUIVALENCE (MPL(1),QPL(1),INBOH(1),QCOM(1))
  IINOPR(1),QOROR(1),INACLT(1),UNLO(11),TOPST(1),OPST(1)
  INTEGER OPST
  REAL INCS1
  REAL MCST
  REAL MCHU,NMUKIU
  COMMON /UCCM32/
  UOLUMP TO BE USED IF SIMULATION IS NOT TO BE RESTARTED
  C***
  IOUN2=57
  PRINT FILE ECHO CHECK
  C***
  WRITE(6,1145)
  1145 FORMAT(11,'//IX,WORKER ABILITY MATRIX',//IX,TIL,'MCH1 MCH2 MCH3 MC
  1H PCV5 PCV6 MCH7 MCH8 MCH9 PC10 MCH11 MCH12 MCH13 MCH14 MC15')
  LETTE(11,150) (1,NABLE(1*15-14),NABLE(1*15-13),NABLE(1*15-12),NABL
  1E1*15-11),NABLE(1*15-10),NABLE(1*15-9),NABLE(1*15-8),NABLE(1*15-7
  2),NABLE(1*15-6),NABLE(1*15-5),NABLE(1*15-4),NABLE(1*15-3),NABLE(1*
  315-2),NABLE(1*15-1),NABLE(1*15) 1-1,NOURKI
  1150 FORMAT(11,'2,WORKER',19,12,113,11,110,11,125,11,120,11,133,11,130
  1,11,14,11,148,11,153,11,156,11,163,11,166,11,173,11,178,11,183,11)
  WRITE(6,1000)
  1000 FORMAT(11,'MACHINE DATA',//IX,T2,'INTERNAL EXTERNAL
  11YN COST PER QUEUE AT SAFETY STANDARD',//IX,T2,'MACH. NO.

```



```

      I=0
620 I=I+1
      IF(I.GT.(NUM2)) GO TO 625
      NORD=PES(LUMPS(I))
      IF(NORD.EQ.0) GO TO 615
      WRITE(6,1C95) I,MP(S(LUMPS(I))*(J-1)*2+1),MP(S(LUMPS(I))*(J-1)*2+2),J
      I=I,NORD
1095 FORMAT(1X,F5.16,I11.16,I20.16,I29.16,I38.16,I47.16,I56.16,I65.16,I
      174.16,I83.16,I92.16)
      GO TO 620
615 WRITE(6,1100) I
1100 FORMAT(1X,F5.16,' NO DEMAND IN THIS BUCKET')
      GO TO 620
625 CONTINUE
      WRITE(6,1115) SERV
1115 FORMAT(1X,///1X,'SERVICE LEVEL=MEAN',F5.2,'STD. DEV. ')
      WRITE(6,1120) INCS
1120 FORMAT(1X,'YEARLY INVENTORY COST=',F5.2,'TIMES INVENTORY VALUE')
      WRITE(6,1125) LBUK
1125 FORMAT(1X,'BUCKET LENGTH=',16,'MINUTES')
      WRITE(6,1130) LIMIT
1130 FORMAT(1X,'MAXIMUM NO. OF OPEN ORDERS =',14)
      WRITE(6,1135) NFIRM
1135 FORMAT(1X,'FIRM HORIZON=',14,'BUCKETS')
      WRITE(6,1140) ORDER
1140 FORMAT(1X,'FIXED ORDERING CCST =',F6.2)
      RETURN
      END

```

APPENDIX C

Example Output Data

WORKER ABILITY MATRIX

	MC11	MC12	MC13	MC14	MC15	MC16	MC17	MC18	MC19	MC20	MC21	MC22	MC23	MC24	MC25
WORKER 1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WORKER 2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WORKER 3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WORKER 4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WORKER 5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WORKER 6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WORKER 7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WORKER 8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WORKER 9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

MACHINE DATA

INTERNAL	EXTERNAL	UTILIZATION	COST PER	QUEUE AT	SAFETY	STANDARD
MACH. NO.	MACH. NO.	FACTOR	MINUTE	100%	FACTOR	EFFICIENCY
1	308	0	-4667	0.0	0.0	1.00
2	849	0	-2833	0.0	0.0	1.00
3	419	0	-7000	0.0	0.0	1.00
4	401	0	-2500	0.0	0.0	1.00
5	114	0	-2667	0.0	0.0	1.00
6	943	0	-3500	0.0	0.0	1.00
7	191	0	-2417	0.0	0.0	1.00
8	222	0	-4583	0.0	0.0	1.00
9	267	0	-5333	0.0	0.0	1.00
10	367	0	-2417	0.0	0.0	1.00
11	209	0	-3167	0.0	0.0	1.00
12	146	0	-2833	0.0	0.0	1.00
13	796	0	-2000	0.0	0.0	1.00
14	285	0	-3167	0.0	0.0	1.00
15	740	0	-3500	0.0	0.0	1.00

MASTER PARTS LIST FILE

INTERNAL	EXTERNAL	BM	OPST	PART	SEQUENCE	ON	NUMBER	AVERAGE
PART NO.	PART NO.	POINTER	PCINTER	LEVEL	POINTER	PANO	ALLOCATED	COST
1	108	1	1	6	65	0.0	0.0	109.39
2	376	11	21	5	17	0.0	0.0	24.61
3	297	6	11	5	73	0.0	0.0	30.89
4	529	14	31	4	41	0.0	0.0	25.14
5	418	0	3	1	81	0.0	0.0	0.02
6	785	19	41	4	137	0.0	0.0	10.95
7	1699	57	139	3	57	0.0	0.0	8.16
8	1781	62	152	3	89	0.0	0.0	5.93
9	801	22	54	6	0	0.0	0.0	279.86
10	1163	38	74	5	129	0.0	0.0	77.08
11	937	0	4	1	121	0.0	0.0	0.06
12	1358	54	100	3	97	0.0	0.0	4.25
13	1249	41	84	3	105	0.0	0.0	6.51
14	1005	55	64	3	145	0.0	0.0	8.69
15	1416	47	113	2	161	0.0	0.0	2.75
16	2232	0	5	1	153	0.0	0.0	0.03
17	1529	52	129	5	0	0.0	0.0	75.96
18	1961	72	184	4	0	0.0	0.0	35.91
19	2059	83	194	3	0	0.0	0.0	12.44

20	2416	0	1	169	0.0	0.0	0.25
21	1872	67	168	177	0.0	0.0	2.40
22	613	0	2	185	0.0	0.0	0.03
23	2141	86	207	0	0.0	0.0	5.08
24	2329	0	1	0	0.0	0.0	0.11

PART NUMBER	19	23	2.00

PART NUMBER	20		
PRIME PART, NO BILL OF MATERIAL			

PART NUMBER	21	22	5.48
		5	24.00

PART NUMBER	22		
PRIME PART, NO BILL OF MATERIAL			

PART NUMBER	23	16	28.00
		24	9.68

PART NUMBER	24		
PRIME PART, NO BILL OF MATERIAL			

PART NUMBER	18	19	20	21	22	23	24
PRIME PART, NO OPERATION SHEET	13	6	14	11	13	24	
	2.67	10.12	27.28	37.97	1.11		
	13.51	0.06	1.93	0.31	6.35		
	9	0	8	12	9		
	4.15	10.11	17.21	6.15	0.71		
	2.28	2.15	0.56	0.03	1.26		
	3	10	15		3		
	4.40	12.15	10.22		9.71		
	1.48	2.22	2.10		1.76		

NEHPI- 24 NECH- 90 NEOPS- 216

MASTER PRODUCTION SCHEDULE

BUCKET	PART NO.	QNTY.	PART NO.	QNTY.	PART NO.	QNTY.	PART NO.	QNTY.	PART NO.	QNTY.
1	NO DEMAND IN THIS BUCKET		1	60	9	100	17	40		
2	NO DEMAND IN THIS BUCKET		2	60	5	100	17	40		
3	NO DEMAND IN THIS BUCKET		3	60	9	100	17	40		
4	NO DEMAND IN THIS BUCKET		4	60	5	100	17	40		
5	NO DEMAND IN THIS BUCKET		5	60	9	100	17	40		
6	NO DEMAND IN THIS BUCKET		6	60	9	100	17	40		
7	NO DEMAND IN THIS BUCKET		7	60	9	100	17	40		
8	NO DEMAND IN THIS BUCKET		8	60	9	100	17	40		
9	NO DEMAND IN THIS BUCKET		9	60	9	100	17	40		
10	NO DEMAND IN THIS BUCKET		10	60	9	100	17	40		
11	NO DEMAND IN THIS BUCKET		11	60	9	100	17	40		
12	NO DEMAND IN THIS BUCKET		12	60	9	100	17	40		
13	NO DEMAND IN THIS BUCKET		13	60	5	100	17	40		
14	NO DEMAND IN THIS BUCKET		14	60	9	100	17	40		
15	NO DEMAND IN THIS BUCKET		15	60	5	100	17	40		
16	NO DEMAND IN THIS BUCKET		16	60	9	100	17	40		
17	NO DEMAND IN THIS BUCKET		17	60	9	100	17	40		
18	NO DEMAND IN THIS BUCKET		18	60	9	100	17	40		
19	NO DEMAND IN THIS BUCKET		19	60	9	100	17	40		
20	NO DEMAND IN THIS BUCKET		20	60	9	100	17	40		
21	NO DEMAND IN THIS BUCKET		21	60	9	100	17	40		
22	NO DEMAND IN THIS BUCKET		22	60	9	100	17	40		
23	NO DEMAND IN THIS BUCKET		23	60	9	100	17	40		
24	NO DEMAND IN THIS BUCKET		24	60	9	100	17	40		
25	NO DEMAND IN THIS BUCKET		25	60	9	100	17	40		
26	NO DEMAND IN THIS BUCKET		26	60	9	100	17	40		
27	NO DEMAND IN THIS BUCKET		27	60	9	100	17	40		
28	NO DEMAND IN THIS BUCKET		28	60	5	100	17	40		
29	NO DEMAND IN THIS BUCKET		29	60	9	100	17	40		
30	NO DEMAND IN THIS BUCKET		30	60	5	100	17	40		
31	NO DEMAND IN THIS BUCKET		31	60	9	100	17	40		
32	NO DEMAND IN THIS BUCKET		32	60	9	100	17	40		
33	NO DEMAND IN THIS BUCKET		33	60	9	100	17	40		
34	NO DEMAND IN THIS BUCKET		34	60	9	100	17	40		
35	NO DEMAND IN THIS BUCKET		35	60	9	100	17	40		
36	NO DEMAND IN THIS BUCKET		36	60	9	100	17	40		
37	NO DEMAND IN THIS BUCKET		37	60	9	100	17	40		
38	NO DEMAND IN THIS BUCKET		38	60	9	100	17	40		
39	NO DEMAND IN THIS BUCKET		39	60	9	100	17	40		
40	NO DEMAND IN THIS BUCKET		40	60	9	100	17	40		
41	NO DEMAND IN THIS BUCKET		41	60	9	100	17	40		
42	NO DEMAND IN THIS BUCKET		42	60	9	100	17	40		
43	NO DEMAND IN THIS BUCKET		43	60	9	100	17	40		
44	NO DEMAND IN THIS BUCKET		44	60	5	100	17	40		
45	NO DEMAND IN THIS BUCKET		45	60	9	100	17	40		
46	NO DEMAND IN THIS BUCKET		46	60	9	100	17	40		
47	NO DEMAND IN THIS BUCKET		47	60	9	100	17	40		
48	NO DEMAND IN THIS BUCKET		48	60	5	100	17	40		
49	NO DEMAND IN THIS BUCKET		49	60	9	100	17	40		
50	NO DEMAND IN THIS BUCKET		50	60	9	100	17	40		
51	NO DEMAND IN THIS BUCKET		51	60	9	100	17	40		
52	NO DEMAND IN THIS BUCKET		52	60	9	100	17	40		
53	NO DEMAND IN THIS BUCKET		53	60	5	100	17	40		
54	NO DEMAND IN THIS BUCKET		54	60	9	100	17	40		
55	NO DEMAND IN THIS BUCKET		55	60	9	100	17	40		
56	NO DEMAND IN THIS BUCKET		56	60	9	100	17	40		

57	1	60	9	100	17	40
58	1	60	9	100	17	40
59	1	60	9	100	17	40
60	1	60	9	100	17	40
61	1	60	9	100	17	40
62	1	60	9	100	17	40
63	1	60	9	100	17	40
64	1	60	9	100	17	40
65	1	60	9	100	17	40
66	1	60	9	100	17	40
67	1	60	9	100	17	40
68	1	60	9	100	17	40
69	1	60	9	100	17	40
70	1	60	9	100	17	40
71	1	60	9	100	17	40
72	1	60	9	100	17	40
73	1	60	9	100	17	40
74	1	60	9	100	17	40
75	1	60	9	100	17	40
76	1	60	9	100	17	40
77	1	60	9	100	17	40
78	1	60	9	100	17	40
79	1	60	9	100	17	40
80	1	60	9	100	17	40
81	1	60	9	100	17	40
82	1	60	9	100	17	40
83	1	60	9	100	17	40
84	1	60	9	100	17	40
85	1	60	9	100	17	40
86	1	60	9	100	17	40
87	1	60	9	100	17	40
88	1	60	9	100	17	40
89	1	60	9	100	17	40
90	1	60	9	100	17	40
91	1	60	9	100	17	40
92	1	60	9	100	17	40
93	1	60	9	100	17	40
94	1	60	9	100	17	40
95	1	60	9	100	17	40
96	1	60	9	100	17	40
97	1	60	9	100	17	40
98	1	60	9	100	17	40

SERVICE LEVEL-MEAN 1.64 STD. DEV.
 YEARLY INVENTORY COST- 0.33 TIMES INVENTORY VALUE
 DUCKET LENGTH- 10000 MINUTES
 MAXIMUM NO. OF OPEN ORDERS = 300
 FIRM HURTCO- 20BUCKETS
 FIXED ORDERING COST = 30.00
 ALPHA- 0.05

**GASP FILE STORAGE AREA DUMP AT TIME 0.0 **

MAXIMUM NUMBER OF ENTRIES IN FILE STORAGE AREA = 62

PRINTOUT OF FILE NUMBER 1

TNUM = 0.0
QQTIN = 0.0

FILE CONTENTS

ENTRY 1	0.0	0.2000E 01	0.5400E 02
ENTRY 2	0.0	0.2000E 01	0.5400E 02
ENTRY 3	0.1008E 05	0.7000E 01	0.0
ENTRY 4	0.1008E 05	0.3000E 01	0.0
ENTRY 5	0.1101E 05	0.1000E 01	0.5100E 02
ENTRY 6	0.1955E 05	0.1000E 01	0.5200E 02
ENTRY 7	0.2551E 05	0.1000E 01	0.5300E 02
ENTRY 8	0.3981E 05	0.2000E 01	0.5700E 02
ENTRY 9	0.4032E 05	0.2000E 01	0.4032E 05
ENTRY 10	0.4280E 05	0.2000E 01	0.5500E 02
ENTRY 11	0.4628E 05	0.2000E 01	0.5600E 02
ENTRY 12	0.5226E 05	0.1000E 01	0.4000E 02
ENTRY 13	0.5381E 05	0.1000E 01	0.4900E 02
ENTRY 14	0.5520E 05	0.1000E 01	0.3700E 02
ENTRY 15	0.5769E 05	0.1000E 01	0.3800E 02
ENTRY 16	0.7089E 05	0.1000E 01	0.3900E 02
ENTRY 17	0.7625E 05	0.1000E 01	0.2900E 02
ENTRY 18	0.7799E 05	0.1000E 01	0.5000E 02
ENTRY 19	0.8020E 05	0.1000E 01	0.4500E 02
ENTRY 20	0.8064E 05	0.2000E 01	0.4032E 05
ENTRY 21	0.8182E 05	0.1000E 01	0.4100E 02
ENTRY 22	0.8390E 05	0.1000E 01	0.3000E 02
ENTRY 23	0.8432E 05	0.1000E 01	0.4200E 02
ENTRY 24	0.8471E 05	0.1000E 01	0.3500E 02
ENTRY 25	0.8784E 05	0.1000E 01	0.1600E 02
ENTRY 26	0.8971E 05	0.1000E 01	0.4400E 02
ENTRY 27	0.9138E 05	0.1000E 01	0.2000E 02
ENTRY 28	0.9502E 05	0.1000E 01	0.1300E 02
ENTRY 29	0.9595E 05	0.1000E 01	0.4800E 02
ENTRY 30	0.9626E 05	0.1000E 01	0.1700E 02
ENTRY 31	0.9673E 05	0.1000E 01	0.3600E 02
ENTRY 32	0.9782E 05	0.1000E 01	0.5000E 01
ENTRY 33	0.1003E 06	0.1000E 01	0.1000E 01
ENTRY 34	0.1015E 06	0.1000E 01	0.2100E 02
ENTRY 35	0.1025E 06	0.1000E 01	0.2700E 02
ENTRY 36	0.1026E 06	0.1000E 01	0.3100E 02
ENTRY 37	0.1029E 06	0.1000E 01	0.4600E 02
ENTRY 38	0.1041E 06	0.1000E 01	0.3200E 02
ENTRY 39	0.1079E 06	0.1000E 01	0.6000E 01
ENTRY 40	0.1115E 06	0.1000E 01	0.2200E 02
ENTRY 41	0.1152E 06	0.1000E 01	0.1400E 02
ENTRY 42	0.1164E 06	0.1000E 01	0.1300E 02
ENTRY 43	0.1171E 06	0.1000E 01	0.4300E 02
ENTRY 44	0.1180E 06	0.1000E 01	0.7000E 01
ENTRY 45	0.1205E 06	0.1000E 01	0.2000E 01
ENTRY 46	0.1216E 06	0.1000E 01	0.2300E 02
ENTRY 47	0.1227E 06	0.1000E 01	0.3300E 02
ENTRY 48	0.1230E 06	0.1000E 01	0.4700E 02
ENTRY 49	0.1247E 06	0.1000E 01	0.3400E 02

ENTRY 50 - 0.1201F 06 0.1000E 01 0.0000E 01
ENTRY 51 - 0.1317E 06 0.1000E 01 0.2400E 02
ENTRY 52 - 0.1327E 06 0.1000E 01 0.2800E 02
ENTRY 53 - 0.1353F 06 0.1000E 01 0.1500E 02
ENTRY 54 - 0.1366E 06 0.1000E 01 0.1500E 02
ENTRY 55 - 0.1391E 06 0.1000E 01 0.9000E 01
ENTRY 56 - 0.1407E 06 0.1000E 01 0.3000E 01
ENTRY 57 - 0.1418E 06 0.1000E 01 0.2500E 02
ENTRY 58 - 0.1482E 06 0.1000E 01 0.1000E 02
ENTRY 59 - 0.1519E 06 0.1000E 01 0.2800E 02
ENTRY 60 - 0.1519E 06 0.1000E 01 0.1100E 02
ENTRY 61 - 0.1600E 06 0.1000E 01 0.4000E 01
ENTRY 62 - 0.1684E 06 0.1000E 01 0.1200E 02

◆◆ INTERMEDIAIE REȘIN 15◆◆

CURRENT TIME IS 1000.00
 RUN INV= 1785.38 WIP= 0.0
 AVERAGE SIMPANT DELAY= 2.00 DAYS
 QUIT(1)= 3401.

QUANTITY	UNIT	DESCRIPTION	PRICE	TOTAL
1	0-0	UTILIZATION OF MACHINE	1	0-0
2	0-0	UTILIZATION OF MACHINE	2	0-0
3	0-0	UTILIZATION OF MACHINE	3	0-0
4	0-0	UTILIZATION OF MACHINE	4	0-0
5	0-0	UTILIZATION OF MACHINE	5	0-0
6	0-0	UTILIZATION OF MACHINE	6	0-0
7	0-0	UTILIZATION OF MACHINE	7	0-0
8	0-0	UTILIZATION OF MACHINE	8	0-0
9	0-0	UTILIZATION OF MACHINE	9	0-0
10	0-0	UTILIZATION OF MACHINE	10	0-0
11	0-0	UTILIZATION OF MACHINE	11	0-0
12	0-0	UTILIZATION OF MACHINE	12	0-0
13	0-0	UTILIZATION OF MACHINE	13	0-0
14	0-0	UTILIZATION OF MACHINE	14	0-0
15	0-0	UTILIZATION OF MACHINE	15	0-0

WORKER U	**STATISTICS FOR TIME-PERSISTENT VARIABLES**				CUR. VALUE
	MEAN	STD DEV	MINIMUM	MAXIMUM	
UTL MCH1			NO VALUES RECORDED		
UTL MCH2			NO VALUES RECORDED		
UTL MCH3			NO VALUES RECORDED		
UTL MCH4			NO VALUES RECORDED		
UTL MCH5			NO VALUES RECORDED		
UTL MCH6			NO VALUES RECORDED		
UTL MCH7			NO VALUES RECORDED		
UTL MCH8			NO VALUES RECORDED		
UTL MCH9			NO VALUES RECORDED		
UTL MCH10			NO VALUES RECORDED		
UTL MCH11			NO VALUES RECORDED		
UTL MCH12			NO VALUES RECORDED		
UTL MCH13			NO VALUES RECORDED		
UTL MCH14			NO VALUES RECORDED		
UTL MCH15			NO VALUES RECORDED		
WIP INVT	0.3026E 03	0.7326E 03	0.0	0.1795E 04	0.1008E 05
RAWL INV			NO VALUES RECORDED		0.1785E 04

UTILIZATION OF MACHINE 12 =0.0
 UTILIZATION OF MACHINE 13 =0.0
 UTILIZATION OF MACHINE 14 =0.32
 UTILIZATION OF MACHINE 15 =0.0

STATISTICS FOR TIME-PERSISTENT VARIABLES

	MEAN	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CUR. VALUE
WORKER U	0.3505E-01	0.5163E-01	C-C	0.1111E 00	0.2016E 05	0.1111E 00
UTL MCH1			AC VALUES RECORDED			
UTL MCH2			AC VALUES RECORDED			
UTL MCH3			NO VALUES RECORDED			
UTL MCH4			NO VALUES RECORDED			
UTL MCH5			NO VALUES RECORDED			
UTL MCH6			NO VALUES RECORDED			
UTL MCH7			AC VALUES RECORDED			
UTL MCH8			NO VALUES RECORDED			
UTL MCH9			AC VALUES RECORDED			
UTL MCH10			NO VALUES RECORDED			
UTL MCH11			NO VALUES RECORDED			
UTL MCH12			AC VALUES RECORDED			
UTL MCH13			NO VALUES RECORDED			
UTL MCH14	0.3154E 00	0.4647E 00	0.0	0.1000E 01	0.2016E 05	0.1000E 01
UTL MCH15			NO VALUES RECORDED			
WIP INV	0.2361E 04	0.3522E 04	C-C	0.1047E 05	0.2016E 05	0.1047E 05
ANTI INV	0.2455E 04	0.2657E 04	0.0	0.1015E 05	0.2016E 05	0.3149E 04

STATISTICS FOR VARIABLES BASED ON OBSERVATION

	MEAN	STD DEV	SP OF MEAN	CV	MINIMUM	MAXIMUM	OBS
QUE MCH1			NO VALUES RECORDED				
QUE MCH2			NO VALUES RECORDED				
QUE MCH3			NO VALUES RECORDED				
QUE MCH4			NO VALUES RECORDED				
CUE MCH5			NO VALUES RECORDED				
CUE MCH6			NO VALUES RECORDED				
QUE MCH7			AC VALUES RECORDED				
CUE MCH8			NO VALUES RECORDED				
QUE MCH9			NO VALUES RECORDED				
QUE MCH10			NO VALUES RECORDED				
QUE MCH11			NO VALUES RECORDED				
QUE MCH12			AC VALUES RECORDED				
CUE MCH13			NO VALUES RECORDED				
CUE MCH14	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1
QUE MCH15			AC VALUES RECORDED				
EO DAYS			NO VALUES RECORDED				
EO DAYS			AC VALUES RECORDED				
EO DAYS			AC VALUES RECORDED				
EO DAYS			NO VALUES RECORDED				
EO DAYS			NO VALUES RECORDED				
EO DAYS			NO VALUES RECORDED				
WIP LOTS			NO VALUES RECORDED				
P-P LOTS	-0.1010E 00	0.288E 01	0.2042E 01	-0.2659E 02	-0.2143E 01	0.1941E 01	2
PRI WAIT	0.1398E 04	0.1577E 04	0.1398E 04	0.1414E 01	0.0	0.2795E 04	2

CURRENT TIME IS 30240.00
 RMINV- -0.02 WIP- 29365.24
 AVERAGE SHIPWAY DELAY- 1.71 DAYS

STATISTICS FOR TIME-PERSISTENT VARIABLES									
	MEAN	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CUR. VALUE			
QUEUE(1) =	3401.								
QUEUE(2) =	577.								
QUEUE(3) =	639.								
QUEUE(4) =	3100.								
QUEUE(5) =	2192.								
QUEUE(6) =	1692.								
QUEUE(7) =	1099.								
QUEUE(8) =	1122.								
QUEUE(9) =	1484.								
QUEUE(10) =	1994.								
QUEUE(11) =	47.								
QUEUE(12) =	34.								
QUEUE(13) =	1528.								
QUEUE(14) =	7042.								
QUEUE(15) =	3373.								
UTILIZATION OF MACHINE 1	-0.0								
UTILIZATION OF MACHINE 2	-0.0								
UTILIZATION OF MACHINE 3	-0.0								
UTILIZATION OF MACHINE 4	-0.0								
UTILIZATION OF MACHINE 5	-0.0								
UTILIZATION OF MACHINE 6	-0.0								
UTILIZATION OF MACHINE 7	-0.0								
UTILIZATION OF MACHINE 8	-0.12								
UTILIZATION OF MACHINE 9	-0.0								
UTILIZATION OF MACHINE 10	-0.0								
UTILIZATION OF MACHINE 11	-0.0								
UTILIZATION OF MACHINE 12	-0.0								
UTILIZATION OF MACHINE 13	-0.0								
UTILIZATION OF MACHINE 14	-0.52								
UTILIZATION OF MACHINE 15	-0.04								
WORKER U	0.7500E-01	0.0104E-01	0.0	0.222E 00	0.3024E 05	0.222E 00			
UTL MCH1				NO VALUES RECORDED					
UTL MCH2				AC VALUES RECORDED					
UTL MCH3				NO VALUES RECORDED					
UTL MCH4				NO VALUES RECORDED					
UTL MCH5				AC VALUES RECORDED					
UTL MCH6				NO VALUES RECORDED					
UTL MCH7				AC VALUES RECORDED					
UTL MCH8	0.1103E 00	0.3230E 00	0.0	0.1000E 01	0.3024E 05	0.0			
UTL MCH9				NO VALUES RECORDED					
UTL MCH10				AC VALUES RECORDED					
UTL MCH11				NO VALUES RECORDED					
UTL MCH12				AC VALUES RECORDED					
UTL MCH13				AC VALUES RECORDED					
UTL MCH14	0.5187E 00	0.4956E 00	0.0	0.1000E 01	0.3024E 05	0.1000E 01			
UTL MCH15	0.3799E-01	0.1912E 00	0.0	0.1000E 01	0.3024E 05	0.1000E 01			
WIP INVT	0.7020E 04	0.827E 04	0.0	0.2937E 05	0.3024E 05	0.2937E 05			
PHIL INV	0.3370E 04	0.3162E 04	-0.1605E-01	0.1015E 05	0.3024E 05	-0.1605E-01			
STATISTICS FOR VARIABLES BASED ON OBSERVATION									
	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM			OBS
QUE MCH1				NO VALUES RECORDED					
QUE MCH2				AC VALUES RECORDED					
QUE MCH3				NO VALUES RECORDED					

QUEU11 91= 1404.
 QUEU1101= 1974.
 QUEU1111= 45.
 QUEU1121= 14.
 QUEU1131= 1528.
 QUEU1141= 7887.
 QUEU1151= 3690.
 UTILIZATION OF MACHINE 1 =0.0
 UTILIZATION OF MACHINE 2 =0.0
 UTILIZATION OF MACHINE 3 =0.0
 UTILIZATION OF MACHINE 4 =0.0
 UTILIZATION OF MACHINE 5 =0.0
 UTILIZATION OF MACHINE 6 =0.0
 UTILIZATION OF MACHINE 7 =0.0
 UTILIZATION OF MACHINE 8 =0.14
 UTILIZATION OF MACHINE 9 =0.0
 UTILIZATION OF MACHINE 10 =0.0
 UTILIZATION OF MACHINE 11 =0.14
 UTILIZATION OF MACHINE 12 =0.0
 UTILIZATION OF MACHINE 13 =0.0
 UTILIZATION OF MACHINE 14 =0.92
 UTILIZATION OF MACHINE 15 =0.29

STATISTICS FOR TIME-PERSISTENT VARIABLES

	MEAN	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CUR. VALUE
WCRKER U	0.1649E 00	0.1237E 00	0.0	0.4444E 00	0.1000E 05	0.4444E 00
UTL MCH1			NO VALUES RECORDED	0.4444E 00		
UTL MCH2			NO VALUES RECORDED			
UTL MCH3			NO VALUES RECORDED			
UTL MCH4			NO VALUES RECORDED			
UTL MCH5			NO VALUES RECORDED			
UTL MCH6			NO VALUES RECORDED			
UTL MCH7	0.1374E 00	0.3443E 00	0.0	0.1000E 01	0.1000E 05	0.1000E 01
UTL MCH8			NO VALUES RECORDED			
UTL MCH9			NO VALUES RECORDED			
UTL MCH10	0.1374E 00	0.3443E 00	0.0	0.1000E 01	0.1000E 05	0.1000E 01
UTL MCH11			NO VALUES RECORDED			
UTL MCH12			NO VALUES RECORDED			
UTL MCH13	0.9174E 00	0.2752E 00	0.0	0.1000E 01	0.1000E 05	0.1000E 01
UTL MCH14	0.2920E 00	0.4547E 00	0.0	0.1000E 01	0.1000E 05	0.1000E 01
UTL MCH15	0.3710E 05	0.5618E 04	0.3486E 05	0.5118E 05	0.1000E 05	0.5118E 05
WIP INV	0.1524E 04	0.2021E 04	-0.1685E-01	0.8319E 04	0.1000E 05	0.3035E 04
PMPL INV						

STATISTICS FOR VARIABLES BASED ON OBSERVATION

	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM	OBS
QUE MCH1				NO VALUES RECORDED			
QUE MCH2				NO VALUES RECORDED			
QUE MCH3				NO VALUES RECORDED			
QUE MCH4				NO VALUES RECORDED			
QUE MCH5				NO VALUES RECORDED			
QUE MCH6				NO VALUES RECORDED			
QUE MCH7	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1
QUE MCH8				NO VALUES RECORDED			
QUE MCH9				NO VALUES RECORDED			
QUE MCH10	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1
QUE MCH11				NO VALUES RECORDED			

STATISTICS FOR VARIABLES BASED ON OBSERVATION									
	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM	OBS		
UTL MCH8	0.2163E 00	0.4117E 00	0.0	0.1000E 01	0.2016E 05	0.0			
UTL MCH9				NO VALUES RECORDED					
LTL MCH0				NO VALUES RECORDED					
UTL MCH1	0.1498E 00	0.3569E 00	0.0	0.1000E 01	0.2016E 05	0.1000E 01			
UTL MCH2	0.8668E-02	0.9270E-01	0.0	0.1000E 01	0.2016E 05	0.0			
UTL MCH3	0.1309E 00	0.3312E 00	0.0	0.1000E 01	0.2016E 05	0.1000E 01			
UTL MCH4	0.5587E 00	0.1589E 00	0.0	0.1000E 01	0.2016E 05	0.1000E 01			
UTL MCH5	0.6460E 00	0.4762E 00	0.0	0.1000E 01	0.2016E 05	0.1000E 01			
UTL MCH6	0.1281E 05	0.1281E 05	0.0	0.6929E 05	0.2016E 05	0.6929E 05			
WIP INV	0.4053E 05	0.1281E 05	0.0	0.6929E 05	0.2016E 05	0.6929E 05			
PATL INV	0.3531E 04	0.1088E 04	-0.1605E-01	0.8319E 04	0.2016E 05	0.3437E 04			
STATISTICS FOR VARIABLES BASED ON OBSERVATION									
QUE MCH1				NO VALUES RECORDED					
QUE MCH2				NO VALUES RECORDED					
QUE MCH3	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1		
QUE MCH4	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1		
QUE MCH5	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1		
QUE MCH6	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1		
QUE MCH7	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1		
QUE MCH8	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1		
QUE MCH9	0.0	0.0	0.0	0.1000E 06	0.0	0.0	2		
QUE MCH10	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1		
QUE MCH11	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1		
QUE MCH12	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1		
QUE MCH13	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1		
QUE MCH14	0.2083E 05	0.0	0.0	0.2083E 05	0.2083E 05	0.2083E 05	1		
QUE MCH15	0.7798E 04	0.2716E 04	0.1920E 04	0.3403E 00	0.5077E 04	0.9710E 04	2		
EO DAYS				NO VALUES RECORDED					
LO DAYS				NO VALUES RECORDED					
FO DAYS				NO VALUES RECORDED					
LO 30 DAYS				NO VALUES RECORDED					
AC DAYS				NO VALUES RECORDED					
AD DAYS				NO VALUES RECORDED					
MFD LOTS	0.8952E 00	0.0	0.0	0.0	0.8952E 00	0.8952E 00	1		
P-P LOTS	-0.2014E 01	0.2682E 01	0.1095E 01	-0.1332E 01	-0.5675E 01	0.2238E 01	6		
PATL WAIT	0.3223E 03	0.6446E 03	0.3223E 03	0.2000E 01	0.0	0.1289E 04	4		

CURRENT TIME IS 70560.00
 RMINV= 4588.04 WIP= 93265.88
 AVERAGE SUBPART DELAY= 1.00 DAYS
 QUEUET 11= 3401.
 QUEUET 21= 577.
 QUEUET 31= 639.
 QUEUET 41= 2798.
 QUEUET 51= 2272.
 QUEUET 61= 1598.
 QUEUET 71= 1034.
 QUEUET 81= 915.
 QUEUET 91= 1410.
 QUEUET 101= 1894.
 QUEUET 111= 42.
 QUEUET 121= 31.
 QUEUET 131= 1379.
 QUEUET 141= 8264.
 QUEUET 151= 3799.
 UTILIZATION OF MACHINE 1 = 0.0

STATISTICS FOR TIME-PERSISTENT VARIABLES									
	MEAN	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CIR. VALUE			
UTILIZATION OF MACHINE 2	-0.0								
UTILIZATION OF MACHINE 3	-0.0								
UTILIZATION OF MACHINE 4	-0.21								
UTILIZATION OF MACHINE 5	-0.27								
UTILIZATION OF MACHINE 6	-0.31								
UTILIZATION OF MACHINE 7	-0.19								
UTILIZATION OF MACHINE 8	-0.18								
UTILIZATION OF MACHINE 9	-0.20								
UTILIZATION OF MACHINE 10	-0.20								
UTILIZATION OF MACHINE 11	-0.11								
UTILIZATION OF MACHINE 12	-0.01								
UTILIZATION OF MACHINE 13	-0.35								
UTILIZATION OF MACHINE 14	-0.97								
UTILIZATION OF MACHINE 15	-0.76								

STATISTICS FOR TIME-PERSISTENT VARIABLES									
	MEAN	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CIR. VALUE			
WORKER U	0.4417E 00	0.2382E 00	0.0	0.7778E 00	0.3024E 05	0.4444E 00			
UTL MCH1			NO VALUES RECORDED	NO VALUES RECORDED					
UTL MCH2			NO VALUES RECORDED	NO VALUES RECORDED					
UTL MCH3			NO VALUES RECORDED	NO VALUES RECORDED					
UTL MCH4	0.2075E 00	0.4055E 00	0.0	0.1000E 01	0.3024E 05	0.0			
UTL MCH5	0.2721E 00	0.4451E 00	0.0	0.1000E 01	0.3024E 05	0.0			
UTL MCH6	0.3072E 00	0.4613E 00	0.0	0.1000E 01	0.3024E 05	0.0			
UTL MCH7	0.1902E 00	0.3924E 00	0.0	0.1000E 01	0.3024E 05	0.0			
UTL MCH8	0.3838E 00	0.4663E 00	0.0	0.1000E 01	0.3024E 05	0.0			
UTL MCH9	0.2030E 00	0.4022E 00	0.0	0.1000E 01	0.3024E 05	0.0			
UTL MCH10	0.2018E 00	0.4014E 00	0.0	0.1000E 01	0.3024E 05	0.0			
UTL MCH11	0.1133E 00	0.3170E 00	0.0	0.1000E 01	0.3024E 05	0.0			
UTL MCH12	0.1084E 01	0.1036E 00	0.0	0.1000E 01	0.3024E 05	0.0			
UTL MCH13	0.3491E 00	0.4787E 00	0.0	0.1000E 01	0.3024E 05	0.0			
UTL MCH14	0.9725E 00	0.1636E 00	0.0	0.1000E 01	0.3024E 05	0.0			
UTL MCH15	0.7640E 00	0.4246E 00	0.0	0.1000E 01	0.3024E 05	0.0			
WIP INV	0.6028E 05	0.2038E 05	0.3486E 05	0.9327E 05	0.3024E 05	0.9327E 05			
PMIL INV	0.3291E 04	0.1712E 04	-0.1685E 01	0.8319E 04	0.3024E 05	0.4589E 04			

STATISTICS FOR VARIABLES BASED ON OBSERVATION									
	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM	OBS		
QUE MCH1	0.0	0.0	NO VALUES RECORDED	NO VALUES RECORDED	0.0	0.0	2		
QUE MCH2	0.0	0.0	NO VALUES RECORDED	NO VALUES RECORDED	0.0	0.0	1		
QUE MCH3	0.0	0.0	NO VALUES RECORDED	NO VALUES RECORDED	0.0	0.0	1		
QUE MCH4	0.0	0.0	NO VALUES RECORDED	NO VALUES RECORDED	0.0	0.0	1		
QUE MCH5	0.0	0.0	NO VALUES RECORDED	NO VALUES RECORDED	0.0	0.0	1		
QUE MCH6	0.0	0.0	NO VALUES RECORDED	NO VALUES RECORDED	0.0	0.0	1		
QUE MCH7	0.0	0.0	NO VALUES RECORDED	NO VALUES RECORDED	0.0	0.0	1		
QUE MCH8	0.5781E 01	0.1001E 02	0.5781E 01	0.1732E 01	0.0	0.1734E 02	3		
QUE MCH9	0.0	0.0	NO VALUES RECORDED	NO VALUES RECORDED	0.0	0.0	1		
QUE MCH10	0.0	0.0	NO VALUES RECORDED	NO VALUES RECORDED	0.0	0.0	1		
QUE MCH11	0.0	0.0	NO VALUES RECORDED	NO VALUES RECORDED	0.0	0.0	1		
QUE MCH12	0.0	0.0	NO VALUES RECORDED	NO VALUES RECORDED	0.0	0.0	2		
QUE MCH13	0.0	0.0	NO VALUES RECORDED	NO VALUES RECORDED	0.0	0.0	2		
QUE MCH14	0.1913E 05	0.3020E 04	0.2701E 04	0.2107E 00	0.0	0.2083E 05	2		
QUE MCH15	0.7798E 04	0.2716E 04	0.1920E 04	0.3483E 00	0.5877E 04	0.9718E 04	2		
EO DAYS			NO VALUES RECORDED	NO VALUES RECORDED					
LO DAYS			NO VALUES RECORDED	NO VALUES RECORDED					
IN DAYS			NO VALUES RECORDED	NO VALUES RECORDED					

AN DAYS
 AD DAYS
 MFD LUIS
 P-P LUIS
 PRT WAIT

0.1612E 01
 -0.7770E 00
 0.2659E C4

0.1014E 01
 0.4160E 01
 0.4437E 04

NO VALUES RECORDED
 NO VALUES RECORDED
 NO VALUES RECORDED
 NO VALUES RECORDED
 NO VALUES RECORDED

0.7172E 00
 0.1471E 01
 0.1812E 04

0.6240E 00
 -0.5134E 01
 0.1669E 01

0.8952E 00
 -0.5675E 01
 0.0

0.2110E 01
 0.7856E 01
 0.1131E 05

2
 8
 6

CURRENT TIME IS 80640.00
 MINV= 4881.92 MIP= 128313.69
 AVERAGE SURPART DELAY= 1.62 DAYS

QUEUE(1)= 3231.
 QUEUE(2)= 577.
 QUEUE(3)= 577.
 QUEUE(4)= 2739.
 QUEUE(5)= 2159.
 QUEUE(6)= 1598.
 QUEUE(7)= 1034.
 QUEUE(8)= 869.
 QUEUE(9)= 1339.
 QUEUE(10)= 2005.
 QUEUE(11)= 36.
 QUEUE(12)= 26.
 QUEUE(13)= 1310.
 QUEUE(14)= 8517.
 QUEUE(15)= 3678.
 UTILIZATION OF MACHINE 1 -0.00
 UTILIZATION OF MACHINE 2 -0.0
 UTILIZATION OF MACHINE 3 -0.02
 UTILIZATION OF MACHINE 4 -0.27
 UTILIZATION OF MACHINE 5 -0.27
 UTILIZATION OF MACHINE 6 -0.23
 UTILIZATION OF MACHINE 7 -0.14
 UTILIZATION OF MACHINE 8 -0.29
 UTILIZATION OF MACHINE 9 -0.37
 UTILIZATION OF MACHINE 10 -0.34
 UTILIZATION OF MACHINE 11 -0.15
 UTILIZATION OF MACHINE 12 -0.02
 UTILIZATION OF MACHINE 13 -0.27
 UTILIZATION OF MACHINE 14 -0.97
 UTILIZATION OF MACHINE 15 -0.82

STATISTICS FOR TIME-PERSISTENT VARIABLES

	MEAN	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CUR. VALUE
ACRKR U	0.4629E 00	0.2157E 00	0.0	0.8889E 00	0.4032E 05	0.8889E 00
UTL MCH1	0.3596E-03	0.1896E-01	0.0	0.1000E 01	0.4032E 05	0.1000E 01
UTL MCH2	0.2017E-01	0.1406E 00	0.0	0.1000E 01	0.4032E 05	0.1000E 01
UTL MCH3	0.2713E 00	0.4466E 00	0.0	0.1000E 01	0.4032E 05	0.1000E 01
UTL MCH4	0.2699E 00	0.4439E 00	0.0	0.1000E 01	0.4032E 05	0.1000E 01
UTL MCH5	0.2304E 00	0.4211E 00	0.0	0.1000E 01	0.4032E 05	0.0
UTL MCH6	0.1426E 00	0.3497E 00	0.0	0.1000E 01	0.4032E 05	0.0
UTL MCH7	0.2907E 00	0.4541E 00	0.0	0.1000E 01	0.4032E 05	0.1000E 01
UTL MCH8	0.3661E 00	0.4817E 00	0.0	0.1000E 01	0.4032E 05	0.0
UTL MCH9	0.3435E 00	0.4148E 00	0.0	0.1000E 01	0.4032E 05	0.0
UTL MCH10	0.1507E 00	0.3578E 00	0.0	0.1000E 01	0.4032E 05	0.0
UTL MCH11	0.1781E-01	0.1322E 00	0.0	0.1000E 01	0.4032E 05	0.0
UTL MCH12	0.2691E 00	0.4435E 00	0.0	0.1000E 01	0.4032E 05	0.1000E 01
UTL MCH13	0.9709E 00	0.1681E 00	0.0	0.1000E 01	0.4032E 05	0.1000E 01
UTL MCH14	0.8230E 00	0.3817E 00	0.0	0.1000E 01	0.4032E 05	0.1000E 01

STATISTICS FOR VARIABLES BASED ON OBSERVATION									
	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM	OBS		
WIP INV1	0.7104E 05	0.2690E 05	0.3406E 05	0.1283E 06	0.4032E 05	0.1283E 06			
WIP INV2	0.3610E 04	0.1616E 04	-0.1685E-01	0.8319E 04	0.4032E 05	0.4082E 04			
QUE MCH1	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1		
QUE MCH2	0.0	0.0	0.0	0.1000E 06	0.0	0.0	2		
QUE MCH3	0.0	0.0	0.0	0.1000E 06	0.0	0.0	2		
QUE MCH4	0.1070E 04	0.2140E 04	0.1070E 04	0.2000E 01	0.0	0.4279E 04	4		
QUE MCH5	0.0	0.0	0.0	0.1000E 06	0.0	0.0	2		
QUE MCH6	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1		
QUE MCH7	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1		
QUE MCH8	0.4336E 01	0.6672E 01	0.4336E 01	0.2000E 01	0.0	0.1734E 02	4		
QUE MCH9	0.0	0.0	0.0	0.1000E 06	0.0	0.0	2		
QUE MCH10	0.2056E 04	0.2907E 04	0.2056E 04	0.1414E 01	0.0	0.4111E 04	2		
QUE MCH11	0.0	0.0	0.0	0.1000E 06	0.0	0.0	5		
QUE MCH12	0.0	0.0	0.0	0.1000E 06	0.0	0.0	5		
QUE MCH13	0.0	0.0	0.0	0.1000E 06	0.0	0.0	3		
QUE MCH14	0.1653E 05	0.3869E 04	0.2234E 04	0.2341E 00	0.1333E 05	0.2003E 05	3		
QUE MCH15	0.5655E 04	0.4170E 04	0.2412E 04	0.7308E 00	0.1370E 04	0.9718E 04	3		
FO DAYS				NO VALUES RECORDED					
LO DAYS				NO VALUES RECORDED					
FO 30 DAYS				NO VALUES RECORDED					
LO 30 DAYS				NO VALUES RECORDED					
AD 30 DAYS				NO VALUES RECORDED					
MFD LOTS	0.2339E 00	0.2457E 01	0.1063E 01	0.1050E 02	-0.2770E 01	0.3180E 01	6		
P-P LOTS	-0.1763E 01	0.4024E 01	0.1213E 01	-0.2282E 01	-0.6681E 01	0.7856E 01	11		
PRT WAIT	0.2097E 04	0.3622E 04	0.1145E 04	0.1728E 01	0.0	0.1131E 05	10		

CURRENT TIME IS 90720.00
 RHINV= 3533.44 WIP= 157450.31
 AVERAGE SURPART DELAY= 1.13 DAYS

QUEUET 11= 3231.
 QUEUET 21= 554.
 QUEUET 31= 549.
 QUEUET 41= 2598.
 QUEUET 51= 1930.
 QUEUET 61= 1518.
 QUEUET 71= 855.
 QUEUET 81= 826.
 QUEUET 91= 1272.
 QUEUET 101= 1958.
 QUEUET 111= 35.
 QUEUET 121= 26.
 QUEUET 131= 1327.
 QUEUET 141= 6517.
 QUEUET 151= 3724.
 UTILIZATION CF MACHINE 1 = 0.16
 UTILIZATION OF MACHINE 2 = 0.15
 UTILIZATION OF MACHINE 3 = 0.27
 UTILIZATION CF MACHINE 4 = 1.00
 UTILIZATION OF MACHINE 5 = 0.56
 UTILIZATION OF MACHINE 6 = 0.09
 UTILIZATION OF MACHINE 7 = 0.61
 UTILIZATION OF MACHINE 8 = 0.67
 UTILIZATION OF MACHINE 9 = 0.24

UTILIZATION OF MACHINE 10 -0.40
 UTILIZATION OF MACHINE 11 -0.01
 UTILIZATION OF MACHINE 12 -0.0
 UTILIZATION OF MACHINE 13 -1.00
 UTILIZATION OF MACHINE 14 -1.00
 UTILIZATION OF MACHINE 15 -1.00

	MEAN	STD DEV	**STATISTICS FOR TIME-PERSISTENT VARIABLES**				CUR. VALUF
			MINIMUM	MAXIMUM	TIME INTERVAL		
WORKER U	0.8635E 00	0.9139E-01	0.6667E 00	0.1000E 01	0.1000E 05		0.1000E 01
UTL MCH1	0.7639E 00	0.4247E 00	0.0	0.1000E 01	0.1000E 05		0.0
UTL MCH2	0.1534E 00	0.3604E 00	0.0	0.1000E 01	0.1000E 05		0.1000E 01
UTL MCH3	0.2740E 00	0.4460E 00	0.0	0.1000E 01	0.1000E 05		0.0
UTL MCH4	0.1000E 01	0.0	0.0	0.1000E 01	0.1000E 05		0.1000E 01
UTL MCH5	0.5592E 00	0.4965E 00	0.0	0.1000E 01	0.1000E 05		0.0
UTL MCH6	0.9004E-01	0.2662E 00	0.0	0.1000E 01	0.1000E 05		0.0
UTL MCH7	0.6069E 00	0.4884E 00	0.0	0.1000E 01	0.1000E 05		0.1000E 01
UTL MCH8	0.6727E 00	0.4692E 00	0.0	0.1000E 01	0.1000E 05		0.0
UTL MCH9	0.2364E 00	0.4261E 00	0.0	0.1000E 01	0.1000E 05		0.1000E 01
UTL MCH10	0.4011E 00	0.4901E 00	0.0	0.1000E 01	0.1000E 05		0.1000E 01
UTL MCH11	0.1212E-01	0.1154E 00	0.0	NO VALUES RECORDED	0.1000E 05		0.1000E 01
UTL MCH12			0.0	NO VALUES RECORDED	0.1000E 05		0.1000E 01
UTL MCH13	0.1000E 01	0.0	0.0	0.1000E 01	0.1000E 05		0.1000E 01
UTL MCH14			0.0	NO VALUES RECORDED	0.1000E 05		0.1000E 01
UTL MCH15	0.1000E 01	0.0	0.0	0.1000E 01	0.1000E 05		0.1000E 01
WIP INVT	0.1354E 06	0.8182E 04	0.1283E 06	0.1575E 06	0.1000E 05		0.1575E 06
PHIL INV	0.7217E 04	0.2497E 04	0.2514E 04	0.9036E 04	0.1000E 05		0.3533E 04

	MEAN	STD DEV	**STATISTICS FOR VARIABLES BASED ON OBSERVATION**				OBS
			SD OF MEAN	CV	MINIMUM	MAXIMUM	
QUE MCH1	0.3360E 03	0.4752E 03	NO VALUES RECORDED	0.1414E 01	0.0	0.6720E 03	2
QUE MCH2	0.0	0.0	0.3360E 03	0.1000E 06	0.0	0.0	1
QUE MCH3	0.1260E 04	0.5637E 03	0.3986E 03	0.4472E 00	0.8619E 03	0.1659E 04	2
QUE MCH5	0.5581E 03	0.9666E 03	0.5581E 03	0.1732E 01	0.0	0.1674E 04	3
QUE MCH6	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1
QUE MCH7	0.7248E 02	0.1450E 03	0.7248E 02	0.2000E 01	0.0	0.2899E 03	4
QUE MCH8	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1
QUE MCH9	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1
QUE MCH10	0.1467E 04	0.2075E 04	0.1467E 04	0.1414E 01	0.0	0.2935E 04	2
QUE MCH11	0.0	0.0	0.0	0.1000E 06	0.0	0.0	1
QUE MCH12			NO VALUES RECORDED		0.0		
QUE MCH13	0.1655E 04	0.0	0.0	0.0	0.1655E 04	0.1655E 04	1
QUE MCH14			NO VALUES RECORDED		0.0		
QUE MCH15	0.4599E 04	0.0	0.0	0.0	0.4599E 04	0.4599E 04	1
PH DAYS			NO VALUES RECORDED				
LO DAYS			NO VALUES RECORDED				
FO DAYS			NO VALUES RECORDED				
LO DAYS			NO VALUES RECORDED				
AD DAYS			NO VALUES RECORDED				
AD DAYS			NO VALUES RECORDED				
MFD LOTS	-0.1680E 01	0.1588E 01	0.9169E 00	-0.9408E 00	-0.3274E 01	-0.9779E-01	3
P-P LOTS	-0.4049E 01	0.9919E 00	0.7056E 00	-0.2464E 00	-0.4755E 01	-0.3144E 01	2
PRT WAIT	0.0	0.0	0.0	0.1000E 06	0.0	0.0	7

CURRENT TIME IS 100800.00

RMINV= 104.04 WIP= 106574.75
AVERAGE SUBPART DELAY= 1.17 DAYS

QUEU(1)= 3231.
QUEU(2)= 539.
QUEU(3)= 446.
QUEU(4)= 2477.
QUEU(5)= 1746.
QUEU(6)= 1370.
QUEU(7)= 772.
QUEU(8)= 706.
QUEU(9)= 2068.
QUEU(10)= 2029.
QUEU(11)= 159.
QUEU(12)= 86.
QUEU(13)= 1314.
QUEU(14)= 8614.
QUEU(15)= 3726.
UTILIZATION OF MACHINE 1 =0.39
UTILIZATION OF MACHINE 2 =0.18
UTILIZATION OF MACHINE 3 =0.34
UTILIZATION OF MACHINE 4 =0.99
UTILIZATION OF MACHINE 5 =0.61
UTILIZATION OF MACHINE 6 =0.43
UTILIZATION OF MACHINE 7 =0.37
UTILIZATION OF MACHINE 8 =0.45
UTILIZATION OF MACHINE 9 =0.62
UTILIZATION OF MACHINE 10 =0.44
UTILIZATION OF MACHINE 11 =0.15
UTILIZATION OF MACHINE 12 =0.02
UTILIZATION OF MACHINE 13 =0.64
UTILIZATION OF MACHINE 14 =1.00
UTILIZATION OF MACHINE 15 =1.00

WORKER U 0.864E 00 0.115E 00 0.558E 00 0.100E 01 0.201E 05 0.100E 01
UTL MCN1 0.381E 00 0.459E 00 0.0 0.100E 01 0.201E 05 0.0
UTL MCN2 0.183E 00 0.381E 00 0.0 0.100E 01 0.201E 05 0.0
UTL MCN3 0.374E 00 0.472E 00 0.0 0.100E 01 0.201E 05 0.100E 01
UTL MCN4 0.990E 00 0.954E-01 0.0 0.100E 01 0.201E 05 0.100E 01
UTL MCN5 0.611E 00 0.487E 00 0.0 0.100E 01 0.201E 05 0.0
UTL MCN6 0.432E 00 0.495E 00 0.0 0.100E 01 0.201E 05 0.100E 01
UTL MCN7 0.369E 00 0.402E 00 0.0 0.100E 01 0.201E 05 0.100E 01
UTL MCN8 0.448E 00 0.494E 00 0.0 0.100E 01 0.201E 05 0.100E 01
UTL MCN9 0.619E 00 0.485E 00 0.0 0.100E 01 0.201E 05 0.0
UTL MC10 0.440E 00 0.496E 00 0.0 0.100E 01 0.201E 05 0.0
UTL MC11 0.153E 00 0.360E 00 0.0 0.100E 01 0.201E 05 0.0
UTL MC12 0.2179E-01 0.146E 00 0.0 0.100E 01 0.201E 05 0.100E 01
UTL MC13 0.644E 00 0.470E 00 0.0 0.100E 01 0.201E 05 0.100E 01
UTL MC14 0.100E 01 0.0 0.0 0.100E 01 0.201E 05 0.100E 01
UTL MC15 0.100E 01 0.0 0.0 0.100E 01 0.201E 05 0.100E 01
WIP INVT 0.1966E 05 0.1203E 06 0.1866E 06 0.1866E 06 0.201E 05 0.1866E 06
RMTL INV 0.1531E 06 0.3659E 04 0.1040E 03 0.9036E 04 0.201E 05 0.1040E 03

STATISTICS FOR TIME-PERSISTENT VARIABLES

MINIMUM MAXIMUM OBS

CV

AC VALUES RECEIVED

STD DEV SD OF MEAN

MEAN

QUE MCN1

QUE MCH2	0.0	0.4221E 03	0.2111E 03	0.1161E 01	0.0	0.1921E 03	4
QUE MCH3	0.0	0.0	C.0	0.1000E 06	0.0	0.0	5
QUE MCH4	0.1540E 04	0.1159E 04	0.5184E 03	0.1524E 00	0.2469E 02	0.3060E 04	5
QUE MCH5	0.3515E 03	0.7401E 03	0.3311E 03	0.2104E 01	0.0	0.1674E 04	5
QUE MCH6	0.0	0.0	C.C	0.1000E 06	0.0	0.0	3
QUE MCH7	0.4332E 02	0.1184E 03	0.4832E 02	0.2449E 01	0.0	0.2099E 03	4
QUE MCH8	0.0	0.0	0.0	0.1000E 06	0.0	0.0	2
QUE MCH9	0.6241E 04	0.5843E 04	0.3374E 04	C.9351E 00	0.0	0.1158E 05	3
QUE MCH10	0.2117E 04	0.1849E 04	0.1067E 04	0.8735E 00	0.0	0.3416E 04	3
QUE MCH11	0.9004E 03	0.1560E 04	0.9004E 03	0.1732E 01	0.0	0.2701E 04	3
QUE MCH12	0.3660E 03	0.4054E 03	0.2027E 03	0.1172E 01	0.0	0.7767E 03	4
QUE MCH13	0.1356E 04	0.4231E 03	0.2992E 01	0.3121E 00	0.1056E 04	0.1635E 04	2
QUE MCH14	0.1046E 05	0.0	0.0	0.0	0.1046E 05	0.1046E 05	1
QUE MCH15	0.4599E 04	0.0	0.0	0.0	0.4599E 04	0.4599E 04	1
LC DAYS			NO VALUES RECORDED				
ED DAYS			NO VALUES RECORDED				
LC DAYS			NO VALUES RECORDED				
AC DAYS			NO VALUES RECORDED				
AD DAYS			NO VALUES RECORDED				
MEN LOTS	-0.7623E 00	0.3137E 01	0.5458E 00	-0.4115E 01	-0.3595E 01	0.0123E 01	11
P-P LOTS	-0.2922E 01	0.2076E 01	0.1199E 01	-0.7105E 00	-0.4755E 01	-0.6674E 00	3
PRT WAIT	0.1011E 04	0.3145E 04	0.8435E 03	0.3110E 01	0.0	0.1170E 05	14

CURRENT TIME IS 110880.00
 RPNV- 2703.80 WIP- 219774.44
 AVERAGE SUBPART DELAY- 1.89 DAYS

QUEU1 11-	3079.
QUEU1 21-	666.
QUEU1 31-	497.
QUEU1 41-	2477.
QUEU1 51-	1718.
QUEU1 61-	1205.
QUEU1 71-	809.
QUEU1 81-	990.
QUEU1 91-	2006.
QUEU1 101-	2158.
QUEU1 111-	152.
QUEU1 121-	90.
QUEU1 131-	1414.
QUEU1 141-	8614.
QUEU1 151-	3707.
UTILIZATION OF MACHINE 1	-0.58
UTILIZATION OF MACHINE 2	-0.27
UTILIZATION OF MACHINE 3	-0.39
UTILIZATION OF MACHINE 4	-0.74
UTILIZATION OF MACHINE 5	-0.41
UTILIZATION OF MACHINE 6	-0.36
UTILIZATION OF MACHINE 7	-0.40
UTILIZATION OF MACHINE 8	-0.49
UTILIZATION OF MACHINE 9	-0.57
UTILIZATION OF MACHINE 10	-0.49
UTILIZATION OF MACHINE 11	-0.19
UTILIZATION OF MACHINE 12	-0.02
UTILIZATION OF MACHINE 13	-0.70
UTILIZATION OF MACHINE 14	-1.00
UTILIZATION OF MACHINE 15	-1.00

STATISTICS FOR TIME-PERSISTENT VARIABLES

	MEAN	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CUR. VALUE	**STATISTICS FOR VARIABLES BASED ON OBSERVATION**			OBS
							STD DEV	SD OF MEAN	CV	
WORKER U	0.8455E 00	0.1215E 00	0.4444E 00	0.1000E 01	0.3024E 05	0.777E 00				
UTL MCH1	0.5024E 00	0.4532E 00	0.0	0.1000E 01	0.3024E 05	0.1000E 01				
UTL MCH2	0.2725E 00	0.4532E 00	0.0	0.1000E 01	0.3024E 05	0.0				
UTL MCH3	0.3076E 00	0.4872E 00	0.0	0.1000E 01	0.3024E 05	0.1000E 01				
UTL MCH4	0.7446E 00	0.4321E 00	0.0	0.1000E 01	0.3024E 05	0.0				
UTL MCH5	0.4111E 00	0.4920E 00	0.0	0.1000E 01	0.3024E 05	0.0				
UTL MCH6	0.3628E 00	0.4868E 00	0.0	0.1000E 01	0.3024E 05	0.0				
UTL MCH7	0.4003E 00	0.4900E 00	0.0	0.1000E 01	0.3024E 05	0.0				
UTL MCH8	0.4851E 00	0.4598E 00	0.0	0.1000E 01	0.3024E 05	0.0				
UTL MCH9	0.5651E 00	0.4957E 00	0.0	0.1000E 01	0.3024E 05	0.0				
UTL MCH10	0.4940E 00	0.5000E 00	0.0	0.1000E 01	0.3024E 05	0.0				
UTL MCH11	0.1851E 00	0.3884E 00	0.0	0.1000E 01	0.3024E 05	0.0				
UTL MCH12	0.2380E-01	0.1524E 00	0.0	0.1000E 01	0.3024E 05	0.0				
UTL MCH13	0.6992E 00	0.4586E 00	0.0	0.1000E 01	0.3024E 05	0.0				
UTL MCH14	0.1000E 01	0.0	0.0	0.1000E 01	0.3024E 05	0.0				
UTL MCH15	0.9955E 00	0.6648E-01	0.0	0.1000E 01	0.3024E 05	0.0				
WIP INVT	0.1682E 06	0.2741E 05	0.1283E 06	0.2198E 06	0.3024E 05	0.2198E 06				
PMTL INVT	0.4117E 04	0.3115E 04	0.1040E 03	0.9494E 04	0.3024E 05	0.2704E 04				
STATISTICS FOR VARIABLES BASED ON OBSERVATION										
	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM				
CUE MCH1	0.2084E 04	0.2725E 04	0.1573E 04	0.1308E 01	0.3923E 03	0.5228E 04				3
QUE MCH2	0.2173E 03	0.3501E 03	0.1325E 03	0.1613E 01	0.0	0.7821E 03				7
QUE MCH3	0.3679E 03	0.9540E 03	0.3017E 03	0.2593E 01	0.0	0.3018E 04				10
QUE MCH4	0.1540E 04	0.1159E 04	0.5184E 03	0.7524E 00	0.2869E 02	0.3040E 04				5
QUE MCH5	0.4896E 03	0.7435E 03	0.3035E 03	0.1519E 01	0.0	0.1674E 04				6
QUE MCH6	0.1108E 03	0.2714E 03	0.1108E 03	0.2449E 01	0.0	0.6648E 03				6
CUE MCH7	0.2587E 03	0.5670E 03	0.2143E 03	0.2192E 01	0.0	0.1521E 04				7
QUE MCH8	0.1441E 04	0.1788E 04	0.8592E 03	0.1122E 01	0.0	0.3406E 04				4
QUE MCH9	0.4894E 04	0.5406E 04	0.2743E 04	0.1121E 01	0.0	0.1158E 05				4
QUE MCH10	0.2490E 04	0.2017E 04	0.8233E 03	0.8100E 00	0.0	0.4725E 04				6
QUE MCH11	0.6753E 03	0.1351E 04	0.6753E 03	0.2000E 01	0.0	0.2701E 04				4
QUE MCH12	0.2730E 03	0.3433E 03	0.1402E 03	0.1258E 01	0.0	0.7767E 03				6
QUE MCH13	0.2008E 04	0.1170E 04	0.6753E 03	0.5824E 00	0.1056E 04	0.3314E 04				3
QUE MCH14	0.1046E 05	0.0	0.0	0.0	0.1046E 05	0.1046E 05				1
QUE MCH15	0.3994E 04	0.8554E 03	0.6048E 03	0.2142E 00	0.3389E 04	0.4599E 04				2
ED DAYS	-0.2720E 01	0.0	0.0	0.0	-0.2720E 01	-0.2720E 01				1
LO DAYS	-0.1791E 05	0.0	0.0	0.0	-0.1791E 05	-0.1791E 05				1
LC DAYS	-0.2720E 01	0.0	0.0	0.0	-0.2720E 01	-0.2720E 01				1
AD DAYS	-0.1791E 05	0.0	0.0	0.0	-0.1791E 05	-0.1791E 05				1
AD DAYS	-0.1791E 05	0.0	0.0	0.0	-0.1791E 05	-0.1791E 05				1
MFD LOTS	0.3222E 00	0.3499E 01	0.6037E 00	0.1086E 02	-0.3595E 01	0.8123E 01				19
P-P LOTS	0.1232E 00	0.4223E 01	0.1744E 01	0.3426E 02	-0.4755E 01	0.6757E 01				6
PRT WAIT	0.2311E 04	0.3894E 04	0.8174E 03	0.1659E 01	0.0	0.1170E 05				22

CURRENT TIME IS 120940.00
 RPIV= 1308.21 WIP= 221015.00
 AVERAGE SUBPART DELAY= 2.38 DAYS
 QUEUES 11= 3100.
 QUEUES 21= 473.
 QUEUES 31= 496.
 QUEUES 41= 2173.
 QUEUES 51= 1650.
 QUEUES 61= 1205.

STATISTICS FOR TIME-PERSISTENT VARIABLES									
	MEAN	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CUR. VALUE			
QUEUE(1)=	809.								
QUEUE(1)=	1002.					0.1000E 01			
QUEUE(1)=	2581.					0.0			
QUEUE(1)=	2150.					0.1000E 01			
QUEUE(1)=	360.					0.1000E 01			
QUEUE(1)=	81.					0.1000E 01			
QUEUE(1)=	1343.					0.1000E 01			
QUEUE(1)=	6513.					0.0			
QUEUE(1)=	3702.					0.0			
UTILIZATION OF MACHINE	1 -0.64					0.1000E 01			
UTILIZATION OF MACHINE	2 -0.28					0.1000E 01			
UTILIZATION OF MACHINE	3 -0.36					0.1000E 01			
UTILIZATION OF MACHINE	4 -0.79					0.1000E 01			
UTILIZATION OF MACHINE	5 -0.42					0.1000E 01			
UTILIZATION OF MACHINE	6 -0.45					0.1000E 01			
UTILIZATION OF MACHINE	7 -0.30					0.1000E 01			
UTILIZATION OF MACHINE	8 -0.52					0.1000E 01			
UTILIZATION OF MACHINE	9 -0.67					0.1000E 01			
UTILIZATION OF MACHINE	10 -0.50					0.1000E 01			
UTILIZATION OF MACHINE	11 -0.15					0.1000E 01			
UTILIZATION OF MACHINE	12 -0.02					0.1000E 01			
UTILIZATION OF MACHINE	13 -0.66					0.1000E 01			
UTILIZATION OF MACHINE	14 -1.00					0.1000E 01			
UTILIZATION OF MACHINE	15 -1.00					0.1000E 01			
WORKER U	0.0614E 00	0.1166E 00	0.4444E 00	0.1000E 01	0.4032E 05	0.1000E 01			
UTL MCH1	0.6374E 00	0.4808E 00	0.0	0.1000E 01	0.4032E 05	0.0			
UTL MCH2	0.2805E 00	0.4492E 00	0.0	0.1000E 01	0.4032E 05	0.1000E 01			
UTL MCH3	0.3562E 00	0.4789E 00	0.0	0.1000E 01	0.4032E 05	0.1000E 01			
UTL MCH4	0.7867E 00	0.4566E 00	0.0	0.1000E 01	0.4032E 05	0.1000E 01			
UTL MCH5	0.4189E 00	0.4934E 00	0.0	0.1000E 01	0.4032E 05	0.1000E 01			
UTL MCH6	0.4500E 00	0.4975E 00	0.0	0.1000E 01	0.4032E 05	0.0			
UTL MCH7	0.3002E 00	0.4584E 00	0.0	0.1000E 01	0.4032E 05	0.0			
UTL MCH8	0.5210E 00	0.4966E 00	0.0	0.1000E 01	0.4032E 05	0.1000E 01			
UTL MCH9	0.6738E 00	0.4688E 00	0.0	0.1000E 01	0.4032E 05	0.1000E 01			
UTL MCH10	0.5033E 00	0.5000E 00	0.0	0.1000E 01	0.4032E 05	0.0			
UTL MCH11	0.1523E 00	0.3553E 00	0.0	0.1000E 01	0.4032E 05	0.0			
UTL MCH12	0.2147E-01	0.1450E 00	0.0	0.1000E 01	0.4032E 05	0.0			
UTL MCH13	0.6555E 00	0.4752E 00	0.0	0.1000E 01	0.4032E 05	0.1000E 01			
UTL MCH14	0.1000E 01	0.0	0.0	0.1000E 01	0.4032E 05	0.1000E 01			
UTL MCH15	0.9907E 00	0.5778E-01	0.0	0.1000E 01	0.4032E 05	0.1000E 01			
WIP INV	0.1790E 06	0.3024E 05	0.1203E 06	0.2223E 06	0.4032E 05	0.2210E 06			
INVTL INV	0.3901E 04	0.2963E 04	0.1040E 03	0.9494E 04	0.4032E 05	0.1308E 04			
STATISTICS FOR VARIABLES BASED ON OBSERVATION									
	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM	URS		
QUE MCH1	0.2602E 04	0.3150E 04	0.1456E 04	0.1211E 01	0.0	0.6758E 04	5		
QUE MCH2	0.2989E 03	0.5088E 03	0.1609E 03	0.1702E 01	0.0	0.1468E 04	10		
QUE MCH3	0.4023E 03	0.9056E 03	0.2512E 03	0.2251E 01	0.0	0.3018E 04	13		
QUE MCH4	0.1207E 04	0.1198E 03	0.3994E 03	0.9928E 00	0.0	0.3060E 04	9		
QUE MCH5	0.4714E 03	0.6805E 03	0.2572E 03	0.1453E 01	0.0	0.1674E 04	7		
QUE MCH6	0.1108E 03	0.2714E 03	0.1108E 03	0.2459E 01	0.0	0.6648E 03	6		
QUE MCH7	0.2587E 03	0.5670E 03	0.2192E 03	0.2192E 01	0.0	0.1521E 04	7		
QUE MCH8	0.1323E 04	0.1569E 04	0.6181E 03	0.1141E 01	0.0	0.3406E 04	6		
QUE MCH9	0.5922E 04	0.4653E 04	0.1981E 04	0.8194E 00	0.0	0.1158E 05	6		

QUE MC10	0.249E 04	0.2017E 04	0.0231E 03	0.0100E 00	0.0	0.4725E 04	6
QUE MC11	0.1260E 04	0.2060E 04	0.0443E 03	0.1641E 01	0.0	0.4059E 04	6
QUE MC12	0.2040E 03	0.3165E 03	0.1119E 03	0.1546E 01	0.0	0.7767E 03	8
QUE MC13	0.1506E 04	0.1306E 04	0.6929E 03	0.9200E 00	0.0	0.3314E 04	4
QUE MC14	0.9120E 04	0.1800E 04	0.1325E 04	0.2060E 00	0.7793E 04	0.1046E 05	2
QUE MC15	0.3994E 04	0.8554E 03	0.6040E 03	0.2142E 00	0.3309E 04	0.4599E 04	2
EN DAYS	-0.2720E 01	0.0	0.0	0.0	-0.2720E 01	-0.2720E 01	1
LO DAYS	0.1369E 01	0.0	0.0	0.0	0.1369E 01	0.1369E 01	1
FO DAYS	-0.1791E 05	0.0	0.0	0.0	-0.1791E 05	-0.1791E 05	1
LO DAYS	0.3036E 05	0.0	0.0	0.0	0.3036E 05	0.3036E 05	1
AN DAYS	-0.6754E 00	0.2091E 01	0.2044E 01	-0.4200E 01	-0.2720E 01	0.1369E 01	2
AN DAYS	0.1023E 05	0.3579E 05	0.2015E 05	0.1091E 01	-0.1791E 05	0.3036E 05	2
PFO LC15	0.1153E 01	0.4366E 01	0.6912E 00	0.3785E 01	-0.3595E 01	0.1226E 02	24
P-P L015	-0.7451E 00	0.3617E 01	0.1266E 01	-0.4055E 01	-0.4755E 01	0.6757E 01	9
PRT WAIT	0.2074E 04	0.5041E 04	0.6715E 03	0.1754E 01	0.0	0.1765E 05	33

CURRENT TIME IS 131040.00
 RMV= 4003.70 WIP= 220470.31
 AVERAGE SURPART DELAY= 1.63 DAYS

QUEUET 11	3410.
QUEUET 21	430.
QUEUET 31	1300.
QUEUET 41	2091.
QUEUET 51	2310.
QUEUET 61	1005.
QUEUET 71	847.
QUEUET 81	1002.
QUEUET 91	2533.
QUEUET 101	1947.
QUEUET 111	396.
QUEUET 121	72.
QUEUET 131	1522.
QUEUET 141	8573.
QUEUET 151	3069.
UTILIZATION OF MACHINE 1	-0.68
UTILIZATION OF MACHINE 2	-0.31
UTILIZATION OF MACHINE 3	-0.46
UTILIZATION OF MACHINE 4	-0.70
UTILIZATION OF MACHINE 5	-0.50
UTILIZATION OF MACHINE 6	-0.39
UTILIZATION OF MACHINE 7	-0.31
UTILIZATION OF MACHINE 8	-0.43
UTILIZATION OF MACHINE 9	-0.69
UTILIZATION OF MACHINE 10	-0.58
UTILIZATION OF MACHINE 11	-0.18
UTILIZATION OF MACHINE 12	-0.03
UTILIZATION OF MACHINE 13	-0.66
UTILIZATION OF MACHINE 14	-1.00
UTILIZATION OF MACHINE 15	-0.98

***STATISTICS FOR TIME-PERSISTENT VARIABLES**

	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CUR. VALUE
WORKER U	0.0771E 00	0.1124E 00	0.4444E 00	0.5040E 05	0.0809E 00
UTL MC10	0.6028E 00	0.4654E 00	0.1000E 01	0.5040E 05	0.1000E 01
UTL MC12	0.3077E 00	0.4615E 00	0.1000E 01	0.5040E 05	0.1000E 01
UTL MC13	0.4643E 00	0.4587E 00	0.1000E 01	0.5040E 05	0.0
UTL MC14	0.7011E 00	0.4578E 00	0.1000E 01	0.5040E 05	0.0
UTL MC15	0.4966E 00	0.5000E 00	0.1000E 01	0.5040E 05	0.0

STATISTICS FOR VARIABLES BASED ON OBSERVATIONS									
	MEAN	STD DEV	SD UP MEAN	CV	MINIMUM	MAXIMUM	OBS		
UTL MCH6	-0.3948E 00	0.4688E 00	C-C	0.1000E 01	0.5040E 05	0.1000E 01	0		
UTL MCH7	0.3128E 00	0.4634E 00	0.0	0.1000E 01	0.5040E 05	0.1000E 01	8		
UTL MCH8	0.4294E 00	0.4550E 00	0.0	0.1000E 01	0.5040E 05	0.1000E 01	13		
UTL MCH9	0.6851E 00	0.5645E 00	0.0	0.1000E 01	0.5040E 05	0.0	18		
UTL MCH10	0.5764E 00	0.4541E 00	0.0	0.1000E 01	0.5040E 05	0.0	10		
UTL MCH11	0.1873E 00	0.3873E 00	0.0	0.1000E 01	0.5040E 05	0.0	11		
UTL MCH12	0.2520E -01	0.1570E 00	0.0	0.1000E 01	0.5040E 05	0.0	9		
UTL MCH13	0.6592E 00	0.4740E 00	0.0	0.1000E 01	0.5040E 05	0.0	10		
UTL MCH14	0.1000E 01	0.0	0.0	0.1000E 01	0.5040E 05	0.1000E 01	6		
UTL MCH15	0.5764E 00	0.1517E 00	0.0	0.1000E 01	0.5040E 05	0.1000E 01	7		
WIP INVT	0.1845E 06	0.2987E 05	0.0	0.1000E 01	0.5040E 05	0.1000E 01	8		
PMIL INV	0.4259E 04	0.3128E 04	0.1283E 06	0.2223E 06	0.5340E 05	0.2205E 06	11		
			0.1040E 03	0.1051E 05		0.4004E 04	43		
QUE MCH1	0.3632E 04	0.3024E 04	0.1069E 04	0.8327E 00	0.0	0.7117E 04	8		
QUE MCH2	0.2857E 03	0.4660E 03	0.1252E 03	0.1631E 01	0.0	0.1468E 04	13		
QUE MCH3	0.1372E 04	0.2391E 04	0.5636E 03	0.1743E 01	0.0	0.9546E 04	18		
QUE MCH4	0.1140E 04	0.1150E 04	0.3635E 03	0.1009E 01	0.0	0.3060E 04	10		
QUE MCH5	0.2200E 04	0.3847E 04	0.1160E 04	0.1748E 01	0.0	0.1028E 05	11		
QUE MCH6	0.1905E 03	0.3901E 03	0.1300E 03	0.2048E 01	0.0	0.1050E 04	9		
QUE MCH7	0.4802E 03	0.1024E 04	0.3239E 03	0.2098E 01	0.0	0.3071E 04	10		
QUE MCH8	0.1323E 04	0.1509E 04	0.6161E 03	0.1141E 01	0.0	0.3404E 04	6		
QUE MCH9	0.5308E 04	0.4719E 04	0.1783E 04	0.8809E 00	0.0	0.1158E 05	7		
QUE MCH10	0.1667E 04	0.2050E 04	0.7215E 03	0.1102E 01	0.0	0.4725E 04	8		
QUE MCH11	0.1105E 04	0.1804E 04	0.4328E 03	0.1633E 01	0.0	0.4859E 04	8		
QUE MCH12	0.1530E 03	0.2795E 03	0.8428E 02	0.1827E 01	0.0	0.7767E 03	11		
QUE MCH13	0.2071E 04	0.2466E 04	0.1019E 04	0.1197E 01	0.0	0.6523E 04	6		
QUE MCH14	0.9128E 04	0.1880E 04	0.1335E 04	0.2668E 00	0.7793E 04	0.1046E 05	2		
QUE MCH15	0.4980E 04	0.1811E 04	0.1046E 04	0.3638E 00	0.3389E 04	0.6951E 04	3		
EN DAYS	-0.1360E 01	0.1923E 01	0.1360E 01	-0.1414E 01	-0.2720E 01	0.0	2		
LO DAYS	0.4333E 01	0.4389E 01	0.2195E 01	0.1013E 01	0.1369E 01	0.1072E 02	4		
LO SPAYS	-0.0955E 04	0.1266E 05	0.4955E 04	-0.1416E 01	-0.1791E 05	0.0	2		
AN DAYS	0.2455E 01	0.1396E 05	0.6919E 04	0.4459E 00	0.1133E 05	0.4287E 05	4		
AN SPAYS	0.1788E 05	0.4576E 01	0.1068E 01	0.1879E 01	-0.2720E 01	0.1072E 02	6		
MFD LCIS	0.2740E 01	0.2411E 05	0.5842E 01	0.1348E 01	-0.1791E 05	0.4287E 05	6		
P-P LCIS	-0.1478E 01	0.4708E 01	0.6074E 00	0.1718E 01	-0.3595E 01	0.1226E 02	34		
PRT WAIT	0.4017E 04	0.3341E 01	0.9702E 00	-0.2273E 01	-0.4755E 01	0.6757E 01	12		
		0.5398E 04	0.8232E 03	0.1344E 01	0.0	0.1765E 05	43		

CURRENT TIME IS 141120.00
 RMINV- 3129.06 WIP- 210806.15
 AVERAGE SURPANT DELAY- 4.29 DAYS
 QUEUET 11- 3947-
 QUEUET 21- 376-
 QUEUET 31- 1172-
 QUEUET 41- 2572-
 QUEUET 51- 2226-
 QUEUET 61- 1029-
 QUEUET 71- 1379-
 QUEUET 81- 884-
 QUEUET 91- 3504-
 QUEUET 101- 1757-
 QUEUET 111- 396-
 QUEUET 121- 68-
 QUEUET 131- 1450-
 QUEUET 141- 8315-

QUEM (151) - 3869.

UTILIZATION OF MACHINE 1 -0.68
 UTILIZATION OF MACHINE 2 -0.32
 UTILIZATION OF MACHINE 3 -0.49
 UTILIZATION OF MACHINE 4 -0.75
 UTILIZATION OF MACHINE 5 -0.52
 UTILIZATION OF MACHINE 6 -0.46
 UTILIZATION OF MACHINE 7 -0.36
 UTILIZATION OF MACHINE 8 -0.50
 UTILIZATION OF MACHINE 9 -0.72
 UTILIZATION OF MACHINE 10 -0.54
 UTILIZATION OF MACHINE 11 -0.15
 UTILIZATION OF MACHINE 12 -0.02
 UTILIZATION OF MACHINE 13 -0.58
 UTILIZATION OF MACHINE 14 -1.00
 UTILIZATION OF MACHINE 15 -0.98

STATISTICS FOR TIME-PERSISTENT VARIABLES**

	MEAN	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CUR. VALUE
WORKER U	0.0060E 00	0.1079E 00	0.4444E 00	0.1000E 01	0.6048E 05	0.8889E 00
UTL MCH1	0.6754E 00	0.4682E 00	0.0	0.1000E 01	0.6048E 05	0.1000E 01
UTL MCH2	0.3222E 00	0.4673E 00	0.0	0.1000E 01	0.6048E 05	0.0
UTL MCH3	0.5917E 00	0.4999E 00	0.0	0.1000E 01	0.6048E 05	0.1000E 01
UTL MCH4	0.7504E 00	0.4320E 00	0.0	0.1000E 01	0.6048E 05	0.1000E 01
UTL MCH5	0.4231E 00	0.4541E 00	0.0	0.1000E 01	0.6048E 05	0.0
UTL MCH6	0.4591E 00	0.4983E 00	0.0	0.1000E 01	0.6048E 05	0.1000E 01
UTL MCH7	0.3556E 00	0.4787E 00	0.0	0.1000E 01	0.6048E 05	0.0
UTL MCH8	0.4551E 00	0.5000E 00	0.0	0.1000E 01	0.6048E 05	0.0
UTL MCH9	0.7244E 00	0.4468E 00	0.0	0.1000E 01	0.6048E 05	0.0
UTL MCH10	0.5426E 00	0.4922E 00	0.0	0.1000E 01	0.6048E 05	0.1000E 01
UTL MCH11	0.1532E 00	0.3602E 00	0.0	0.1000E 01	0.6048E 05	0.0
UTL MCH12	0.2222E 01	0.1474E 00	0.0	0.1000E 01	0.6048E 05	0.0
UTL MCH13	0.5785E 00	0.4938E 00	0.0	0.1000E 01	0.6048E 05	0.1000E 01
UTL MCH14	0.1000E 01	0.0	0.0	0.1000E 01	0.6048E 05	0.1000E 01
UTL MCH15	0.9804E 00	0.1387E 00	0.0	0.1000E 01	0.6048E 05	0.1000E 01
WIP INV	0.1904E 06	0.3047E 05	0.1283E 06	0.2315E 06	0.6048E 05	0.2108E 06
WHL INV	0.3983E 04	0.2924E 04	0.1040E 03	0.1051E 05	0.6048E 05	0.3129E 04

STATISTICS FOR VARIABLES BASED ON OBSERVATION**

	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM	OBS	
QUE MCH1	0.4800E 04	0.4505E 04	0.1502E 04	0.9384E 00	0.0	0.1415E 05	9	
QUE MCH2	0.2321E 03	0.4324E 03	0.1001E 03	0.1863E 01	0.0	0.1468E 04	16	
QUE MCH3	0.1221E 04	0.2180E 04	0.4546E 03	0.1786E 01	0.0	0.9548E 04	23	
QUE MCH4	0.2112E 04	0.2491E 04	0.6914E 03	0.1180E 01	0.0	0.8422E 04	13	
QUE MCH5	0.2070E 04	0.3655E 04	0.1067E 04	0.1785E 01	0.0	0.1028E 05	12	
QUE MCH6	0.2451E 03	0.4297E 03	0.1296E 03	0.1753E 01	0.0	0.1050E 04	11	
QUE MCH7	0.1453E 04	0.2462E 04	0.7108E 03	0.1695E 01	0.0	0.7120E 04	12	
QUE MCH8	0.9392E 03	0.1233E 04	0.4443E 03	0.1419E 01	0.0	0.3406E 04	9	
QUE MCH9	0.6478E 04	0.4687E 04	0.1482E 04	0.7235E 00	0.0	0.1215E 05	10	
QUE MCH10	0.1494E 04	0.1578E 04	0.6255E 03	0.1324E 01	0.0	0.4725E 04	10	
QUE MCH11	0.1105E 04	0.1864E 04	0.6378E 03	0.1633E 01	0.0	0.4959E 04	8	
QUE MCH12	0.1403E 03	0.2701E 03	0.7797E 02	0.1926E 01	0.0	0.7767E 03	12	
QUE MCH13	0.1805E 04	0.2401E 04	0.9074E 03	0.1330E 01	0.0	0.6523E 04	7	
QUE MCH14	0.7225E 04	0.3566E 04	0.2053E 04	0.4922E 00	0.3419E 04	0.1046E 05	3	
QUE MCH15	0.4980E 04	0.1811E 04	0.1066E 04	0.3638E 00	0.6931E 04	0.6931E 04	3	
END DAYS	-0.9065E 00	0.1570E 01	0.5063E 00	-0.1732E 01	-0.2720E 01	0.0	0.0	3
LN DAYS	0.3881E 01	0.3702E 01	0.1511E 01	0.9539E 00	-0.2431E 00	0.1072E 02	6	

EO DAYS -0.5970E 04
 LO DAYS -0.4533E 05
 AO DAYS 0.2285E 01
 MO DAYS 0.2823E 05
 MFD LOTS 0.3294E 01
 P-P LOTS -0.1716E 01
 PRT BALT 0.4534E 04

0.1034E 05
 0.4894E 05
 0.3422E 01
 0.4671E 05
 0.4684E 01
 0.3308E 01
 0.5700E 04

0.5970E 04
 0.1998E 05
 0.1287E 01
 0.1557E 05
 0.7406E 00
 0.5236E 00
 0.6314E 03

-0.1732E 01
 0.1080E 01
 0.1630E 01
 0.1655E 01
 0.1422E 01
 -0.1940E 01
 0.1257E 01

-0.1791E 05
 0.6196E 04
 -0.2720E 01
 -0.1791E 05
 -0.3595E 01
 -0.4755E 01
 0.0

0.0
 0.1406E 06
 0.1072E 02
 0.1406E 06
 0.1226E 02
 0.6757E 01
 0.1765E 05

3 6 9 9 40 13 47

CURRENT TIME IS 151200.00
 RMINV= 1676.77 WIP= 253269.19
 AVERAGE SHIPART DELAY= 4.41 DAYS

QUEUE(1)= 3670.
 QUEUE(2)= 322.
 QUEUE(3)= 1378.
 QUEUE(4)= 2911.
 QUEUE(5)= 1910.
 QUEUE(6)= 932.
 QUEUE(7)= 1244.
 QUEUE(8)= 840.
 QUEUE(9)= 3162.
 QUEUE(10)= 2433.
 QUEUE(11)= 409.
 QUEUE(12)= 59.
 QUEUE(13)= 1378.
 QUEUE(14)= 8076.
 QUEUE(15)= 4006.

UTILIZATION OF MACHINE 1 -0.72
 UTILIZATION OF MACHINE 2 -0.33
 UTILIZATION OF MACHINE 3 -0.52
 UTILIZATION OF MACHINE 4 -0.77
 UTILIZATION OF MACHINE 5 -0.40
 UTILIZATION OF MACHINE 6 -0.46
 UTILIZATION OF MACHINE 7 -0.33
 UTILIZATION OF MACHINE 8 -0.45
 UTILIZATION OF MACHINE 9 -0.66
 UTILIZATION OF MACHINE 10 -0.61
 UTILIZATION OF MACHINE 11 -0.17
 UTILIZATION OF MACHINE 12 -0.02
 UTILIZATION OF MACHINE 13 -0.56
 UTILIZATION OF MACHINE 14 -1.00
 UTILIZATION OF MACHINE 15 -0.98

STATISTICS FOR TIME-PERSISTENT VARIABLES

WORKER U	MEAN	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CUR. VALUE
UTL MC01	0.8841E 00	0.1081E 00	0.4444E 00	0.1000E 01	0.7056E 05	0.1000E 01
UTL MC02	0.7217E 00	0.4481E 00	0.0	0.1000E 01	0.7056E 05	0.1000E 01
UTL MC03	0.3319E 00	0.4709E 00	0.0	0.1000E 01	0.7056E 05	0.0
UTL MC04	0.5207E 00	0.4956E 00	0.0	0.1000E 01	0.7056E 05	0.1000E 01
UTL MC05	0.7722E 00	0.4194E 00	0.0	0.1000E 01	0.7056E 05	0.1000E 01
UTL MC06	0.3987E 00	0.4856E 00	0.0	0.1000E 01	0.7056E 05	0.1000E 01
UTL MC07	0.4602E 00	0.4984E 00	0.0	0.1000E 01	0.7056E 05	0.1000E 01
UTL MC08	0.3281E 00	0.4695E 00	0.0	0.1000E 01	0.7056E 05	0.0
UTL MC09	0.4544E 00	0.4510E 00	0.0	0.1000E 01	0.7056E 05	0.0
UTL MC10	0.6508E 00	0.4741E 00	0.0	0.1000E 01	0.7056E 05	0.0
UTL MC11	0.4077E 00	0.4683E 00	0.0	0.1000E 01	0.7056E 05	0.1000E 01
UTL MC12	0.1718E 00	0.3772E 00	C.C	0.1000E 01	0.7056E 05	0.0
UTL MC13	0.2357E-01	0.1517E 00	0.0	0.1000E 01	0.7056E 05	0.0
UTL MC14	0.5563E 00	0.4588E 00	0.0	0.1000E 01	0.7056E 05	0.1000E 01

STATISTICS FOR VARIABLES BASED ON OBSERVATIONS									
	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM	ORS		
UTL MC14	0.1000E 01	0.0	0.0	0.1000E 01	0.7056E 05	0.1000E 01	12		
UTL MC15	0.5781E 00	0.1464E 00	0.0	0.1000E 01	0.7056E 05	0.1000E 01	19		
WIP INVT	0.1956E 06	0.1169E 05	0.2283E 06	0.2533E 06	0.7056E 05	0.2533E 06	31		
RML INV	0.3958E 04	0.2763E 04	0.1040E 03	0.1051E 05	0.7056E 05	0.1677E 04	16		
QUE MC11	0.4099E 04	0.4071E 04	0.1176E 04	0.9938E 00	0.0	0.1415E 05	15		
QUE MC12	0.1955E 04	0.4042E 03	0.9273E 02	0.2068E 01	0.0	0.1468E 04	19		
QUE MC13	0.1394E 04	0.2277E 04	0.4090E 03	0.1645E 01	0.0	0.9548E 04	31		
QUE MC14	0.2639E 04	0.3659E 04	0.9147E 03	0.1386E 01	0.0	0.1333E 05	16		
QUE MC15	0.1659E 04	0.3385E 04	0.6739E 03	0.2041E 01	0.0	0.1028E 05	15		
QUE MC16	0.2127E 03	0.4004E 03	0.1111E 03	0.1802E 01	0.0	0.1050E 04	13		
QUE MC17	0.1245E 04	0.2326E 04	0.6216E 03	0.1868E 01	0.0	0.1120E 04	14		
QUE MC18	0.8652E 03	0.1291E 04	0.4084E 03	0.1520E 01	0.0	0.3406E 04	10		
QUE MC19	0.5399E 04	0.4933E 04	0.1524E 04	0.9137E 00	0.0	0.1215E 05	12		
QUE MC10	0.2680E 04	0.3555E 04	0.1026E 04	0.1327E 01	0.0	0.1173E 05	12		
QUE MC11	0.9881E 03	0.1628E 04	0.2150E 03	0.1649E 01	0.0	0.4859E 04	10		
QUE MC12	0.1130E 03	0.2460E 03	0.6351E 02	0.2176E 01	0.0	0.7767E 03	15		
QUE MC13	0.1580E 04	0.2313E 04	0.8176E 03	0.1664E 01	0.0	0.6523E 04	8		
QUE MC14	0.6299E 04	0.3443E 04	0.1722E 04	0.5666E 00	0.3419E 04	0.1046E 05	4		
QUE MC15	0.5380E 04	0.1690E 04	0.6445E 03	0.3136E 00	0.3389E 04	0.6951E 04	4		
ED DAYS	-0.6799E 00	0.1360E 01	0.6799E 00	-0.2000E 01	-0.2720E 01	0.0	4		
LD DAYS	0.3881E 01	0.3722E 01	0.1511E 01	0.9539E 00	0.9431E 00	0.0	6		
RD DAYS	-0.4478E 04	0.8955E 04	0.4478E 04	-0.2000E 01	-0.1791E 05	0.0	4		
AD DAYS	0.5533E 05	0.8894E 05	0.1998E 05	0.1800E 01	0.6196E 04	0.1406E 04	4		
MD DAYS	0.2057E 01	0.3712E 01	0.1174E 01	0.1805E 01	-0.2720E 01	0.1072E 02	10		
PD LOTS	0.2541E 05	0.4494E 05	0.1621E 05	0.1769E 01	-0.1791E 05	0.1406E 04	10		
MFO LOTS	0.4051E 01	0.4478E 01	0.6150E 00	0.1105E 01	-0.3595E 01	0.1226E 02	53		
P-P LOTS	-0.9123E 00	0.3457E 01	0.8384E 00	-0.3789E 01	-0.4755E 01	0.6757E 01	17		
PAT WAIT	0.5131E 04	0.5544E 04	0.7098E 03	0.1081E 01	0.0	0.1765E 05	61		

CURRENT TIME IS 161280.00
 RMINV- 3635.15 WIP- 214675.56
 AVERAGE SUBPART DELAY- 4.21 DAYS
 QUEUET 11- 3667.
 QUEUET 21- 493.
 QUEUET 31- 1407.
 QUEUET 41- 3388.
 QUEUET 51- 2048.
 QUEUET 61- 1284.
 QUEUET 71- 1144.
 QUEUET 81- 1419.
 QUEUET 91- 3041.
 QUEUET 101- 2312.
 QUEUET 111- 389.
 QUEUET 121- 56.
 QUEUET 131- 1609.
 QUEUET 141- 8076.
 QUEUET 151- 4006.
 UTILIZATION OF MACHINE 1 -0.74
 UTILIZATION OF MACHINE 2 -0.30
 UTILIZATION OF MACHINE 3 -0.55
 UTILIZATION OF MACHINE 4 -0.80
 UTILIZATION OF MACHINE 5 -0.45
 UTILIZATION OF MACHINE 6 -0.47
 UTILIZATION OF MACHINE 7 -0.33

UTILIZATION OF MACHINE 9 =0.43
 UTILIZATION OF MACHINE 9 =0.60
 UTILIZATION OF MACHINE 10 =0.60
 UTILIZATION OF MACHINE 11 =0.16
 UTILIZATION OF MACHINE 12 =0.07
 UTILIZATION OF MACHINE 13 =0.56
 UTILIZATION OF MACHINE 14 =1.00
 UTILIZATION OF MACHINE 15 =0.90

STATISTICS FOR TIME-PERSISTENT VARIABLES

	MEAN	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CUR. VALUE
LEADER 11	0.0970E 01	0.1066E 00	0.4444E 00	0.1000E 01	0.8064E 05	0.1000E 01
UTL MCH1	0.7387E 00	0.4353E 00	0.0	0.1000E 01	0.8064E 05	0.0
UTL MCH2	0.3755E 03	0.4843E 00	0.0	0.1000E 01	0.8064E 05	0.0
UTL MCH3	0.5545E 00	0.4970E 00	0.0	0.1000E 01	0.8064E 05	0.1000E 01
UTL MCH4	0.8006E 00	0.3955E 00	0.0	0.1000E 01	0.8064E 05	0.1000E 01
UTL MCH5	0.5544E 00	0.4979E 00	0.0	0.1000E 01	0.8064E 05	0.0
UTL MCH6	0.5664E 00	0.4589E 00	0.0	0.1000E 01	0.8064E 05	0.0
UTL MCH7	0.3147E 00	0.4719E 00	0.0	0.1000E 01	0.8064E 05	0.1000E 01
UTL MCH8	0.4236E 00	0.4944E 00	0.0	0.1000E 01	0.8064E 05	0.1000E 01
UTL MCH9	0.5908E 00	0.4941E 00	0.0	0.1000E 01	0.8064E 05	0.1000E 01
UTL MCH10	0.6024E 00	0.4894E 00	0.0	0.1000E 01	0.8064E 05	0.1000E 01
UTL MCH11	0.1556E 00	0.3625E 00	0.0	0.1000E 01	0.8064E 05	0.1000E 01
UTL MCH12	0.2212E 01	0.1471E 00	0.0	0.1000E 01	0.8064E 05	0.0
UTL MCH13	0.5631E 00	0.4960E 00	0.0	0.1000E 01	0.8064E 05	0.0
UTL MCH14	0.1000E 01	0.0	0.0	0.1000E 01	0.8064E 05	0.1000E 01
UTL MCH15	0.9808E 00	0.1193E 05	0.0	0.1000E 01	0.8064E 05	0.1000E 01
WIP INV	0.1997E 06	0.1372E 00	0.0	0.2547E 06	0.8064E 05	0.2147E 06
RMT INV	0.3846E 04	0.2435E 04	0.1040E 03	0.1051E 05	0.8064E 05	0.3635E 04

STATISTICS FOR VARIABLES BASED ON OBSERVATION

	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM	OBS
QUE MCH1	0.4044E 04	0.3924E 04	0.1049E 04	0.9703E 00	0.0	0.1415E 05	14
QUE MCH2	0.3891E 03	0.6652E 03	0.1358E 03	0.1709E 01	0.0	0.2854E 04	24
QUE MCH3	0.1394E 04	0.2185E 04	0.3691E 03	0.1568E 01	0.0	0.9548E 04	35
QUE MCH4	0.3210E 04	0.3844E 04	0.9081E 03	0.1198E 01	0.0	0.1333E 05	18
QUE MCH5	0.1852E 04	0.2226E 04	0.7827E 03	0.1741E 01	0.0	0.1020E 05	17
QUE MCH6	0.7670E 03	0.2109E 04	0.5637E 03	0.2750E 01	0.0	0.7973E 04	14
QUE MCH7	0.1116E 04	0.1219E 04	0.5488E 03	0.1967E 01	0.0	0.7120E 04	16
QUE MCH8	0.1815E 04	0.3275E 04	0.9451E 03	0.1805E 01	0.0	0.1149E 05	12
QUE MCH9	0.4908E 04	0.4768E 04	0.1274E 04	0.9715E 00	0.0	0.1215E 05	14
QUE MCH10	0.2474E 04	0.3484E 04	0.9663E 03	0.1409E 01	0.0	0.1173E 05	13
QUE MCH11	0.8938E 03	0.1571E 04	0.4744E 03	0.1751E 01	0.0	0.4859E 04	16
QUE MCH12	0.1060E 03	0.2353E 03	0.5983E 02	0.2259E 01	0.0	0.6523E 04	9
QUE MCH13	0.2071E 04	0.2618E 04	0.8728E 03	0.1264E 01	0.0	0.1046E 05	4
QUE MCH14	0.6299E 04	0.3443E 04	0.1722E 04	0.5466E 00	0.3419E 04	0.1046E 05	4
QUE MCH15	0.5388E 04	0.1690E 04	0.6449E 03	0.3136E 00	0.3389E 04	0.6951E 04	4
ED DAYS	0.6799E 00	0.1360E 01	0.6799E 00	-0.2000E 01	-0.2720E 01	0.0	4
ED DAYS	0.4766E 01	0.3501E 01	0.1107E 01	0.7345E 00	-0.1791E 05	0.0	4
ED DAYS	0.4478E 04	0.8955E 04	0.4478E 04	-0.2000E 01	-0.1791E 05	0.0	4
AN DAYS	0.6679E 05	0.7424E 05	0.2348E 05	0.1112E 01	0.6196E 04	0.2250E 06	10
AN DAYS	0.3210E 01	0.3928E 01	0.1650E 01	0.1224E 01	-0.2120E 01	0.1072E 02	14
AN DAYS	0.4643E 05	0.7036E 05	0.1880E 05	0.1515E 01	-0.1791E 05	0.2250E 06	14
ED DAYS	0.4372E 01	0.4373E 01	0.5694E 00	0.1000E 01	-0.3595E 01	0.1226E 02	59
P-P LC15	0.9822E 00	0.3367E 01	0.7936E 00	-0.3428E 01	-0.4755E 01	0.6757E 01	18
PRT WAIT	0.5147E 04	0.5445E 04	0.8693E 03	0.1058E 01	0.0	0.1765E 05	68

CURRENT TIME IS 171360.00
 RPNV= 4072.53 MID= 204530.41
 AVERAGE SUPPLY DELAY= 4.71 DAYS

QUEUET 11= 3931.
 QUEUET 21= 562.
 QUEUET 31= 1180.
 QUEUET 41= 3920.
 QUEUET 51= 1056.
 QUEUET 61= 1101.
 QUEUET 71= 1521.
 QUEUET 81= 1351.
 QUEUET 91= 2920.
 QUEUET 101= 2178.
 QUEUET 111= 465.
 QUEUET 121= 45.
 QUEUET 131= 1476.
 QUEUET 141= 8076.
 QUEUET 151= 1876.
 UTILIZATION OF MACHINE 1 -0.76
 UTILIZATION OF MACHINE 2 -0.38
 UTILIZATION OF MACHINE 3 -0.58
 UTILIZATION OF MACHINE 4 -0.79
 UTILIZATION OF MACHINE 5 -0.41
 UTILIZATION OF MACHINE 6 -0.43
 UTILIZATION OF MACHINE 7 -0.36
 UTILIZATION OF MACHINE 8 -0.48
 UTILIZATION OF MACHINE 9 -0.62
 UTILIZATION OF MACHINE 10 -0.63
 UTILIZATION OF MACHINE 11 -0.17
 UTILIZATION OF MACHINE 12 -0.02
 UTILIZATION OF MACHINE 13 -0.55
 UTILIZATION OF MACHINE 14 -0.94
 UTILIZATION OF MACHINE 15 -0.96

	MEAN	STD DEV	**STATISTICS FOR TIME-PERSISTENT VARIABLES**				CUR. VALUE
			MINIMUM	MAXIMUM	TIME INTERVAL		
WORKER U	0.0964E 00	0.1003E 00	0.4444E 00	0.1000E 01	0.9072E 05	0.6667E 00	
UTL MCH1	0.7575E 00	0.4286E 00	0.0	0.1000E 01	0.9072E 05	0.1000E 01	
UTL MCH2	0.3767E 00	0.4846E 00	0.0	0.1000E 01	0.9072E 05	0.0	
UTL MCH3	0.5777E 00	0.4939E 00	0.0	0.1000E 01	0.9072E 05	0.0	
UTL MCH4	0.7878E 00	0.4088E 00	0.0	0.1000E 01	0.9072E 05	0.1000E 01	
UTL MCH5	0.4065E 00	0.4912E 00	0.0	0.1000E 01	0.9072E 05	0.0	
UTL MCH6	0.4318E 00	0.4933E 00	0.0	0.1000E 01	0.9072E 05	0.0	
UTL MCH7	0.3581E 00	0.4794E 00	0.0	0.1000E 01	0.9072E 05	0.0	
UTL MCH8	0.4798E 00	0.4996E 00	0.0	0.1000E 01	0.9072E 05	0.1000E 01	
UTL MCH9	0.6217E 00	0.4650E 00	0.0	0.1000E 01	0.9072E 05	0.1000E 01	
UTL MCH10	0.6207E 00	0.4831E 00	0.0	0.1000E 01	0.9072E 05	0.0	
UTL MCH11	0.1745E 00	0.3795E 00	0.0	0.1000E 01	0.9072E 05	0.0	
UTL MCH12	0.2476E-01	0.1554E 00	0.0	0.1000E 01	0.9072E 05	0.0	
UTL MCH13	0.5405E 00	0.4976E 00	0.0	0.1000E 01	0.9072E 05	0.1000E 01	
UTL MCH14	0.9377E 00	0.2417E 00	0.0	0.1000E 01	0.9072E 05	0.0	
UTL MCH15	0.9566E 00	0.2037E 00	0.0	0.1000E 01	0.9072E 05	0.1000E 01	
WIP INV	0.2014E 06	0.3077E 05	0.1203E 06	0.2567E 06	0.9072E 05	0.2045E 06	
RML INV	0.3787E 04	0.2497E 04	0.1040E 03	0.1051E 05	0.9072E 05	0.4073E 04	
	MEAN	STD DEV	**STATISTICS FOR VARIABLES BASED ON CONSERVATION**		MINIMUM	MAXIMUM	
			SD OF MEAN	CV			

STATISTICS FOR VARIABLES BASED ON CONSERVATION

MEAN

STD DEV

SD OF MEAN

CV

MINIMUM

MAXIMUM

ODS

QUE MCH1	0.432E 04	0.404E 04	C.1012E 04	C.9364E 00	0.0	0.0	0.1415E 05	16
QUE MCH2	0.3762E 03	0.6401E 03	0.1232E 03	0.1702E 01	0.0	0.0	0.2854E 04	27
QUE MCH3	0.1614E 04	0.2790E 04	0.3576E 03	0.1519E 01	0.0	0.0	0.9548E 04	41
QUE MCH4	0.3794E 04	0.4110E 04	0.8779E 03	0.1085E 01	0.0	0.0	0.1333E 05	22
QUE MCH5	0.1666E 04	0.3092E 04	0.7094E 03	0.1857E 01	0.0	0.0	0.1028E 05	19
QUE MCH6	0.6317E 03	0.1925E 04	0.4669E 03	0.3048E 01	0.0	0.0	0.1973E 04	17
QUE MCH7	0.1520E 04	0.2514E 04	0.5622E 03	0.1645E 01	0.0	0.0	0.7120E 04	20
QUE MCH8	0.1657E 04	0.3043E 04	0.8134E 03	0.1837E 01	0.0	0.0	0.1149E 05	14
QUE MCH9	0.4623E 04	0.4726E 04	C.122CF 04	0.1022E 01	0.0	0.0	0.1215E 05	15
QUE MCH10	0.2255E 04	0.3240E 04	0.8099E 03	0.1436E 01	0.0	0.0	0.1173E 05	16
QUE MCH11	0.8961E 03	0.1459E 04	0.3858E 03	0.1628E 01	0.0	0.0	0.4859E 04	14
QUE MCH12	0.8274E 02	0.2117E 03	0.4621E 02	0.2559E 01	0.0	0.0	0.7767E 03	21
QUE MCH13	0.1740E 04	0.2457E 04	0.7409E 03	0.1412E 01	0.0	0.0	0.6523E 04	11
QUE MCH14	0.6290E 04	0.3443E 04	0.1722E 04	0.5466E 00	0.3419E 04	0.1395E 04	0.1046E 05	4
QUE MCH15	0.5590E 04	0.2309E 04	0.1033E 04	0.5031E 00	0.1395E 04	0.1395E 04	0.6951E 04	5
ED DAYS	-0.5439E 00	0.1214E 01	0.5439E 00	-0.2236E 01	-0.2720E 01	0.0	0.0	5
ED DAYS	-0.4719E 01	0.3409E 01	0.9456E 00	0.7225E 00	0.1843E 00	0.1072E 02	0.0	13
ED DAYS	-0.3582E 04	0.8010E 04	0.3582E 04	-0.2236E 01	-0.1791E 05	0.0	0.0	5
ED DAYS	0.8874E 05	0.7439E 05	0.2043E 05	0.1082E 01	0.1214E 04	0.2250E 06	0.0	13
AD DAYS	0.3257E 01	0.3799E 01	0.8955E 00	0.1167E 01	-0.2720E 01	0.1072E 02	0.0	18
AD DAYS	0.4865E 05	0.7694E 05	0.1672E 05	0.1450E 01	-0.1791E 05	0.2250E 06	0.0	18
PD LOTS	0.5602E 01	0.4070E 01	0.4764E 00	0.8844E 00	-0.3595E 01	0.1226E 02	0.0	73
P-P LOTS	-0.1884E 01	0.3903E 01	0.9517E 00	-0.2072E 01	-0.8804E 01	0.6757E 01	0.0	21
PRI WAIT	0.5490E 04	0.5264E 04	0.5999E 03	0.9589E 00	0.0	0.0	0.1765E 05	77

CURRENT TIME IS 181440.00

RPNV= 4955.29 MIP= 237307.94

AVERAGE SUBPART DELAY= 4.56 DAYS

QUEUFI 11= 4074.

QUEUFI 21= 431.

QUEUFI 31= 1371.

QUEUFI 41= 3597.

QUEUFI 51= 1734.

QUEUFI 61= 1310.

QUEUFI 71= 1445.

QUEUFI 81= 1298.

QUEUFI 91= 3116.

QUEUFI 101= 2326.

QUEUFI 111= 442.

QUEUFI 121= 43.

QUEUFI 131= 1492.

QUEUFI 141= 8076.

QUEUFI 151= 30764.

UTILIZATION OF MACHINE 1 =0.78

UTILIZATION OF MACHINE 2 =0.39

UTILIZATION OF MACHINE 3 =0.58

UTILIZATION OF MACHINE 4 =0.80

UTILIZATION OF MACHINE 5 =0.41

UTILIZATION OF MACHINE 6 =0.48

UTILIZATION OF MACHINE 7 =0.33

UTILIZATION OF MACHINE 8 =0.46

UTILIZATION OF MACHINE 9 =0.64

UTILIZATION OF MACHINE 10 =0.63

UTILIZATION OF MACHINE 11 =0.16

UTILIZATION OF MACHINE 12 =0.02

UTILIZATION OF MACHINE 13 =0.58

UTILIZATION OF MACHINE 14 =0.04

UTILIZATION OF MACHINE 15 =0.76

STATISTICS FOR TIME-PERSISTENT VARIABLES									
	MEAN	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CUR. VALUE			
WIPKPR U	0.897E 00	0.1076E 00	0.4444E 00	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	20	
UTL MCH1	0.7817E 00	0.4131E 00	0.0	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	31	
UTL MCH2	0.3079E 00	0.4873E 00	0.0	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	48	
UTL MCH3	0.5752E 00	0.4943E 00	0.0	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	24	
UTL MCH4	0.8004E 00	0.3997E 00	0.0	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	21	
UTL MCH5	0.4071E 00	0.4913E 00	0.0	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	19	
UTL MCH6	0.4761E 00	0.4554E 00	0.0	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	15	
UTL MCH7	0.3319E 00	0.4708E 00	0.0	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	12	
UTL MCH8	0.4593E 00	0.4583E 00	0.0	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	14	
UTL MCH9	0.6555E 00	0.4752E 00	0.0	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	5	
UTL MCH10	0.6346E 00	0.4915E 00	0.0	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	5	
UTL MCH11	0.1610E 00	0.3675E 00	0.0	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	14	
UTL MCH12	0.2337E-01	0.1511E 00	0.0	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	14	
UTL MCH13	0.5177E 00	0.4539E 00	0.0	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	19	
UTL MCH14	0.8439E 00	0.3629E 00	0.0	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	19	
UTL MCH15	0.9610E 00	0.1937E 00	0.0	0.1000E 01	0.1000E 06	0.1000E 01	0.1000E 01	19	
WIP INVT	0.2034E 06	0.2954E 05	0.1283E 06	0.2567E 06	0.1000E 06	0.2373E 06	0.2373E 06	19	
WIP L TW	0.3027E 04	0.2461E 04	0.1040E 03	0.1051E 05	0.1000E 06	0.4955E 04	0.4955E 04	24	

STATISTICS FOR VARIABLES BASED ON OBSERVATIONS									
	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM	OBS		
QUE MCH1	0.4417E 04	0.3754E 04	0.8394E 03	0.1701E 01	0.0	0.1415E 05	20		
QUE MCH2	0.3671E 03	0.6245E 03	0.1122E 03	0.1701E 01	0.0	0.2854E 04	31		
QUE MCH3	0.1439E 04	0.2161E 04	0.3115E 03	0.1502E 01	0.0	0.9548E 04	48		
QUE MCH4	0.3521E 04	0.4045E 04	0.8257E 03	0.1149E 01	0.0	0.1333E 05	24		
QUE MCH5	0.1567E 04	0.2554E 04	0.6546E 03	0.1889E 01	0.0	0.1028E 05	21		
QUE MCH6	0.9089E 03	0.2013E 04	0.4617E 03	0.2214E 01	0.0	0.7973E 04	19		
QUE MCH7	0.1455E 04	0.2473E 04	0.5397E 03	0.1700E 01	0.0	0.7120E 04	21		
QUE MCH8	0.1566E 04	0.2954E 04	0.7626E 03	0.1887E 01	0.0	0.1149E 05	15		
QUE MCH9	0.4520E 04	0.4398E 04	0.1009E 04	0.1379E 01	0.0	0.1215E 05	19		
QUE MCH10	0.2426E 04	0.3347E 04	0.7688E 03	0.1379E 01	0.0	0.1173E 05	18		
QUE MCH11	0.8167E 03	0.1425E 04	0.3678E 03	0.1703E 01	0.0	0.4859E 04	15		
QUE MCH12	0.7898E 02	0.2074E 03	0.4422E 02	0.2626E 01	0.0	0.7167E 03	22		
QUE MCH13	0.1745E 04	0.2343E 04	0.6164E 03	0.1362E 01	0.0	0.6523E 04	12		
QUE MCH14	0.6299E 04	0.3443E 04	0.1722E 04	0.5466E 00	0.3419E 04	0.1046E 05	4		
EO DAYS	-0.5439E 00	0.2309E 04	0.1033E 04	0.5031E 00	0.1395E 04	0.6951E 04	5		
EO DAYS	-0.3582E 04	0.8010E 04	0.5439E 00	-0.2236E 01	-0.2720E 01	0.0	5		
LO DAYS	0.4790E 01	0.3266E 01	0.8783E 00	-0.2236E 01	-0.1843E 00	0.1072E 02	14		
AN DAYS	0.6852E 05	0.7196E 05	0.1923E 05	0.1082E 01	0.1214E 04	0.2250E 06	14		
AN DAYS	0.3806E 05	0.3135E 05	0.8569E 00	0.1103E 01	-0.2720E 01	0.1072E 02	19		
WFO LOTS	0.4816E 01	0.6899E 05	0.1583E 05	0.1435E 01	-0.1791E 05	0.2250E 06	19		
PRI LOTS	-0.1895E 01	0.4013E 01	0.4466E 00	0.8337E 00	-0.3595E 01	0.1226E 02	80		
PRI WAIT	0.5594E 04	0.3645E 04	0.7440E 00	-0.1924E 01	-0.8804E 01	0.6157E 01	24		
		0.5329E 04	0.5713E 03	0.9525E 00	0.0	0.1765E 05	87		

CURRENT TIME IS 191520.00
 RMV= 4227.36 WIP= 210276.25
 AVERAGE SUBPART DELAY= 4.12 DAYS
 QUEUE1 11= 4154
 QUEUE1 21= 685
 QUEUE1 31= 1042
 QUEUE1 41= 3647

STATISTICS FOR TIME-PERSISTENT VARIABLES									
	MEAN	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CUR. VALUE			
QUEUF 51 = 2121.									
QUEUF 61 = 1244.									
QUEUF 71 = 1458.									
QUEUF 81 = 1233.									
QUEUF 91 = 3116.									
QUEUF 101 = 2326.									
QUEUF 111 = 399.									
QUEUF 121 = 39.									
QUEUF 131 = 1537.									
QUEUF 141 = 7901.									
QUEUF 151 = 5316.									
UTILIZATION OF MACHINE 1 = 0.80									
UTILIZATION OF MACHINE 2 = 0.41									
UTILIZATION OF MACHINE 3 = 0.60									
UTILIZATION OF MACHINE 4 = 0.01									
UTILIZATION OF MACHINE 5 = 0.44									
UTILIZATION OF MACHINE 6 = 0.47									
UTILIZATION OF MACHINE 7 = 0.33									
UTILIZATION OF MACHINE 8 = 0.53									
UTILIZATION OF MACHINE 9 = 0.69									
UTILIZATION OF MACHINE 10 = 0.63									
UTILIZATION OF MACHINE 11 = 0.17									
UTILIZATION OF MACHINE 12 = 0.02									
UTILIZATION OF MACHINE 13 = 0.59									
UTILIZATION OF MACHINE 14 = 0.80									
UTILIZATION OF MACHINE 15 = 0.95									
STATISTICS FOR VARIABLES BASED ON OBSERVATIONS									
	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM			OBS
WORKER U	0.9061E 00	0.1066E 00	0.4444E 00	0.1000E 01	0.1109E 06	0.1000E 01			
UTL MCH1	0.8016E 00	0.3588E 00	0.0	0.1000E 01	0.1109E 06	0.1000E 01			
UTL MCH2	0.4092E 00	0.5517E 00	0.0	0.1000E 01	0.1109E 06	0.1000E 01			
UTL MCH3	0.6049E 00	0.4889E 00	0.0	0.1000E 01	0.1109E 06	0.1000E 01			
UTL MCH4	0.8146E 00	0.3887E 00	0.0	0.1000E 01	0.1109E 06	0.1000E 01			
UTL MCH5	0.4356E 00	0.4558E 00	0.0	0.1000E 01	0.1109E 06	0.1000E 01			
UTL MCH6	0.4741E 00	0.4553E 00	0.0	0.1000E 01	0.1109E 06	0.1000E 01			
UTL MCH7	0.3295E 00	0.4700E 00	0.0	0.1000E 01	0.1109E 06	0.1000E 01			
UTL MCH8	0.4305E 00	0.4551E 00	0.0	0.1000E 01	0.1109E 06	0.1000E 01			
UTL MCH9	0.6863E 00	0.4640E 00	0.0	0.1000E 01	0.1109E 06	0.1000E 01			
UTL MCH10	0.6309E 00	0.4827E 00	0.0	0.1000E 01	0.1109E 06	0.1000E 01			
UTL MCH11	0.1713E 00	0.3768E 00	0.0	0.1000E 01	0.1109E 06	0.1000E 01			
UTL MCH12	0.2422E 01	0.1537E 00	0.0	0.1000E 01	0.1109E 06	0.1000E 01			
UTL MCH13	0.5692E 00	0.4920E 00	0.0	0.1000E 01	0.1109E 06	0.1000E 01			
UTL MCH14	0.8015E 00	0.3989E 00	0.0	0.1000E 01	0.1109E 06	0.1000E 01			
UTL MCH15	0.9525E 00	0.2127E 00	0.0	0.1000E 01	0.1109E 06	0.1000E 01			
WIP INV1	0.2056E 06	0.2950E 05	0.1282E 06	0.2567E 06	0.1109E 06	0.2103E 06			
RMTL INV	0.3639E 04	0.2479E 04	0.1040E 03	0.1051E 05	0.1109E 06	0.4227E 04			
STATISTICS FOR VARIABLES BASED ON OBSERVATIONS									
	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM			OBS
QUE MCH1	0.4439E 04	0.3619E 04	0.7544E 03	0.815CE 00	0.0	0.1415E 05			23
QUE MCH2	0.5371E 03	0.8109E 03	0.1383E 03	0.1547E 01	0.0	0.2006E 04			36
QUE MCH3	0.1293E 04	0.2079E 04	0.2825E 03	0.1608E 01	0.0	0.9548E 04			54
QUE MCH4	0.3549E 04	0.4148E 04	0.1983E 03	0.1162E 01	0.0	0.1333E 05			27
QUE MCH5	0.1935E 04	0.3173E 04	0.6476E 03	0.1639E 01	0.0	0.1028E 05			24
QUE MCH6	0.8634E 03	0.1569E 04	0.4404E 03	0.2281E 01	0.0	0.7973E 04			20
QUE MCH7	0.1458E 04	0.2414E 04	0.5146E 03	0.1456E 01	0.0	0.7120E 04			22

QUE MCH9	0.1560E 04	0.2080E 04	C.7201E 03	0.1962E 01	0.0	0.1149E 05	16
QUE MCH9	0.5200E 04	0.4390E 04	0.1009E 04	0.9230E 00	0.0	0.1215E 05	19
QUE MCH9	0.2426E 04	0.3747E 04	C.7800E 03	0.1379E 01	0.0	0.1173E 05	18
QUE MCH9	0.7379E 03	0.1361E 04	0.3301E 03	0.1845E 01	0.0	0.4859E 04	17
QUE MCH9	0.7240E 02	0.1554E 03	0.4071E 02	0.2755E 01	0.0	0.7767E 03	24
QUE MCH9	0.1761E 04	0.2295E 04	0.6134E 03	0.1280E 01	0.0	0.6523E 04	14
QUE MCH9	0.5955E 04	0.3080E 04	0.1337E 04	0.5171E 00	0.3419E 04	0.1046E 05	5
QUE MCH9	0.5939E 04	0.3057E 04	0.1591E 04	0.6562E 00	0.1395E 04	0.1269E 05	6
FO DAYS	-0.5333E 00	0.1110E 01	0.4533E 00	-0.2449E 01	-0.2720E 01	0.0	6
FO DAYS	0.5343E 01	0.3325E 01	0.7037E 00	0.6223E 00	0.1843E 00	0.1072E 02	18
FO DAYS	-0.2985E 04	0.7312E 04	0.2985E 04	-0.2449E 01	-0.1791E 05	0.0	6
AD DAYS	0.3094E 01	0.8333E 05	0.1564E 05	0.1063E 01	0.1214E 04	0.2514E 06	18
AD DAYS	0.5806E 05	0.3875E 01	0.7909E 00	0.9951E 00	-0.2720E 01	0.1072E 02	24
MD LOTS	0.4944E 01	0.8025E 05	0.1630E 05	0.1382E 01	-0.1791E 05	0.2514E 06	24
P-P LOTS	-0.1090E 01	0.3910E 01	0.4144E 00	0.7908E 00	-0.3595E 01	0.1224E 02	69
PRT WAIT	0.5523E 04	0.5220E 04	0.7136E 00	-0.1888E 01	-0.8804E 01	0.6157E 01	25
			0.5335E 03	0.5466E 00	0.0	0.1165E 05	96

CURRENT TIME IS 201600.00
 RPNV= 3322.58 MIP= 223698.06
 AVERAGE SUPPORT DELAY= 4.44 DAYS

QUEUET 11=	4026.
QUEUET 21=	618.
QUEUET 31=	981.
QUEUET 41=	3610.
QUEUET 51=	2249.
QUEUET 61=	1713.
QUEUET 71=	1438.
QUEUET 81=	1223.
QUEUET 91=	3310.
QUEUET 101=	2136.
QUEUET 111=	399.
QUEUET 121=	35.
QUEUET 131=	1501.
QUEUET 141=	7901.
QUEUET 151=	4316.

	MEAN	STD DEV	**STATISTICS FOR TIME-PERSISTENT VARIABLES**			CUR. VALUE
			MINIMUM	MAXIMUM	TIME INTERVAL	
WORKER U	0.9064E 00	0.1179E 00	0.5444E 00	0.1000E 01	0.1210E 06	0.4667E 00
UTL MCH1	0.9101E 00	0.3050E 00	0.0	0.1000E 01	0.1210E 06	0.1000E 01
UTL MCH2	0.3975E 00	0.5894E 00	0.0	0.1000E 01	0.1210E 06	0.0
UTL MCH3	0.6076E 00	0.4883E 00	0.0	0.1000E 01	0.1210E 06	0.0

STATISTICS FOR VARIABLES BASED ON OBSERVATION							
	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM	UBS
UTL MCH4	0.8209E 00	0.3835E 00	0.0	0.1000E 01	0.1210E 06	0.1000E 01	
UTL MCH5	0.4137E 00	0.4927E 00	0.0	0.1000E 01	0.1210E 06	0.0	
UTL MCH6	0.5824E 00	0.4997E 00	0.0	0.1000E 01	0.1210E 06	0.0	
UTL MCH7	0.1604E 00	0.4801E 00	0.0	0.1000E 01	0.1210E 06	0.0	
UTL MCH8	0.4282E 00	0.4948E 00	C.C	0.1000E 01	0.1210E 06	0.1000E 01	
UTL MCH9	0.6842E 00	0.4648E 00	0.0	0.1000E 01	0.1210E 06	0.1000E 01	
UTL MCH10	0.6230E 00	0.4644E 00	0.0	0.1000E 01	0.1210E 06	0.1000E 01	
UTL MCH11	0.1571E 00	0.3639E 00	0.0	0.1000E 01	0.1210E 06	0.0	
UTL MCH12	0.2287E-01	0.1495E 00	0.0	0.1000E 01	0.1210E 06	0.0	
UTL MCH13	0.5906E 00	0.4917E 00	0.0	0.1000E 01	0.1210E 06	0.0	
UTL MCH14	0.7949E 00	0.4039E 00	0.0	0.1000E 01	0.1210E 06	0.0	
UTL MCH15	0.5945E 00	0.2041E 00	0.0	0.1000E 01	0.1210E 06	0.1000E 01	
WIP INV	0.2063E 06	0.2841E 05	0.1283E 06	0.2567E 06	0.1210E 06	0.2237E 06	
RMTL INV	0.3587E 04	0.2385E 04	0.1040E 03	0.1051E 05	0.1210E 06	0.3323E 04	
STATISTICS FOR VARIABLES BASED ON OBSERVATION							
	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM	UBS
QUE MCH1	0.4321E 04	0.3586E 04	0.7319E 03	0.8299E 00	0.0	0.1415E 05	24
QUE MCH2	0.5089E 03	0.8172E 03	0.1326E 03	0.1606E 01	0.0	0.2906E 04	38
QUE MCH3	0.1249E 04	0.2000E 04	0.2604E 03	0.1602E 01	0.0	0.9548E 04	59
QUE MCH4	0.3547E 04	0.4014E 04	0.7453E 03	0.1132E 01	0.0	0.1333E 05	29
QUE MCH5	0.2057E 04	0.3231E 04	0.6337E 03	0.1571E 01	0.0	0.1028E 05	26
QUE MCH6	0.1301E 04	0.2636E 04	0.5382E 03	0.1909E 01	0.0	0.8160E 04	24
QUE MCH7	0.1470E 04	0.2434E 04	0.4685E 03	0.1636E 01	0.0	0.7120E 04	27
QUE MCH8	0.1418E 04	0.2678E 04	0.6145E 03	0.1889E 01	0.0	0.1149E 05	19
QUE MCH9	0.4527E 04	0.4174E 04	0.8899E 03	0.9221E 00	0.0	0.1215E 05	22
QUE MCH10	0.2220E 04	0.3136E 04	0.6844E 03	0.1413E 01	0.0	0.1173E 05	21
QUE MCH11	0.7379E 03	0.1361E 04	0.3301E 03	0.1855E 01	0.0	0.4859E 04	17
QUE MCH12	0.6683E 02	0.1923E 03	0.3771E 02	0.2817E 01	0.0	0.7767E 03	26
QUE MCH13	0.1718E 04	0.2225E 04	0.5745E 03	0.1295E 01	0.0	0.7767E 03	15
QUE MCH14	0.5955E 04	0.3080E 04	0.1377E 03	0.5717E 00	0.0	0.6523E 04	5
QUE MCH15	0.5937E 04	0.3057E 04	0.1591E 04	0.6562E 00	0.3419E 04	0.1269E 05	6
EO DAYS	-0.3885E 00	0.1028E 01	0.3885E 00	-0.2646E 01	-0.2720E 01	0.0	7
LO DAYS	-0.5155E 01	0.3334E 01	0.7648E 00	0.6466E 00	-0.1791E 05	0.1072E 02	19
EO SCAYS	-0.2559E 04	0.6769E 04	0.2559E 04	-0.2646E 01	-0.1791E 05	0.0	7
LO SCAYS	-0.7489E 05	0.8242E 05	0.1891E 05	0.1100E 01	0.1214E 04	0.2514E 06	19
AO DAYS	0.3663E 01	0.3814E 01	0.7479E 00	0.1041E 01	-0.2720E 01	0.1072E 02	26
AO ARAYS	0.5004E 05	0.7829E 05	0.1535E 05	0.1449E 01	-0.1791E 05	0.2514E 06	26
WFO LCIS	0.5027E 01	0.3815E 01	0.3815E 00	0.7588E 00	-0.3595E 01	0.1253E 02	100
P-P LOTS	-0.1966E 01	0.3518E 01	0.6895E 00	-0.1789E 01	-0.8804E 01	0.6757E 01	26
PRT MAT	0.5669E 04	0.5242E 04	0.5092E 03	0.9247E 00	0.0	0.1804E 05	106

PART NUMBER	QUANTITY	DATE	POINT TO
0	0.0	0.0	NEXT DEMAND
0	0.0	0.0	0
6	240.00	314146.38	0
2	120.00	340994.56	0
0	0.0	0.0	0
5	6160.00	296011.94	57
3	100.00	348561.44	81
20	3702.40	27625.25	169
0	0.0	0.0	0
18	126.00	343117.00	0
0	0.0	0.0	0
1	60.00	372960.00	53

ORDER NUMBER	PART NUMBER	QUANTITY	ORDER DUE DATE	CURRENT OPERATION	WORKER IN USE	PRIORITY PCENTER	ORDER PRIORITY	COST COST	WAIT
5	1	6160.00	292320.00	0	10	0	0.0	0.0	0.0
1	1	60.00	312480.00	0	10	0	0.0	0.0	0.0
5	5	6160.00	352800.00	0	10	0	0.0	0.0	0.0
0	0	0.0	352800.00	0	10	0	0.0	0.0	0.0
23	0	480.00	292320.00	0	10	0	0.0	0.0	0.0
0	0	0.0	312460.00	0	10	0	0.0	0.0	0.0
0	0	0.0	322560.00	0	10	0	0.0	0.0	0.0
0	0	0.0	32640.00	0	10	0	0.0	0.0	0.0
3	0	100.00	342720.00	0	10	0	0.0	0.0	0.0
0	0	0.0	326112.00	0	10	0	0.0	0.0	0.0
0	0	0.0	372560.00	0	10	0	0.0	0.0	0.0
19	7	240.00	346563.44	0	10	0	0.0	0.0	0.0
7	7	1200.00	272160.00	0	10	0	0.0	0.0	0.0
4	4	600.00	302400.00	0	10	0	0.0	0.0	0.0
0	0	0.0	332640.00	0	10	0	0.0	0.0	0.0
11	11	167.00	282240.00	0	10	0	0.0	0.0	0.0
0	0	600.00	308625.50	0	10	0	0.0	0.0	0.0
0	0	0.0		0	10	0	0.0	0.0	0.0
0	0	0.0		0	10	0	0.0	0.0	0.0
24	0	5808.00		0	10	0	0.0	0.0	0.0
15	15	800.00		0	10	0	0.0	0.0	0.0
11	11	167.00		0	10	0	0.0	0.0	0.0
11	11	167.00		0	10	0	0.0	0.0	0.0
0	0	0.0		0	10	0	0.0	0.0	0.0
13	13	100.00		0	10	0	0.0	0.0	0.0
13	13	100.00		0	10	0	0.0	0.0	0.0
0	0	0.0		0	10	0	0.0	0.0	0.0
14	14	400.00		0	10	0	0.0	0.0	0.0
0	0	0.0		0	10	0	0.0	0.0	0.0
0	0	0.0		0	10	0	0.0	0.0	0.0
20	0	2136.00		0	10	0	0.0	0.0	0.0
0	0	0.0		0	10	0	0.0	0.0	0.0
0	0	0.0		0	10	0	0.0	0.0	0.0
24	24	5808.00		0	10	0	0.0	0.0	0.0
9	9	100.00		0	10	0	0.0	0.0	0.0
0	0	0.0		0	10	0	0.0	0.0	0.0
0	0	0.0		0	10	0	0.0	0.0	0.0
11	11	167.00		0	10	0	0.0	0.0	0.0

OPEN ORDER FILE

79	3	440.00	328112.00	0	10	0	0.0	0.0	0.0	0.0
80	10	200.00	275819.00	0	10	0	0.0	0.0	0.0	0.0
81	7	3200.00	203214.66	3	7	0	-0.61156	25981.73	0.0	0.0
82	12	940.00	217509.19	0	10	0	0.0	0.0	0.0	0.0
83	4	600.00	332514.94	0	10	0	0.0	0.0	0.0	0.0
84	4	440.00	296011.94	0	10	0	0.0	0.0	0.0	0.0
85	4	600.00	303256.25	0	10	0	0.0	0.0	0.0	0.0
86	15	3120.00	205533.94	3	0	0	-0.40599	8254.16	195104.	0.0
87	10	200.00	205702.88	0	0	0	0.0	0.0	0.0	0.0
88	0	0.0	0.0	1	0	0	0.0	0.0	0.0	0.0
89	1	120.00	211640.00	1	10	0	-0.08123	0.0	201134.	0.0
90	9	100.00	221760.00	0	10	0	0.0	0.0	0.0	0.0
91	10	120.00	313189.69	0	10	0	0.0	0.0	0.0	0.0
92	0	0.0	0.0	1	0	0	0.0	0.0	0.0	0.0
93	0	0.0	0.0	1	0	0	0.0	0.0	0.0	0.0
94	17	120.00	201600.00	1	10	141	-0.95057	0.0	193101.	0.0
95	7	1200.00	312097.56	0	10	0	0.0	0.0	0.0	0.0
96	18	120.00	283369.88	0	10	0	0.0	0.0	0.0	0.0
97	10	200.00	318187.31	0	10	0	0.0	0.0	0.0	0.0
98	4	440.00	278447.13	0	10	0	0.0	0.0	0.0	0.0
99	21	6560.00	257228.15	0	10	0	0.0	0.0	0.0	0.0
100	5	157440.00	210719.19	1	10	0	0.0	3148.80	0.0	0.0
101	11	23845.20	231060.38	0	10	0	0.0	0.0	0.0	0.0
102	4	600.00	265366.56	0	10	0	0.0	0.0	0.0	0.0
103	4	440.00	315587.88	0	10	0	0.0	0.0	0.0	0.0
104	16	109800.00	231060.38	0	10	0	0.0	0.0	0.0	0.0
105	4	600.00	322950.44	0	10	0	0.0	0.0	0.0	0.0
106	14	800.00	198622.88	2	0	0	-0.57943	5449.06	198098.	0.0
107	7	2000.00	283711.69	0	10	0	0.0	0.0	0.0	0.0
108	19	240.00	254081.00	0	10	0	0.0	0.0	0.0	0.0
109	17	120.00	231040.00	0	10	0	0.0	0.0	0.0	0.0
110	4	1040.00	259112.19	0	10	0	0.0	0.0	0.0	0.0
111	4	480.00	216404.00	0	10	0	0.0	0.0	0.0	0.0
112	8	2240.00	293313.94	0	10	0	0.0	0.0	0.0	0.0
113	3	440.00	208702.88	1	10	89	-0.39612	0.0	197217.	0.0
114	10	200.00	218702.88	0	10	0	0.0	0.0	0.0	0.0
115	4	1040.00	197217.13	1	4	0	-1.00135	24558.00	0.0	0.0
116	12	900.00	198622.88	3	8	0	-1.13610	3794.64	0.0	0.0
117	4	600.00	212541.31	0	10	0	0.0	0.0	0.0	0.0
118	18	120.00	193180.56	2	0	0	-1.40848	4054.74	198050.	0.0
119	0	0.0	0.0	1	0	0	0.0	0.0	0.0	0.0
120	12	840.00	305411.38	0	10	0	0.0	0.0	0.0	0.0
121	0	0.0	0.0	1	0	0	0.0	0.0	0.0	0.0
122	0	0.0	0.0	1	0	0	0.0	0.0	0.0	0.0
123	8	2680.00	266409.25	0	10	0	0.0	0.0	0.0	0.0
124	6	120.00	257875.69	0	10	0	0.0	0.0	0.0	0.0
125	8	1640.00	203874.06	3	0	0	-0.50004	8368.45	199413.	0.0
126	21	9160.00	197508.00	3	2	0	0.0	20775.41	0.0	0.0
127	4	1040.00	217645.56	0	10	0	0.0	0.0	0.0	0.0
128	14	520.00	305411.38	0	10	0	0.0	0.0	0.0	0.0
129	7	720.00	246201.13	0	10	0	0.0	0.0	0.0	0.0
130	0	0.0	0.0	1	0	0	0.0	0.0	0.0	0.0
131	14	800.00	226662.88	0	10	0	0.0	0.0	0.0	0.0
132	7	2080.00	302247.31	0	10	0	0.0	0.0	0.0	0.0
133	14	520.00	275229.19	0	10	0	0.0	0.0	0.0	0.0
134	19	240.00	283369.88	0	10	0	0.0	0.0	0.0	0.0
135	21	1440.00	231131.44	0	10	0	0.0	0.0	0.0	0.0
136	23	600.00	217509.15	0	10	0	0.0	0.0	0.0	0.0
137	5	40720.00	210054.44	1	10	0	0.0	814.40	0.0	0.0
138	14	520.00	217509.19	0	10	0	0.0	0.0	0.0	0.0

13	1249	41	84	3	105	100.00	0.0	6.56
14	1005	35	64	3	145	0.0	0.0	8.76
15	1416	47	113	2	161	0.0	0.0	2.76
16	2232	0	5	1	153	0.0	0.0	0.03
17	1529	52	179	5	0	0.0	0.0	76.11
18	1761	72	184	4	0	0.0	0.0	36.10
19	2059	83	194	3	0	0.0	0.0	12.47
20	2416	0	1	1	169	240.00	0.0	0.25
21	1872	67	168	2	177	10202.39	0.0	2.42
22	613	0	2	1	195	0.0	0.0	0.03
23	2141	86	207	2	0	0.0	0.0	5.08
24	2329	0	1	1	0	5000.00	0.0	0.11

MACHINE NO. 1, STATE=1.0
 MACHINE NO. 2, STATE=0.0
 MACHINE NO. 3, STATE=0.0
 MACHINE NO. 4, STATE=1.0
 MACHINE NO. 5, STATE=0.0
 MACHINE NO. 6, STATE=0.0
 MACHINE NO. 7, STATE=0.0
 MACHINE NO. 8, STATE=1.0
 MACHINE NO. 9, STATE=1.0
 MACHINE NO. 10, STATE=1.0
 MACHINE NO. 11, STATE=0.0
 MACHINE NO. 12, STATE=0.0
 MACHINE NO. 13, STATE=0.0
 MACHINE NO. 14, STATE=0.0
 MACHINE NO. 15, STATE=1.0
 WORKER NO. 1, STATE=1.0
 WORKER NO. 2, STATE=1.0
 WORKER NO. 3, STATE=0.0
 WORKER NO. 4, STATE=1.0
 WORKER NO. 5, STATE=1.0
 WORKER NO. 6, STATE=0.0
 WORKER NO. 7, STATE=1.0
 WORKER NO. 8, STATE=1.0
 WORKER NO. 9, STATE=0.0

CURRENT TIME= 201600.00

AVERAGE WAITING TIME ON SUPPORTS= 6388.

MACHINE	QUEUE
1	4026.
2	618.
3	981.
4	3610.
5	2249.
6	1713.
7	1438.
8	1223.
9	3310.
10	2136.
11	399.
12	35.
13	1501.
14	7901.
15	4316.

57	1	60	9	100	17	40
58	1	50	9	100	17	40
59	1	60	9	100	17	40
60	1	60	9	100	17	40
61	1	60	9	100	17	40
62	1	60	9	100	17	40
63	1	60	9	100	17	40
64	1	60	9	100	17	40
65	1	60	9	100	17	40
66	1	60	9	100	17	40
67	1	60	9	100	17	40
68	1	60	9	100	17	40
69	1	60	9	100	17	40
70	1	60	9	100	17	40
71	1	60	9	100	17	40
72	1	60	9	100	17	40
73	1	60	9	100	17	40
74	1	60	9	100	17	40
75	1	60	9	100	17	40
76	1	60	9	100	17	40
77	1	60	9	100	17	40
78	1	60	9	100	17	40
79	1	60	9	100	17	40
80	1	60	9	100	17	40
81	1	60	9	100	17	40
82	1	60	9	100	17	40
83	1	60	9	100	17	40
84	1	60	9	100	17	40
85	1	60	9	100	17	40
86	1	60	9	100	17	40
87	1	60	9	100	17	40
88	1	60	9	100	17	40
89	1	60	9	100	17	40
90	1	60	9	100	17	40
91	1	60	9	100	17	40
92	1	60	9	100	17	40
93	1	60	9	100	17	40
94	1	60	9	100	17	40
95	1	60	9	100	17	40
96	1	60	9	100	17	40
97	1	60	9	100	17	40

NEW SEED FOR ISIRM 11-53241-0000
NEW SEED FOR ISIRM 21-78563-0000

GASP SUMMARY REPORT

SIMULATION PROJECT NUMBER 2 BY NUD BASLUM

DATE 1/30/1976 RUN NUMBER 1 OF 1

CURRENT TIME = 0.2016E 06

PARAMETER SET	1 =	2 =	3 =	4 =	5 =	6 =
PARAMETER SET	0.1000E 05	0.7200E 04	0.1296E 05	0.1440E 04	0.1440E 04	0.1440E 04
PARAMETER SET	0.1152E 05	0.1920E 04	0.1512E 05	0.1800E 04	0.1800E 04	0.1800E 04
PARAMETER SET	0.1296E 05	0.2160E 04	0.1728E 05	0.2160E 04	0.2160E 04	0.2160E 04
PARAMETER SET	0.1440E 05	0.2400E 04	0.1872E 05	0.2400E 04	0.2400E 04	0.2400E 04
PARAMETER SET	0.1584E 05	0.2640E 04	0.1992E 05	0.2640E 04	0.2640E 04	0.2640E 04
PARAMETER SET	0.1728E 05	0.2880E 04	0.2112E 05	0.2880E 04	0.2880E 04	0.2880E 04
PARAMETER SET	0.1872E 05	0.3120E 04	0.2232E 05	0.3120E 04	0.3120E 04	0.3120E 04
PARAMETER SET	0.2016E 05	0.3360E 04	0.2352E 05	0.3360E 04	0.3360E 04	0.3360E 04
PARAMETER SET	0.2160E 05	0.3600E 04	0.2472E 05	0.3600E 04	0.3600E 04	0.3600E 04
PARAMETER SET	0.2304E 05	0.3840E 04	0.2592E 05	0.3840E 04	0.3840E 04	0.3840E 04
PARAMETER SET	0.2448E 05	0.4080E 04	0.2712E 05	0.4080E 04	0.4080E 04	0.4080E 04
PARAMETER SET	0.2592E 05	0.4320E 04	0.2832E 05	0.4320E 04	0.4320E 04	0.4320E 04
PARAMETER SET	0.2736E 05	0.4560E 04	0.2952E 05	0.4560E 04	0.4560E 04	0.4560E 04
PARAMETER SET	0.2880E 05	0.4800E 04	0.3072E 05	0.4800E 04	0.4800E 04	0.4800E 04
PARAMETER SET	0.3024E 05	0.5040E 04	0.3192E 05	0.5040E 04	0.5040E 04	0.5040E 04
PARAMETER SET	0.3168E 05	0.5280E 04	0.3312E 05	0.5280E 04	0.5280E 04	0.5280E 04
PARAMETER SET	0.3312E 05	0.5520E 04	0.3432E 05	0.5520E 04	0.5520E 04	0.5520E 04
PARAMETER SET	0.3456E 05	0.5760E 04	0.3552E 05	0.5760E 04	0.5760E 04	0.5760E 04
PARAMETER SET	0.3600E 05	0.6000E 04	0.3672E 05	0.6000E 04	0.6000E 04	0.6000E 04
PARAMETER SET	0.3744E 05	0.6240E 04	0.3792E 05	0.6240E 04	0.6240E 04	0.6240E 04
PARAMETER SET	0.3888E 05	0.6480E 04	0.3912E 05	0.6480E 04	0.6480E 04	0.6480E 04
PARAMETER SET	0.4032E 05	0.6720E 04	0.4032E 05	0.6720E 04	0.6720E 04	0.6720E 04
PARAMETER SET	0.4176E 05	0.6960E 04	0.4152E 05	0.6960E 04	0.6960E 04	0.6960E 04
PARAMETER SET	0.4320E 05	0.7200E 04	0.4272E 05	0.7200E 04	0.7200E 04	0.7200E 04
PARAMETER SET	0.4464E 05	0.7440E 04	0.4392E 05	0.7440E 04	0.7440E 04	0.7440E 04
PARAMETER SET	0.4608E 05	0.7680E 04	0.4512E 05	0.7680E 04	0.7680E 04	0.7680E 04
PARAMETER SET	0.4752E 05	0.7920E 04	0.4632E 05	0.7920E 04	0.7920E 04	0.7920E 04
PARAMETER SET	0.4896E 05	0.8160E 04	0.4752E 05	0.8160E 04	0.8160E 04	0.8160E 04
PARAMETER SET	0.5040E 05	0.8400E 04	0.4872E 05	0.8400E 04	0.8400E 04	0.8400E 04
PARAMETER SET	0.5184E 05	0.8640E 04	0.4992E 05	0.8640E 04	0.8640E 04	0.8640E 04
PARAMETER SET	0.5328E 05	0.8880E 04	0.5112E 05	0.8880E 04	0.8880E 04	0.8880E 04
PARAMETER SET	0.5472E 05	0.9120E 04	0.5232E 05	0.9120E 04	0.9120E 04	0.9120E 04
PARAMETER SET	0.5616E 05	0.9360E 04	0.5352E 05	0.9360E 04	0.9360E 04	0.9360E 04
PARAMETER SET	0.5760E 05	0.9600E 04	0.5472E 05	0.9600E 04	0.9600E 04	0.9600E 04
PARAMETER SET	0.5904E 05	0.9840E 04	0.5592E 05	0.9840E 04	0.9840E 04	0.9840E 04
PARAMETER SET	0.6048E 05	1.0080E 04	0.5712E 05	1.0080E 04	1.0080E 04	1.0080E 04
PARAMETER SET	0.6192E 05	1.0320E 04	0.5832E 05	1.0320E 04	1.0320E 04	1.0320E 04
PARAMETER SET	0.6336E 05	1.0560E 04	0.5952E 05	1.0560E 04	1.0560E 04	1.0560E 04
PARAMETER SET	0.6480E 05	1.0800E 04	0.6072E 05	1.0800E 04	1.0800E 04	1.0800E 04
PARAMETER SET	0.6624E 05	1.1040E 04	0.6192E 05	1.1040E 04	1.1040E 04	1.1040E 04
PARAMETER SET	0.6768E 05	1.1280E 04	0.6312E 05	1.1280E 04	1.1280E 04	1.1280E 04
PARAMETER SET	0.6912E 05	1.1520E 04	0.6432E 05	1.1520E 04	1.1520E 04	1.1520E 04
PARAMETER SET	0.7056E 05	1.1760E 04	0.6552E 05	1.1760E 04	1.1760E 04	1.1760E 04
PARAMETER SET	0.7200E 05	1.2000E 04	0.6672E 05	1.2000E 04	1.2000E 04	1.2000E 04
PARAMETER SET	0.7344E 05	1.2240E 04	0.6792E 05	1.2240E 04	1.2240E 04	1.2240E 04
PARAMETER SET	0.7488E 05	1.2480E 04	0.6912E 05	1.2480E 04	1.2480E 04	1.2480E 04
PARAMETER SET	0.7632E 05	1.2720E 04	0.7032E 05	1.2720E 04	1.2720E 04	1.2720E 04
PARAMETER SET	0.7776E 05	1.2960E 04	0.7152E 05	1.2960E 04	1.2960E 04	1.2960E 04
PARAMETER SET	0.7920E 05	1.3200E 04	0.7272E 05	1.3200E 04	1.3200E 04	1.3200E 04
PARAMETER SET	0.8064E 05	1.3440E 04	0.7392E 05	1.3440E 04	1.3440E 04	1.3440E 04
PARAMETER SET	0.8208E 05	1.3680E 04	0.7512E 05	1.3680E 04	1.3680E 04	1.3680E 04
PARAMETER SET	0.8352E 05	1.3920E 04	0.7632E 05	1.3920E 04	1.3920E 04	1.3920E 04
PARAMETER SET	0.8496E 05	1.4160E 04	0.7752E 05	1.4160E 04	1.4160E 04	1.4160E 04
PARAMETER SET	0.8640E 05	1.4400E 04	0.7872E 05	1.4400E 04	1.4400E 04	1.4400E 04
PARAMETER SET	0.8784E 05	1.4640E 04	0.7992E 05	1.4640E 04	1.4640E 04	1.4640E 04
PARAMETER SET	0.8928E 05	1.4880E 04	0.8112E 05	1.4880E 04	1.4880E 04	1.4880E 04
PARAMETER SET	0.9072E 05	1.5120E 04	0.8232E 05	1.5120E 04	1.5120E 04	1.5120E 04
PARAMETER SET	0.9216E 05	1.5360E 04	0.8352E 05	1.5360E 04	1.5360E 04	1.5360E 04
PARAMETER SET	0.9360E 05	1.5600E 04	0.8472E 05	1.5600E 04	1.5600E 04	1.5600E 04
PARAMETER SET	0.9504E 05	1.5840E 04	0.8592E 05	1.5840E 04	1.5840E 04	1.5840E 04
PARAMETER SET	0.9648E 05	1.6080E 04	0.8712E 05	1.6080E 04	1.6080E 04	1.6080E 04
PARAMETER SET	0.9792E 05	1.6320E 04	0.8832E 05	1.6320E 04	1.6320E 04	1.6320E 04
PARAMETER SET	0.9936E 05	1.6560E 04	0.8952E 05	1.6560E 04	1.6560E 04	1.6560E 04
PARAMETER SET	1.0080E 05	1.6800E 04	0.9072E 05	1.6800E 04	1.6800E 04	1.6800E 04
PARAMETER SET	1.0224E 05	1.7040E 04	0.9192E 05	1.7040E 04	1.7040E 04	1.7040E 04
PARAMETER SET	1.0368E 05	1.7280E 04	0.9312E 05	1.7280E 04	1.7280E 04	1.7280E 04
PARAMETER SET	1.0512E 05	1.7520E 04	0.9432E 05	1.7520E 04	1.7520E 04	1.7520E 04
PARAMETER SET	1.0656E 05	1.7760E 04	0.9552E 05	1.7760E 04	1.7760E 04	1.7760E 04
PARAMETER SET	1.0800E 05	1.8000E 04	0.9672E 05	1.8000E 04	1.8000E 04	1.8000E 04
PARAMETER SET	1.0944E 05	1.8240E 04	0.9792E 05	1.8240E 04	1.8240E 04	1.8240E 04
PARAMETER SET	1.1088E 05	1.8480E 04	0.9912E 05	1.8480E 04	1.8480E 04	1.8480E 04
PARAMETER SET	1.1232E 05	1.8720E 04	1.0032E 05	1.8720E 04	1.8720E 04	1.8720E 04
PARAMETER SET	1.1376E 05	1.8960E 04	1.0152E 05	1.8960E 04	1.8960E 04	1.8960E 04
PARAMETER SET	1.1520E 05	1.9200E 04	1.0272E 05	1.9200E 04	1.9200E 04	1.9200E 04
PARAMETER SET	1.1664E 05	1.9440E 04	1.0392E 05	1.9440E 04	1.9440E 04	1.9440E 04
PARAMETER SET	1.1808E 05	1.9680E 04	1.0512E 05	1.9680E 04	1.9680E 04	1.9680E 04
PARAMETER SET	1.1952E 05	1.9920E 04	1.0632E 05	1.9920E 04	1.9920E 04	1.9920E 04
PARAMETER SET	1.2096E 05	2.0160E 04	1.0752E 05	2.0160E 04	2.0160E 04	2.0160E 04
PARAMETER SET	1.2240E 05	2.0400E 04	1.0872E 05	2.0400E 04	2.0400E 04	2.0400E 04
PARAMETER SET	1.2384E 05	2.0640E 04	1.0992E 05	2.0640E 04	2.0640E 04	2.0640E 04
PARAMETER SET	1.2528E 05	2.0880E 04	1.1112E 05	2.0880E 04	2.0880E 04	2.0880E 04
PARAMETER SET	1.2672E 05	2.1120E 04	1.1232E 05	2.1120E 04	2.1120E 04	2.1120E 04
PARAMETER SET	1.2816E 05	2.1360E 04	1.1352E 05	2.1360E 04	2.1360E 04	2.1360E 04
PARAMETER SET	1.2960E 05	2.1600E 04	1.1472E 05	2.1600E 04	2.1600E 04	2.1600E 04
PARAMETER SET	1.3104E 05	2.1840E 04	1.1592E 05	2.1840E 04	2.1840E 04	2.1840E 04
PARAMETER SET	1.3248E 05	2.2080E 04	1.1712E 05	2.2080E 04	2.2080E 04	2.2080E 04
PARAMETER SET	1.3392E 05	2.2320E 04	1.1832E 05	2.2320E 04	2.2320E 04	2.2320E 04
PARAMETER SET	1.3536E 05	2.2560E 04	1.1952E 05	2.2560E 04	2.2560E 04	2.2560E 04
PARAMETER SET	1.3680E 05	2.2800E 04	1.2072E 05	2.2800E 04	2.2800E 04	2.2800E 04
PARAMETER SET	1.3824E 05	2.3040E 04	1.2192E 05	2.3040E 04	2.3040E 04	2.3040E 04
PARAMETER SET	1.3968E 05	2.3280E 04	1.2312E 05	2.3280E 04	2.3280E 04	2.3280E 04
PARAMETER SET	1.4112E 05	2.3520E 04	1.2432E 05	2.3520E 04	2.3520E 04	2.3520E 04
PARAMETER SET	1.4256E 05	2.3760E 04	1.2552E 05	2.3760E 04	2.3760E 04	2.3760E 04
PARAMETER SET	1.4400E 05	2.4000E 04	1.2672E 05	2.4000E 04	2.4000E 04	2.4000E 04
PARAMETER SET	1.4544E 05	2.4240E 04	1.2792E 05	2.4240E 04	2.4240E 04	2.4240E 04
PARAMETER SET	1.4688E 05	2.4480E 04	1.2912E 05	2.4480E 04	2.4480E 04	2.4480E 04
PARAMETER SET	1.4832E 05	2.4720E 04	1.3032E 05	2.4720E 04	2.4720E 04	2.4720E 04
PARAMETER SET	1.4976E 05	2.4960E 04	1.3152E 05	2.4960E 04	2.4960E 04	2.4960E 04
PARAMETER SET	1.5120E 05	2.5200E 04	1.3272E 05	2.5200E 04	2.5200E 04	2.5200E 04
PARAMETER SET	1.5264E 05	2.5440E 04	1.3392E 05	2.5440E 04	2.5440E 04	2.5440E 04
PARAMETER SET	1.5408E 05	2.5680E 04	1.3512E 05	2.5680E 04	2.5680E 04	2.5680E 04
PARAMETER SET	1.5552E 05	2.5920E 04	1.3632E 05	2.5920E 04	2.5920E 04	2.5920E 04
PARAMETER SET	1.5696E 05	2.6160E 04	1.3752E 05	2.6160E 04	2.6160E 04	2.6160E 04
PARAMETER SET	1.5840E 05	2.6400E 04	1.3872E 05	2.6400E 04	2.6400E 04	2.6400E 04
PARAMETER SET	1.5984E 05	2.6640E 04	1.3992E 05	2.6640E 04	2.6640E 04	2.6640E 04
PARAMETER SET	1.6128E 05	2.6880E 04	1.4112E 05	2.6880E 04	2.6880E 04	2.6880E 04
PARAMETER SET	1.6272E 05	2.7120E 04	1.4232E 05	2.7120E 04	2.7120E 04	2.7120E 04
PARAMETER SET	1.6416E 05	2.7360E 04	1.4352E 05	2.7360E 04	2.7360E 04	

UTL MC12	0.2287E-01	0.1495E 00	0.0	0.1000E 01	0.1210E 06	0.0
UTL MC13	0.5906E 00	0.4917E 00	0.0	0.1000E 01	0.1210E 06	0.0
LTL MC14	0.7548E 00	0.4039E 00	0.0	0.1000E 01	0.1210E 06	0.0
UTL MC15	0.9565E 00	0.2041E 00	0.0	0.1000E 01	0.1210E 06	0.1000E 01
WIP INV	0.2063E 06	0.2841E 05	0.1283E 06	0.2567E 06	0.1210E 06	0.2237E 06
RMIL INV	0.3587E 04	0.2385E 04	0.1040E 03	0.1051E 05	0.1210E 06	0.3123E 04

GASP FILE STORAGE AREA DUPLICATION AT TIME 0-2016E 06

MAXIMUM NUMBER OF ENTRIES IN FILE STORAGE AREA =150

PRINTOUT OF FILE NUMBER 1
 FROM = 0-2016E 06
 QUIT = 0-2016E 06

TIME PERIOD FOR STATISTICS 0-1210E 06
 AVERAGE NUMBER IN FILE 131-8604
 STANDARD DEVIATION 6-2039
 MAXIMUM NUMBER IN FILE 150

FILE CONTENTS

ENTRY 1	0-2016E 06	9-3000E 01	0-0
ENTRY 2	0-2017E 06	0-4000E 01	0-5800E 02
ENTRY 3	0-2021E 06	0-4000E 01	0-1160E 03
ENTRY 4	0-2023E 06	0-1000E 01	0-0700E 02
ENTRY 5	0-2023E 06	0-4000E 01	0-1150E 03
ENTRY 6	0-2032E 06	0-4000E 01	0-4700E 02
ENTRY 7	0-2033E 06	0-1000E 01	0-1550E 03
ENTRY 8	0-2039E 06	0-1000E 01	0-1170E 03
ENTRY 9	0-2041E 06	0-1000E 01	0-4500E 02
ENTRY 10	0-2044E 06	0-4000E 01	0-1260E 03
ENTRY 11	0-2044E 06	0-1000E 01	0-1510E 03
ENTRY 12	0-2046E 06	0-1000E 01	0-1590E 03
ENTRY 13	0-2055E 06	0-1000E 01	0-1300E 03
ENTRY 14	0-2057E 06	0-1000E 01	0-1270E 03
ENTRY 15	0-2065E 06	0-1000E 01	0-1360E 03
ENTRY 16	0-2072E 06	0-1000E 01	0-1460E 03
ENTRY 17	0-2074E 06	0-1000E 01	0-1370E 03
ENTRY 18	0-2077E 06	0-1000E 01	0-1430E 03
ENTRY 19	0-2078E 06	0-1000E 01	0-1110E 03
ENTRY 20	0-2078E 06	0-1000E 01	0-8200E 02
ENTRY 21	0-2083E 06	0-1000E 01	0-1530E 03
ENTRY 22	0-2087E 06	0-4000E 01	0-8100E 02
ENTRY 23	0-2087E 06	0-1000E 01	0-9000E 02
ENTRY 24	0-2092E 06	0-1000E 01	0-1500E 03
ENTRY 25	0-2096E 06	0-1000E 01	0-1000E 03
ENTRY 26	0-2101E 06	0-1000E 01	0-1350E 03
ENTRY 27	0-2107E 06	0-1000E 01	0-9900E 02
ENTRY 28	0-2112E 06	0-1000E 01	0-1490E 03
ENTRY 29	0-2113E 06	0-1000E 01	0-4800E 02
ENTRY 30	0-2117E 06	0-7000E 01	0-0
ENTRY 31	0-2125E 06	0-1000E 01	0-1140E 03
ENTRY 32	0-2134E 06	0-2000E 01	0-1520E 03
ENTRY 33	0-2138E 06	0-1000E 01	0-4600E 02
ENTRY 34	0-2141E 06	0-1000E 01	0-1310E 03
ENTRY 35	0-2164E 06	0-1000E 01	0-4900E 02
ENTRY 36	0-2175E 06	0-1000E 01	0-6800E 02
ENTRY 37	0-2175E 06	0-1000E 01	0-1390E 03
ENTRY 38	0-2176E 06	0-1000E 01	0-5300E 02
ENTRY 39	0-2187E 06	0-2000E 01	0-1580E 03
ENTRY 40	0-2188E 06	0-1000E 01	0-5700E 02
ENTRY 41	0-2201E 06	0-2000E 01	0-1010E 03
ENTRY 42	0-2213E 06	0-1000E 01	0-5100E 02
ENTRY 43	0-2227E 06	0-1000E 01	0-7200E 02
ENTRY 44	0-2234E 06	0-1000E 01	0-1090E 03

ENTRY 45	0-2215E 06	0-2300E 01	0-1040E 03
ENTRY 46	0-2245E 06	0-1000E 01	0-1900E 02
ENTRY 47	0-2250E 06	0-1000F 01	0-4300E 02
ENTRY 48	0-2270E 06	0-1000E 01	0-5000E 02
ENTRY 49	0-2295E 06	0-1000F 01	0-5500E 02
ENTRY 50	0-2311E 06	0-1000F 01	0-1800F 02
ENTRY 51	0-2311E 06	0-1000E 01	0-1290E 03
ENTRY 52	0-2325E 06	0-1000F 01	0-7100E 02
ENTRY 53	0-2331E 06	0-1000E 01	0-6500E 02
ENTRY 54	0-2349E 06	0-1000E 01	0-1640E 03
ENTRY 55	0-2352E 06	0-1000E 01	0-1230E 03
ENTRY 56	0-2363E 06	0-1000E 01	0-6400E 02
ENTRY 57	0-2372E 06	0-1000E 01	0-2000E 02
ENTRY 58	0-2385E 06	0-1000E 01	0-3000E 02
ENTRY 59	0-2389E 06	0-1000F 01	0-5200E 02
ENTRY 60	0-2391E 06	0-2000E 01	0-1570E 03
ENTRY 61	0-2417E 06	0-1000E 01	0-1700E 02
ENTRY 62	0-2419E 06	0-1000E 01	0-1470E 03
ENTRY 63	0-2437E 06	0-1000E 01	0-3500E 02
ENTRY 64	0-2442E 06	0-1000E 01	0-6900E 02
ENTRY 65	0-2461E 06	0-1000E 01	0-2100E 02
ENTRY 66	0-2462E 06	0-1000E 01	0-1240E 03
ENTRY 67	0-2466E 06	0-1000E 01	0-3200E 02
ENTRY 68	0-2470E 06	0-2000E 01	0-1560E 03
ENTRY 69	0-2479E 06	0-1000F 01	0-1100E 03
ENTRY 70	0-2483E 06	0-1000E 01	0-1080E 03
ENTRY 71	0-2493E 06	0-1000E 01	0-4000E 02
ENTRY 72	0-2541E 06	0-1000E 01	0-4400E 02
ENTRY 73	0-2542E 06	0-1000E 01	0-4200E 02
ENTRY 74	0-2576E 06	0-1000E 01	0-3300E 02
ENTRY 75	0-2579E 06	0-1000E 01	0-3600E 02
ENTRY 76	0-2580E 06	0-1000E 01	0-1450E 03
ENTRY 77	0-2585E 06	0-1000E 01	0-1870E 03
ENTRY 78	0-2591E 06	0-1000E 01	0-4100E 02
ENTRY 79	0-2594E 06	0-1000E 01	0-2900E 02
ENTRY 80	0-2609E 06	0-1000E 01	0-1330E 03
ENTRY 81	0-2620E 06	0-1000E 01	0-1300E 02
ENTRY 82	0-2639E 06	0-1000E 01	0-1540E 03
ENTRY 83	0-2645E 06	0-1000E 01	0-6100E 02
ENTRY 84	0-2646E 06	0-1000E 01	0-1700E 02
ENTRY 85	0-2664E 06	0-1000E 01	0-3100E 02
ENTRY 86	0-2666E 06	0-1000E 01	0-1120E 03
ENTRY 87	0-2696E 06	0-1000E 01	0-1600E 02
ENTRY 88	0-2709E 06	0-1000E 01	0-9800E 02
ENTRY 89	0-2712E 06	0-1000E 01	0-6200E 02
ENTRY 90	0-2717E 06	0-1000E 01	0-1480E 03
ENTRY 91	0-2741E 06	0-1000E 01	0-5900E 02
ENTRY 92	0-2749E 06	0-1000E 01	0-8000E 02
ENTRY 93	0-2751E 06	0-1000E 01	0-1900E 02
ENTRY 94	0-2752E 06	0-1000E 01	0-9600E 02
ENTRY 95	0-2756E 06	0-1000E 01	0-1020E 03
ENTRY 96	0-2767E 06	0-1000E 01	0-1340E 03
ENTRY 97	0-2769E 06	0-1000E 01	0-1320E 03
ENTRY 98	0-2784E 06	0-1000E 01	0-2300E 02
ENTRY 99	0-2788E 06	0-1000E 01	0-1900E 02
ENTRY 100	0-2799E 06	0-1000E 01	0-1000E 01
ENTRY 101	0-2823E 06	0-1000E 01	0-5000E 01
ENTRY 102	0-2816E 06	0-1000E 01	0-2700E 02
ENTRY 103	0-2837E 06	0-1000E 01	0-2400E 02
ENTRY 104	0-2844E 06	0-1000E 01	0-7200E 02

ENTRY 105	=	0.2873E 06	0.1000E 01	0.84CCE 02
ENTRY 106	=	0.2819E 06	0.1000E 01	0.1400E 02
ENTRY 107	=	0.2909E 06	0.1000E 01	0.1200E 03
ENTRY 108	=	0.2910E 06	0.1000E 01	0.4300E 02
ENTRY 109	=	0.2933E 06	0.1000E 01	0.9501E 02
ENTRY 110	=	0.2544E 06	0.1000E 01	0.1200E 03
ENTRY 111	=	0.2944E 06	0.1000E 01	0.9500E 02
ENTRY 112	=	0.2560E 06	0.1000E 01	0.2500E 02
ENTRY 113	=	0.2989E 06	0.1000E 01	0.6CGCF 01
ENTRY 114	=	0.1006E 06	0.1000E 01	0.7500E 02
ENTRY 115	=	0.1011E 06	0.1000E 01	0.2000E 01
ENTRY 116	=	0.1022E 06	0.1000E 01	0.2600E 02
ENTRY 117	=	0.3033E 06	0.1000E 01	0.1800E 02
ENTRY 118	=	0.3054E 06	0.1000E 01	0.91CCE 02
ENTRY 119	=	0.3067E 06	0.1000E 01	0.1420E 03
ENTRY 120	=	0.3072E 06	0.1000E 01	0.1030E 03
ENTRY 121	=	0.1086E 06	0.1000E 01	0.7CCCE 01
ENTRY 122	=	0.3129E 06	0.1000E 01	0.1050E 03
ENTRY 123	=	0.3131E 06	0.1000E 01	0.2800E 02
ENTRY 124	=	0.3132E 06	0.1000E 01	0.8700E 02
ENTRY 125	=	0.3147E 06	0.1000E 01	0.7600E 02
ENTRY 126	=	0.3160E 06	0.1000E 01	0.79CCE 02
ENTRY 127	=	0.3188E 06	0.1000E 01	0.1500E 02
ENTRY 128	=	0.3211E 06	0.1000E 01	0.8000E 01
ENTRY 129	=	0.3224E 06	0.1000E 01	0.9300E 02
ENTRY 130	=	0.3230E 06	0.1000E 01	0.1000E 02
ENTRY 131	=	0.3287E 06	0.1000E 01	0.9C0CE 01
ENTRY 132	=	0.3324E 06	0.1000E 01	0.9700E 02
ENTRY 133	=	0.3382E 06	0.1000E 01	0.3000E 01
ENTRY 134	=	0.3410E 06	0.1000E 01	0.4000E 01
ENTRY 135	=	0.3425E 06	0.1000E 01	0.1200E 02
ENTRY 136	=	0.3431E 06	0.1000E 01	0.6000E 02
ENTRY 137	=	0.3486E 06	0.1000E 01	0.6600E 02
ENTRY 138	=	0.3596E 06	0.1000E 01	0.1100E 02

HISTOGRAM NUMBER 1**

LATNESS

ORSV FREQ	REL FREQ	CUML FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
0	0.0	0.0	-0.1000E 02	C					C
0	0.0	0.0	-0.9000E 01	C					C
0	0.0	0.0	-0.8000E 01	C					C
0	0.0	0.0	-0.7000E 01	C					C
0	0.0	0.0	-0.6000E 01	C					C
0	0.0	0.0	-0.5000E 01	C					C
0	0.0	0.0	-0.4000E 01	C					C
0	0.0	0.0	-0.3000E 01	C					C
1	0.038	0.038	-0.2000E 01	C					C
0	0.0	0.038	-0.1000E 01	C					C
6	0.231	0.269	0.0	C	C				C
2	0.077	0.346	0.1000E 01	C	C				C
3	0.115	0.462	0.2000E 01	C	C				C
1	0.038	0.500	0.3000E 01	C	C				C
2	0.077	0.577	0.4000E 01	C	C				C
1	0.038	0.615	0.5000E 01	C	C				C
2	0.077	0.692	0.6000E 01	C	C				C
2	0.077	0.769	0.7000E 01	C	C				C
1	0.038	0.808	0.8000E 01	C	C				C
2	0.077	0.885	0.9000E 01	C	C				C
1	0.038	0.923	0.1000E 02	C	C				C
2	0.077	1.000	0.1100E 02	C	C				C
0	0.0	1.000	0.1200E 02	C					C
0	0.0	1.000	0.1300E 02	C					C
0	0.0	1.000	0.1400E 02	C					C
0	0.0	1.000	0.1500E 02	C					C
0	0.0	1.000	0.1600E 02	C					C
0	0.0	1.000	0.1700E 02	C					C
0	0.0	1.000	0.1800E 02	C					C
0	0.0	1.000	0.1900E 02	C					C
0	0.0	1.000	0.2000E 02	C					C
0	0.0	1.000	0.2100E 02	C					C
0	0.0	1.000	0.2200E 02	C					C
0	0.0	1.000	0.2300E 02	C					C
0	0.0	1.000	0.2400E 02	C					C
0	0.0	1.000	0.2500E 02	C					C
0	0.0	1.000	0.2600E 02	C					C
0	0.0	1.000	0.2700E 02	C					C
0	0.0	1.000	0.2800E 02	C					C
0	0.0	1.000	0.2900E 02	C					C
0	0.0	1.000	0.3000E 02	C					C
0	0.0	1.000	IMF	C					C

HISTOGRAM NUMBER 200

STM LATE

UBSV FREQ	RELA FREQ	CUML FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
1	0.038	0.038	-0.200E 04	C	C	C	C	C	C
6	0.231	0.269	0.0	C	C	C	C	C	C
1	0.030	0.308	0.200E 04	C	C	C	C	C	C
0	0.0	0.308	0.400E 04	C	C	C	C	C	C
0	0.0	0.308	0.600E 04	C	C	C	C	C	C
2	0.077	0.385	0.800E 04	C	C	C	C	C	C
1	0.030	0.423	0.100E 05	C	C	C	C	C	C
2	0.077	0.500	0.120E 05	C	C	C	C	C	C
0	0.0	0.500	0.140E 05	C	C	C	C	C	C
0	0.0	0.500	0.160E 05	C	C	C	C	C	C
0	0.0	0.500	0.180E 05	C	C	C	C	C	C
0	0.0	0.500	0.200E 05	C	C	C	C	C	C
0	0.0	0.500	0.220E 05	C	C	C	C	C	C
0	0.0	0.500	0.240E 05	C	C	C	C	C	C
0	0.0	0.500	0.260E 05	C	C	C	C	C	C
0	0.0	0.500	0.280E 05	C	C	C	C	C	C
1	0.038	0.538	0.300E 05	C	C	C	C	C	C
1	0.038	0.577	0.320E 05	C	C	C	C	C	C
1	0.038	0.615	0.340E 05	C	C	C	C	C	C
0	0.0	0.615	0.360E 05	C	C	C	C	C	C
1	0.038	0.654	0.380E 05	C	C	C	C	C	C
1	0.038	0.692	0.400E 05	C	C	C	C	C	C
0	0.0	0.692	0.420E 05	C	C	C	C	C	C
1	0.038	0.731	0.440E 05	C	C	C	C	C	C
0	0.0	0.731	0.460E 05	C	C	C	C	C	C
7	0.269	1.000	INF	C	C	C	C	C	C

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HISTOGRAM NUMBER 3

QTY LATE

URSV FREQ	RELA FREQ	CUML FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
0	0.0	0.0	-0.1000E 03	0	0	0	0	0	0
0	0.0	0.0	-0.8000E 02	0	0	0	0	0	0
4	0.154	0.154	-0.6000E 02	0	0	0	0	0	0
3	0.115	0.269	-0.4000E 02	0	0	0	0	0	0
0	0.0	0.269	-0.2000E 02	0	0	0	0	0	0
0	0.0	0.269	0.0	0	0	0	0	0	0
0	0.0	0.269	0.2000E 02	0	0	0	0	0	0
6	0.231	0.500	0.4000E 02	0	0	0	0	0	0
5	0.192	0.692	0.6000E 02	0	0	0	0	0	0
0	0.0	0.692	0.8000E 02	0	0	0	0	0	0
0	0.308	1.000	0.1000E 03	0	0	0	0	0	0
0	0.0	1.000	0.1200E 03	0	0	0	0	0	0
0	0.0	1.000	INF	0	0	0	0	0	0

HISTOGRAM NUMBER 4

HCPML RD

UNSV FREQ	PELA FREQ	CUML FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
6	0.017	0.017	0.5400E 00	C	C	C	C	C	C
4	0.011	0.028	0.9450E 00	C	C	C	C	C	C
5	0.014	0.042	0.5500E 00	C	C	C	C	C	C
343	0.958	1.000	INF	C	C	C	C	C	C
---				C	C	C	C	C	C
358				0	20	40	60	80	100

HISTOGRAM NUMBER 5**

MFD LOTS

URSV FREQ	RELA FREQ	CUML FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
0	0.0	0.0	-0.1000E 02	C	C	C	C	C	C
0	0.0	0.0	-0.9000E 01	C	C	C	C	C	C
0	0.0	0.0	-0.8000E 01	C	C	C	C	C	C
0	0.0	0.0	-0.7000E 01	C	C	C	C	C	C
0	0.0	0.0	-0.6000E 01	C	C	C	C	C	C
0	0.0	0.0	-0.5000E 01	C	C	C	C	C	C
0	0.0	0.0	-0.4000E 01	C	C	C	C	C	C
2	0.020	0.020	-0.3000E 01	C	C	C	C	C	C
1	0.010	0.030	-0.2000E 01	C	C	C	C	C	C
8	0.080	0.110	-0.1000E 01	C	C	C	C	C	C
5	0.050	0.160	0.0	C	C	C	C	C	C
2	0.020	0.180	0.1000E 01	C	C	C	C	C	C
6	0.060	0.240	0.2000E 01	C	C	C	C	C	C
2	0.020	0.260	0.3000E 01	C	C	C	C	C	C
7	0.070	0.330	0.4000E 01	C	C	C	C	C	C
7	0.070	0.400	0.5000E 01	C	C	C	C	C	C
14	0.140	0.540	0.6000E 01	C	C	C	C	C	C
14	0.140	0.680	0.7000E 01	C	C	C	C	C	C
6	0.060	0.740	0.8000E 01	C	C	C	C	C	C
11	0.110	0.850	0.9000E 01	C	C	C	C	C	C
9	0.090	0.940	0.1000E 02	C	C	C	C	C	C
4	0.040	0.980	0.1100E 02	C	C	C	C	C	C
0	0.0	0.980	0.1200E 02	C	C	C	C	C	C
2	0.020	1.000	0.1300E 02	C	C	C	C	C	C
0	0.0	1.000	0.1400E 02	C	C	C	C	C	C
0	0.0	1.000	0.1500E 02	C	C	C	C	C	C
0	0.0	1.000	0.1600E 02	C	C	C	C	C	C
0	0.0	1.000	0.1700E 02	C	C	C	C	C	C
0	0.0	1.000	0.1800E 02	C	C	C	C	C	C
0	0.0	1.000	0.1900E 02	C	C	C	C	C	C
0	0.0	1.000	0.2000E 02	C	C	C	C	C	C
0	0.0	1.000	INF	C	C	C	C	C	C
---	100								

HISTOGRAM NUMBER 6

P-P LOTS

ORSV FREQ	RELA FREQ	CUML FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
0	0.0	0.0	-0.2000E 02	0	0	0	0	0	0
0	0.0	0.0	-0.1900E 02	0	0	0	0	0	0
0	0.0	0.0	-0.1800E 02	0	0	0	0	0	0
0	0.0	0.0	-0.1700E 02	0	0	0	0	0	0
0	0.0	0.0	-0.1600E 02	0	0	0	0	0	0
0	0.0	0.0	-0.1500E 02	0	0	0	0	0	0
0	0.0	0.0	-0.1400E 02	0	0	0	0	0	0
0	0.0	0.0	-0.1300E 02	0	0	0	0	0	0
0	0.0	0.0	-0.1200E 02	0	0	0	0	0	0
0	0.0	0.0	-0.1100E 02	0	0	0	0	0	0
0	0.0	0.0	-0.1000E 02	0	0	0	0	0	0
0	0.0	0.0	-0.9000E 01	0	0	0	0	0	0
2	0.077	0.077	-0.8000E 01	0	0	0	0	0	0
0	0.0	0.077	-0.7000E 01	0	0	0	0	0	0
0	0.0	0.077	-0.6000E 01	0	0	0	0	0	0
0	0.0	0.077	-0.5000E 01	0	0	0	0	0	0
4	0.154	0.231	-0.4000E 01	0	0	0	0	0	0
3	0.192	0.423	-0.3000E 01	0	0	0	0	0	0
3	0.115	0.538	-0.2000E 01	0	0	0	0	0	0
4	0.154	0.692	-0.1000E 01	0	0	0	0	0	0
4	0.154	0.846	0.0	0	0	0	0	0	0
0	0.0	0.846	0.1000E 01	0	0	0	0	0	0
0	0.0	0.846	0.2000E 01	0	0	0	0	0	0
1	0.038	0.885	0.3000E 01	0	0	0	0	0	0
1	0.038	0.923	0.4000E 01	0	0	0	0	0	0
0	0.0	0.923	0.5000E 01	0	0	0	0	0	0
1	0.038	0.962	0.6000E 01	0	0	0	0	0	0
1	0.038	1.000	0.7000E 01	0	0	0	0	0	0
0	0.0	1.000	0.8000E 01	0	0	0	0	0	0
0	0.0	1.000	0.9000E 01	0	0	0	0	0	0
0	0.0	1.000	0.1000E 02	0	0	0	0	0	0
0	0.0	1.000	INF	0	0	0	0	0	0

HISTOGRAM NUMBER 8

DELAY 1

HDSV FREQ	RELA FREQ	CUML FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
1	0.042	0.042	0.0	C**	C**				
5	0.208	0.250	0.1440E 04	C**	C**				
5	0.208	0.458	0.2880E 04	C**	C**				
2	0.083	0.542	0.4320E 04	C**	C**				
3	0.125	0.667	0.5760E 04	C**	C**				
4	0.167	0.833	0.7200E 04	C**	C**				
2	0.083	0.917	0.8640E 04	C**	C**				
0	0.0	0.917	0.1008E 05	C**	C**				
1	0.042	0.958	0.1152E 05	C**	C**				
0	0.0	0.958	0.1296E 05	C**	C**				
1	0.042	1.000	0.1440E 05	C**	C**				
0	0.0	1.000	0.1584E 05	C**	C**				
0	0.0	1.000	0.1728E 05	C**	C**				
0	0.0	1.000	0.1872E 05	C**	C**				
0	0.0	1.000	0.2016E 05	C**	C**				
0	0.0	1.000	0.2160E 05	C**	C**				
0	0.0	1.000	0.2304E 05	C**	C**				
0	0.0	1.000	0.2448E 05	C**	C**				
0	0.0	1.000	0.2592E 05	C**	C**				
0	0.0	1.000	0.2736E 05	C**	C**				
0	0.0	1.000	0.2880E 05	C**	C**				
0	0.0	1.000	INF	C**	C**				

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HISTOGRAM NUMBER 9

DELAY 2

ORSV FREQ	RELA FREQ	CUMUL FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
20	0.526	0.526	0.0	0	0	0	0	0	0
13	0.342	0.868	0.1440E 04	0	0	0	0	0	0
4	0.105	0.974	0.2880E 04	0	0	0	0	0	0
1	0.026	1.000	0.4320E 04	0	0	0	0	0	0
0	0.0	1.000	0.5760E 04	0	0	0	0	0	0
0	0.0	1.000	0.7200E 04	0	0	0	0	0	0
0	0.0	1.000	0.8640E 04	0	0	0	0	0	0
0	0.0	1.000	0.1008E 05	0	0	0	0	0	0
0	0.0	1.000	0.1152E 05	0	0	0	0	0	0
0	0.0	1.000	0.1296E 05	0	0	0	0	0	0
0	0.0	1.000	0.1440E 05	0	0	0	0	0	0
0	0.0	1.000	0.1584E 05	0	0	0	0	0	0
0	0.0	1.000	0.1728E 05	0	0	0	0	0	0
0	0.0	1.000	0.1872E 05	0	0	0	0	0	0
0	0.0	1.000	0.2016E 05	0	0	0	0	0	0
0	0.0	1.000	0.2160E 05	0	0	0	0	0	0
0	0.0	1.000	0.2304E 05	0	0	0	0	0	0
0	0.0	1.000	0.2448E 05	0	0	0	0	0	0
0	0.0	1.000	0.2592E 05	0	0	0	0	0	0
0	0.0	1.000	0.2736E 05	0	0	0	0	0	0
0	0.0	1.000	0.2880E 05	0	0	0	0	0	0
---	0.0	1.000	INF	0	0	0	0	0	0
38				0	0	0	0	0	0

←HISTOGRAM NUMBER 10→

DELAY 3

ORSV FREQ	REL FREQ	CUMUL FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
22	0.373	0.373	0.0	0	0	0	0	0	0
20	0.339	0.712	0.1540E 04	0	0	0	0	0	0
9	0.153	0.864	0.2880E 04	0	0	0	0	0	0
5	0.085	0.949	0.4320E 04	0	0	0	0	0	0
0	0.0	0.949	0.5760E 04	0	0	0	0	0	0
0	0.0	0.949	0.7200E 04	0	0	0	0	0	0
2	0.034	0.983	0.8640E 04	0	0	0	0	0	0
1	0.017	1.000	0.1008E 05	0	0	0	0	0	0
0	0.0	1.000	0.1152E 05	0	0	0	0	0	0
0	0.0	1.000	0.1296E 05	0	0	0	0	0	0
0	0.0	1.000	0.1440E 05	0	0	0	0	0	0
0	0.0	1.000	0.1584E 05	0	0	0	0	0	0
0	0.0	1.000	0.1728E 05	0	0	0	0	0	0
0	0.0	1.000	0.1872E 05	0	0	0	0	0	0
0	0.0	1.000	0.2016E 05	0	0	0	0	0	0
0	0.0	1.000	0.2160E 05	0	0	0	0	0	0
0	0.0	1.000	0.2304E 05	0	0	0	0	0	0
0	0.0	1.000	0.2448E 05	0	0	0	0	0	0
0	0.0	1.000	0.2592E 05	0	0	0	0	0	0
0	0.0	1.000	0.2736E 05	0	0	0	0	0	0
0	0.0	1.000	0.2880E 05	0	0	0	0	0	0
0	0.0	1.000	INF	0	0	0	0	0	0

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HISTOGRAM NUMBER 11**

DELAY 4

OBSV FREQ	REL FREQ	CUMUL FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
4	0.130	0.130	0.0	C	C	C	C	C	C
6	0.276	0.414	0.1440E 04	C	C	C	C	C	C
2	0.069	0.621	0.2880E 04	C	C	C	C	C	C
1	0.034	0.690	0.4320E 04	C	C	C	C	C	C
3	0.103	0.724	0.5760E 04	C	C	C	C	C	C
1	0.034	0.828	0.7200E 04	C	C	C	C	C	C
1	0.034	0.862	0.8640E 04	C	C	C	C	C	C
1	0.034	0.897	0.1008E 05	C	C	C	C	C	C
1	0.034	0.931	0.1152E 05	C	C	C	C	C	C
0	0.0	0.931	0.1296E 05	C	C	C	C	C	C
2	0.069	1.000	0.1440E 05	C	C	C	C	C	C
0	0.0	1.000	0.1584E 05	C	C	C	C	C	C
0	0.0	1.000	0.1728E 05	C	C	C	C	C	C
0	0.0	1.000	0.1872E 05	C	C	C	C	C	C
0	0.0	1.000	0.2016E 05	C	C	C	C	C	C
0	0.0	1.000	0.2160E 05	C	C	C	C	C	C
0	0.0	1.000	0.2304E 05	C	C	C	C	C	C
0	0.0	1.000	0.2448E 05	C	C	C	C	C	C
0	0.0	1.000	0.2592E 05	C	C	C	C	C	C
0	0.0	1.000	0.2736E 05	C	C	C	C	C	C
0	0.0	1.000	0.2880E 05	C	C	C	C	C	C
0	0.0	1.000	INF	C	C	C	C	C	C

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HISTOGRAM NUMBER 12

DELAY 5

ORSV FREQ	RFLA FREQ	CUML FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
6	0.231	0.231	0.0	C	C	C	C	C	C
12	0.462	0.692	0.1440E 04	C	C	C	C	C	C
2	0.077	0.769	0.2880E 04	C	C	C	C	C	C
1	0.038	0.808	0.4320E 04	C	C	C	C	C	C
1	0.038	0.846	0.5760E 04	C	C	C	C	C	C
1	0.038	0.885	0.7200E 04	C	C	C	C	C	C
1	0.038	0.923	0.8640E 04	C	C	C	C	C	C
1	0.038	0.962	0.1008E 05	C	C	C	C	C	C
1	0.038	1.000	0.1152E 05	C	C	C	C	C	C
0	0.0	1.000	0.1296E 05	C	C	C	C	C	C
0	0.0	1.000	0.1440E 05	C	C	C	C	C	C
0	0.0	1.000	0.1584E 05	C	C	C	C	C	C
0	0.0	1.000	0.1728E 05	C	C	C	C	C	C
0	0.0	1.000	0.1872E 05	C	C	C	C	C	C
0	0.0	1.000	0.2016E 05	C	C	C	C	C	C
0	0.0	1.000	0.2160E 05	C	C	C	C	C	C
0	0.0	1.000	0.2304E 05	C	C	C	C	C	C
0	0.0	1.000	0.2448E 05	C	C	C	C	C	C
0	0.0	1.000	0.2592E 05	C	C	C	C	C	C
0	0.0	1.000	0.2736E 05	C	C	C	C	C	C
0	0.0	1.000	0.2880E 05	C	C	C	C	C	C
0	0.0	1.000	INF	C	C	C	C	C	C
---	26			0	C	C	C	C	100

HISTOGRAM NUMBER 13**

DELAY 6

OBSV FREQ	REL FREQ	CUML FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
14	0.583	0.583	0.0	0	0	0	0	0	0
5	0.208	0.792	0.1440E 04	0	0	0	0	0	0
1	0.042	0.833	0.2880E 04	0	0	0	0	0	0
1	0.042	0.875	0.4320E 04	0	0	0	0	0	0
0	0.0	0.875	0.5760E 04	0	0	0	0	0	0
1	0.042	0.917	0.7200E 04	0	0	0	0	0	0
2	0.083	1.000	0.8640E 04	0	0	0	0	0	0
0	0.0	1.000	0.1008E 05	0	0	0	0	0	0
0	0.0	1.000	0.1152E 05	0	0	0	0	0	0
0	0.0	1.000	0.1296E 05	0	0	0	0	0	0
0	0.0	1.000	0.1440E 05	0	0	0	0	0	0
0	0.0	1.000	0.1584E 05	0	0	0	0	0	0
0	0.0	1.000	0.1728E 05	0	0	0	0	0	0
0	0.0	1.000	0.1872E 05	0	0	0	0	0	0
0	0.0	1.000	0.2016E 05	0	0	0	0	0	0
0	0.0	1.000	0.2160E 05	0	0	0	0	0	0
0	0.0	1.000	0.2304E 05	0	0	0	0	0	0
0	0.0	1.000	0.2448E 05	0	0	0	0	0	0
0	0.0	1.000	0.2592E 05	0	0	0	0	0	0
0	0.0	1.000	0.2736E 05	0	0	0	0	0	0
0	0.0	1.000	0.2880E 05	0	0	0	0	0	0
0	0.0	1.000	INF	0	0	0	0	0	0
24				0	0	0	0	0	0

**HISTOGRAM NUMBER 144*

DELAY 7

URSV FREQ	RELA FREQ	CUML FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
12	0.544	0.544	0.0	*****	*****	*****	*****	*****	*****
7	0.259	0.704	0.1440E 04	*****	*****	*****	*****	*****	*****
2	0.074	0.778	0.2880E 04	*****	*****	*****	*****	*****	*****
1	0.037	0.815	0.4320E 04	*****	*****	*****	*****	*****	*****
2	0.074	0.889	0.5760E 04	*****	*****	*****	*****	*****	*****
3	0.111	1.000	0.7200E 04	*****	*****	*****	*****	*****	*****
0	0.0	1.000	0.8640E 04	*****	*****	*****	*****	*****	*****
0	0.0	1.000	0.1000E 05	*****	*****	*****	*****	*****	*****
0	0.0	1.000	0.1152E 05	*****	*****	*****	*****	*****	*****
0	0.0	1.000	0.1296E 05	*****	*****	*****	*****	*****	*****
0	0.0	1.000	0.1440E 05	*****	*****	*****	*****	*****	*****
0	0.0	1.000	0.1584E 05	*****	*****	*****	*****	*****	*****
0	0.0	1.000	0.1728E 05	*****	*****	*****	*****	*****	*****
0	0.0	1.000	0.1872E 05	*****	*****	*****	*****	*****	*****
0	0.0	1.000	0.2016E 05	*****	*****	*****	*****	*****	*****
0	0.0	1.000	0.2160E 05	*****	*****	*****	*****	*****	*****
0	0.0	1.000	0.2304E 05	*****	*****	*****	*****	*****	*****
0	0.0	1.000	0.2448E 05	*****	*****	*****	*****	*****	*****
0	0.0	1.000	0.2592E 05	*****	*****	*****	*****	*****	*****
0	0.0	1.000	0.2736E 05	*****	*****	*****	*****	*****	*****
0	0.0	1.000	0.2880E 05	*****	*****	*****	*****	*****	*****
0	0.0	1.000	INF	*****	*****	*****	*****	*****	*****

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HISTOGRAM NUMBER 15**

DELAY 0

ORSV FREQ	RELA FREQ	CUML FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
8	0.421	0.421	0.0	0	0	0	0	0	0
5	0.263	0.684	0.1440E 04	0	0	0	0	0	0
4	0.211	0.895	0.2880E 04	0	0	0	0	0	0
1	0.053	0.947	0.4320E 04	0	0	0	0	0	0
0	0.0	0.947	0.5760E 04	0	0	0	0	0	0
0	0.0	0.947	0.7200E 04	0	0	0	0	0	0
0	0.0	0.947	0.8640E 04	0	0	0	0	0	0
0	0.0	0.947	0.1008E 05	0	0	0	0	0	0
1	0.053	1.000	0.1152E 05	0	0	0	0	0	0
0	0.0	1.000	0.1296E 05	0	0	0	0	0	0
0	0.0	1.000	0.1440E 05	0	0	0	0	0	0
0	0.0	1.000	0.1584E 05	0	0	0	0	0	0
0	0.0	1.000	0.1728E 05	0	0	0	0	0	0
0	0.0	1.000	0.1872E 05	0	0	0	0	0	0
0	0.0	1.000	0.2016E 05	0	0	0	0	0	0
0	0.0	1.000	0.2160E 05	0	0	0	0	0	0
0	0.0	1.000	0.2304E 05	0	0	0	0	0	0
0	0.0	1.000	0.2448E 05	0	0	0	0	0	0
0	0.0	1.000	0.2592E 05	0	0	0	0	0	0
0	0.0	1.000	0.2736E 05	0	0	0	0	0	0
0	0.0	1.000	0.2880E 05	0	0	0	0	0	0
0	0.0	1.000	INF	0	0	0	0	0	0

HISTOGRAM NUMBER 16**

DELAY 9

OBSV FREQ	RELA FREQ	CUMUL FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
5	0.227	0.227	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.116	0.364	0.1440E 04	0.0	0.0	0.0	0.0	0.0	0.0
1	0.055	0.409	0.2980E 04	0.0	0.0	0.0	0.0	0.0	0.0
2	0.091	0.500	0.4320E 04	0.0	0.0	0.0	0.0	0.0	0.0
4	0.182	0.682	0.5760E 04	0.0	0.0	0.0	0.0	0.0	0.0
2	0.091	0.773	0.7200E 04	0.0	0.0	0.0	0.0	0.0	0.0
1	0.045	0.818	0.8640E 04	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	0.818	0.1008E 05	0.0	0.0	0.0	0.0	0.0	0.0
2	0.091	0.909	0.1152E 05	0.0	0.0	0.0	0.0	0.0	0.0
2	0.091	1.000	0.1296E 05	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	1.000	0.1440E 05	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	1.000	0.1584E 05	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	1.000	0.1728E 05	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	1.000	0.1872E 05	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	1.000	0.2016E 05	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	1.000	0.2160E 05	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	1.000	0.2304E 05	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	1.000	0.2448E 05	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	1.000	0.2592E 05	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	1.000	0.2736E 05	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	1.000	0.2880E 05	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	1.000	INF	0.0	0.0	0.0	0.0	0.0	0.0

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HISTOGRAM NUMBER 17**

DELAY 10

NRV FREQ	RFLA FREQ	CUML FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
4	0.429	0.429	0.0	C	C	C	C	C	C
3	0.143	0.571	0.1440E 04	C	C	C	C	C	C
1	0.048	0.619	0.2080E 04	C	C	C	C	C	C
4	0.190	0.810	0.4320E 04	C	C	C	C	C	C
2	0.095	0.905	0.5160E 04	C	C	C	C	C	C
0	0.0	0.905	0.7200E 04	C	C	C	C	C	C
0	0.0	0.905	0.8640E 04	C	C	C	C	C	C
1	0.048	0.952	0.1008E 05	C	C	C	C	C	C
0	0.0	0.952	0.1152E 05	C	C	C	C	C	C
0	0.0	0.952	0.1296E 05	C	C	C	C	C	C
1	0.048	1.000	0.1440E 05	C	C	C	C	C	C
0	0.0	1.000	0.1584E 05	C	C	C	C	C	C
0	0.0	1.000	0.1728E 05	C	C	C	C	C	C
0	0.0	1.000	0.1872E 05	C	C	C	C	C	C
0	0.0	1.000	0.2016E 05	C	C	C	C	C	C
0	0.0	1.000	0.2160E 05	C	C	C	C	C	C
0	0.0	1.000	0.2304E 05	C	C	C	C	C	C
0	0.0	1.000	0.2448E 05	C	C	C	C	C	C
0	0.0	1.000	0.2592E 05	C	C	C	C	C	C
0	0.0	1.000	0.2736E 05	C	C	C	C	C	C
0	0.0	1.000	0.2880E 05	C	C	C	C	C	C
0	0.0	1.000	INF	C	C	C	C	C	C

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HISTOGRAM NUMBER 100

DELAY 11

HMSV FREQ	RTLA FREQ	CUHL FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
11	0.647	0.647	0.0	0	0	0	0	0	0
3	0.176	0.824	0.1540E 04	0	0	0	0	0	0
2	0.118	0.541	0.2800E 04	0	0	0	0	0	0
0	0.0	0.541	0.4320E 04	0	0	0	0	0	0
1	0.039	1.000	0.5760E 04	0	0	0	0	0	0
0	0.0	1.000	0.7200E 04	0	0	0	0	0	0
0	0.0	1.000	0.8640E 04	0	0	0	0	0	0
0	0.0	1.000	0.1008E 05	0	0	0	0	0	0
0	0.0	1.000	0.1152E 05	0	0	0	0	0	0
0	0.0	1.000	0.1296E 05	0	0	0	0	0	0
0	0.0	1.000	0.1440E 05	0	0	0	0	0	0
0	0.0	1.000	0.1584E 05	0	0	0	0	0	0
0	0.0	1.000	0.1728E 05	0	0	0	0	0	0
0	0.0	1.000	0.1872E 05	0	0	0	0	0	0
0	0.0	1.000	0.2016E 05	0	0	0	0	0	0
0	0.0	1.000	0.2160E 05	0	0	0	0	0	0
0	0.0	1.000	0.2304E 05	0	0	0	0	0	0
0	0.0	1.000	0.2448E 05	0	0	0	0	0	0
0	0.0	1.000	0.2592E 05	0	0	0	0	0	0
0	0.0	1.000	0.2736E 05	0	0	0	0	0	0
0	0.0	1.000	0.2880E 05	0	0	0	0	0	0
0	0.0	1.000	INF	0	0	0	0	0	0
17				0	0	0	0	0	0

HISTOGRAM NUMBER 19

DELAY 12

NRSV FREQ	RFLA FREQ	CUML FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
20	0.769	0.769	0.0	0	0	0	0	0	0
6	0.231	1.000	0.1440E 04	0	0	0	0	0	0
0	0.0	1.000	0.2880E 04	0	0	0	0	0	0
0	0.0	1.000	0.4320E 04	0	0	0	0	0	0
0	0.0	1.000	0.5760E 04	0	0	0	0	0	0
0	0.0	1.000	0.7200E 04	0	0	0	0	0	0
0	0.0	1.000	0.8640E 04	0	0	0	0	0	0
0	0.0	1.000	0.1008E 05	0	0	0	0	0	0
0	0.0	1.000	0.1152E 05	0	0	0	0	0	0
0	0.0	1.000	0.1296E 05	0	0	0	0	0	0
0	0.0	1.000	0.1440E 05	0	0	0	0	0	0
0	0.0	1.000	0.1584E 05	0	0	0	0	0	0
0	0.0	1.000	0.1728E 05	0	0	0	0	0	0
0	0.0	1.000	0.1872E 05	0	0	0	0	0	0
0	0.0	1.000	0.2016E 05	0	0	0	0	0	0
0	0.0	1.000	0.2160E 05	0	0	0	0	0	0
0	0.0	1.000	0.2304E 05	0	0	0	0	0	0
0	0.0	1.000	0.2448E 05	0	0	0	0	0	0
0	0.0	1.000	0.2592E 05	0	0	0	0	0	0
0	0.0	1.000	0.2736E 05	0	0	0	0	0	0
0	0.0	1.000	0.2880E 05	0	0	0	0	0	0
0	0.0	1.000	INF	0	0	0	0	0	0
26				0	0	0	0	0	0

HISTOGRAM NUMBER 20

DELAY 13

UNSV FREQ	REL FREQ	CUMUL FREQ	UPPER CELL LIMIT		0	20	40	60	80	100
5	0.333	0.333	0.0							
4	0.267	0.600	0.1440E 04							
2	0.133	0.733	0.2880E 04							
2	0.133	0.867	0.4320E 04							
0	0.0	0.867	0.5760E 04							
2	0.133	1.000	0.7200E 04							
0	0.0	1.000	0.8640E 04							
0	0.0	1.000	0.1008E 05							
0	0.0	1.000	0.1152E 05							
0	0.0	1.000	0.1296E 05							
0	0.0	1.000	0.1440E 05							
0	0.0	1.000	0.1584E 05							
0	0.0	1.000	0.1728E 05							
0	0.0	1.000	0.1872E 05							
0	0.0	1.000	0.2016E 05							
0	0.0	1.000	0.2160E 05							
0	0.0	1.000	0.2304E 05							
0	0.0	1.000	0.2448E 05							
0	0.0	1.000	0.2592E 05							
0	0.0	1.000	0.2736E 05							
0	0.0	1.000	0.2880E 05							
0	0.0	1.000	INF							

---15

HISTOGRAM NUMBER 21

DELAY 14

UBSV FRFQ	RFLA FRFQ	CUNL FRFQ	UPPER CELL LIMIT	0	20	40	60	80	100
0	0.0	0.0	0.0	0	0	0	0	0	0
0	0.0	0.0	0.1450E 04	0	0	0	0	0	0
0	0.0	0.0	0.2800E 04	0	0	0	0	0	0
2	0.400	0.400	0.4320E 04	0	0	0	0	0	0
1	0.200	0.600	0.5160E 04	0	0	0	0	0	0
0	0.0	0.600	0.7200E 04	0	0	0	0	0	0
1	0.200	0.800	0.8640E 04	0	0	0	0	0	0
0	0.0	0.800	0.1008E 05	0	0	0	0	0	0
1	0.200	1.000	0.1152E 05	0	0	0	0	0	0
0	0.0	1.000	0.1296E 05	0	0	0	0	0	0
0	0.0	1.000	0.1440E 05	0	0	0	0	0	0
0	0.0	1.000	0.1584E 05	0	0	0	0	0	0
0	0.0	1.000	0.1728E 05	0	0	0	0	0	0
0	0.0	1.000	0.1872E 05	0	0	0	0	0	0
0	0.0	1.000	0.2016E 05	0	0	0	0	0	0
0	0.0	1.000	0.2160E 05	0	0	0	0	0	0
0	0.0	1.000	0.2304E 05	0	0	0	0	0	0
0	0.0	1.000	0.2448E 05	0	0	0	0	0	0
0	0.0	1.000	0.2592E 05	0	0	0	0	0	0
0	0.0	1.000	0.2736E 05	0	0	0	0	0	0
0	0.0	1.000	0.2880E 05	0	0	0	0	0	0
0	0.0	1.000	INF	0	0	0	0	0	0
5				0	0	0	0	0	0

HISTOGRAM NUMBER 22

DELAY 15

UNSV FREQ	RELA FREQ	CUMUL FREQ	UPPER CELL LIMIT	0	20	40	60	80	100
0	0.0	0.0	0.0	C	C	C	C	C	C
1	0.167	0.167	0.1440E 04	C	C	C	C	C	C
0	0.0	0.167	0.2880E 04	C	C	C	C	C	C
1	0.167	0.333	0.4320E 04	C	C	C	C	C	C
1	0.167	0.500	0.5760E 04	C	C	C	C	C	C
2	0.333	0.833	0.7200E 04	C	C	C	C	C	C
0	0.0	0.833	0.8640E 04	C	C	C	C	C	C
0	0.0	0.833	0.1008E 05	C	C	C	C	C	C
0	0.0	0.833	0.1152E 05	C	C	C	C	C	C
1	0.167	1.000	0.1296E 05	C	C	C	C	C	C
0	0.0	1.000	0.1440E 05	C	C	C	C	C	C
0	0.0	1.000	0.1584E 05	C	C	C	C	C	C
0	0.0	1.000	0.1728E 05	C	C	C	C	C	C
0	0.0	1.000	0.1872E 05	C	C	C	C	C	C
0	0.0	1.000	0.2016E 05	C	C	C	C	C	C
0	0.0	1.000	0.2160E 05	C	C	C	C	C	C
0	0.0	1.000	0.2304E 05	C	C	C	C	C	C
0	0.0	1.000	0.2448E 05	C	C	C	C	C	C
0	0.0	1.000	0.2592E 05	C	C	C	C	C	C
0	0.0	1.000	0.2736E 05	C	C	C	C	C	C
0	0.0	1.000	0.2880E 05	C	C	C	C	C	C
0	0.0	1.000	INF	C	C	C	C	C	C
6				D	C	C	C	C	100

APPENDIX D

Example Of Significance Calculations

EXAMPLE OF SIGNIFICANCE CALCULATIONS

Machine utilization

Machine #2, FCFS vs. CR

	<u>FCFS</u>	<u>CR</u>
$\bar{x} =$	47.22	51.78
$s =$	49.92	49.47
$n =$	276	306

$$F = s_1^2/s_2^2 = 49.92^2/49.47^2 = 1.018$$

$$F_{.05} = 1.16$$

Since $F < F_{.05}$, the difference in standard deviations
is not significant.

$$s^2 = \frac{s_1^2 + s_2^2}{2} = \frac{49.92^2 + 49.47^2}{2} = 2,469.64$$

$$s_{\bar{x}_1 - \bar{x}_2} = (s^2 (\frac{n_1 + n_2}{n_1 \times n_2}))^{1/2} = (2,469.64 (\frac{276 + 306}{276 \times 306}))^{1/2}$$

$$= 4.125$$

$$t = \frac{51.78 - 47.22}{4.125} = 1.105$$

$$t_{.05} (580) = 1.980$$

Since $t < t_{.05}$, the difference is not significant.

SIMULATION AND EVALUATION OF MANUFACTURING
LEAD TIME ESTIMATION EQUATIONS IN
COMBINATION WITH VARIOUS PRIORITY
RULES IN A MATERIAL REQUIREMENTS
PLANNING SYSTEM

by

Robert Arthur Bascom

B. S., Kansas State University, 1974

AN ABSTRACT OF
A MASTER'S THESIS

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Department of Industrial Engineering

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1980

ABSTRACT

A great deal of research has been done in the area of job-shop simulation. The objective of much of this research was to find ways to increase the efficiency of production facilities through improved scheduling and production control. It has generally been agreed that by minimizing production throughput time this goal would be met. The measures used to evaluate the effectiveness of the systems tested in past research have been either average throughput time or order lateness.

By the use of either average throughput time or order lateness as measures of effectiveness, some of the production-inventory control related costs have been ignored. The costs affected by the production-inventory control system are: work-in-process inventory costs, order lateness costs, and facility utilization costs.

Past research has also been hampered by the unrealistic simplifying assumptions used in model construction. Such assumptions as random operation times, regular order arrivals, and random job routings hardly represent real life situations. These assumptions and the criteria used to judge the results obtained place serious doubts on the general application of the findings of previous research.

The research described in this paper represents an attempt to construct a more realistic model and to consider all of the production-inventory control related costs when evaluating the results obtained. In addition, the model used in this research concerns a Material Requirements Planning system.

Several combinations of priority rules and lead time estimation equations are tested. The results are evaluated based on the sum of the three production-inventory control costs mentioned above. The model itself does not make use of the simplifying assumptions used in previous research. As a result, the results obtained should be of practical value and fit for application to real-life MRP system use.

The model simulates the production of twenty-four part numbers of six levels: from purchased parts, through weld assemblies, through final assemblies. Fifteen machines and nine workers are simulated. Purchased parts deliveries are normally distributed, with a service level of 90% leading to purchased part delays. Operation times are also normally distributed. Operation sequences are fixed and no alternate routings are allowed.

Priority rules tested include First Come-First Serve, Shortest Operation Time and Critical Ratio. The lead time equations employed all involve an allowance for processing time based on production standards factored for efficiency and an allowance for queue time based on smoothed historical

queue times. The first development of this equation involves the addition of a factor times the standard deviation of the queue times to provide a higher estimate of flow time. The idea here was similar to the service level approach in purchased parts lead times.

Another development was the addition of an allowance for average delays caused by inadequate subpart availability. It was felt that problems with the lead time equation were compounding through the several part levels. This modification was an attempt to minimize this effect.

Degeneration problems were encountered with the development on the original lead time equation causing experimentation with these equations to cease. Experimentation continued with the original lead time equation and the three priority rules mentioned.

In evaluating the three priority rules tested it quickly became apparent that the Critical Ratio rule performed best. It provided the shortest queue lengths, lowest work-in-process inventory, lowest order lateness, and good worker and machine utilization.

This research shows that only average flow time or order lateness should not be used alone as a basis for measuring effectiveness. In addition, the Shortest Operation Time rule was shown not to perform as well under these real-life conditions and criteria as it had in past research.