Team SMU

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Scope of Study

Areas of Investigation:

- INFISY System
- Machine Shop Layout
- Forecasting Job Completion Time
- Scheduling of Parts at Each Work Center
- Machine Repair Issues

INFISY Statistics Gathered

- Part flows within each work center
- Part flows between work centers
- Percentage of entire Manufacturing Division using INFISY
- Average positive variance (overestimation) of part completion time
- Average negative variance (underestimation) of part completion time

** Data from a ten month period*

Machine Repair Statistics

Data for estimating down-times:

- Costs of repair by manufacturer, machine type, and serial number
- Repair time by machine type and serial number

** Data from a three month period*

Models

- **Machine Shop Layout**
- **Estimated Forecasting**
- **Heuristic Part Scheduling**

Using these models, we developed a plan for the Manufacturing Division to possibly improve their machine shop layout, and make part production more efficient

Statistical Results

Machine Shop Layout

- Layout of the machine shop was examined by calculating the matrix of part flows between each machine
- From the matrix, the machines with the greatest part flows were determined
- These machines were then compared against the current machine shop map to determine the most efficient layout for the machines

Machine Shop Layout Benefits

- By determining where the largest part flows are in the machine shop, the heads of the machine shop can place the machines with the largest flows together
  - This reduces the transportation time between machines
  - This reduces the volume, decreases damage to parts and injuries to employees
- Technicians know where the parts have the highest probability of coming and going; they can get or send those parts accordingly

Results and Conclusions

Machine-Shop Layout

- In looking at the machine shop part flows matrix, it was determined that there were only two substantial flows of parts between machines.
- After checking these machines on the shop layout it was determined that these machines were
  1) already close enough together or
  2) assembly room which cannot be moved
- We concluded that the **machine shop is optimal at this time**

Estimated Forecasting Model

- Because the production centers produce parts as needed, the parts do not have trend, cyclical, seasonal, or average production cycles for which to do true forecasting models
- Instead, we used the positive and negative variances of part completion times to forecast
- The average over and underestimations correspond to a constant to multiply by the current estimated completion time, to get a more accurate completion time

Estimated Forecasting Benefits

- By using these new estimated times, the planners can more accurately predict how long a part will take given that it must be processed at each machine
- Better estimations means the parts can be tracked better and that planners can give a better prediction to the engineers about when parts will be completed
- Also, new estimated times will help in making actual costs closer to estimated costs

Results and Conclusions

Estimated Forecasting Model

- Based on the evaluation of data from the last 10 months, it was determined that the estimated completion times were underestimated according to the actual completion times
- For each machine, we evaluated the average difference for all parts and have recommended that the estimated completion time for a machine be increased by a certain percentage

Heuristic Job Scheduling

- Presently, there is no system to schedule parts production on each machine
- A heuristic program was developed to place jobs on the appropriate machines over a given time period
  - The model places parts in the first open space when a specific machine is available;
  - Based on the completion of the part on that machine, it then sends the part to the next open space on the machine where the part goes next
  - This is done for all machines that are presently in the system

Job Scheduling Benefits

Heuristic Job Scheduling

- By running this software, the planners and technicians can get a better understanding of where parts should be at any given time
- This software also allows for priority parts to be run through the system ahead of regular parts
- An option on the software allows for machine breakdowns to be simulated or planned for
- Knowing and planning for a breakdown provides a more accurate system for planning the parts

Results and Conclusions

Heuristic Job Scheduling

- Based on the 15 parts that were run through the system, the current scheduling of parts appears to be feasible.
- However, there are sections that have unusually high amounts of parts flowing through them
- Planners should examine these centers to determine if parts can be rerouted or rescheduled in order to avoid backups

Recommendations

- **Modify the INFISY software** to include the actual time that a part was completed; also include a signature or ID number of the employee who completed the part
- If INFISY can not do this, have employees manually sign and date the completion of a part at each machine
- At the end of the each work day, have INFISY **automatically log the work station out**; allow for manual adjustments for overtime as needed

Recommendations

- Schedule a meeting with all Division heads and several technicians to discuss the benefits of using INFISY in keeping better track of parts
- Stress to all employees the necessity of logging in and out of INFISY; offer incentives for accurately using the system

Conclusions

After examining results from the models, the team recommends the following:

Machine Shop Layout

- Keep the machine shop layout as is, however, periodically check the layout map for accuracy and update accordingly
- Periodically evaluate where the largest part flows are and try to ensure that the machines with the largest part flows are close

Conclusions

Estimated Forecasting

- Use the new machine projected estimated completion times to more accurately plan time for parts at each machine
- Ensure that the actual completion time of each part is monitored to continually evaluate the system and determine if it is accurately projecting these completion times

Conclusions

Part Scheduling Program

- Use the program to lay out where and when a part is at a machine
- The program output can also be looked at to see where bottlenecks occur; based on these backups, try to re-route parts or find better times to schedule parts

Difficulties in using Optimizing Techniques

One of the greatest problems that faced the team was the inability to use models that totally optimized areas of the production center. These problems can be attributed to the following causes:

- Data that was missing due to shortcomings in the software or by employees incorrectly using the system
- Results of data that was obtained by looking at routing sheets was often inconclusive due to insignificant levels of part flows

Difficulties in using Optimizing Techniques

- The non-profit mentality of NASA does not encourage the complete gathering of information that would lead to accurate optimization models
- Hesitance of employees to switch to a new system does not promote accuracy or make it easy to find information

Steps to Overcome Difficulties

By obtaining better information, the production centers would be able to help themselves and others evaluate these centers. This information can be obtained in the following ways:

- Employees know how to use the systems and actually use the system
- Keep the system up to date with any changes
- Have the system keep track of as much data as possible
- Make sure that all data is kept, i.e. breakdown times of all machines

Steps to Overcome Difficulties

- Keep track of cost of parts, this includes how many hours of overtime are used, how much does a machine cost to repair including unused labor during downtimes, how much time is wasted between jobs
- Better plan for the production of parts with engineers, planners, technicians, AND Quality Assurance before producing parts