Subject: Decision Analysis – Task 1

MEMORANDUM

TO: ALISTAR WU, U, Operating Director Of Shuzworld

FROM: Jon Horsman (operations consultant)

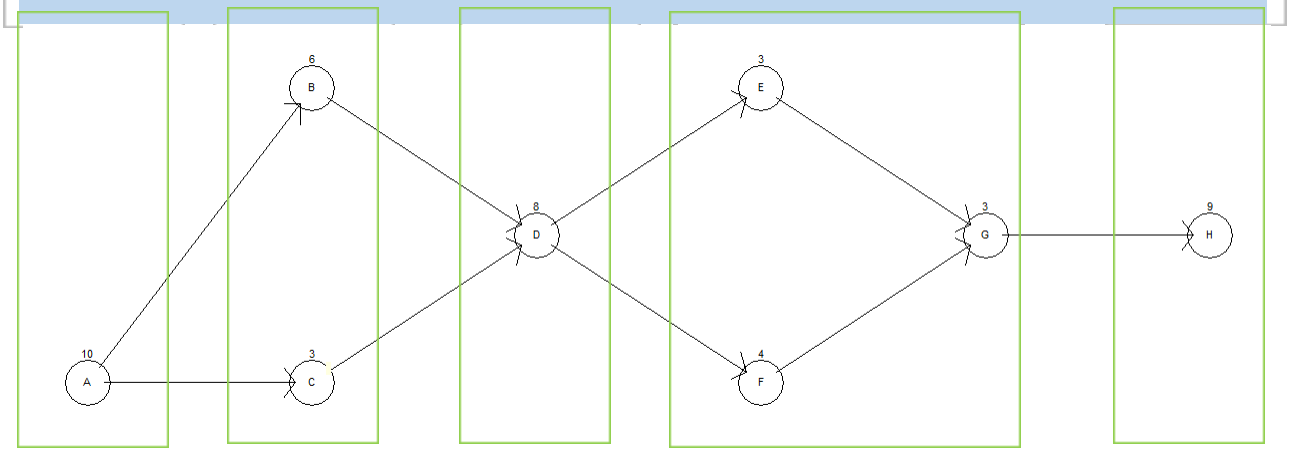
SUBJECT: Assembly Schedule, New Product, Production Challenges & Short-Term Scheduling

In this task, I will use the Shuzworld case study as an operation consultant to provide a recommendation after analyzing the problem, applying the appropriate decision analysis. Currently, Shuzworld has eight different workstations to produce their Rugged Wear Workboot. After analysis, we determined that the company could reduce that number to five workstations, thus improving the efficiency of the assembly line. Layout is one of the key decisions that determine the long-run efficiency of operations. Layout has numerous strategic implications because it establishes an organization's competitive priorities in regard to capacity, processes, flexibility, and cost, as well as quality of work life, customer contact, and image. (Render)

A1. Recommendation how to improve the current workflow in the plant for the Rugged Wear Workboot.

We recommend that Shuzworld organizes their production process into 5 workstations with the appropriate tasks in each workstation to produce the Rugged Wear Workboot.

Station #	Task	Time
1	A	10
2	B, C	9
3	D	8
4	E, F, G	10
5	H	9



The creating of 5 workstation layouts this would create a maximum cycle time of 10 minutes or less per station with a total time needed for each cycle of 46 minutes. Task A would begin the cycle, and it would take 10 minutes. Task B and C would follow and would only consume 9 minutes combined. Task D only requires 8 minutes. Task E, F and G combined would only require 10 minutes followed by the final Task of H which requires 9 minutes.

Since there are 2 workstations (Workstation 2 and 4) that require multiple tasks. The employees in those workstations should be cross trained in performing both tasks in the workstation. This cross training arrangement would be the most efficient in time savings as well as provide a huge cost savings to the company for the production of the Rugged Wear Workboot. This improved workflow was about to achieve a 92% efficiency with an 8% balance delay.

Justification of Recommendation:

Since mentioning your eagerness to improve the efficiency and Cynthia Crowninshield wanted to know the best way to organize their assembly line. We felt that an Assembly-Line Balancing analysis would be the appropriate first step. This Assembly-Line Balancing Analysis would identify the imbalance between machines/personnel while meeting the required output. So we imputed the performance times for each Task(A through H) and the sequence requirements into an assembly-line balancing tool to perform an analysis to determine the proper number of stations and to identify the most efficient, equal and effective workflow possible. The Assembly-Line Balancing Analysis tool calculated that the number of workstations needed was 5 stations. The 5 stations were selected because the maximum task time was 10 minutes

with the time needed of 46 minutes per cycle. Grouping of the Tasks into Stations that had extra time would reduce the idle time and increase efficiency while reducing the balance delay. Line Balancing is usually undertaken to minimize imbalance between machines or personnel while meeting a required output from the line. (Render)

The Original Tasks

Method: Most following tasks

Cycle time computation: Given 10 / Computed

TASK	Minutes	Predecessor 1	Predecessor 2	Predecessor 3	Predecessor 4	Predecessor 5	Predecessor 6
A	10						
B	6	a					
C	3	a					
D	8	b	c				
E	3	d					
F	4	d					
G	3	e	f				
H	9	g					

Assembly-Line Balancing Analysis

Assembly Line Balancing Results

(untitled) S

Station	Task	Time (minutes)	Time left (minutes)	Ready tasks	
				A	
1	A	10	0	B,C	
2	C	3	7	B	
	B	6	1	D	
3	D	8	2	E,F	
4	E	3	7	F	
	F	4	3	G	
	G	3	0	H	
5	H	9	1		
Summary Statistics					
Cycle time	10	minutes			
Min (theoretical) # of stations	5				
Actual # of stations	5				
Time allocated (cycle time * # stations)	50	minutes/cycle			
Time needed (sum of task times)	46	minutes/unit			
Idle time (allocated-needed)	4	minutes/cycle			
Efficiency (needed/allocated)	92%				
Balance Delay (1-efficiency)	8%				

These calculations gave this process an efficiency score of 92.00%.

This decision tool was selected to help achieve a higher efficiency of production time (decrease Balance Delay), reduce production floor space/number of stations, and minimize the imbalance between machines/personnel, the delay on material handling while meeting required output. With a properly balanced assembly-line, the company will notice an increase in throughput and lower production costs.

B. Cost Analysis

This the initial output table for inputs by the Shuzworld's Hetty Tarbox

Parameter	Value
Display times given a learning coefficient	
Unit number of base unit	1
Labor time for base unit,Y1	1000
Unit number of last unit,N	50
Learning coefficient	.8
Time for last unit	283.8271

B1. Analyze the initial and ongoing costs needed for the new sandal line being introduced. Management wants to know the hours and cost of labor each month to produce the schedule set forth.

Learning Curves are based on the premise that people and organizations become better at their tasks as the tasks are repeated. (Render) The time taken to produce a unit also decreases as more units are produced. Typically, Learning curves follow a negative exponential distribution. Learning curves also notice a decrease in the rate of improvement over time.

The following table shows the amounts for the first four months that Shuzworld should budget for the Maui Sandal project.

The following chart shows an increase in units over the first four months. This demonstrates the importance of understanding the improved rate of production as time progresses.

The information supply to us from Hetty Tarbox projects that the production is going to be in batches of 10,000 with the first batch being estimated at 1,000 labor hours to produce. This also projects labor cost hourly rate to be at $1.08 in U.S. Dollars. Below is the Output all 50 batches for the first four months. This will reflect the 5 Batches produced the first month, 10 Batches from the second month, 15 from the third and 20 from the fourth month for the total of 50 (5+10+15+20) Batches. Shuzworld should be surprised by the fact in 50^{th} batch, it will only take 283.8271 hours, which will result in greatly reduced labor cost associated with each batch. Although the declines in labors decrease as time goes on, the labor hours will still continue to decrease in future months. Shuzworld should take advantage of the potential product demand for the sandals without changing the model. If the model is changed, the company will have to restart the whole learning curve process again at a greater expense, higher labor costs, and a reduced production efficiency than sticking with the Maui sandal.

Learning Curves — Determining times

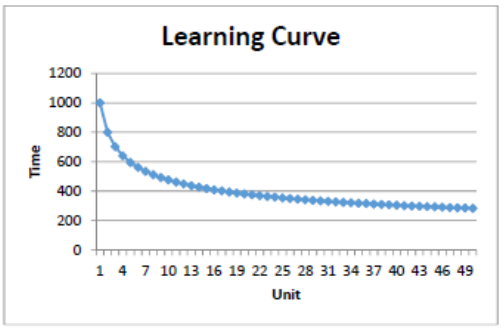
Data

Unit number of base unit	1
Time for base unit	1000
Learning curve coefficient	80%

Time for first unit 1000 (Do not change this value)
b -0.321928

Results

Unit	Time	Cumulative time	Month	#Batches	Total labor	labor cost	avg cost/batch
Unit 1	1000	1000					
Unit 2	800	1800					
Unit 3	702.1037	2502.1037					
Unit 4	640	3142.1037					
Unit 5	595.63734	3737.741	1	5	3737.741	$ 4,036.76	$ 807.35
Unit 6	561.68296	4299.424					
Unit 7	534.48952	4833.9135					
Unit 8	512	5345.9135					
Unit 9	492.94961	5838.8631					
Unit 10	476.50987	6315.373					
Unit 11	462.11114	6777.4842					
Unit 12	449.34637	7226.8305					
Unit 13	437.91552	7664.746					
Unit 14	427.59162	8092.3377					
Unit 15	418.19918	8510.5369	2	10	4772.7958	$ 5,154.62	$ 515.46
Unit 16	409.6	8920.1369					
Unit 17	401.68344	9321.8203					
Unit 18	394.35969	9716.18					
Unit 19	387.55495	10103.735					
Unit 20	381.2079	10484.943					
Unit 21	375.26707	10860.21					
Unit 22	369.68891	11229.899					
Unit 23	364.43624	11594.335					
Unit 24	359.4771	11953.812					
Unit 25	354.78385	12308.596					
Unit 26	350.33242	12658.928					
Unit 27	346.10175	13005.03					
Unit 28	342.0733	13347.103					
Unit 29	338.23068	13685.334					
Unit 30	334.55935	14019.893	3	15	5509.3566	$ 5,950.11	$ 396.67
Unit 31	331.04633	14350.94					
Unit 32	327.68	14678.62					
Unit 33	324.44994	15003.07					
Unit 34	321.34675	15324.416					
Unit 35	318.36192	15642.778					
Unit 36	315.48775	15958.266					
Unit 37	312.71723	16270.983					
Unit 38	310.04396	16581.027					
Unit 39	307.46211	16888.489					
Unit 40	304.96632	17193.456					
Unit 41	302.55168	17496.007					
Unit 42	300.21366	17796.221					
Unit 43	297.94809	18094.169					
Unit 44	295.75113	18389.92					
Unit 45	293.6192	18683.54					
Unit 46	291.54899	18975.089					
Unit 47	289.53743	19264.626					
Unit 48	287.58168	19552.208					
Unit 49	285.67905	19837.887					
Unit 50	283.82708	20121.714	4	20	6101.8203	$ 6,589.97	$ 329.50



Cost for each month

Schedule:

Month	# of Batches for that Month
1	5
2	10
3	15
4	20
	50 Batches

Labor rate: $1.08

Solution for the output, schedule and labor rate:

Month 1: we need 1,000 + 800 + 702.1037 + 640 + 595.637 hours

Cost = 3737.41 x $1.08 = $4036.76

Average Cost per Batch is Cost of $4036.76 / number of batches 5 = **807.35**

Month 2: we need 561.6829 + 534.489 + 512 + 492.94 + 476.5098 + 462.11 + 449.346 + 437.9155 + 427.59 + 418.199 hours

Cost = 4772.795 x $1.08 = $5154.62

Average Cost per Batch is Cost of $5154.62 / number of batches 10 = **515.46**

Month 3: we need

409.6+401.683+394.359+387.55+381.20+375.267+369.688+364.43+359.47+354.78+350.33+346.10+342.07+338.23+334.55 hours

Cost = 5,950.11 x $1.08 = $5509.35

Average Cost per Batch is Cost of $5509.35/ number of batches 15 = **396.67**

Month 4: we need

331.04+327.68+324.44+321.34+318.36+315.48+312.71+310.04+307.46+304.96+302.55+300.21+297.94+295.75+293.6192+291.54+289.53+287.58+285.67+283.82 hours

Cost = 6101.82 x $1.08 = $6589.97

Average Cost per Batch is Cost of $6589.97/ number of batches 20 = **329.50**

It also becomes clear that as time goes on the company will see a truer baseline for total production time, total monthly costs, and the average cost per batch as the employee's learning curve decreases.

As you can see, the chart below shows the hours that are required for the production of sandals decrease as more sandals are produced. By continuing to produce this Maui Sandal line your total labor costs will continue to decrease, but at a slower rate as more sandals are produced.

This information will help the Shuzworld determine the employment levels, capacity, costs and their pricing of this product in the marketplace.

Justification

The learning curve decision tool was selected because of the strategic, internal and external importance that is placed on the learning curve. The reason for this tool is to help Shuzworld determine labor forecasting, scheduling, establish budget costs and budgets. This information can also help in supply chain negotiations. This tool can also help in evaluating the company's industry performance which includes pricing and costs.

The learning curve is applied to further aid in the formulation of strategic decisions about capacity, costs, employment levels, and pricing. Repetition of the same operation will result in finding efficiencies that will decrease the time expanded on that operation. This means there will be more time available to produce even more products because it takes less time to produce the previous product. The available resources and process changes can have an impact and alter the learning curve. As the Shuzworld pursues the learning curve to achieve cost savings volume must also increase for the curve to exist. As production time goes on for Shuzworld the amount of labor decrease is smaller than when production first started.

C1. Recommend a staffing plan for the assignment of machine operators on a shift at the Shuzworld Shanghai plant that will increase cost effectiveness.

Handel has asked us to address an issue with the manufacturing of several women's shoes that require a significant skill by the machine operator. He had mentioned that they have four

operators that they can trust to do the job. They know that they can run similar jobs but complete them at different times. He has for women's shoes jobs to assign and wants to know the costs for each operator doing the job. Here is the spreadsheet given to us.

Job	Machine Operator			
	A	B	C	D
1	$10	$12	$10	$11
2	11	9	11	11
3	9	8	11	9
4	10	8	9	10

After inputting the information into the POM under the Assignment (This decision analysis tool was selected because it showed the optimal staffing plan), we were able to find the most effective way to assign the jobs. The result shows that the staffing plan assignment will achieve the most efficient cost of $37 for the company. The graph below also shows the best operators to assign the corresponding job to achieve the maximum cost savings.

Optimal solution value = $37	Machine O A	Machine O B	Machine O C	Machine O D
Job 1	Assign 10	12	10	11
Job 2	11	Assign 9	11	11
Job 3	9	8	11	Assign 9
Job 4	10	8	Assign 9	10

Machine operator 1 will perform job 1. Machine operator 2 will perform job 2. Machine operator 3 will perform job 4 and machine operator 4 will perform job 3. This minimizes time and reduces company costs.

Justification

The assignment tool was selected to perform a cost effectiveness analysis for the 4 machines and the 4 jobs because it will determine which machine would perform which job and provide the lowest cost to the company. By performing this analysis on each job or machine the company will be able to minimize costs and the time to perform the job.

D. Outline short-term scheduling techniques and rules that can be used to achieve efficient movement of units through Shuzworld's production systems.

In order to help Shuzworld effectively move products through the production systems, short-terms scheduling techniques and rules should be established. The results mean faster movement of goods through the facility and faster delivery. This equates to lower costs for the company. The importance of Short-term scheduling is to gain the competitive advantage. Some of the ways Shuzworld can gain a competitive advantage is by Faster Movement of goods (better use of assets and lower costs), Additional Capacity (faster throughput which improves customer service through faster delivery), and Good Schedules (dependable deliveries that enforces the company's integrity).

There are four different types of scheduling criteria to determine which technique Shuzworld should use for scheduling.

The criteria are: utilization maximization, minimization of completion time, minimization of work-in progress inventory and minimization of customer's wait time.

Shuzworld is more of a repetitive facility that utilizes an assembly line type of production. This company uses the type of facilities that utilize a Forward-Looking Schedule. It would also use a Kanban or Just-in-time type of system in order to keep the assembly line moving. A repetitive facility such as Shuzworld would notice the most costly part of their repetitive facility is the introduction of a new product or process. This was solidified by the results for the Shuzworld's learning curve. The other process strategies include: Process Focused, Product Focused, Mass Customization Focus and even Comparison of Process Choices.

Scheduling Issues

For Shuzworld to address the scheduling issues, they must find ways to be more efficient in the following areas:

Capacity Plans (an annual or quarterly evaluation of the equipment or facilities that are purchased or discarded.

Aggregate Planning in the operational activity for the production processes that are made in advance. (These are decisions regarding resources, subcontractors, people, facilities, equipment and inventory)

Master Production Schedule(MPS) which breaks down aggregate schedule and makes weekly schedule for specific product lines or products. This plan quantifies significant processes, resources, and parts in order optimize production by identifying bottlenecks in the production.

Forward and Backward Scheduling: Forward scheduling starts schedule when job requirements are known and runs on the philosophy of "As Early As Possible". It schedules the

job as early as possible as soon as possible. This process could cause an inventory buildup if the client doesn't want the product until a specific future date. So Shuzworld should also look at Backward Scheduling "As Late As Possible" which begins with the due date and schedules the last operation first.

Scheduling Criteria for our priorities should reflect the following: Minimum completion time (This evaluation determines the average completion time of each job), Maximum utilization (This Evaluation determines utilization percentage of facility), Minimize work in process(WIP) inventory (which results in Minimum work in process inventory) and even Minimize customer wait time (This Evaluation is based on the determination of the average number of late days). The strategy that should be most important to Shuzworld is to have an Input-Output control system. This Input-Output System needs to help manager's take corrective action against overloading and underloading in the manufacturing facility.

Loading Jobs means the assignment of jobs to work or processing centers. Operations managers assign jobs to work centers that costs, idle time, or completion times are kept to a minimum. (Render) Loading work centers can take on two forms. One that is oriented to capacity and the second is related to assigning specific jobs to the work centers.

In order to keep this constant work process steady, a ConWIP (Constant pull oriented work in progress) should be established. This process should optimize the use of resources so that production objectives are met.

Gantt Charts are useful for short-term scheduling. These charts serve as a visual aid for scheduling which displays workloads over time and monitoring of jobs in process. They also monitor works in progress, determine if jobs are on schedule or not. If the project is not on

schedule, the Gantt schedule chart will show if the production is ahead of or behind schedule. The Gantt Charts will show Load Charts and Idle Times of departments, machines, or facilities. This type of short-term scheduling would be beneficial to Shuzworld because it would be easy to visually assess the efficiency of their production schedule and allow to make adjustments when necessary.

The Assignment Method minimizes both cost and time required to produce a product. With this method, Shuzworld can determine what resources are assigned to which department, machine or center of operation. This method is specifically used to allocate the proper number of employees to a machine or task, and the number of jobs that the given machine or facility can produce.

The Sequencing of Jobs is another method for specifying which order jobs should be performed. These are the four guidelines are used to prioritize the Sequencing of how the jobs should be worked when it comes to dispatching jobs:

FCFS: first come first served: This is not the most advantageous of criteria, but it appears fairer to customers in a service. The job that is received first is the first one processed type system.

SPT: short processing time: This minimizes workflow and orders in the system. The short processing time takes the shortest jobs and completes them first. While it keeps the number of job orders down, it also causes longer projects to have delays while longer processing times.

EDD: earliest due date: This technique minimizes the maximum tardiness for jobs that include a harsh penalty if the job is not completed by a certain due date. The sooner the job is due is the sooner it is to be completed. This is a good rule if time is of the essence.

LPT: longest processing time: This is generally the largest jobs that will take the most amount of time. They are scheduled first. While this rule allows for the "important" jobs to be processed first, it often pushes back on jobs that have a shorter processing time.

Critical Ratio is another method that can be used to achieve an effective movement throughout the Shuzworld's production facility. This is an index number that is calculated by dividing the remaining time until the due date by the remaining work time. This ratio can be updated easily and performs better than the four priority rules mentioned earlier.

The Critical Ratio will help with: Determining the status of a specific job, Establishing a common basis jobs priority, Automatically adjust priorities for demand and job progress and even track job progress dynamically. This critical ratio is often used to make sure that the units are shipping on time.

Johnson's rule can be used when there is more than one work center. The Johnson's rule is an approach that will help reduce the processing time for sequencing a group of jobs across two work hubs while reducing total down time in the work hubs.

The Limitations of rule-based dispatching system techniques are dynamic. Therefore, the rules need to be constantly revised to adjust to the changes in the process, product mix, equipment, facilities, etc. As a result, all of these techniques are rule based, and they all have limitations. Rules do not look up or down the production process so idle resources or bottlenecks may not be known in other departments. Rules do not look beyond due dates. Two orders can have the same due date but a different priority status.

Finite Capacity Scheduling (FCS) is another short-term scheduling technique that Shuzworld can use. This computerized scheduling system is an interactive computing process

that always for up-to the minute scheduling changes, which is based on what the scheduler needs and the data that the computer is collecting. This system has the ability to determine match resource requirements to a finite supply of available resources to create a realistic production plan.

Level material Use is a method that lowers inventory levels, releasing capital for other uses, creates faster product throughput, improves component quality(which improves product quality), reduces floor space requirements, improve communications among employees, and smooth production process because large lots are not hidden. This method is commonly used in repetitive facilities, such as Shuzworld.

Short term scheduling is a necessity for companies like Shuzworld. Even though the short-term scheduling can be complex, it will allow Shuzworld to streamline their production systems.

References

Render, J. H. (n.d.). Operations Management 10th edition. In B. R. Jay Heizer, *Operations Management 10th edition* (pp. 344, 361, 588, and 700). Prentice Hall.