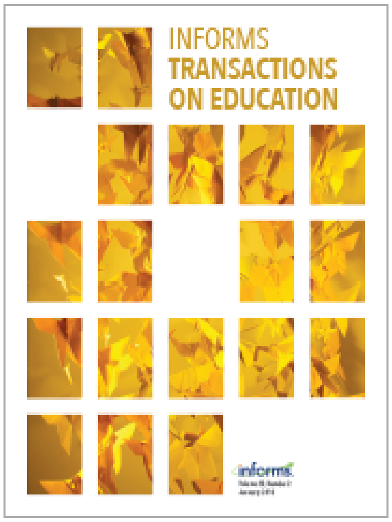

INFORMS Transactions on Education

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INFORMS TRANSACTIONS ON EDUCATION
Vol. 20, No. 1, September 2019, pp. 44–48
ISSN 1532-0545 (online)

Case

Agile Auto Sub Assemblies: Challenges in Managing Growth, Resource Productivity, and Demand Variability

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Received: November 7, 2017
Revised: June 17, 2018; October 16, 2018; January 3, 2019
Accepted: January 3, 2019
Published Online in Articles in Advance: August 23, 2019

https://doi.org/10.1287/ited.2019.0206cs

Keywords: assembly line design • level production • utilization • operations • production • critical thinking

Ms. Swathi Bhargava, welcome and thank you for agreeing to join us for your internship. As you know, we are a small-scale auto parts manufacturing company but have quite a reputation in the local market. We just secured an order from a well-known automobile equipment manufacturer in the Detroit area. Good times are ahead, and I am quite excited. However, I am also nervous about meeting the new surge in demand. How much more can I get out of my present workforce without overexerting them? Should I be on the lookout for new employees? I seek your help in making sure that we have production plans to ensure deliveries on time.

— Bob Williams, Owner, Agile Sub Assemblies.

Agile Sub Assemblies

Agile Sub Assemblies (ASA) was started in 2014 when a private investor group led by Bob Williams purchased the unit from one of the big automobile companies in the area. ASA supplies driveline and drivetrain components for Original Equipment Manufacturers in the passenger car and commercial vehicle segments primarily in the Detroit area. The company has plans to expand its business and is shortly planning to go public. Bob Williams is an economics graduate from Michigan State University. He has a master's degree in entrepreneurship from the University of Michigan. ASA's primary clients are located in the Detroit area in Michigan.

ASA's two production lines, A and B, are supervised by Mr. Bill Sampson and Mr. Tony Greig. Bill has an engineering degree and extensive experience in the manufacturing industry. Bill is also quite accomplished in personnel management and oversees seven workers in ASA. Tony is an engineer and recently completed his MBA from University of Michigan.

Swathi Bhargava is from Chennai, India. She has a bachelor's in production engineering from Anna University, India, and in 2015, she joined a premier business school in the state of California for her MBA.

Meeting with Bill Sampson (Supervisor, Line A)

Swathi followed up with Bill after her meeting with Bob. Following is an excerpt from the conversation:

Swathi: Hello Bill. Thanks for meeting with me during a busy morning. Can you briefly explain what you do at the production line?

Bill: Hello Swathi. Always busy around here, but glad to help. The subassembly performed in the production line requires 16 different subtasks. Despite the complexity, ours is the best managed line in this company. I allot the tasks to the seven available workers as equally as possible. The task times, the precedence relationship, and the work allocation are given here in this sheet (see Exhibit 1). Here is a map of our assembly line (also available in Exhibit 1).

Swathi: Thanks Bob. What is your current daily production plan?

Bill: We operate eight hours per day, including four 15-minute breaks. Our current production rate is 315 units per day.

Swathi: What will be the production requirements with the new order? What are your thoughts on managing the surge in demand?

Bill: Under the new contract, we are required to supply 420 units/day, which is a 33% increase in current daily production. So we would need at least 33% more workers, that is, at least two additional workers.

Swathi: How easy is it to get additional workers?

Bill: The way the labor market currently is, it requires a lot of effort and investment to train new employees. We would be spending close to $10,000 to bring a new employee up to speed on the job. Bob does not want to hire more than three new workers for lines A and B put together. We can explore the overtime option as well but need be wary of worker fatigue.

Swathi: Have you used overtime before? How was your experience?

Bill: Fatigue was a significant concern. My folks are already here from 8 a.m. to about 4 p.m. I would not want them to work beyond 7 p.m. I am also worried about quality if we push these workers into working overtime.

Swathi: Thank you, Bill, for the inputs. I need to go and meet Tony next to get an idea about his line.

Bill: Tony handles it a little differently. Nice meeting you, and let me know if you need any help.

Meeting with Tony Greig (Supervisor, Line B)

Swathi then met with Tony to get similar details on the line that he manages. Tony was visibly busier than Bill. She had to wait for a few minutes before Tony could join her. Following is an excerpt from their conversation:

Swathi: Hi Tony. Sorry for bothering you when you are busy, but thanks for meeting with me.

Tony: No problem! It's just busy when we begin the day. Then it is more or less on autopilot unless we hit any production issues. How can I help? I heard you are our new intern.

Swathi: Yes, thank you. I am just trying to understand the basic operations here. Can you briefly explain what you do at production line B?

Tony: I guess you visited Bill first. Mine is relatively simpler. Our subassembly requires eight different tasks. We just have two workers. The task times, the precedence relationship, and the work allocation are given here in this sheet (see Exhibit 2). Here is a map of the assembly line (also available in Exhibit 2).

Swathi: Thank you, Tony. What is your current daily production plan?

Tony: Our current production rate is 140 units per day. Just like Bill's, we also operate eight hours per day, including four 15-minute breaks.

Swathi: What will be the production requirements with the new order? Any thoughts on managing the increased work load?

Tony: I heard it's about a 50% increase under the new contract. So we need to plan to supply 210 units/day. We will definitely need some extra hands. We are a team of two, and our hands are full. We will need to double our team.

Swathi: How easy is it to get additional workers?

Tony: It's not going to be easy. I can tell that for sure. There is a combined cap of three additional workers that Bob mentioned. In my opinion, additional hands are definitely better than overtime.

Swathi: Have you used overtime before? How was your experience?

Tony: We have done it a few times. Overtime implies overwork, and quality needs to be monitored. I would venture there a little carefully and have some buffer at least.

Swathi: Thank you, Tony, for all the information. I now need to go to my desk and start analyzing.

Tony: Good luck, Swathi!

Preliminary Analysis by Swathi

Based on her operations class lecture notes, Swathi began her analysis. She considered different workstation designs (subject to the precedence relationship) to meet the existing production volume and also the future expected production per day. She explored operating different numbers of workstations, each with up to three hours of overtime. During her calculations, she found that the current production requirements of line A could actually be met by using six workstations. She was scheduled to meet with Bob the next day. She planned to summarize her analysis using the format in Table 1.

Follow-up Meeting with Bob Williams

Swathi mentioned her key findings to Bob in the next meeting:

Bob: I am quite surprised that you were able to meet line A's current production volume with just six workstations, which is actually one less than the current setup.

Swathi: Yes, and with additional overtime, we can actually meet the new demand with the existing workforce for line A.

Bob: That may be true, but it may just be a temporary solution. Can you look closely if capacity increases proportionately with the number of workstations? For instance, if I increase the number of stations by 50%, does the actual output go up by 50%?

Swathi: Not always. . .

Bob (cutting her short): I am sure you have an explanation, Swathi. I am sorry though. I have to hurry for a client's meeting. They seem to want daily shipments, and this meeting is crucial to understand

Table 1. Summary of Production Capacity Analysis

Number of workstations	Overtime (hours per day)	Capacity (units per day)	Labor utilization, %
6	0	315	100
..	..	..	

their demand and get their requirements. Before I go, I want a couple of additional things from you. I would like to know what the financial implications of each option are. This would definitely be one of the important criteria in making a final decision. Second, I am wondering how flexible our current lines are to manage production variability. Our production consultant Mr. Craig Wilson will be here this evening. Why don't we all meet at 3 p.m. with him? We can then discuss several things, including the future scope of these production lines.

Swathi: Sure, Bob. I will work on these and prepare a presentation.

Joint Meeting with Craig Wilson

Bob: Thanks, everyone, for joining us on a busy day. I think, except for Swathi and Craig, we all know each other. Swathi, this is Craig Wilson, our production consultant. He has been our go-to man ever since I started the company. Craig, this is Swathi, interning with us this summer, a very promising student currently pursuing her MBA. Swathi, can you brief us on your analysis of our production lines?

Swathi (draws their attention to Table 1): Here is a summary of the number of workstations along with their respective capacity.

Tony (after a minute's pause, takes a friendly jibe at Bill): Bill, you always seem to suggest yours is the best managed assembly line, but it looks like Swathi is able to achieve the same output with one less workstation!

Bill: Yes, I noticed that. Swathi, can you elaborate on how you configured your assembly line to achieve the daily output of 315 with six workstations?

Swathi: Sure (looks at her notes and quickly draws the configuration on the whiteboard. The figure is presented in Figure 1).

Bill: Ah, you seem to put immediately succeeding activities in the same cell. For example, activity 6 cannot be started until activity 3 is completed; still, you have put both of them in the same cell. Traditionally, assembly lines are configured such that activities in each workstation can be done in any order.

Swathi: True, I assumed that the activities can be arranged and workers within each cell could be easily trained to respect the precedence relationship.

Tony: I agree that there are some logistics and practical difficulties. Even then, I don't see any reason why it could not be implemented. This will increase your current utilization from about 87% to near 100%.

Bill: You are overlooking that my current setup is flexible to accommodate any demand surges and production changes without needing overtime. In fact, if I extend your logic, we might as well put all the activities in one big cell to always achieve 100% utilization.

Swathi: That is certainly true and is the fundamental idea behind a cellular layout. Assembly line manufacturing is based on division of labor and focuses on labor efficiency. Cellular manufacturing is at the other end of the assembly line and is configured in such a way to minimize material movement.

Bob: Thanks, Swathi. What did you find in the case of line B?

Swathi: I found that producing the new requirements will require four workers without considering overtime.

Craig: Given the discussions we have had so far, I am more interested in the three workstations scenario for line B. Can you show me your configuration for that?

Swathi: Sure (Swathi shows them the configuration on the whiteboard. It is presented in Figure 2).

Craig: This configuration is not 100% efficient. How about this configuration? (He draws the configuration shown in Figure 3.)

Craig (continues): I understand the last activity is now part of the first work cell and will involve some special considerations. However, the advantage is that we may not need four workstations to meet the new production requirements.

Tony: In addition, it will also increase the work in process and inventory requirements.

Craig: True, certainly there are some considerations.

Bill: Another possibility is that, with four hours of overtime, you can achieve the higher demand even with your existing setup.

Tony: Don't you think that will be overkill given what you just said about flexibility?

Figure 1. Assembly Line with Six Workstations: Sub Assembly A

Activities	1,2	3,6,8,9	4,5,7	12,13	10,16	11,14,15
Worker	1	2	3	4	5	6
Total time	80	80	80	80	80	80

Figure 2. Assembly Line with Three Workstations: Sub Assembly B

Activities	1,4,5	2,3	6,7,8
Worker	1	2	2
Total Time	110	120	130

Figure 3. Assembly Line with Three Workstations (Modified): Sub Assembly B

Activities	1,2,8	3,5	4,6,7
Worker	1	2	2
Total Time	120	120	120

Bob: There are definitely trade-offs. Craig, can you suggest a few criteria that we can use to compare the different options?

Craig: Production capacity and utilization of the line are definitely important. I also agree with Tony and Bill. Overtime and flexibility are also things that we need to pay attention to. In addition, I would also look at hiring and training costs of new employees.

Bob: Thank you, Craig. Those five criteria seem like they will cover most bases. Shall we also shortlist a few options for Swathi to work on?

Craig: For line A, we should probably look closer at the current setup with sufficient overtime and an option with no overtime. For line B, we can pay closer attention to the two three-workstation configurations, adding overtime if needed, and one other option with no overtime.

Bob: Thanks, everyone. We will keep in mind the interests of everyone and, more importantly, the company's long-term interests. It is time I share with you another piece of development. Our customers are starting to adopt just-in-time, and as a result, they want deliveries dispatched daily. We will need to prepare line A first to meet the new requirements.

Craig: Is there a lot of variability in their daily needs?

Bob: It seems to be significant. (Bob writes the figures on the board—presented in Exhibit 3.)

Craig: You have two options. You may choose to level produce, that is, produce a fixed quantity every day such that you meet the daily requirement on average. This will mean you will be overproducing on a few days and have to make arrangements to store the excess inventory. Another option is to schedule the workforce such that the company meets the demand precisely on each day. The trade-off will be between holding cost of inventory and overtime cost of labor. Bill, what is your estimate of inventory holding costs?

Bill: It may be around $1 per unit, per day.

Bob: Swathi, I hope you have taken note of everything and can help us in arriving at a final decision. At least it is not obvious which option is better and how to best deal with the requirements.

The meeting was adjourned soon after. Tony and Bill walked back to their lines vigorously chatting about a long list of things to be done before the end of day. Bob took Craig for another consultation to his office. Swathi walked back to her desk trying to absorb all the new pieces of information.

Swathi needs to summarize her analysis using the formats presented in Tables 2–4. She is looking forward to her presentation to Bob in a week.

Acknowledgments

This document is based on a problem that is in circulation among the academic community of the production and quantitative methods area in the Indian Institute of Management (IIM) Ahmedabad. The problem under circulation is neither registered as an academic document with the institute nor is affiliated to any author. Subsequently, this problem was extended by N Ravichandran and Devanath Tirupati, faculty at IIM Ahmedabad, to design an examination for the core MBA operations course. The case has been developed solely for the purpose of class discussion. The case is not intended to serve as a source of primary data or illustrations of effective or ineffective management.

Table 2. Options to Manage Capacity

Configuration	Utilization	Capacity	Hiring costs	Overtime cost per day	Additional regular wage cost per day	Total cost per day
..						
..						

Table 3. Level Production Cost for Line A

Configuration	Inventory cost per week	One-time new hire cost	Additional worker cost per day	Overtime cost per day	Total cost per week
..					
..					

Table 4. Variable Production Cost for Line A

Configuration	Additional worker cost per week	Overtime cost per week	Total cost per week
..			
..			

Exhibit 1

Figure E1. Assembly Line: Sub Assembly A

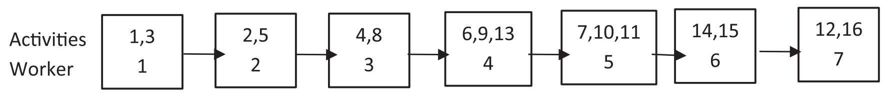

Table E1. Sub Assembly A

Activity	Time, seconds	Immediate predecessor	Worker allotted
1	30	None	1
2	50	None	2
3	40	1	1
4	50	1	3
5	20	2	2
6	10	3	4
7	10	4, 5	5
8	20	2	3
9	10	6	4
10	40	9	5
11	20	7	5
12	30	7	7
13	50	9	4
14	50	10	6
15	10	11	6
16	40	8, 12	7

Notes. Contribution per unit: $30. The workers were paid at an hourly wage rate of $60 and an overtime rate of $90 per hour (1.5 times regular wages).

Exhibit 2

Figure E2. Assembly Line: Sub Assembly B

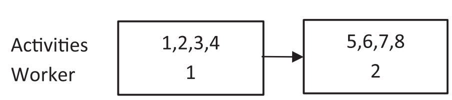

Table E2. Sub Assembly B

Activity	Time, seconds	Immediate predecessor	Worker allotted
1	40	None	1
2	50	None	1
3	70	1	1
4	20	1	1
5	50	1	2
6	40	2, 3	2
7	60	5	2
8	30	4, 6, 7	2

Exhibit 3

Table E3. Daily Delivery Requirements: Line A

Day	1	2	3	4	5
Requirement, units	455	460	465	465	455