

TRIM Inc.

By

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### **Abstract**

A fictional example demonstrates the danger of using fully allocated costs, even ABC, to determine the profitability of a new proposed product line. Using marginal costing improves the solution, but does not fully consider the option of increasing capacity. In order to determine whether capacity should be increased additional analysis must be done that focuses on the best way to use constraints and simultaneously balance demand against risk. The main focus of the case is the behavior of step-fixed costs. Capacity usually must be purchased in lumps that are rarely divisible. Students seldom have the opportunity in cases to deal with step-fixed costs and changing capacity. This case allows them to do both.

Key words: activity-based costing, target costing, constraints, step-fixed costs, capacity choices, profitability analysis.

### **Introduction**

Taylor's Reduction Improvement Machines Inc., (TRIM), produces exercise equipment. The company has a mature market line of reliable products. However, recently the demand for robust exercise equipment for home and club use has dramatically increased. TRIM Inc. has maintained their sales volume but they have been gradually losing market share of an ever expanding market for exercise equipment as clubs and individuals turn to newer innovative machines outside of TRIM Inc.'s repertoire. Therefore the company president, Summer Taylor, a former swimsuit model, Miss America first runner up, and Smith College alum has decided to try and develop new profitable products for the market.

Summer's Research and Development team, headed by Edward Smith, have recently developed a new product that they feel will be well received. The product is a new exercise machine that in the testing phase dramatically reduced waistlines in as little as 14 days. The initial marketing results have indicated that the market is firm for this product and that a price of \$100 would be well received. At that price, TRIM Inc. believes that 7,500 machines can be sold each year for the next two years. The material cost for each unit is \$60. One of the major benefits of the new product line is that the new product can be produced on the existing equipment.

Summer called a meeting of the management team. During the meeting Summer and Edward discussed the production needs and sales potential of the Waist Line Reduction Machine, (WLRM), with Chris Kelly, the head of production, Montgomery Bradford, the Vice President of Marketing and Joshua Sears, the Controller. Edward stated that given the flexibility of the current equipment, and the skill of the setup personnel, the existing equipment could be used to produce the new machines. In fact, Edward stated that he had designed the new product so that it could be produced using the existing processes and machines. The skill set of the current labor force is considered to be sufficient to produce this new product. During the meeting the following discussion took place:

**Summer:** "Ed, this machine looks wonderful, and the marketing results look very positive. I am really impressed with your ingenuity and your practicality at the same time. Developing a machine that we could make on our existing resources is incredible."

"You've done the market analysis Montgomery. What do you think of Ed's invention? "

**Montgomery:** “I love it. So do our customers. The current clients are very interested and have made solid commitments for purchases if we can get it to them fast. Hopefully the competition has not caught wind of this. You know how clients talk. It won’t be long before the usual suspects come out with a clone.

Even if they do hear about the WLRM, I think we can hold our lead for the next two years and sell 7,500 units at a minimum. We may even be able to increase that to 10,000 units if we decide to. I do not know if I can promise much more than that. You know that I would like to say that “the sky is the limit”, but I would rather be conservative and make sure that we do not build more than we can sell. We want to keep the price high until the competition catches up.

**Chris:** I like that conservative outlook Montgomery. I know that we can handle 7,500 units now. I have determined our current capacity utilization with our current product lines and I projected how much of our capacity we would use for this new product. If you will review Exhibit 1, I think that my projections are clear.

Insert Exhibit 1

It looks like we can handle the 7,500 units right now. If we do decide to go above that, we will need to expand. Do you want to do that right now?

**Ed:** Before you answer that, I probably should inform you that the Waist reduction machine is not the only product my team has developed. They also created a smaller machine great for building biceps. Therefore I call it the Bicep Builder. Catchy isn’t it?

**Montgomery:** Ed gave me a few prototypes and we have done some preliminary research, and again he has a winner. This machine should sell for a lot less than our WLRM, but it should cost less to build too.

**Summer:** Ed and Montgomery, this is wonderful news. Make sure that Chris sees it and gives you her input on what she thinks it will cost to build. In the meantime, I would like a decision on the WLRM. I do not think that we can afford to let our products lag behind our competitors. I would like to see some projections of the full cost of the WLRM for the lower volume level of 7,500 units given Chris’ projections on how much capacity she believes that it will use.

**Joshua:** Since we are already using Activity Based Costing for our product lines, it should be simple for me to determine the ABC cost of the WLRM for you. I will look over Chris’ notes and get that to you right away. I would also like to confirm whether we are aiming for a profit margin of 25% of sales. Are we? I would like to determine if the WLRM meets our Target Cost requirements.

**Summer:** Good point Josh. Would you do that please? Montgomery, do you think that the WLRM can command our traditional profit margin?

**Montgomery:** It should. I have the price information right here. According to our research, we can sell the 7,500 for \$100 each. Hopefully that will be enough to give us the margins we need. But Josh can tell us that.

**Summer:** Great. Well, let’s meet again on Friday and discuss what Josh finds. We can then decide if we should go ahead at the 7,500 unit level or not. If we think the lower volume level is profitable, we can then decide whether to expand or not and make more WLRMs or stay at the lower volume. By then we should have some more information on the Bicep Builder too. Right?

#### **Requirement 1**

Based on the projections in **Exhibit 1** for the total resource utilization of the WLRM product on their pre-existing equipment, TRIM Inc. management is still trying to determine if the new exercise machine should be produced.

- a) Determine the Target Cost for the Waist Reduction Machine.
- b) Determine what TRIM should do. Should they build the new product? Determine the impact on profit from your decision.
- c) What additional information would you like before making a decision about adding this new product?

**Friday meeting results:**

In the meeting on Friday, Chris shared the results of her study of the resource needs for making 10,000 units of the WLRM. These projections are not in addition to the 7,500 units she previously calculated, but are in place of them. **See Exhibit 2.** In addition, Chris and Ed and Montgomery worked together to determine how many Bicep Builders, BBs, they could sell and at what price. The projected resource needs for the BB and its sales price and volume is included in **Exhibit 3.**

**Requirement 2**

- a) Help the management of TRIM to decide whether to increase production to the higher level or to keep production at the lower level. Specify which products you will add to the product offerings and how much your decision will change profit. You are not required to build all of any product. For example, you could choose to build all 20,000 units of BB or any value from 0 to 20,000 units. The same applies for the WLRM.
- b) How would you track the success of the new product line or lines?
- c) How would you monitor production?
- d) What information would sales need in order to promote the optimal level of product sales?

Insert Exhibits 2 and 3 here

**Exhibit 1**

Current cost, cost drivers and utilization of resources by Taylor's Reduction Improvement Machines Inc. for production of the current product lines, (without the WLRM) are as follows:

	<u>Activity Cost</u>	<u>Cost Driver</u>	<u>Practical Capacity of Resources</u>	<u>Capacity Used</u>
Handling Material	\$ 200,000	# of moves	12,500	10,000
Setting up Equipment	\$1,200,000	set up hours	12,000	10,000
Designing Processes and Products	\$ 180,000	types of products	12	8
Designing Packaging	\$ 240,000	types of products	12	8
Machining the Product	\$ 360,000	machine hours	300,000	240,000
Direct Labor	\$ 600,000	direct labor hours	20,000	18,500

**Projected needs of the New Waist Line Reduction Machine if 7,500 units are manufactured:**

Projected Production = 7,500 units	<u>Capacity Needed</u>	<u>Cost Driver</u>		
Handling Material	938	# of moves	8	Units per move
Setting up Equipment	1,875	set up hours	2	Set up hours per move

Designing Processes and Products	1	types of products	1	Per product
Designing Packaging	1	types of products	1	Per product
Machining the Product	26,250	machine hours	3.5	Machine Hours per unit
Direct Labor	1,500	direct labor hours	0.2	Direct labor hours per unit
The material for the new waist reduction machine is expected to cost			\$60	per unit.
The labor requirements are		0.20	hours at	\$30 per hour
Units = 7,500				
TRIM Inc. wants to earn a profit margin of		25%	of sales.	

**Exhibit 2**

The Marketing Team has just informed you that their original projections for sales for the Waist Reduction Machine were understated. Based on the new surveys, the potential market is at least 10,000 units annually for a minimum of two years. There is evidence that the market could last longer depending on the response of the TRIM's competitors to the new machine. TRIM would be first to the market with this new equipment.

New Sales Volume 10,000 units  
The Sales Price for this higher volume will remain at \$100.00 per unit  
The need for resources however will increase to the following:

	<u>Capacity Needed</u>	<u>Cost Driver</u>	<u>Capacity for the next step</u>	<u>Cost for the next step*</u>
Handling Material	1,250	# of moves	5,000	\$ 40,000
Setting up Equipment	2,500	set up hours	1,500	\$ 200,000
Designing Processes and Products	1	types of products	6	\$ 90,000
Designing Packaging	1	types of products	6	\$ 125,000
Machining the Product	35,000	machine hours	16,000	\$ 25,000
Direct Labor	2,000	direct labor hours	2,000	\$ 60,000

\* Steps must be purchased in their entirety if more capacity is needed.

**Exhibit 3**

TRIM Inc. also has the opportunity to begin production on another exercise machine. This product, the Bicep Builder, promises to increase muscle mass while decreasing underarm fat significantly in one month if used only 15 minutes every other day.

The cost to produce the Bicep Builder and the capacity needed to produce it appears below. After testing the market TRIM Inc. believes that it can sell 20,000 units if the price is \$ 50.00 per unit. The market for the Bicep Builder, (BB), is equivalent to that for the Waist Line Reduction Machine, (WLRM). The BB market is expected to last for a minimum of two years and dependent on the response of the competitors, could last for another two to five years at significant volumes. It is even projected that the sales volume could dramatically increase if the results across the user population equal the results to date in the test market.

**Bicep Builder**

Bicep Builder Units produced and sold 20,000 units  
 Material cost for one unit \$15.00

Handling Material	40	units per move	Handling Material
Setting up Equipment	2	hours per move	Setting up Equipment
Designing Processes and Products	1	per product line	Designing Processes and Products
Designing Packaging	1	per product line	Designing Packaging
Machining the Product	1.5	Machine hours per unit	Machining the Product
Direct Labor	0.2	Direct Labor Hours per unit	Direct Labor

	<u>Capacity Needed</u>	<u>Cost Driver</u>	<u>Capacity for the next step</u>	<u>Cost for the next step*</u>
Handling Material	500	# of moves	5,000	\$ 40,000
Setting up Equipment	1,000	set up hours	2,000	\$200,000
Designing Processes and Products	1	types of products	2	\$ 90,000
Designing Packaging	1	types of products	2	\$125,000
Machining the Product	30,000	machine hours	16,000	\$ 25,000
Direct Labor	4,000	direct labor hours	2,000	\$ 60,000

\* Steps must be purchased in their entirety if more capacity is needed.

Personnel:

Summer Taylor – President  
 Edward Smith – Head of Research and Development  
 Chris Kelly – Head of Production  
 Montgomery Bradford – Vice President of Marketing  
 Joshua Sears – Controller

### Case Learning Objectives

The primary goal of this case is to clarify the importance of treating step-fixed costs correctly, realizing that step-fixed costs cannot be partially purchased as unit-driven costs can. Students familiar with activity-based costing, ABC, and relevant or marginal costing are best prepared to tackle the tasks in the case. Familiarity with the Theory of Constraints method, TOC, of dealing with an internal constraint for purposes of product mix selection is also helpful. However, the case could be used in order to introduce the students to TOC. A more complete list of learning objectives is listed below:

1. To recognize when full cost allocations, even sophisticated methods such as ABC, gives misleading information to managers for making decisions about expansion into new product lines.
2. To master the problem of step-fixed costs in full costing and the impact step-fixed costs have on decision making.
3. Realize the benefit of using practical capacity to determine rates and highlight unused capacity when using ABC.
4. To determine the Target Cost and to realize when the anticipated production cost exceeds it and when it does not.

5. To use relevant revenues and costs to make decisions on product mix and on capacity levels.
6. To factor levels of capacity choices into decision making, using both profit predictions and market factors.
7. To deal with Direct Labor when it is not a unit variable cost.
8. To factor market risk into capacity based decisions.
9. To be able to pick the limiting factor or constraint for a company based on profit options and potential market cycles.
10. To be able to choose metrics that foster choices beneficial to the entire company.

### **The Problem of Step-Fixed Costs:**

The use of newer allocation techniques, such as Activity Based Costing, focus on the causes of changes in indirect cost by finding the driver of those costs. The benefit of an ABC implementation is the recognition of those drivers by managers and the process analysis that should accompany any reasonable implementation. During the process analysis, improvements to the current process can be discovered or created and non-value added steps can be eliminated or reduced.

The danger of ABC is the illusion that it gives to users that reduction in driver use results in reductions in cost. Similarly, ABC allocations to products can imply that costs increase *within steps* as the drivers of those costs increase. It is the within step driver increase phenomenon that part one of this case addresses.

Students are first asked to find the Target Cost of the WLRM and then to determine whether it would be advisable for the company to start producing the WRLM. Students must decide whether to calculate the full cost of the WLRM using ABC, or to use another technique to determine the advocacy of expanding TRIM's product line.

### **Capacity Choice for Overhead Allocation Rates:**

Despite the admonition of ABC advocates and Managerial and Cost texts to use practical capacity to determine overhead rates and to allocate overhead for non-unit based costs, most students persist in using anticipated annual capacity levels to find those rates and allocate overhead. The unused capacity variance is troublesome to many students at both the graduate and undergraduate level. The lower allocated cost that results from the use of practical capacity is of concern to those students. The common complaint stated is that an unallocated cost is a forgotten cost. The primary reason students give for their concern is that managers will set prices that do not fully cover the full cost of the product.

The cost-plus pricing argument is troublesome since markets are the primary source of price. The cost-plus price advocates ignore the fact that any allocated cost rests on several precarious assumptions:

1. The price will be acceptable to consumers at the sales volume needed to validate the allocated cost.
2. Cost does not change as:
  - a. Volumes change
  - b. Mix changes

Since both assumptions can easily be proven false, the primary argument for using anticipated volumes of cost drivers to determine allocation rates is weakened. Students using anticipated volumes to allocate cost will have a higher allocated cost and be less likely to approve the addition of the new product. They may decide that the market price is too low and they might be less likely to recognize the existence of sufficient capacity to manufacture the lower volume of the WLRM.

When the allocated costs are step-fixed costs, the use of practical capacity highlights the step behavior of the cost. When unallocated overhead exists at any step, users should be alerted

to the existence of available capacity. Such awareness should make them less likely to invest in new capacity or to over-cost a product when determining relevant costs for decision making.

### **Capacity Choice for Increasing Profit**

In order to fully investigate the options available to TRIM, students must choose capacity levels for each overhead category and for direct labor. Students can add sufficient capacity to meet demand of all of the products, or they can choose to limit capacity to its current level or to some level between the current level and what is needed to fill demand. In order to make that choice, trial and error can be used, or students can learn how to choose an internal constraint.

### **Metrics to Measure the Production and Sales of the New Products**

### **Implementation Guidance**

The case has been used five times in the classroom over three quarters. Three times it was used in the required undergraduate cost management course for accounting juniors. Once it was an exam question, and twice it was a class problem. The case was also used in the MBA class as a case. At the undergraduate level the case enlightens the students to the limitations of ABC. It also reinforces the need to only use marginal costs and revenues for decisions on expansion into new product lines. Finally, the case reinforces the behavior of step-fixed costs and demonstrates the choices managers do and do not have regarding cost increases and decreases.

At the graduate level the case adds on the nuances of market demand and risk. Graduate students recognize the need for expansion into new product lines, and may even push for the expansion even if the Target Cost is lower than the achievable cost. The reaction of my graduate students was varied. The accounting graduates found the case very challenging. They realized that capacity levels had to be altered in order to find the most profitable solution. They realized how many choices were possible and sought a system to simplify that choice.

Non-accounting majors in the MBA program added layers of expertise regarding process improvements and marketing choices.

The most difficult task was the choice of metrics for production and sales. Through class discussion, students can discover the potential of metrics to guide behavior and to signal when course correction is required. Building cause-effect logic trees is very helpful in discovering the possible results of using certain metrics. Usually I have my students read an article by Cox and Boyd (1997) describing a cause and effect technique named the Current Reality Tree, CRT. Having students use the CRT to test out the effects of their metric choices shows the impact measurements have on results throughout the organization.

### **References**

Boyd, Lynn H., and James F Cox III, (1997) "A cause-and-effect approach to analyzing performance measures", Production and Inventory Management Journal. Third Quarter 1997. Vol. 38, Iss. 3; p. 25 -32

Teaching Note is available upon request

**TRIM Inc.**  
**Teaching Notes**  
**By**  
**Audrey Taylor**

**Background:**

The Taylor's Reduction Improvement Machines Inc., (TRIM), produces exercise equipment. They have a mature market line of reliable products. However, recently the demand for robust exercise equipment for home and club use has dramatically increased. TRIM Inc. has maintained their sales volume but they have been gradually losing market share in an ever increasing market as clubs and individuals turn to newer innovative machines outside of TRIM Inc.'s repertoire. Therefore the company management has decided to try and develop profitable products for the market.

They have recently developed two new products that they feel will be well received. The first product is a new exercise machine that in the testing phase dramatically reduced waistlines in as little as 14 days. The initial marketing results have indicated that the market is firm for the Waist Line Reduction Machine, WLRM, and that a price of \$100 would be well received. At that price, TRIM Inc. believes that 7,500 machines can be sold each year for the next two years with the possibility of that volume increasing to 10,000 units. The material cost for each unit is \$60. One of the major benefits of the new product line is that the new product can be produced on the existing equipment.

The second product is the Bicep Builder, BB, that promises to increase muscle mass while decreasing underarm fat significantly in one month if used only 15 minutes every other day. TRIM Inc. believes that it can sell 20,000 units if the price is \$ 50.00 per unit. The BB has a material cost of only \$15 per unit. The market for the Bicep Builder, (BB), is equivalent to that for the Waist Line Reduction Machine, (WLRM). The BB market is expected to last for a minimum of two years and dependent on the response of the competitors, could last for another two to five years at significant volumes. It is even projected that the sales volume could dramatically increase if the results across the user population equal the results to date in the test market.

**Learning Goals:**

1. To recognize when full cost allocations, even sophisticated methods such as ABC, gives misleading information to managers for making decisions about expansion into new product lines.
2. Realize the benefit of using practical capacity to determine rates and highlight unused capacity when using ABC.
3. To determine the Target Cost
4. To use relevant revenues and costs to make decisions on product mix and on capacity levels.
5. To factor levels of capacity choices into decision making, using both profit predictions and market factors.
6. To master the problem of step-fixed costs in full costing and the impact step-fixed costs have on decision making.
7. To deal with Direct Labor when it is not a unit variable cost.
8. To factor market risk into capacity based decisions.
9. To be able to pick the limiting factor or constraint for a company based on profit options and potential market cycles.

**The Problem of Step-Fixed Costs:**

The use of newer allocation techniques, such as Activity Based Costing, focus on the causes of changes in indirect cost by finding the driver of those costs. The benefit of an ABC implementation is the recognition of those drivers by managers and the process analysis that

should accompany any reasonable implementation. During the process analysis, improvements to the current process can be discovered or created and non-value added steps can be eliminated or reduced.

The danger of ABC is the illusion that it gives to users that reduction in driver use results in reductions in cost. Similarly, ABC allocations to products can imply that costs increase *within steps* as the drivers of those costs increase. It is the within step driver increase phenomenon that part one of this case addresses.

Students are first asked to determine whether it would be advisable for the company to start producing the WLRM. Some students may calculate the full cost of the WLRM using ABC. They are asked to find the Target Cost. The Target Cost for the WLRM is higher than the fully allocated cost using ABC. Once both the ABC cost and the Target Cost are determined some students may decide to not build the new product since the target cost is less than the fully allocated cost using ABC. Unfortunately, many of my accounting major students in the undergraduate program decided that the WLRM should not be produced since the ABC cost exceeded the Target Cost. Some stated that process improvements should be sought to bring the cost below the Target Cost. A few stated that the product should be produced even at a loss in order to maintain a loyal customer base. Both are good points and are valid observations. However, the best response should address the fact that sufficient excess capacity existed on all of the resources used to make the WLRM without investing in any new resources. Therefore, the incremental profit from producing the WLRM was significant.

### **Capacity Choice for Overhead Allocation Rates:**

Despite the admonition of ABC advocates and Managerial and Cost texts to use practical capacity to determine overhead rates and to allocate overhead, most students persist in using anticipated annual capacity levels to find those rates and allocate overhead. The unused capacity variance is troublesome to many students at both the graduate and undergraduate level. The lower allocated cost that results from the use of practical capacity is of concern to those students. The common complaint stated is that an unallocated cost is a forgotten cost. The primary reason students give for their concern is that managers will set prices that do not fully cover the full cost of the product.

The cost-plus pricing argument is troublesome since markets are the primary source of price. The cost-plus price advocates ignore the fact that any allocated cost rests on several precarious assumptions:

1. The price will be acceptable to consumers at the sales volume needed to validate the allocated cost.
2. Cost does not change as:
  - a. Volumes change
  - b. Mix changes

Since both assumptions can easily be proven false, the primary argument for using anticipated volumes of cost drivers to determine allocation rates is weakened. Students using anticipated volumes to allocate cost will have a higher allocated cost and be less likely to approve the addition of the new product. They may decide that the market price is too low and they might be less likely to recognize the existence of sufficient capacity to manufacture the lower volume of the WLRM.

When the allocated costs are step-fixed costs, the use of practical capacity highlights the step behavior of the cost. When unallocated overhead exists at any step, users should be alerted to the existence of available capacity. Such awareness should make them less likely to invest in new capacity or to over-cost a product when determining relevant costs for decision making.

### **Requirement 1**

Based on the projections in **Exhibit 1** for the total resource utilization of the WLRM product on their pre-existing equipment, TRIM Inc. management is still trying to determine if the new exercise machine should be produced.

- a) Determine the Target Cost for the Waist Reduction Machine.

The Target cost is \$75.00

- b) Determine what TRIM should do. Should they build the new product? Determine the impact on profit from your decision.

To find the answer, some students will find the ABC cost of the WLRM. In TN 1 below, the overhead allocation rates based on practical capacity are determined. Then in TN 2, the fully allocated cost of the WLRM using ABC is presented.

**The ABC fully allocated cost allocation**  
**Exhibit 1 modified to include the ABC Allocation Rates Using Practical Capacity**  
**Teaching Note 1**

**TN 1**

	<u>Activity Cost</u>	<u>Cost Driver</u>	<u>Practical Capacity of Resources</u>	<u>Capacity Used</u>	<u>Rate based on Practical Capacity</u>
Handling Material	\$ 200,000	# of moves	12,500	10,000	\$ 16.00
Setting up Equipment	\$ 1,200,000	set up hours	12,000	10,000	\$ 100.00
Designing Processes and Products	\$ 180,000	types of products	12	8	\$ 15,000.00
Designing Packaging	\$ 240,000	types of products	12	8	\$ 20,000.00
Machining the Product	\$ 360,000	machine hours	300,000	240,000	\$ 1.20
Direct Labor	\$ 600,000	direct labor hours	20,000	18,500	\$ 30

The solution presented below is the cost of the WLRM when practical capacity is used.

**Projected needs of the New Waist Reduction Machine:**

	<u>Capacity Needed</u>	<u>Cost Driver</u>		
Handling Material	938	# of moves	8	units per move
Setting up Equipment	1,875	set up hours	2	set up hours per move
Designing Processes and Products	1	types of products	1	product per product
Designing Packaging	1	types of products	1	product per product
Machining the Product	26,250	machine hours	3.5	machine hours per unit
Direct Labor	1,500	hours	0.2	direct labor hours per unit
The material for the new waist reduction machine is expected to cost			\$ 60.00	per unit.
The labor requirements are	0.20	hours at	\$ 30.00	per hour

**Units** **7,500**

TRIM Inc. wants to earn a profit margin of 25% of sales.

**Teaching Note 2 – The ABC cost for the WLRM using practical capacity to determine overhead rates and allocated amounts**

<b>TN 2 - The ABC cost for the WLRM using practical capacity to determine overhead rates and allocated amounts</b>	<b><u>Applied OH</u></b>
Handling Material	\$ 15,000
Setting up Equipment	\$ 187,500
Designing Processes and Products	\$ 15,000
Designing Packaging	\$ 20,000
Machining the Product	\$ 31,500
Total Applied Overhead	<u>\$ 269,000</u>
Material	\$ 450,000
Labor	<u>\$ 45,000</u>
Total Cost	<u>\$ 764,000</u>
Total Cost per Unit	<b>\$ 101.87</b>
Target Price	\$ 100.00
Desired Profit per unit	<u>\$ 25.00</u>
Target Cost	<u>\$ 75.00</u>

At this point some students will conclude that the WLRM should not be produced since the fully allocated cost is higher than the sales prices as well as the target cost.

Some students may use anticipated capacity to determine allocation rates for ABC. The allocation rates using Anticipated Capacity are presented in TN 3 below with the fully allocated cost of the WLRM using those rates is presented.

**The ABC fully allocated cost allocation  
Exhibit 1 modified to include the ABC Allocation Rates Using Annual Anticipated  
Capacity Teaching Note 3**

**TN-3**

	<b><u>Activity Cost</u></b>	<b><u>Cost Driver</u></b>	<b><u>New Capacity Used</u></b>	<b><u>Rate Based on Anticipated Capacity</u></b>	<b><u>ABC Anticipated Cost of New Job</u></b>
Handling Material	\$ 200,000	# of moves	<b>10,938</b>	\$ 18.29	\$ 17,142.86
Setting up Equipment	\$1,200,000	set up hours	<b>11,875</b>	\$ 101.05	\$189,473.68
Designing Processes and Products	\$ 180,000	types of products	<b>9</b>	\$ 20,000.00	\$ 20,000.00
Designing Packaging	\$ 240,000	types of products	<b>9</b>	\$ 26,666.67	\$ 26,666.67
Machining the Product	\$ 360,000	machine hours direct labor	<b>266,250</b>	\$ 1.35	\$ 35,492.96
Direct Labor	\$ 600,000	hours	<b>20,000</b>	\$ 30.00	\$ 45,000.00
<b><u>Projected needs of the New Waist Reduction Machine:</u></b>				TOH and DL	\$333,776.17
				Materials	\$450,000.00
				Total Cost	<u>\$783,776.17</u>
				Unit Cost	<u>\$ 104.50</u>

**Teaching Note 4 - Recognizing Excess Capacity Available  
Excess Capacity Available AFTER producing 7,500 units of the WLRM**

Hopefully students will recognize the available capacity on the current resources. (See TN 4).

TN 4	<u>Waist Reduction Machine Capacity Remaining after production of 7,500 units</u>		
	<u>Initial Excess Capacity</u>	<u>Capacity Used by WLRM</u>	<u>Post WLRM Excess Capacity</u>
Handling Material	2,500	938	1,563
Setting up Equipment	2,000	1,875	125
Designing Processes and Products	4	1	3
Designing Packaging	4	1	3
Machining the Product	60,000	26,250	33,750
Direct Labor	1,500	1,500	0

If students notice that there is sufficient capacity to produce the 7,500 WLRMs without purchasing any additional resources they will also determine that the production of the WLRMs increases overall profit by a considerable amount. The incremental cost of \$60 is also less than the target cost of \$75. At this point students will determine that the WLRM should be produced. (See TN 5)

**Teaching Note 5 – The Incremental Profit Possible From the Production and Sale of 7,500 units of the WLRM**

<b>The incremental revenue for 7,500 units of the WLRM</b>			
TN - 5	WLRM	7,500	\$ 750,000
	The incremental cost is		
	Handling Material		\$ -
	Setting up Equipment		\$ -
	Designing Processes and Products		\$ -
	Designing Packaging		\$ -
	Machining the Product		\$ -
	Material		\$ 450,000
	Labor		\$ -
	<b>Total incremental Cost</b>		<b>\$ 450,000</b>
	Incremental cost per unit		\$ 60
	Target Price		\$ 100
	Target Profit		\$ 25
	Target Cost		\$ 75.00
	Projected Profit		\$ 40.00
	Projected Profit as percentage of sales price		40%
	<b>The incremental Profit for 7500 units</b>		<b>\$ 300,000</b>
			<b>Build the product!!</b>

- c) What additional information would you like before making a decision about adding this new product?

Student answers to this question can be far ranging. For example, some may want to know about the opportunity cost of using the capacity to make the WLRMs in place of another option. Additionally, students might reference the competition and desire to know how fast the competitors could come to the market with a clone of the WLRM. If competition is fierce, the \$100 price could be driven down. If competition is sparse, some may advocate testing a higher introductory price. Regardless, as the innovator, the initial price should be dramatically raised, as high as the market will allow, until competition enters the market.

Cycle times for individual products and the ratio of value added to non-value-added processes could show managers whether processes could be improved and the current level of flexibility possible for TRIM. Since TRIM is at the beginning of their venture into the production new products, it is critical that TRIM ensure that they are using their capacity wisely over the long-term.

Since labor is fully utilized, others may desire to know the skill levels of the labor pool and the availability of labor in the outside market in case more laborers are desired. The same need could quickly occur for setups. Right now set up time utilization is close to capacity. Could that capacity be expanded easily? Could setups be done more efficiently, saving time for each kind of setup and for each kind of product so that setup time does not become an interactive constraint with labor?

What is important here is to encourage students to look beyond the immediate numbers. Risk can easily be factored in via the potential response of the competition and differing capacity choices. The life-cycle of products should be investigated. How long has the competition taken in the past to clone new products? These choices for capacity expansion can be delved into in the rest of the case scenarios.

### **The Higher Volume for the WLRM and The Second Product, the BB:**

The Marketing Team has just informed you that their original projections for sales for the Waist Reduction Machine were understated. Based on the new surveys, the potential market is at least 10,000 units annually for a minimum of two years. There is evidence that the market could last longer depending on the response of the TRIM's competitors to the new machine. TRIM would be first to the market with this new equipment.

### **Exhibit 2**

New Sales Volume 10,000 units  
 The Sales Price for this higher volume will remain at \$100.00 per unit  
 The need for resources however will increase to the following:

	<u>Capacity Needed</u>	<u>Cost Driver</u>	<u>Capacity for the next step</u>	<u>Cost for the next step*</u>
Handling Material	1,250	# of moves	5,000	\$ 40,000
Setting up Equipment	2,500	set up hours	1,500	\$ 200,000
Designing Processes and Products	1	types of products	6	\$ 90,000
Designing Packaging	1	types of products	6	\$ 125,000
Machining the Product	35,000	machine hours	16,000	\$ 25,000
Direct Labor	2,000	direct labor hours	2,000	\$ 60,000

\* Steps must be purchased in their entirety if more capacity is needed.

**Requirement 2**

- a) Help the management of TRIM to decide whether to increase production to the higher level or to keep production at the lower level. Specify which products you will add to the product offerings and how much your decision will change profit. You are not required to build all of any product. For example, you could choose to build all 20,000 units of BB or any value from 0 to 20,000 units. The same applies for the WLRM.

In order to determine the best choice, the first step might be to list the options available to management.

**List the alternatives.**

- 1. Build the original level (7,500 units) of the Waist Reduction Machine only.
- 2. Build the higher volume (10,000 units) of the Waist Reduction Machine only.
- 3. Build the full demand for the Bicep Builder Only
- 4. Build the full demand for the Bicep builder and the Waist Reduction Machine.
- 5. Build the full demand for the Bicep Builder and the reduced demand for the Waist Reduction Machine.
- 6. Choose a constraint and build the full demand for the product producing the highest contribution for each unit of the constrained resource and then use the remaining capacity on the constraint to build the alternative product.

Once the alternatives are listed, students should find the incremental profit from each choice. Hopefully, students will not be using fully allocated costs to make the decision on which product mix to choose. Listed below are the results of alternatives 1-6 in Teaching Notes 6 - 11.

**Rank the alternatives. Indicate your choice and why you made that choice.**

**Alternative 1 Rank = 5 – Build the original level (7,500 units) of the Waist Reduction Machine only**

**Teaching Note 6**

<b>The incremental revenue is</b>	<b>\$ 750,000</b>
The incremental cost is	
Handling Material	\$ -
Setting up Equipment	\$ -
Designing Processes and Products	\$ -
Designing Packaging	\$ -
Machining the Product	\$ -
Material	\$ 450,000
Labor	\$ -
Total incremental Cost	<b>\$ 450,000</b>
Incremental cost per unit	\$ 60
Target Price	\$ 100
Target Profit	\$ 25
Target Cost	\$ 75.00
Projected Profit	\$ 40.00
Projected Profit as percentage of sales price	40%
<b>The incremental Profit is</b>	<b>\$ 300,000</b>

**Alternative 2 Rank = 6 – Build the higher volume (10,000 units) of the Waist Reduction Machine only.**

**Teaching Note 7**

**Capacity Computation for New Machine Higher Volume for Waist Reducer Only**

	<u>Excess Capacity</u>	<u>Used by New Machine</u>	<u>Excess</u>
Handling Material	2,500	750	1,750
Setting up Equipment	2,000	2,625	<b>-625</b>
Designing Processes and Products	4	1	3
Designing Packaging	4	1	3
Machining the Product	60,000	35,000	25,000
Direct Labor	1,500	2,000	<b>-500</b>

**The incremental revenue is**

**\$1,000,000**

The incremental cost is

Handling Material	\$ -
Setting up Equipment	\$ 200,000
Designing Processes and Products	\$ -
Designing Packaging	\$ -
Machining the Product	\$ -
Material	\$ 600,000
Labor	\$ 60,000
<b>Total incremental Cost</b>	<b>\$ 860,000</b>
Incremental cost per unit	\$ 86
Target Price	\$ 100
Target Profit	\$ 25
Target Cost	\$ 75.00
Projected Profit	\$ 14.00
Projected Profit as percentage of sales price	14%

**The Incremental profit is**

**\$ 140,000**

**Do not Build the Waist Reducer Only at the higher volume since profit drops by \$160,000.**

**Bicep Builder**

**Alternative 3 Rank = 4 – Build the full demand for the Bicep Builder, (20,000 units), only**

**Teaching Note 8**

Bicep Builder Units produced and sold 20,000 units

Material cost for one unit \$15.00

Handling Material	40	<b>units per move</b>	Handling Material
Setting up Equipment	2	<b>hours per move</b>	Setting up Equipment
Designing Processes and Products	1	<b>per product line</b>	Designing Processes and Products
Designing Packaging	1	<b>per product line</b>	Designing Packaging
Machining the Product	1.5	<b>Machine hours per unit</b>	Machining the Product

Direct Labor

0.2 **Direct Labor Hours per unit**

Direct Labor

	<u>Capacity Needed</u>	<u>Cost Driver</u>	<u>Capacity for the next step</u>	<u>Cost for the next step*</u>
Handling Material	500	# of moves	5,000	\$ 40,000
Setting up Equipment	1,000	set up hours	1,500	\$200,000
Designing Processes and Products	1	types of products	6	\$ 90,000
Designing Packaging	1	types of products	6	\$125,000
Machining the Product	30,000	machine hours	16,000	\$ 25,000
Direct Labor	4,000	direct labor hours	2,000	\$ 60,000

\* Steps must be purchased in their entirety if more capacity is needed.

**Bicep Builder Machine ONLY Option**

	<u>Excess Capacity</u>	<u>Used by New Machine</u>	<u>Excess Capacity</u>	<u>New Capacity Purchased</u>	<u>Cost of New Capacity</u>
Handling Material	2,500	500	2,000	0	
Setting up Equipment	2,000	1,000	1,000	0	
Designing Processes and Products	4	1	3	0	
Designing Packaging	4	1	3	0	
Machining the Product	60,000	30,000	30,000	0	
Direct Labor	1,500	4,000	<b>-2,500</b>	4000	\$ 120,000

**The incremental revenue is**

**\$ 1,000,000**

The incremental cost is

Material	\$ 300,000
Direct Labor	\$ 120,000
Handling Material	\$ -
Setting up Equipment	\$ -
Designing Processes and Products	\$ -
Designing Packaging	\$ -
Machining the Product	\$ -
<b>Total Incremental Cost</b>	<b>\$ 420,000</b>
Incremental Cost per unit	\$ 21.00
Target Price	\$ 50.00
Target Profit	\$ 12.50
Target Cost	\$ 37.50
Projected Profit	\$ 29.00

Projected Profit as percentage of sales price 58%

**The incremental Profit is**

**\$ 580,000**

**Alternative 4 Rank = 2 - Build the full demand for the Bicep builder and the Waist Reduction Machine.**

**WLRM = 10,000 units and BB = 20,000 units.**

**Teaching Note 9**

	<u>Current Capacity Used</u>	<u>Capacity Needed for WLRM 10,000 units</u>	<u>Capacity Needed for BB 20,000 units</u>	<u>Capacity Used</u>	<u>Capacity Available</u>	<u>Excess or Deficient Capacity</u>
Handling Material	10,000	1,250	500	11,750	12,500	750
Setting up Equipment	10,000	2,500	1,000	13,500	12,000	-1,500
Designing Processes and Products	8	1	1	10	12	2
Designing Packaging	8	1	1	10	12	2
Machining the Product	240,000	35,000	30,000	305,000	300,000	-5,000
Direct Labor	18,500	2,000	4,000	24,500	20,000	-4,500

<u>Cost Driver</u>	<u>Current Capacity Needed for BOTH Products</u>	<u>New Capacity Available</u>	<u>New Capacity Total Cost</u>	<u>Unused Capacity</u>
# of moves	11,750	12,500	\$ 200,000	750
set up hours	13,500	13,500	\$ 1,400,000	0
types of products	10	12	\$ 180,000	2
types of products	10	12	\$ 240,000	2
machine hours	305,000	316,000	\$ 385,000	11,000
direct labor hours	24,500	26,000	\$ 780,000	1,500

<u>Units produced and sold</u>	<u>10,000</u>	<u>20,000</u>	
	<u>Waist-Line Reduction</u>	<u>Bicep Builder</u>	<u>Total</u>
<b>The incremental revenue is</b>	<b>\$1,000,000</b>	<b>\$1,000,000</b>	\$ 2,000,000
The incremental cost is			
Material	\$ 600,000	\$ 300,000	\$ 900,000
<b>Contribution Margin or Throughput Incremental Cost</b>	<b>\$ 400,000</b>	<b>\$ 700,000</b>	<b>\$1,100,000</b>
Labor			\$ 180,000
Handling Material			\$ -
Setting up Equipment			\$ 200,000
Designing Processes and Products			\$ -
Designing Packaging			\$ -
Machining the Product			\$ 25,000
<b>Total Incremental Cost</b>			<b>\$ 405,000</b>
<b>Incremental Profit</b>			<b>695,000</b>

**Alternative 5 Rank = 3 – Build the full demand for the Bicep Builder and the reduced demand for the Waist Reduction Machine – (Reduce production of WLRM so that the extra machine purchase is avoided. Produce 7,500 WLRMs and 20,000 BBs).**

Teaching Note 10

<b>Units produced and sold</b>	<u><b>7,500</b></u>	<u><b>20,000</b></u>	
	<u><b>Waist</b></u>	<u><b>Bicep</b></u>	<u><b>Total</b></u>
	<u><b>Reducer</b></u>	<u><b>Builder</b></u>	
<b>The incremental revenue is</b>	<b>\$ 750,000</b>	<b>\$1,000,000</b>	<b>\$ 1,750,000</b>
The incremental cost is	<u><b>\$ 450,000</b></u>	<u><b>\$ 300,000</b></u>	<u><b>\$ 750,000</b></u>
<b>Throughput</b>	\$ 300,000	\$ 700,000	\$ 1,000,000
<b>Incremental Cost</b>			
Labor			\$ 120,000
Handling Material			\$ -
Setting up Equipment			\$ 200,000
Designing Processes and Products			\$ -
Designing Packaging			\$ -
Machining the Product			\$ -
<b>Total Incremental Cost</b>			<u><u>\$ 320,000</u></u>
<b>Incremental Profit</b>			<u><u>\$ 680,000</u></u>

**Alternative 6 Rank = 1 – Choose a constraint and build the full demand for the product producing the highest contribution for each unit of the constrained resource and then use the remaining capacity on the constraint to build the alternative product.**

**If Setup hours is chosen as the constraint, all 20,000 units of BB are produced, with the remaining setup time producing 4,000 WLRMs.**

**Recognize the impact of Constraints on Profit:**

Before deciding which products to emphasize, TRIM should determine the profitability of the competing products on the constrained resources. The only costs attached to the competing products are those that would change if the product volumes changed.

The following table shows the profitability of each product for each unit of the constrained resource. In the preceding scenarios, direct labor hours, set up hours and machine hours were the only constrained resources. Therefore, the contribution for each unit of the constraint is calculated below:

**Teaching Note 11**

<b>Product</b>	<u><b>Waist Line Reduction Machine, WLRM</b></u>	<u><b>Bicep Builder, BB</b></u>
<b>Sales Price per unit</b>	\$ 100.00	\$ 50.00
<b>Material Cost Per Unit</b>	<u>\$ 60.00</u>	<u>\$ 15.00</u>
<b>Throughput Per Unit</b>	\$ 40.00	\$ 35.00
<b>T/DLH</b>	<b>\$ 200.00</b>	\$ 175.00
<b>T/SUH</b>	\$ 160.00	<b>\$ 700.00</b>
<b>T/MH</b>	\$ 11.43	<b>\$ 23.33</b>

The preferred product depends on the resource constrained. If labor is constrained, the WLRM should be produced first. If either machine hours or setup hours are constrained, the BB should be produced first.

If TRIM decides to elevate the capacity to be able to produce the full demand of both products, then incremental profit should be higher than for the options where TRIM chooses to maintain capacity limits.

	Waist Reducer	Bicep Builder	Total
<b>Units produced and sold</b>	4,000	20,000	
<b>The incremental revenue is</b>	\$ 400,000	\$ 1,000,000	\$ 1,400,000
<b>The incremental cost is</b>	<u>\$ 240,000</u>	<u>\$ 300,000</u>	<u>\$ 540,000</u>
<b>Throughput</b>	\$ 160,000	\$ 700,000	\$ 860,000
<b>Incremental Cost</b>			
<b>Labor</b>			\$ 120,000
<b>Handling Material</b>			\$ -
<b>Setting up</b>			
<b>Equipment</b>			\$ -
<b>Designing Processes and Products</b>			\$ -
<b>Designing</b>			
<b>Packaging</b>			\$ -
<b>Machining the Product</b>			\$ -
<b>Total Incremental Cost</b>			<u>\$ 120,000</u>
<b>Incremental Profit</b>			<u><u>\$ 740,000</u></u>

**Build the Products. This is the highest Profit of all of the alternatives**

The summary of incremental income from each alternative is presented below:

<b>Profit Summary</b>	<b>Units Produced</b>		<b>Profit</b>
	<b>WLRM</b>	<b>BB</b>	
<b>Alternative</b>			
1	7,500	0	\$ 300,000
2	10,000	0	\$ 140,000
3	0	20,000	\$ 580,000
4	10,000	20,000	\$ 695,000
5	7,500	20,000	\$ 680,000
6	4,000	20,000	\$ 740,000

**Linear Programming Solution Using Solver.**

There are many who would argue that this is a simple linear programming problem and to an extent that argument carries validity. In linear programming capacity is fixed. To test for the optimal solution given the current set of assumptions about the market volumes and the cost of additional steps, one can add all of the capacity to complete all of the demand and then scale back the steps and the capacity to test for higher incremental profit levels.

The other method of finding the highest profit level is to choose the constraint based on the dollar amount of the step cost. According to constraint theory, the constraint ideally should be chosen based on the cost of the step. Resources costing the most should be the ones management chooses to limit. Such limitations pull the constraint inside of the company, therefore giving the

company control over its own constraint. If capacity exceeds demand, the market becomes the constraint and the system will be subject to the typical cyclical swings of the market.

One has only to remember the strategies of DuPont in his Powder Company and Carnegie in his Steel Mills. Both men purposely limited the capacity of their mills, large as they were, so that smaller, higher priced competitors could fill orders at market peaks. Due to the leverage both companies maintained due to the size of their mills and the cost advantage they had over their competitors, they were able to maintain a core group of laborers and maintain relatively steady production levels. Such is the advantage of an internal constraint, (Johnson and Kaplan, p. 78, 1987, Chandler and Salsbury, pp. 93,156). By limiting capacity to an amount less than demand, companies can reduce the typical impact of the down cycle for any product.

Using solver, following constraint theory, setup hours are chosen as the constraint. Setup hours cost \$200,000 for an additional 1,500 hours of setup time. This is the most expensive step. If the setup capacity is not purchased the highest profit level is attained. Given the capacity levels chosen for setups, the following solution matches that of Alternative 5:

### Teaching Note 12

	<u>WLRM</u> <u>CM</u>	<u>WLRM</u> <u>units</u>	<u>BB</u> <u>CM</u>	<u>BB</u> <u>units</u>	<u>Incremental Profit</u>			
<b>Maximize</b>	\$40.00	4,000	\$35.00	20,000	<b>\$740,000</b>			
<b><u>Constraints</u></b>					<u>Capacity Available</u>	<u>Capacity Used</u>	<u>Unused Capacity</u>	
Labor	0.20	4,000	0.2	20,000	5,500	4,800	700	
Machining	3.5	4,000	1.5	20,000	60,000	44,000	16,000	
Setting Up								
Equipment	0.25	4,000	0.05	20,000	2,000	2,000	0	
Material Handling	0.125	4,000	0.025	20,000	2,500	1,000	1,500	
Sales WLRM	1	4,000	0	20,000	10,000	4,000	6,000	
Sales BB	0	4,000	1	20,000	20,000	20,000	0	
Positive		4,000			0	4,000	-4,000	
Positive				20,000	0	20,000	-20,000	

**Alternative Solutions assuming the constraint should be machine time or labor time are presented below:**

### Teaching Note 13

**If Machine Capacity is Limited:**

	<u>WLRM</u> <u>CM</u>	<u>WLRM</u> <u>units</u>	<u>BB</u> <u>CM</u>	<u>BB</u> <u>units</u>	<u>Incremental Profit</u>			
<b>Maximize</b>	\$ 40.00	8,571	\$ 35.00	20,000	<b>\$ 662,857.14</b>			
<b><u>Constraints</u></b>					<u>Capacity Available</u>	<u>Capacity Used</u>	<u>Unused Capacity</u>	
Labor	0.20	8,571	0.2	20,000	7,500	5,714	1,786	
Machining	3.5	8,571	1.5	20,000	60,000	60,000	0	
Setting Up	0.25	8,571	0.05	20,000	3,500	3,143	357	

Equipment								
Material Handling	0.125	8,571	0.025	20,000	2,500	1,571	929	
Sales WLRM	1	8,571	0	20,000	10,000	8,571	1,429	
Sales BB	0	8,571	1	20,000	20,000	20,000	0	
Positive		8,571			0	8,571	-8,571	
Positive				20,000	0	20,000	-20,000	
Handling Material Step Cost					\$ 40,000			
Setting Up Equipment Step Cost					\$ 200,000			
Machining Product Sep Cost					\$ 25,000			
Direct Labor Step Cost					\$ 60,000			

**If Labor Capacity is Limited:**

**Teaching Note 14**

	<u>WLRM</u> <u>CM</u>	<u>WLRM</u> <u>units</u>	<u>BB</u> <u>CM</u>	<u>BB</u> <u>units</u>	<u>Incremental Profit</u>			
<b>Maximize</b>	\$ 40.00	7,500	\$ 35.00	20,000	<b>\$ 680,000.00</b>			
<b><u>Constraints</u></b>						<u>Capacity</u> <u>Available</u>	<u>Capacity</u> <u>Used</u>	<u>Unused</u> <u>Capacity</u>
Labor	0.20	7,500	0.2	20,000		5,500	5,500	0
Machining	3.5	7,500	1.5	20,000		60,000	56,250	3,750
Setting Up								
Equipment	0.25	7,500	0.05	20,000		3,500	2,875	625
Material Handling	0.125	7,500	0.025	20,000		2,500	1,438	1,063
Sales WLRM	1	7,500	0	20,000		10,000	7,500	2,500
Sales BB	0	7,500	1	20,000		20,000	20,000	0
Positive		7,500				0	7,500	-7,500
Positive				20,000		0	20,000	-20,000
Handling Material Step Cost					\$ 40,000			
Setting Up Equipment Step Cost					\$ 200,000			
Machining Product Sep Cost					\$ 25,000			
Direct Labor Step Cost					\$ 60,000			

**If capacity expanded in order to produce the full demand:**

**Teaching Note 15**

	<u>WLRM</u> <u>CM</u>	<u>WLRM</u> <u>units</u>	<u>BB</u> <u>CM</u>	<u>BB</u> <u>units</u>	<u>Incremental Profit</u>			
<b>Maximize</b>	\$ 40.00	10,000	\$ 35.00	20,000	<b>\$ 695,000.00</b>			
<b><u>Constraints</u></b>						<u>Capacity</u> <u>Available</u>	<u>Capacity</u> <u>Used</u>	<u>Unused</u> <u>Capacity</u>
Labor	0.20	10,000	0.2	20,000		7,500	6,000	1,500
Machining	3.5	10,000	1.5	20,000		76,000	65,000	11,000

Setting Up								
Equipment	0.25	10,000	0.05	20,000	3,500	3,500	0	
Material Handling	0.125	10,000	0.025	20,000	2,500	1,750	750	
Sales WLRM	1	10,000	0	20,000	10,000	10,000	0	
Sales BB	0	10,000	1	20,000	20,000	20,000	0	
Positive		10,000			0	10,000	-10,000	
Positive				20,000	0	20,000	-20,000	
Handling Material Step Cost					\$	40,000		
Setting Up Equipment Step Cost					\$	200,000		
Machining Product Sep Cost					\$	25,000		
Direct Labor Step Cost					\$	60,000		

Choosing different capacity levels does alter the solver solution, obviously. What constraint theory brings to the process is an analysis of which constraint yields the most profit for each unit of its use, factoring in the cost of the extra capacity step. The optimal solution has setup hours as the limiting factor and demand is not fully filled for the WLRMs. By limiting capacity, TRIM management would ensure that reductions in sales of the BBs would not necessarily limit capacity utilization as long as the demand for the WLRMs held up.

Some students may add a concern that limiting production of the WLRMS could frustrate customers and result in overall demand for all products. Again, this is a valid concern and should be factored into any product mix decision.

### **Recognizing the importance of step-fixed costs in product mix choices.**

The major benefit of this analysis by students is the recognition of the necessity in many instances to purchase capacity in lumps, even discretionary fixed costs. In the piloting of this case, some students purchased portions of steps. This case focuses on the impact of the whole step and the inability to send "part of an employee home", or to purchase only part of a machine.

Secondly, the case should highlight the danger of using fully allocated costs when those costs will not be changed by the decision being considered.

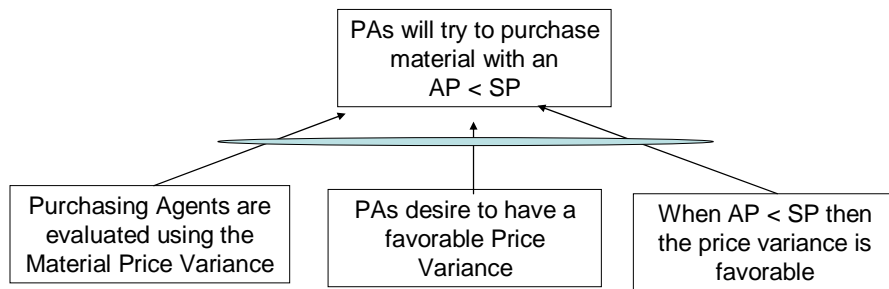
#### **Requirement 2 continued:**

- b) How would you track the success of the new product line or lines?

The goal of this question is to highlight the importance of metrics in monitoring performance, especially when a new action is taken. Answers to this question can lead to discussions about the behavioral impact of metrics. Additionally, the linkages between production and sales can be addressed given the metric choices that students make. Do the choices foster a system-wide view or do they encourage managers of departments to take actions in their individual departments that are harmful to the overall profitability of the company?

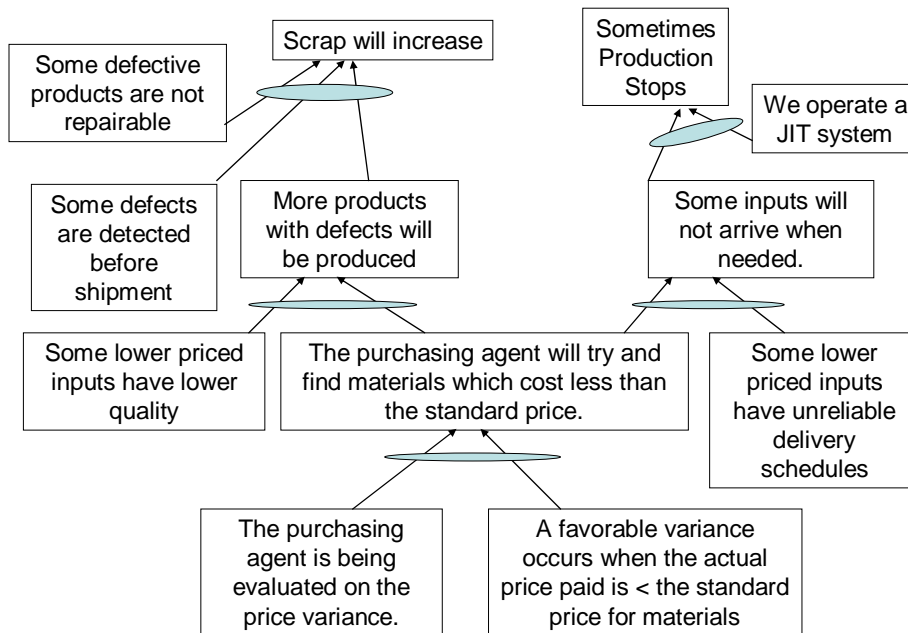
One way to test out the ripple effect of the metrics is to use a cause and effect diagram. An excellent example of this tool can be found in the Boyd and Cox (1997) article containing Negative Branches. Usually what I do is to start with any metric proposed and place it at the bottom of the board. Then using cause and effect logic and some added facts we as a class build up to see what the impact of the metric might be. One example that I use is the one shown below in Figure 1.

Figure 1  
Initial diagram



Initial linkages that are placed on the board. Then students are asked to fill in the effects using if-then questions. If material is purchased with an actual price below the standard cost, what could result?

Possible result\*



\*This cause and effect diagram continued for three more slides.

My personal choice for the company as a whole would be to track total throughput, inventory and operating expense CHANGES to see the impact of the decisions on profit. Throughput as defined by Goldratt is Sales less truly variable costs. This definition matches that of the contribution margin if only unit based variable costs are deducted from sales revenue to determine the contribution margin. In addition, overall Throughput, Inventory and Operating Expense can be tracked long-term to see the overall trends and to encourage long-term improvements in profit as well as in the components of profit. The inclusion of Assets or Inventory in the trend line encourages wise use of resources.

Inventory as defined by Goldratt is the cost of Raw Materials, Property, Plant and Equipment. Any asset that the company owns can theoretically be sold in order to increase cash flow if times demand it. Operating Expense includes any non-unit based manufacturing cost, in addition to the traditional items such as Selling and Administrative Expense. Given this definition of operating expense, direct labor, variable overhead and fixed overhead are classified as period costs and are expensed as incurred.

If throughput increases more than both inventory and operating expense, then the decision can be seen as one that increases overall profit.

c) How would you monitor production?

Since the choice from alternative 6 limits the capacity for setups, the profitability of each product per set-up hour should also be tracked. If setup time is no longer the constraint, then the next constraint should be identified and similarly used to track constraint utilization.

The process for determining product mix in production should follow the following steps:

1. Determine if any constraints exist.
2. Determine the profits that produce the highest levels of throughput or contribution for each unit of the constrained resource.
3. Prioritize production from most to least profitable per unit of the constrained resource.
4. Do not produce beyond the demand for any one product.
5. If the prioritization eliminates the production of products considered vital for a "full product line" and therefore for long-term customer satisfaction and demand, then determine a minimum quantity for the less profitable products and adjust production accordingly.

In addition, other steps should be taken to ensure that the constraint is not idled:

1. Ensure that the constraint is not starved by establishing an amount of buffer inventory in front of the constraint.
2. Monitor the Buffer for depletion and when significant "holes" develop in the feeder buffer to the constraint, expedite production to fill the buffer holes.
3. Allow a buffer of inventory to accumulate after the constraint so that the constraint will not be blocked in a pure kanban process.
4. Track changes in Unused Capacity for the protective resources.
5. Track Due Date Delivery and the Shipping Buffers to ensure that products reach customers in time.
6. Track the Raw Material Buffer to ensure that production is not starved for inputs when needed.

Metrics for production in items 1 - 6 above are all non-financial and easily monitored by those responsible for the tasks in real time and do not require a sophisticated computerized system in many instances. In addition, the Due Date Delivery Metric links production to sales.

Students should be encouraged to find metrics that do link production and sales and keep capacity limitations in mind for both sales and for production.

d) What information would sales need in order to promote optimal product sales?

In the absence of an internal constraint, choose products that have the highest Throughput per unit. Since all products are produced using all of the resources, throughput can be tracked to determine which products to emphasize. Tracking throughput also works whenever capacity levels are fixed for the short-run, even when dedicated resources exist.

In this company, all resources are used on all products; therefore none of the resources are dedicated to any one line. Any increase in capacity therefore could be used by any product.

Once constraints are identified or emerge, switch sales priority to the highest Throughput per unit of the constrained resource. In determining the products to “push” sales personnel should be push products in order of their Throughput per unit of the constrained resource. In TRIM, if setups continue to be the constraint, BBs should be “pushed” before WLRMs are sold.

Product line depth may trump this rule and lowest levels of the lower ranked products might be encouraged to maintain a full product line for customers demanding depth.

Sales personnel should be apprised of areas of excess capacity and the products currently made on that capacity that could be produced without a strain on the current resources.

Sales needs a transparent information platform detailing current capacity utilization, orders in process, anticipated due dates and ideally a feedback function informing sales of due dates possible for future sales given current orders in process.

Regardless of the metrics chosen by the students, the discussion should focus on the impact of the chosen metrics on other departments and on overall profit.

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