

Measuring the Financial Benefits of DFMA Using the Lean Accounting Box Score

By Nick Katko, Senior Consultant, BMA Inc.



The Issue

The primary operational benefits of DFMA are well known and documented. These are:

- Decrease of inventory
- Decrease in assembly time
- Decrease in product development time
- Decrease in parts

Lean practices achieve similar benefits. Lean companies use the Lean Accounting Box Score to analyze the impact and perform the financial analysis of these types of improvements. The Lean Accounting Box Score can be used to perform the same analyses for DFMA. This paper will explain the benefits of using the Box Score to calculate the true financial impact of DFMA.

The Current State

Some financial benefits are easy to model. One benefit of DFMA is fewer parts, so the decrease in material costs and inventory is relatively easy to model financially. DFMA also creates two other significant benefits:

1. Reducing the labor content to produce products, which means the cycle times to produce products will decrease.
2. Reducing the wastes associated with the number of parts – such as defects, movement, transportation, waiting and the over-processing of parts. Fewer parts means there will be fewer incidents of waste occurring.

Quantifying the financial benefits of reduced labor content and waste is more difficult because these operating improvements are related to **creating time**. The challenge for analysts is how to convert **time created** into meaningful financial numbers – or to put it another way, “how to dollarize time.”

Current methods for analyzing the labor cost savings of DFMA are:

1. Quantify the reduction in labor content and waste reduction usually by calculating the amount of time saved and multiplying it by a labor rate, or;
2. Recalculate a standard product cost using the new amount of labor time to produce.

Neither method calculates true labor savings because both methods are based on a faulty paradigm: namely, the assumption that labor costs for a product vary by the amount of time it takes to produce the product.

In most cases when labor content and waste are reduced, these labor savings never really show up on the income statement as projected. This is a source of frustration for everyone looking for the bottom line return of DFMA. The real reason these labor savings don't appear as expected on the financial statements is because ***time is being created*** rather than costs are reduced.

A company's labor cost depends on the number of people employed and the hours worked and not on reducing the amount of time it take to produce one product (or group of products). ***Reducing the amount of time to produce a product simply creates more time for your resources (labor and machines.)***

The elimination of waste also ***creates time***. The impact of using DFMA is to have fewer parts, which means that the time spent on defects, transportation, downtime, over-processing and waiting is reduced. Again, this ***creates time***.

Costs are reduced only when actual spending is decreased. In terms of a company's resources, such as labor and machines, costs are reduced only when headcount and machines are actually reduced, not when labor content of parts and waste are reduced.

The Future State

The solution for this problem is to use the Lean Accounting Box Score as the primary analysis tool to analyze, project and measure the actual financial benefits of DFMA. Lean companies use the Lean Accounting Box Score as the primary tool for measuring operating performance and for analyzing the impact of business decisions. The Box Score can also work well for DFMA because DFMA works just like lean. Lean identifies waste and eliminates it through continuous improvement projects. DFMA makes improvement in production processes by eliminating both parts and the waste associated with parts.

Box Scores are deployed at the value stream organizational level in lean companies. The Box Score is composed of three sections, as shown in Exhibit #1:

- **Operating performance measures** – which measure improvements in productivity, flow, quality, delivery and cost. Waste elimination is measured by rates of improvement in these measures.
- **Capacity** – which measures how much time is being spent on value added (productive) activities; non-value added (nonproductive activities) and how much time is available. As waste is eliminated, non-value added capacity will decrease and available capacity will increase.
- **A value stream income statement** – which shows the actual direct revenue, costs and profitability of a value stream, without using cost allocations or standard costs. The value

stream income statement recognizes the fact that the primary cost drivers are the amount of capacity required and the stability of operating performance.

Exhibit #1 – Sample Weekly Box Score

	Last Week 4-Oct	This Week 11-Oct	Next Week 18-Oct	23-Oct	Planned Futute State 31-Dec
Operational	Units per Person	36.16	42.05		51.39
	On-Time-Shipment	98.00%	94.00%		98.00%
	Dock-to-Dock Days	23.58	20.50		16.50
	First Time Thru	46%	42%		50%
	Average Product Cost	\$388.46	\$348.66		\$316.91
	AR Days	34.5	37.0		35.0
Capacity	Productive	10.8%	10.8%		24.7%
	Non-Productive	54.8%	54.8%		23.4%
	Available Capacity	34.4%	34.4%		51.9%
Financial	Revenue	\$1,101,144	\$1,280,400		\$1,408,440
	Material Cost	\$462,480	\$512,160		\$535,207
	Conversion Cost	\$250,435	\$231,884		\$208,696
	Value Stream Gross Profit	\$388,228	\$536,356		\$664,537

Financial Analysis Using the Box Score

Use of the Box Score in business decision analysis recognizes that there are interrelationships between operating performance, capacity requirements and costs. Briefly, these include:

- The cost of capacity (conversion costs: labor, machines and facilities) is increased or decreased as the actual amount of capacity resources changes;
- Changes in how the capacity is used (e.g. less waste reduces non-productive capacity), does not change costs because the amount of capacity does not change. Thus creation of time can be measured;
- If a business decision requires additional capacity and there is enough available capacity, there is no impact on costs;
- Decisions made that use available capacity (**time created**) will impact costs and revenue.

Performance measurements gauge lean improvements, which ultimately will change how capacity is used and reduce costs. The Box Score can be applied to DFMA financial analysis as follows:

- Decreasing the number of parts will decrease the material costs;
- Decreasing the labor content to produce parts will decrease productive capacity and increase available capacity. There is no immediate financial impact due to the decrease in labor content;
- Lean improvements – eliminating wastes associated with parts – improves performance measurements, decreases non-productive capacity and increases available capacity;
- The decisions made on the newly created available capacity are incorporated into the DFMA financial analysis, because the DFMA improvements created this capacity.

The advantage the Box Score provides in analyzing DFMA is that it objectively displays time creation as the creation of capacity. With this information the operating benefits of DFMA – reducing labor content and waste associated with parts – can be measured. Additionally, the total benefits of DFMA – what is done with the time (capacity) created – can also be modeled in the box score to get a complete picture of the comprehensive financial benefits of DFMA.

Let’s look at an example of the application of the Box Score to DFMA financial analysis.

DFMA Box Score Example

We’ll examine a plausible scenario to show how this would work. First some background information:

A lean manufacturing company has a simple 4-step manufacturing process:

- Machining – raw materials are machined into component parts;
- Welding – component parts are welded into sub-assemblies;
- Assembly – finished products are assembled;
- Shipping – products are shipped to customers.

This company uses a Box Score (Exhibit #2) for weekly reporting. Current performance measures are as follows:

- Productivity is measured using sales per person;
- Flow is measured by inventory days;
- On-time delivery is measured against customer request date;
- Quality is measured as the percentage of products produced the first time through the value stream;
- Cost is measured by the reduction in average cost per unit.

Wastes in the production process include scrap, rework, downtime, inspection time, wait time and some over-production. Waste currently accounts for 31% of the total time of its resources, as shown by the nonproductive capacity in the Box Score (Exhibit #2).

Value stream profitability is measured using actual revenue generated by the value stream and the actual direct costs of the value stream, without any cost allocations.

We’ll use the current state Box Score (right) as the starting point of the financial analysis.

Exhibit # 2

	Current State	
Performance Measures	Productivity	54.55
	Flow	24
	On-time Delivery	86%
	Quality	60%
	Average Cost Per Unit	\$426.54
Capacity	Productive	49%
	Non-Productive	31%
	Available Capacity	20%
Income Statement	Revenue	\$1,875,000
	Material Costs	829,835
	Conversion Costs	
	Labor	307,130
	Machines	88,800
	Outside Processing	36,000
	Facilities	15,450
	Other	2,416
	Total Costs	\$1,279,631
	Value Stream Profit	\$595,369
Return on Sales	31.75%	

The DFMA Opportunity

Engineering would like to invest in DFMA because it believes that DFMA will achieve the following benefits:

- Reduce the number of parts machined and welded by 30%;
- Reduce the labor content (production time) in machining, welding and assembly by 25%;
- Eliminate rework in machining, welding and assembly;
- Eliminate other wastes associated with the number of parts.

To calculate the financial benefits of DFMA using a Box Score, the following three steps must be completed:

Step 1 - Calculate the Future State Box Score

The future state box score is a projection of the box score based on the expected benefits of DFMA. Using standard lean decision making methodologies, the impact of each DFMA benefit is analyzed by its impact on each element of the box score. The Exhibit # 3 below summarizes the impact of the DFMA operational benefits on the Box Score.

Exhibit #3 – Expected Benefits of DFMA

DFMA Benefit	Performance Measurements	Capacity	Value Stream Profit
30% Decrease in parts and eliminate rework	Improve Flow	Nonproductive decreases from 31% to 16%	Material Cost decreases \$248,950
	Improve Quality	Available increases from 20% to 46%	
25% Decrease in Labor Content	Improve On-Time Delivery	Improve Cost per Unit	No changes
		Decrease productive from 38% to 29%	
		Available increases from 46 % to 56%	

After this analysis, the future state Box Score (Exhibit #4) can now be projected, which shows the impact of DFMA's benefits.

The decrease in material costs has increased value stream profits by \$248,950, which is very good. DFMA has also created capacity – available capacity is now 56%, so the financial analysis is not completed until decisions are made about using the available capacity.

Exhibit #4 – Future State Box

		Current State	Future State
Performance Measures	Productivity	54.55	54.55
	Flow	24.00	16.80
	On-time Delivery	86%	95%
	Quality	60%	90%
	Average Cost Per Unit	\$426.54	\$343.56
Capacity	Productive	49%	29%
	Non-Productive	31%	15%
	Available Capacity	20%	56%
Income Statement	Revenue	\$1,875,000	\$1,875,000
	Material Costs	829,835	580,885
	Conversion Costs		
	Labor	307,130	307,130
	Machines	88,800	88,800
	Outside Processing	36,000	36,000
	Facilities	15,450	15,450
	Other	2,416	2,416
	Total Costs	\$1,279,631	\$1,030,681
	Value Stream Profit	\$595,369	\$844,319
	Return on Sales	31.75%	45.03%

Step 2 - Project the Box Score impact of using Available Capacity.

The company determined that the available capacity created by DFMA could be used as follows:

1. Demand is expected to increase 33% in the near future.
2. Available capacity can be transferred to another value stream in the company.

Based on this information, the final step of the financial analysis is to project the Box Score with the additional 33% in demand and the transfer of available capacity to another value stream. The increase in demand will increase revenue and material cost, but will not increase conversion costs because no new capacity

needs to be purchased. The transfer of capacity will reduce labor and machine costs.

As a result of these changes, there is a 230% increase in profits due to the investment in DFMA and the decisions made about using available capacity. Additionally, a greater percentage of capacity is being used on productive activities and significant improvements have been made in operational performance. The final projected Box Score is shown in Exhibit #5.

Exhibit #5 - The Final Box Score

		Current State	Future State	Increase demand	Redeploy people	Improvement
Performance Measures	Productivity	54.55	54.55	70.91	125.81	230%
	Flow	24.00	16.80	16.8	16.8	30%
	On-time Delivery	86%	95%	95%	95%	7%
	Quality	60%	90%	90%	90%	50%
	Average Cost Per Unit	\$426.54	\$343.56	\$316.48	\$270.49	37%
Capacity	Productive	49%	29%	38%	57%	
	Non-Productive	31%	15%	16%	21%	
	Available Capacity	20%	56%	45%	23%	
Income Statement	Revenue	\$1,875,000	\$1,875,000	\$2,493,750	\$2,437,500	33%
	Material Costs	829,835	580,885	772,577	755,151	9%
	Conversion Costs					
	Labor	307,130	307,130	307,130	173,110	43%
	Machines	88,800	88,800	88,800	65,000	27%
	Outside Processing	36,000	36,000	47,880	47,880	-33%
	Facilities	15,450	15,450	15,450	11,345	27%
	Other	2,416	2,416	2,416	2,416	
	Total Costs	\$1,279,631	\$1,030,681	\$1,234,253	\$1,054,902	18%
	Value Stream Profit	\$595,369	\$844,319	\$1,259,497	\$1,382,599	230%
	Return on Sales	31.75%	45.03%	50.51%	56.72%	

Step 3 - Use weekly Box Score reporting to measure the realized financial benefits of DFMA.

The final step in the process is to employ weekly Box Score reporting to manage and measure value stream performance and to evaluate the actual impact of DFMA. Weekly reporting is accompanied by weekly root cause analysis and corrective action on all three dimensions of value stream performance. This weekly cycle of Plan, Do, Check, Act ensures that issues will be discovered in a timely manner, allowing for faster root cause analysis and corrective action. Weekly reporting will also ensure that the benefits of DFMA are being realized as the trends in the weekly Box Score move towards the future state.

Exhibit #6 - Example of a weekly Box Score

Value Stream		Current State	Week #1	Week #2	Week #3...	Future State
Performance Measures	Productivity	54.55				125.81
	Flow	24				16.8
	On-time Delivery	86%				95%
	Quality	60%				90%
	Average Cost Per Unit	\$426.54				\$270.49
Capacity	Productive	49%				57%
	Non-Productive	31%				21%
	Available Capacity	20%				23%
Income Statement	Revenue	\$1,875,000				\$2,437,500
	Material Costs	829,835				755,151
	Conversion Costs					
	Labor	307,130				173,110
	Machines	88,800				65,000
	Outside Processing	36,000				47,880
	Facilities	15,450				11,345
	Other	2,416				2,416
	Total Costs	\$1,279,631				\$1,054,902
	Value Stream Profit	\$595,369				\$1,382,599
Return on Sales	31.75%				56.72%	

Conclusion

The Lean Accounting Box Score represents a superior method for analyzing the financial impact of DFMA and for tracking the progress of DFMA projects. Capacity measures the **time savings** of DFMA and the value stream income statement illustrates that the complete financial impact of DFMA. The Box Score puts all this information together. In the end, the financial benefits of DFMA, as projected by the Box Score, will be realized as real profitability improvement because the value stream income statement reflects real changes in revenue and spending, rather than in artificial labor rates or product costs.