Manufacturing Yield vs. Product Level Nesting Yield: Taking Material Utilization to the Next Level

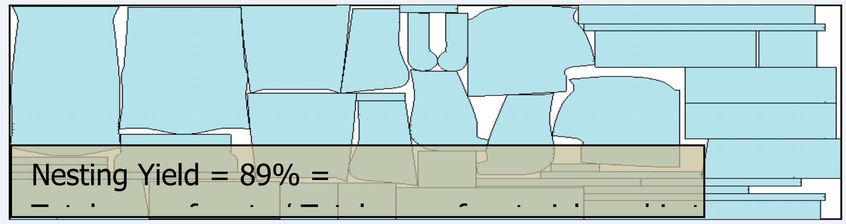
Avner Ben-Bassat, President & CEO, Plataine Inc.

Introduction

Best of class manufacturers track their performance by measuring a set of key metrics for a variety of needs such as continuous improvement and costing. Given the importance of these metrics, it is important to ask - **are the correct metrics being used, and which potential savings are overlooked when measuring the wrong ones?**

The topics of "material utilization" or "material savings" were the center of intense discussions and process evaluations conducted with dozens of manufacturers worldwide, specifically as it pertains to optimal roll selection, cut-planning and nesting. Effectively all manufacturers place a great emphasis on tracking their material yield. However, the vast majority of them measure the yield through the eyes of the Product -level nesting process. Such manufacturers measure their **'Product-level Nesting Yield' (Figure 1)**, which is the total area of the parts in a product divided by the area of the material used for the nest. **In many cases, the nests are prepared once per product, on a given material size, and then stored for future use and reference.**

Figure 1 - Single Product Nest: Length: 9.1 yards. Nesting yield equals to 89% as the parts take up 89% of the fabric area.



By associating nesting with the **product-level** entity, this metric completely ignores the broader realities of manufacturing and the **actual level of material utilization** as driven by operational decisions such as scheduling of similar products to cut, selection of raw material to use (including remnant utilization) and more. In fact, most manufacturers we meet are intuitively (and practically) aware that there is "additional waste

By assuming that increased material utilization can only be driven by bett 'Nesting' capabilities (software or human), many manufacturers feel th have already taken those to the limit and therefore choose to focus on ot areas for continuous improvement.

in the process", but they accept it as an unavoidable cost given the [lack of] systems and processes they currently have in place.

To realize the true utilization of material in production, it is important to look at the overall Manufacturing Yield, that is – the total material that becomes finished product, as a percentage of the total raw material purchased by the plant. This paper will focus on measuring material utilization during the nesting/cutting processes.

Table 1: Nesting Yield vs. Manufacturing Yield

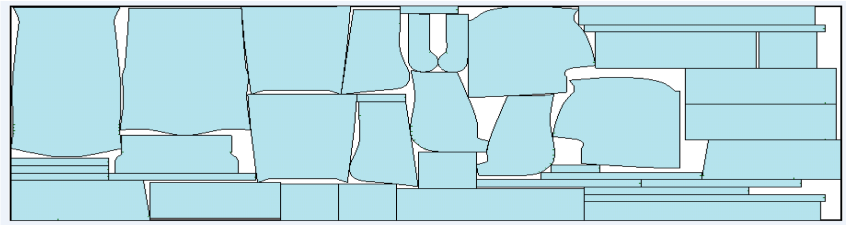
Product-Level Nesting Yield	Manufacturing Yield
Total Area of the parts in a product nest **Total area of the material used for the ne**	Total material that becomes product Total material purchased by the plant
Engineering (CAD/CAM) oriented Metric	Manufacturing/Operational Metric
Independent of manufacturing plan	Tightly related to actual manufacturing
Static - Does not change as long as no ne products are introduced	**Dynamic** - Changes daily according to actual product mix, scheduling decisions, selection of raw material (including remnants) etc.

On site process studies have shown that the gap between these two metrics typically ranges between 5% and 10%, exposing a set of significant inefficiencies. Conversely, overlooking these inefficiencies allows them to cement themselves and become a given 'cost of doing business', until the time they bubble up to management as some amortized – fixed – factor that is added in all decisions related to material consumption or costs. Then, the waste in production adversely impacts other processes and leads to excess purchase of raw material, over-priced products, over-costing of future contracts and more.

Example – Remnants Utilization and its impact on true Manufacturing Yield

To illustrate this concept, take for example the following nest, used to produce a single sofa product (Figure 2). This nest is 9.1 yards long, and its ***Nesting Yield*** is 89%.

Figure 2: Single Product Nest, 9.1 yards in length, 89% Material Utilization



In a simplified world, let's assume this is the only product in production, and that the manufacturer needs to produce 6 such units per day. By looking strictly at the single-unit yield, the overall yield would remain the same year-long at 89%.

However, by looking at the overall production sequence, one realizes the *Manufacturing Yield* is much lower.

For the sake of this example, let's assume a new roll of material is 50 yards long, and that the plant always cuts the same product with the same nest. Therefore, they could fit 5 sofas in a single roll (total of 45.5 yards), but cutting the 6th sofa would require starting a new roll, while leaving 4.5 unused yards in stock. Let's also assume that this remnant is discarded (we'll get back to this assumption later). In such a scenario, the ***Manufacturing Yield* drops to 82%** and the difference compared with the 89% ***Nesting Yield*** represents the waste ignored when using the wrong metric.

Table 2 –Comparing utilization metrics

	Nesting Yield View	Manufacturing Yield View
Sofas #1 to #5	9.1 yards each (Total of 45.5 yards)	9.1 yards each (Total of 45.5 yards)
Sofa #6	Uses Same Nest as Sofas #1-5. Total: 9.1 yards	Uses Same Nest as Sofas 1-5. Total: 9.1 yards
Remnant	**Ignored** in Metric	Remnant included in metric, but not used in production: 4.5 yards are discarded
Total Material Used (length)	54.6 yards	59.1 yards
Total Area of Material used (54" wide material)	81.9 Sq Yards	88.6 Sq Yards
Total Area of Parts Cut	72.9 Sq Yards	72.9 Sq Yards
Resulting Measurement	89%	82%

Utilizing remnants

In the previous example it was assumed that the unutilized remnant is discarded. This is a critical assumption which has a clear bearing on the ***Manufacturing Yield***, but **no impact** on the ***Nesting Yield.***

There are various ways that each manufacturer deals with remnants, both formally and informally. These are highly dependent on a variety of factors, and get further complicated by the questions of variable material width, yet they could be consolidated into two main practices, as shown in **Table 3** below.

Table 3 – Main practices of dealing with remnants

I	Return them to the shelf for future use, typically for re-cuts, and then discard them if no use was found.	Requires **additional labor** and attention on the shop floor, but at least **attempts** to use the material
II	**Discard them immediately** (for example, "if the remn is shorter than 3 yards*, discard it")	Loses the material, but saves the la of managing it.

***** The definition of a "remnant" also varies widely in the industry (typically between 3-5 yards).

In practice, given the amount of labor and 'hassle' required to utilize remnants, those that are shorter than 3-5 yards are seldom used, certainly not consistently or in entirety. However, if one can boast a high level of remnant utilization, it would typically come at the expense of additional labor & WIP costs.

In any event, to the extent remnants are used, the gap between the ***Nesting Yield*** and ***Manufacturing Yield*** will be narrowed accordingly.

Increasing your Manufacturing Yield

Once the ***Manufacturing Yield*** is established as a more accurate metric, the obvious question becomes how can one improve it, or in this example, how to **methodically utilize remnants in the routine manufacturing processes?**

First, why are remnants not typically utilized? In most cases we see, the Nesting process is tied to the Engineering room, or more precisely to the CAD system. The nest is pre-prepared for any given style (or mix of styles), and is then retrieved and cut each time the product(s) are needed. Thus, nesting is typically **disconnected** from the production realities and variability such as order mix, material dye-lots/shades, material width and more.

Therefore, if a given product requires 9 yards of material (as in this example), three distinct capabilities are required to routinely use rolls shorter than 9 yards for it, let alone 3-5 yard remnants:

1. **An Integrated or Holistic Approach:** the knowledge that such remnants exist at the time the nesting decision is made.
2. **A Dynamic Approach**: given the knowledge about the remnants, the ability to utilize them by creating a suitable nest **<u>on-demand</u>**, i.e. not reusing a pre-prepared nest suitable for some arbitrary standard.
3. The practical ability (software algorithm or human-based) to nest a single product to multiple rolls of various sizes

   To be more precise, using software to support the third capability saves tremendous amounts of labor and ensures optimal decisions are made every time.

Given these three capabilities, one can routinely utilize the remnants in stock, with each day presenting a **different demand** for products and a **different set of rolls as resources**.

Figure 3 illustrates the usage of remnants corresponding to the example above where 4.5 yards would otherwise remain uncut.

Figure 3 – Splitting a single sofa to be nested on a 4.5 yards remnant and an additional section of a new roll

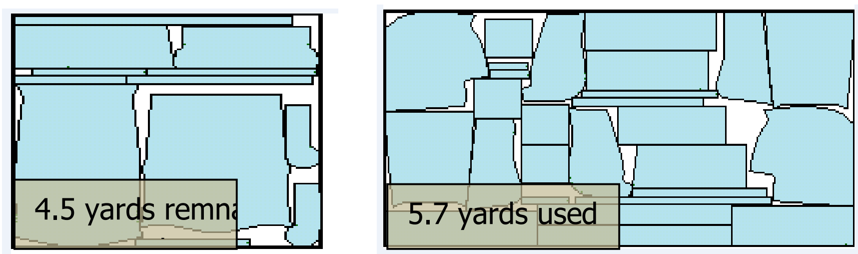


Table 4 (below) summarizes this example:

I. When remnants are both discarded and ignored in measurement, the ***Nesting Yield*** shows an **illusion** of a higher yield in production **(89%).** This deviation then adversely impacts other decisions such as purchase of raw material, costing etc.
II. When remnants are considered in measurement, but not used in practice, the ***Manufacturing Yield*** is exposed at **82%**
III. When remnants are methodically used in production, the ***Manufacturing Yield*** climbs up to **87.3%** and **<u>represents a true figure.</u>**

	Nesting Yield View	Manufacturing Yield View	
	I	II	III
Treatment of Remnants in Process	Remnants are discarded	Remnants are discarded	Remnants are utilized
Treatment of Remnants in Metric	Excluded	Included	Included
Sofas #1 to #5	9.1 yards each (Total of 45.5 yards)	9.1 yards each (Total of 45.5 yards)	9.1 yards each (Total of 46.5 yards)
Sofa #6	Uses Same Nest as Sofas 1-5. Total: 9.1 yards	Uses Same Nest as Sofas 1-5. Total: 9.1 yards	5.7 yards in New Roll + 4.5 Remnant from First Roll
Remnant	**Ignored** in metric	4.5 yards remnant is discarded	4.5 yards remnant is utilized
Total Material Used (length)	54.6 yards (ignoring the	59.1 yards (Accounting for	55.7 yards (Both accounting for

	discarded remnant)	Remnant, but not using it)	Remnant AND using it)
Total Area of material used (54" roll width)	81.9 Sq yards	88.6 Sq yards	83.6 Sq yards
Total Area of Parts Cut	72.9 Sq yards	72.9 Sq yards	72.9 Sq yards
Measured Yield	**89%** (ignoring the discarded remnant)	**82%** (Accounting for Remnant, but not using it)	**87.3%** (Both accounting for Remnant AND using it)

Summary

Effectively all manufacturers place a great emphasis on tracking their material yield, yet a vast majority of them measures it through the eyes of the Product-Level nesting process. By associating Nesting with the **product-level** entity, this metric completely ignores the broader realities of manufacturing and the **actual level of material utilization** as driven by operational decisions such as scheduling of orders to cut, selection of raw material to use (including remnant utilization, rolls width optimization) and more.

In fact, most manufacturers are aware that there is "additional waste in the process" beyond what they measure, but they accept it as an unavoidable "cost of doing business". After a while, this waste becomes a given: manufacturers do not attempt to reduce it, and factor it uniformly into a wide range of decisions made in the plant such as material purchasing, project costing and more.

The *Manufacturing Yield* therefore represents a more accurate metric, and measuring it is a big first step towards improving it. The challenge of utilizing short rolls is just one of many difficulties dealt with daily in an attempt to increase the *Manufacturing Yield*. Other dilemmas include those of Scheduling, WIP Optimization, and managing material width variations. Our future white papers will discuss these topics.

Addressing these challenges methodically and efficiently requires a dynamic and integrated optimization approach, based on close collaboration between the various teams involved (Engineering, Manufacturing etc.), and bridging that gaps between the systems they use (ERP, CAD, PLM etc.). Solving this truly complex problem requires suitable optimization software tools and processes. Without them, improving the ***Manufacturing Yield*** becomes a labor-intensive task that is often set aside.