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POINT

# SQUARE ROOT COSTING

Revealing the Cost of Complexity



# Most companies do not know where they make money

This is shocking, yet understandable given the challenges leaders have in tracking and allocating costs. Calculating overall profitability is straightforward, but determining product-, SKU-, or customer-level profitability is close to impossible.

Typical costing methods prove inadequate as continuous changes in product mix, processes, and organizational support structures render standard costing meaningless, and activity-based costing exercises obsolete before the lengthy exercise is complete. In fact, countless times executives from various industries have told us that they do not believe in the accuracy of their standard product costs.

But without a robust costing tool, it is impossible to truly understand which SKUs are driving profits and which are losing money—this is a perilous situation to be in because in most organizations there are big winners and losers.

For example, Wilson Perumal & Company (WP&C) worked with a regional beverage distributor operating under the belief that its high-end products, with very high price points and gross margins, were its primary profit drivers. However, the standard costs developed by the company's finance department did not accurately represent true costs and led to misinformed strategic decisions, such as an overinvestment in the sales force focused on small volume, premium purchasers.

**After using WP&C's proprietary Square Root Costing (SRC) methodology, the business obtained greater clarity—it found that fewer than 20% of SKUs were profitable, and that all of those profitable products were actually the low-margin, high-volume products originally thought to be loss leaders.**



Research affirmed by client experience shows that typically, **only 20 to 30 percent of products generate profit, often over 300 percent of total profit.**

**The remaining 70 to 80 percent of products destroy 200 percent or more of total profit.**

Slower-moving, high-margin products added complexity to purchasing, sales, warehousing, and distribution, substantially increasing overall costs, but in hidden ways.

Correctly allocating these costs to the company's high-end products showed that those products were, in fact, highly unprofitable. Massive cross-subsidizations had been disguising the true costs and profits of products, customers, and channels.

**Until the development of SRC, there has been no feasible way to quickly and dynamically understand true SKU or customer profitability. WP&C developed SRC as a means to help companies quantify the costs of complexity and unlock the systemic cross-subsidizations distorting the view of profitability by product, customer, and so on.**

**It is rooted in a deep understanding of complexity and its impacts on operations and costs, and can therefore move beyond the fixed and variable cost paradigm. SRC adds a third cost category in order to account for costs driven by complexity (e.g., changeover time, inventory management) and the unique behaviors of those costs.**

This additional cost category accounts for Non-Value Added (NVA) complexity costs that increase with volume but are not proportional to it—hence the square root relationship after which this approach is named. Additionally, SRC employs the same top-down, allocation-based approach used in standard costing that is both fast and dynamic, giving it many advantages over activity-based costing.

# Square Root Costing is Different

Traditionally, businesses could confidently use standard costs based on fixed and variable costs to make decisions regarding product rationalization, pricing, and new product development. **Today, however, complexity has changed the game.**

While standard cost models accurately account for value-added costs like raw materials and direct labor, these models fail to truly account for the complexity costs created by a portfolio of many different SKUs. Standard cost models fail to associate NVA costs like changeovers, inventory

management, and corporate overhead with specific SKUs. This is because standard costs are typically calculated at the gross margin level, and either ignore overhead or assume it is equally driven by all products.

However, as overhead typically accounts for a significant portion of overall costs (depending on industry, between 25-50%), it deserves a more careful accounting.

**Square Root Costing accurately captures the complexity-driven NVA costs that standard costs fail to consider.**

## Consider a manufacturing line producing 1,000 yellow pencils per day

In a bid to draw new consumers, management decides to diversify and produce 90% yellow pencils, 10% blue pencils. To do this, the line has to stop production to change over between colors. Scheduling is now more important and raw materials and finished goods inventories need to be coordinated.

Equipment has to be cleaned and recalibrated with every change, creating downtime, and material scrap was produced

each time a machine stopped and started production. Overall, the downtime associated with color complexity reduces capacity to 900 pencils per day.

**Standard costing would spread the lost-time NVA costs across all products by volume, whereas the SRC approach would accurately assign the source of complexity, blue pencils, greater NVA costs.**



# Why Square Root Costing?

WP&C co-founder Andrei Perumal theorized the square root relationship between volume and complexity costs after a series of plant simulations. These models isolated the impact of individual variables, revealing that certain complexity costs, such as product setup times, demand variability, and inventory holding costs, varied exactly proportionally to the square root of volume.

In a manufacturing environment using optimal production scheduling for two items that are the same (i.e., same setup time, run rate, yield, etc.), average working inventory levels were proportional to the square root of each product’s volume. If Product A had 4x the demand of Product B, then Product A had 2x the average cycle stock inventory.

For complexity costs, volume is the dominant driver of cost differences between products—or customers, regions, and so on. By accurately modeling these relationships, SRC can quickly and significantly improve the accuracy of costing figures. However, the true value of Square Root Costing comes from the insights one can generate using the

methodology’s outputs, which allow companies to understand the actual drivers of product, SKU, and customer profitability.

**SRC can provide valuable information about the cost of delivering new SKUs to the market and provide insights into how a company can deliver the complexity required to meet customer demands in a more effective and profitable way.**

The following example demonstrates how WP&C has helped various companies use Square Root Costing to inform strategic decisions and transform their businesses.

## SITUATION

- You have two products, ‘A’ and ‘B’
- Product A: volume = 1 unit
- Product B: volume = 49 units
- You identified \$100 in complexity-driven costs to allocate

## EXERCISE

**Allocate the \$100 in costs across the two products using each of the three methods (by volume, by square-root of volume, and equal by product) to complete the table below.**

	BY VOLUME		BY SQRT OF VOLUME		EQUAL BY PRODUCT	
<b>Total Cost (\$)</b>	\$2.00	\$98.00	\$12.50	\$87.50	\$50.00	\$50.00
<b>Volume</b>	1	49	1	49	1	49
<b>Unit Cost (\$/unit)</b>	\$2.00	\$2.00	\$12.50	\$1.79	\$50.00	\$1.02
	<b>PRODUCT A</b>	<b>PRODUCT B</b>	<b>PRODUCT A</b>	<b>PRODUCT B</b>	<b>PRODUCT A</b>	<b>PRODUCT B</b>



# CASE #1

## Diagnosing product profitability to inform new product development

A \$5B HVAC manufacturer (HVAC Co) had maintained profitability over recent years as its portfolio of products continued to grow. With pending technology and regulatory changes, management expected the number of SKUs to triple while volumes grew at a slower rate.

This would result in higher production and sales costs to support a more variable portfolio and impact existing scale. HVAC Co needed to understand how this added complexity would impact the business and how to best manage it moving forward.

**WP&C used SRC to analyze the impact of complexity in HVAC Co's furnace offerings.** Two furnaces, Model A and Model B, were identical apart from the location of the flow port. Model A's port was on top of the unit

to comply with construction standards in the Midwest while Model B's port was on the bottom of the unit to support the Southeast market. Model A sold 13 times the volume of Model B.

HVAC Co assumed the costs to sell these nearly identical products would be similar, but **our SRC analysis revealed the real costs associated with bringing the slower-selling Model B to market** (e.g., manufacturing, selling, distribution, marketing, other overhead, etc.) was \$912, compared to only \$550 for Model A.

At this true cost, Model B was losing money, but HVAC Co had to keep offering that format to serve its Southeastern market. A solution was needed to deliver the added complexity of Model B in a more efficient way.

With an understanding of HVAC Co’s operations and customers, we recommended the development of a dual port product. Reengineering a furnace to have both a top and bottom port location would reduce the number of furnace SKUs by half, driving down inventory costs, reducing changeovers, and lowering supply chain costs.

Analysis showed that if the less costly Model A could be reengineered as a dual port product for an additional unit cost of \$25 or less (difference between Model A’s unit cost of \$550 and the weighted average unit cost of Models A & B, \$575), it would be profitable to transition to the dual port design (Figure 1).

**Figure 1: Economics of Proposed Dual Port Product**

	CURRENT SALES		PROSPECTIVE DUAL PORT SALES	
	Model A	Model B	Dual Port (\$5)	Dual Port (\$10)
Annual Volume	105,000	7,800	112,800	112,800
Average Sales Price	\$750	\$842	\$756	\$756
Cost/Unit	\$550	\$912	\$555	\$560
OP/Unit	\$200	<b>(\$70)</b>	\$201	\$196
<b>Total Profit</b>	<b>\$20,454,000</b>		<b>\$22,672,800</b>	<b>\$22,108,800</b>

**Figure 2: Additional Cost/Unit Impact on Profit**

ADDITIONAL COST/UNIT	POTENTIAL PROFIT INCREASE
\$5	\$2.2M
\$10	\$1.7M
\$15	\$1.1M
\$20	\$0.5M
\$25	\$0.1M

Model A and Model B’s sales volumes would combine and represent the sales of a new, dual port product. The unit cost to bring this dual product to market would be Product A’s current unit cost (\$550) plus the cost to add the additional port.

Based on engineering estimates, the change would only cost an additional \$5 to \$10 to make and would result in profits increasing by \$1.7M to \$2.2M (Figure 2).

# CASE #2



## Understanding customer profitability to improve economic profit

An international CPG contract manufacturer (Consumer Co) was having difficulty balancing the demands of its three largest customers.

These customers were pressuring Consumer Co to reduce minimum order quantities and order frozen zones (e.g., periods where no changes can be made to work orders), decrease prices, increase SKU variety, and hold more inventory for longer periods of time.

Management needed to understand the impact of these demands on the business while finding a way to profitably navigate them.

**Leveraging SRC, WP&C quickly calculated the complexity-adjusted economic profit for all three customers and help the company understand how each customer's particular demands and behaviors impacted profits.**

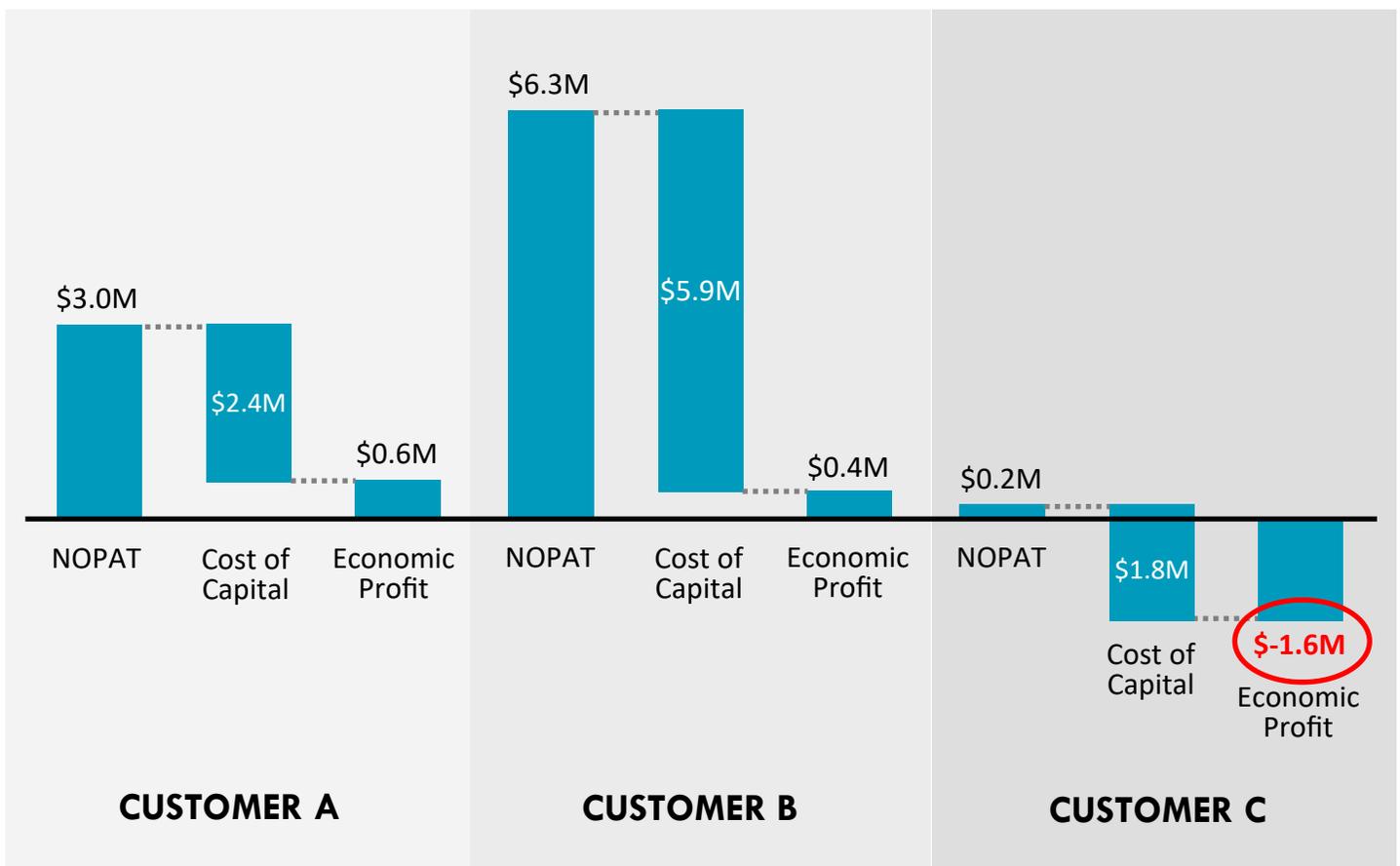
Further, when factoring in the assets used to generate this revenue and the high levels of finished goods and WIP inventory required by Customer C's current contract, a more extreme picture emerged. Customer C was actually destroying economic profit, generating a loss of \$1.6M (Figure 3).

Consumer Co used this insight to inform the structure of new contracts with customers. It renegotiated pricing and terms to better

balance customer demands with plant capacity.

It also built new consignment inventory arrangements with some clients to ensure they were not disproportionately bearing the burden of inventory carrying costs. **These changes drove improvements in profitability and customer service while creating better flexibility to manage future SKU growth.**

**Figure 3: Economic Profit by Customer Type**



# Assessing country profitability to shape international strategy

A multibillion-dollar international cosmetics company (Cosmo Co) had been pursuing international growth by adding new products to its international portfolios. While innovation was only initiated by large strategic markets, once a product was introduced, any small market could include the SKU in its specific portfolio.

This “everything available everywhere” approach to the country portfolio meant that smaller markets could offer a huge variety of products with the belief that product development contained

most of the cost of bringing a product to market, and therefore, offering additional SKUs in new markets carried no extra costs. Through examination, the WP&C team found that hidden costs such as marketing and inventory management significantly impacted profitability as regional portfolios continued to grow.

**Square Root Costing illuminated the fact that larger markets with fewer products were able to build revenue density and scale while small markets bore higher costs to support larger portfolios.**

In countries like Russia where the physical size of the country is vast and difficult to navigate, each additional product caused distribution costs to grow.

Thus, small-volume products were difficult to deliver to market profitably. Retail prices also varied between regions and were subject to exchange rates, which further exposed how different markets required

## CASE #3

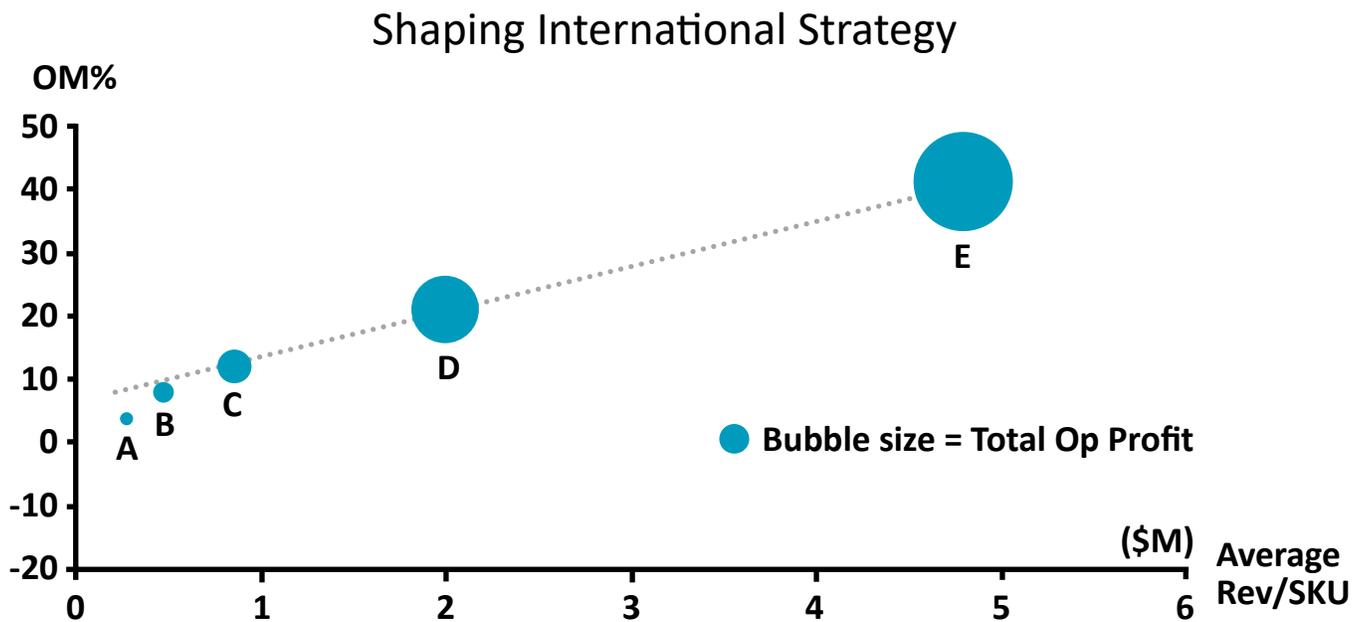
different product offerings and strategies. By using SRC to understand cost drivers and their impact on profitability, the WP&C team was able to pinpoint variables that predicted success for geographic and portfolio expansion.

Using multivariate regression, it was illustrated that pricing power, market size, and portfolio efficiency significantly drove total profit and operating margin. When revenue density (revenue/SKU) was higher, markets were able to leverage scale and grow revenue faster than complexity.

In other words, those markets with more targeted portfolios (rather than the one-size-fits-all approach) were able to gain share with fewer SKUs, reducing cost, and increasing margin (Figure 4).

**Armed with this information, the WP&C team helped Cosmo Co build targeted product-market strategies by creating country level playbooks highlighting opportunities for SKU rationalization, investment, pricing, and service changes.**

**Figure 4: Operating Margin by Country**



Metric	Country A	Country B	Country C	Country D	Country E
Revenue (\$M)	\$100	\$220	\$440	\$950	\$1,000
Operating Profit (\$M)	\$4	\$18	\$48	\$200	\$413
SKUs	374	467	471	478	209

# CONCLUSION

As the world continues to evolve and businesses compete in new, unpredictable ways, companies that are best positioned to succeed are those that are best informed.

Managing a business with inaccurate cost and profit numbers will lead to poor decision-making, a false understanding of how to grow the bottom line, and a bloated portfolio filled with redundancies.

**By using Square Root Costing, companies can gain a true understanding of how different SKUs and customer segments drive profitability.**

Armed with the knowledge from Square Root Costing, companies can build better strategies around business problems such as product mix, innovation, and international expansion—enabling them to better compete in our complex world.

# About Wilson Perumal & Company

Wilson Perumal & Company (WP&C) is a premier strategy consultancy that helps clients navigate an increasingly complex business environment. For the last decade, WP&C has served multinational corporations, private equity firms, and government entities, supporting their growth agendas.

**Our focus is helping these organizations develop and execute strategies for successfully competing in the Age of Complexity.** We are laser-focused on client value and results—our projects often yield a 20–40% improvement in EBITDA.

Co-founded by experienced consultants and bestselling authors Stephen Wilson and Andrei Perumal, we are not only practitioners but also thought leaders. We have published two books on competing in a complex world: *Waging War on Complexity Costs* and *Growth in the Age of Complexity* (McGraw-Hill).

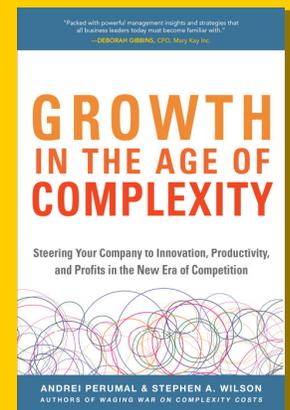
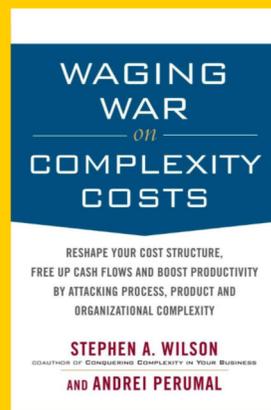
**Our services range from growth strategy to business simplification—whether that be your portfolio or your business operations—to organizational transformation.** Our work is informed by a distinct perspective and supported with unique methodologies.

Given our focus on complexity, our employees have deeper knowledge and more experience on this topic than any other consultancy. This translates into faster insights, and ultimately better results.

**Learn how we can help you:**  
[info@wilsonperumal.com](mailto:info@wilsonperumal.com)

***“Perumal and Wilson offer a nuanced and evidence-based analysis of the paradox of complex growth, but they move beyond description to offer practical and field-tested advice on how to avoid the traps they identify.”***

**Don Sull, Senior Lecturer  
MIT SLOAN SCHOOL**





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**Revealing the true  
cost of complexity**

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