

# Customer/Product Rationalization:

## *CPR* for Profitability

by

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### **Background**

This article is intended as a continuation of the article appearing in Volume 2.5 which described the Total Asset Utilization (TAU) metric, the calculation of which is the first step in assessing the true profitability of a current Customer/Product portfolio. In this article, we will explore how TAU data may be employed to:

- (1) assess the true profitability of an existing portfolio (the mix of customers and products sold by a firm); and
- (2) portray how these data may be employed by Sales & Marketing to design a strategy by which profitability may be enhanced (Customer/Product Rationalization; or *CPR*).

In order to illustrate these methods, we will utilize a limited (but actual) data set for a manufacturing firm selling a mix of four products (four alloys of steel or aluminum, or four types of bread products, for example) to three customers, all produced on a production line at a single manufacturing facility. The data set has been limited in this way so as to illustrate the basic steps associated with the *CPR* process. In actual applications, the steps that follow may be employed in exactly the same fashion as detailed (but with admittedly more complex analyses and results). Table I illustrates the current state of the sample firm's portfolio, based upon a year of data, which is typically aggregated and summarized monthly. For this reason, the sample size of the data sets illustrated contain  $n = 12$  cases or sets of observations. For this Table, the data in each Customer x Product cell may be interpreted as follows:

\$332.95	Average Monthly Profit/Unit, based on Activity-Based Costing Measures
\$6.29	Standard Deviation of Monthly Profit/Unit
20%	Average Monthly Percentage of Product Mix for that Product, As Purchased by that Customer
2000	Average # Units Purchased Monthly
31.38	Average Monthly TAU Index for that Customer & Product

A few observations are in order related to these data, before reviewing the complete Table.

1. The average monthly profit/unit represented in each cell should correspond to the monthly net profit per unit sold to that customer, for that product, as calculated on the basis of Activity-Based Costing<sup>1</sup>, or at least Cost Allocation, principles.
2. The variability in the net profit/unit measures represented by the Standard Deviation value is reflective of fluctuations in invoice pricing, claims, returns, shipment costs, and other factors which vary from month to month. For purposes of this article, we will assume that these fluctuations are relatively uniform across all customers and products; an assumption which, in actual applications, would have to be tested. If this variability were not equivalent across customer and product categories, it would have to be taken into account in the subsequent analyses.
3. The Average Monthly TAU indices were calculated as described in the previous article<sup>2</sup>.

## **Method**

The complete data set utilized to provide a baseline for the CPR analysis appeared as follows.

Table I  
Description of the Current Portfolio

		<b>Customer</b>			Total % of Mix
		1	2	3	
<b>Product</b>	1	\$332.95 \$6.29 20% 810 31.37	\$312.76 \$11.99 30% 2431 31.38	\$294.45 \$1.23 15% 608 31.43	23.75
	2	\$279.98 \$4.22 25% 1013 43.48	\$247.98 \$10.57 10% 809 43.81	\$245.06 \$1.91 55% 2227 43.92	25.00
	3	\$292.75 5.45 45% 1823 46.35	\$283.32 \$12.58 30% 2431 46.27	\$265.21 \$1.17 15% 608 46.55	30.00
	4	\$298.64 \$5.61 10% 405 57.34	\$296.29 \$7.72 30% 2431 57.33	\$290.21 \$1.48 15% 608 57.05	21.25
Total % of Mix		25	50	25	100

As shown by the data in Table I, the average monthly profit generated from this portfolio is \$4,640,378.60. The next step in the CPR process is to determine the major source of variability associated with

<sup>1</sup> Shim, J. and Siegel, J. Modern Cost Management & Analysis. Barron's Business Library, 1992

<sup>2</sup> Refer to Table III in the initial article for a review of the calculations employed

the Average Monthly Profit/Unit generated by each product and customer in the current mix. Treating the monthly data as a random sequence of  $n = 12$  observations, a Two-Way ANOVA<sup>33</sup> is conducted using SPSS for Windows™. The results appear as shown in Table II.

Table II  
Two Way ANOVA for Revenue Data

Tests of Between-Subjects Effects

Dependent Variable: REVENUE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	83008.174 <sup>a</sup>	11	7546.198	151.485	.000
Intercept	11828320.2	1	11828320.2	237445.389	.000
CUSTOMER	17985.030	2	8992.515	180.519	.000
PRODUCT	60152.792	3	20050.931	402.509	.000
CUSTOMER * PRODUCT	4870.351	6	811.725	16.295	.000
Error	6575.568	132	49.815		
Total	11917903.9	144			
Corrected Total	89583.742	143			

a. R Squared = .927 (Adjusted R Squared = .920)

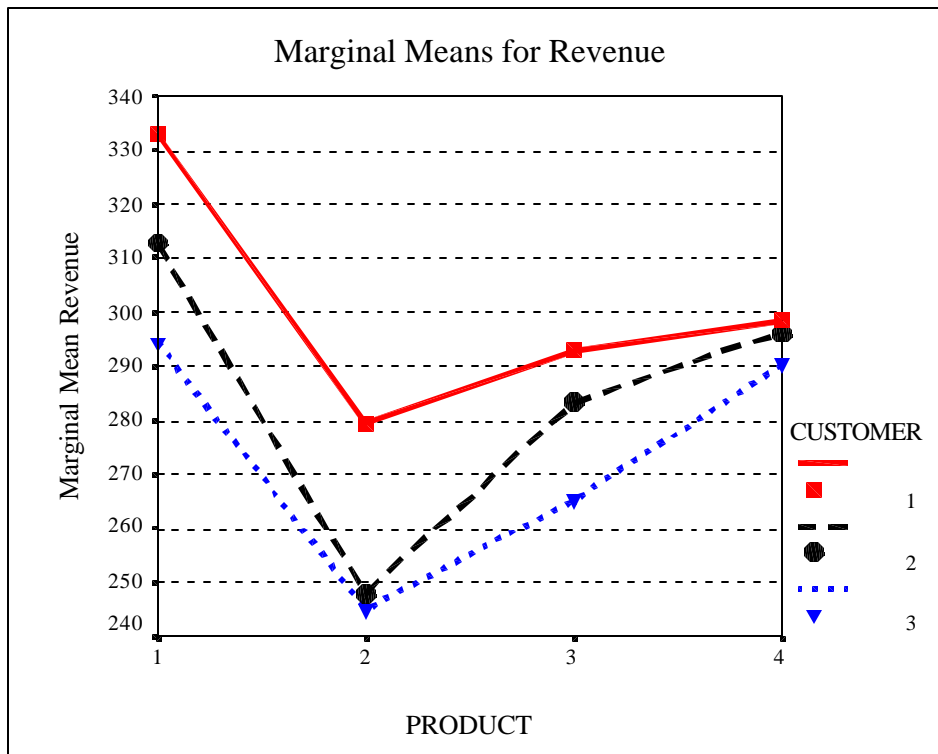
As shown by this table, the majority of the variability in the model associated with Revenue is a function of the Product category (refer to the MS column, which represents variance). In fact, 66.94% of the variability in Revenue ( $\omega^2$ ) is directly associated with the Product sold<sup>4</sup>. Although there is a significant interaction between the Customer and Product sold, this effect is only 5.10% of the variability observed. It makes sense in this case, therefore, to concentrate our portfolio improvement (for profitability purposes) on the Products we have chosen to sell. Illustration I, below, provides a visual display of these data, showing why the analysis resulted in the Product category yielding the most promising opportunity.

Illustration I

<sup>3</sup> Luftig, J. and Jordan, V. Design of Experiments in Quality Engineering. McGraw-Hill, 1998

<sup>4</sup> The statistic ‘omega-squared’ ( $\omega^2$ ) allows for the estimate of the importance, rather than statistical significance, of each effect in the ANOVA model as a function of explained variability. The general formula for this statistic

$$\text{is: } \omega^2 = \frac{SS_{\text{Effect}} - (df_{\text{Effect}} (MS_{\text{Residual}}))}{SS_{\text{Total}} + MS_{\text{Residual}}}$$



The next step is to conduct a second Two-Way ANOVA, with the Average Monthly TAU indices as the dependent variable. Table III presents the results of this analysis.

Table III  
Two Way ANOVA for TAU Data

Tests of Between-Subjects Effects

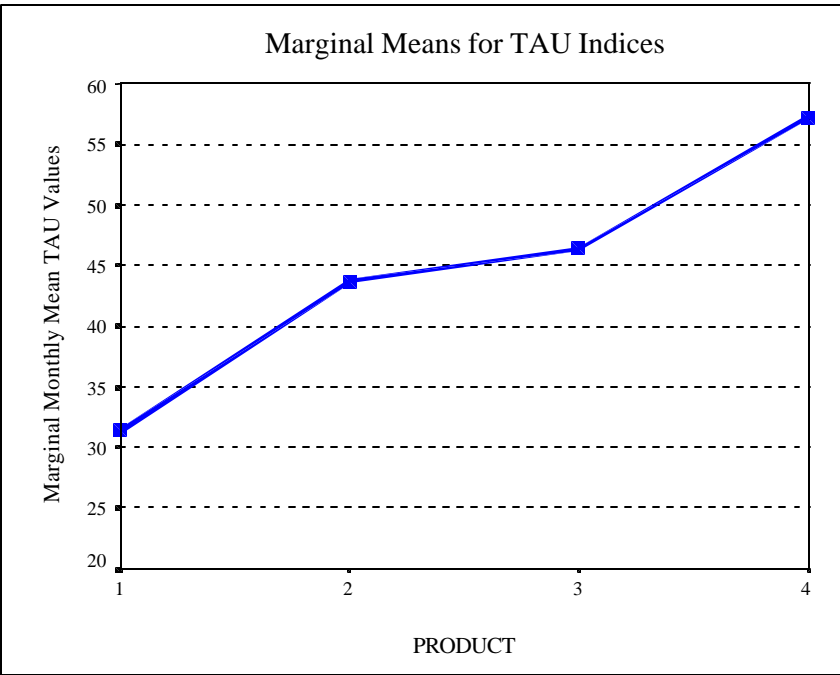
Dependent Variable: TAU

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	12170.013 <sup>a</sup>	11	1106.365	4530.805	.000
Intercept	287589.088	1	287589.088	1177740.0	.000
CUSTOMER	.265	2	.133	.543	.582
PRODUCT	12167.560	3	4055.853	16609.603	.000
CUSTOMER * PRODUCT	2.188	6	.365	1.493	.185
Error	32.233	132	.244		
Total	299791.334	144			
Corrected Total	12202.246	143			

a. R Squared = .997 (Adjusted R Squared = .997)

As shown by the data in Table III, 'Product' is the only variable reflecting significant differences in monthly Average TAU indices. Illustration II, which follows, presents a visual depiction of these data.

Illustration II



The third step in the CPR process is to determine those components of the TAU model which serve as predictors for productivity (simply measured at this point in terms of the number of Units produced), within each Product group ('Units'). These data would have been collected and aggregated during the period of study preparing for this analysis. As described in the previous article, it would **not** typically be expected that (a) there would be a significant and important statistical relationship between TAU and Units; and (b) the same regression model would be serviceable for predicting productivity across all product groups. Table IV reflects the results of this analysis.

Table IV

**TAU Component Regression Model Coefficients Associated with Units Produced**

PRODUCT	Model		Unstandardized Coefficients		Stadzed. Coeffs.	t	Sig.	
			B	Std. Error	Beta			
1	1	(Constant)	10832.795	655.472		16.527	.000	
		DC Duty Cycle	4507.542	904.465	.844	4.984	.001	
	2	(Constant)	7585.691	955.797		7.937	.000	
		DC Duty Cycle	4854.366	597.789	.909	8.121	.000	
		AV Availability	3497.550	920.452	.426	3.800	.004	
	3	(Constant)	6044.705	849.071		7.119	.000	
		DC Duty Cycle	5806.979	528.908	1.088	10.979	.000	
		AV Availability	3557.410	660.779	.433	5.384	.001	
		EFF Efficiency	1598.634	519.248	.302	3.079	.015	
2	1	(Constant)	10410.130	993.314		10.480	.000	
		DC Duty Cycle	7518.040	1408.602	.860	5.337	.000	
	2	(Constant)	3677.325	2554.742		1.439	.184	
		DC Duty Cycle	6592.180	1142.213	.754	5.771	.000	
		YLD Yield (% Acceptable)	7535.474	2726.331	.361	2.764	.022	
	3	(Constant)	617.076	1695.834		.364	.725	
		DC Duty Cycle	5785.372	709.830	.662	8.150	.000	
		AV Availability	2942.494	709.565	.325	4.147	.003	
		YLD Yield (% Acceptable)	9081.071	1671.483	.435	5.433	.001	
	3	1	(Constant)	7233.850	2354.890		3.072	.012
			EFF Efficiency	11041.957	2534.974	.809	4.356	.001
		2	(Constant)	2767.541	2044.650		1.354	.209
AV Availability			8234.548	2331.134	.497	3.532	.006	
EFF Efficiency			8084.202	1921.729	.592	4.207	.002	
4	1	(Constant)	10168.332	1099.304		9.250	.000	
		EFF Efficiency	9727.065	1449.730	.905	6.710	.000	
	2	(Constant)	2817.641	992.451		2.839	.019	
		AV Availability	8823.930	1089.061	.426	8.102	.000	
		EFF Efficiency	8160.779	564.731	.759	14.451	.000	

a. Dependent Variable: UNITS

As shown by the Regression data, the models that would predict productivity as generated from the TAU database vary significantly. While Duty Cycle, Availability, and Efficiency (in that order) would be used to predict Units for Product 1, for example, only Availability and Efficiency (respectively) would be used in conjunction with Products 3 and 4. Further, Yield is a significant component only in conjunction with Product 2, reinforcing the observations related to Quality presented in the first article.

The next step is to utilize the individual regression models to predict the number of units that would be produced at the current TAU levels, and at the current Customer mix, if only that Product were to be manufactured. Utilizing the principles stated in the first article for these calculations, Table V presents the results of this exercise, including an estimate for potential monthly profit using current average invoice (Revenue) levels. The profitability of each Product has been generated for both the observed component mean values, and the M.O.E. (Moment of Excellence) values for each component within each Product. The result of the ANOVA over the TAU data allows us to use a single prediction model for all Customers within each Product category. Had this not been the case, differentiated models would have to be generated and deployed.

Finally, the Customer mix within each Product category was calculated from within, versus across, all Product groups from the historical data base. For example, the Customer mix for Product category 1 was calculated as 21% (810/3849), 63% (2431/3849), and 16% (608/3849), respectively.

## Table V

## Potential Portfolio Analysis

Product	Regression Model for Unit* Prediction	Calculations Based Upon Observed Mean Values			Calculations Based Upon Observed M.O.E. Values		
		Component Values	Predicted Number of Average Units	Estimated Monthly Profitability	Component Values	Predicted Number of Average Units	Estimated Monthly Profitability
1	$Y' = 6044.705 + 5806.979(\text{DC}) + 3557.41(\text{AV}) + 1598.634(\text{EFF})$	DC = 0.7233 AV = 0.8567 EFF = 0.5008	14,093	<b>\$4,426,179.80</b>  2959*332.95 + 8879*312.76 + 2255*294.45	DC = 0.8100 AV = 0.9000 EFF = 0.5500	14,829	<b>\$4,65</b>  3114*3 9342*3 2373*2
2	$Y' = 617.076 + 5785.372(\text{DC}) + 2942.494(\text{AV}) + 9081.071(\text{YLD})$	DC = 0.7042 AV = 0.7183 YLD = .9800	15,704	<b>\$3,994,689.90</b>  3926*279.98 + 3141*247.98 + 8637*245.06	DC = 0.7500 AV = 0.7900 YLD = 1.000	16,362	<b>\$4,16</b>  4091*2 3272*2 8999*2
3	$Y' = 2767.541 + 8234.548(\text{AV}) + 8084.202(\text{EFF})$	AV = 0.8753 EFF = 0.9283	17,480	<b>\$4,977,422.50</b>  6642*292.75 + 8740*283.36 + 2098*265.21	AV = 0.9100 EFF = 0.9800	18,184	<b>\$5,17</b>  6910*2 9092*2 2182*2
4	$Y' = 2817.641 + 8823.93(\text{AV}) + 8160.779(\text{EFF})$	AV = 0.9675 EFF = 0.7575	17,537	<b>\$5,181,769.50</b>  2062*298.64 + 12379*296.29 + 3095*290.21	AV = 0.9900 EFF = 0.8200	18,245	<b>\$5,39</b>  2146*2 12879* 3220*2

\* The measure of productivity used by the firm

### Summary

The steps we have employed in illustrating a CPR analysis to this point are as follows:

1. The development of an data base for concurrent productivity and TAU analysis, with linkage to Sales, (Activity-Based) Cost, and Profitability data.
2. The databases were then analyzed with the use of multiple ANOVA assessments to determine (a) the significant contributors to Profitability of the products sold by Product Category and Customer; and (b) to determine whether Product Category or Customer yielded significant differences in TAU indices.
3. Using the results of the ANOVAs, regression models were generated to allow for the prediction of productivity within the appropriate Customer / Product categories.
4. The regression models were then employed to conduct a Potential Portfolio analysis (Table V).

The potential portfolio analysis reveals a number of interesting observations, which would not normally have appeared as intuitively obvious when simply inspecting the descriptive data in the previous tables.

- (1) A cursory review of Table I might lead one to assume that Product 1 represented the best chance for the company to increase its profitability. In fact, when the TAU analysis is employed, this category is revealed to be the third most profitable for the company, despite its apparent advantage in margin per ton. In terms of *asset dollars* generated (the total number of dollars in profit per unit which could be generated on an equalized time basis) Products 4 and 3 are superior. Their lower margin per unit is more than offset by the degree to which they are 'friendlier' to the production facility.
- (2) The current monthly profit for the existing mix is \$4,640,378.60. If the same capacity were utilized to produce and sell only Product 4, without any change in current productivity levels as measured by the TAU index, the potential profitability for the same facility would be \$5,181,769.60; or 11.67% more. If the productivity associated with Product 4 were to be raised to only the M.O.E. levels, the TAU index for the product category would shift from 0.59 to 0.71 (at little or no cost in capital investment). This change would represent an increase in monthly profitability to \$5,391,276.60, or a 16% increase over current state. If the mix within this category could be shifted toward Customer 1, and away from Customer 3, the change in profit level would increase even more.
- (3) Of course, the author is not suggesting that in this (or any actual) case, 100% of all of Product 4 which the facility could produce could actually be sold to the existing Customers at the higher unit levels. The discussion in item 2., above, is intended for illustrative purposes only. What *is* true, however, is that a matrix of this type could be used in a horizontally integrated effort to increase sales in the more truly profitable Product / Customer categories; the stated definition of CPR. One could easily calculate the effect of a 10% shift away from Product 2, for example, if the sales were re-allocated to (again, for example) Customer 1, for Products 3 and 4. If this activity is undertaken, incidentally, it would be essential to make certain that the Key Performance Indicators (KPIs) used to reward or provide incentives to the Sales force were in concert with the desired goals. For example, some companies using this method have abandoned the old KPI of 'Units Sold' (without regard to *which* units were sold) in favor of a KPI associated with a measure of the 'Richness of Product Mix Sold'. This KPI would take into account the asset dollars generated for the company, as compared to simply tracking potentially illusory margin dollars.
- (4) In many industries, a 'feed the beast' mentality exists which tells management that it is better to sell 'anything' as opposed to letting facilities sit idle. They believe this to be true even if it creates bottlenecks and increased costs. A cursory review of the Portfolio Analysis presented on Table V, specifically associated with Product 2, shows the fallacy of this belief and illustrates how difficult conditions may become in the absence of considering the implications and effects of TAU as related to a firm's Customer/Product mix.

Finally, the following observations may also be advanced:

- (5) The model and process as depicted may also be employed for *Process* (as well as Customer and Product rationalization). In organizations with multiple production lines and facilities

producing, or capable of producing, the same product, this procedure often can lead to increased profitability through flow path optimization.

- (6) The model as presented is a *dynamic*, **not** *static* tool. Firms with automated management information systems (e.g. SAP) should have little trouble updating the decision matrix at appropriate periods, as improvements occur within the production system or as prices change.

## **ABOUT THE AUTHOR**

[Dr. Jeffrey T. Luftig](#) is a Senior Instructor in the Management Division of the College of Business at the University of Colorado, Boulder, Colorado. Dr. Luftig has also authored a number of textbooks and articles on the topics of Business Performance Improvement, the Quality Sciences, and Experimental Design.

## **NETWORKER**

For more detailed information on creating industry-dedicated metrics for TAU and its associated components; or on how to conduct a Customer/Product Rationalization analysis; or to receive the data sets employed in conducting the analyses presented in this article, contact Dr. Luftig directly at [Jeffrey.Luftig@Colorado.Edu](mailto:Jeffrey.Luftig@Colorado.Edu).