A White Paper on

Calculating the Benefit
of
Total Matrix Management (TM^2)

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Introduction

Moving to an enterprise project management system allows us to use controls and strategies that are impossible to implement when treating the projects as an independent set of activities. Two types of improvement routinely occur when utilizing Velocity Pointe's Total Matrix Management (TM^2) system:

1. Project length reduces by half.
2. The number of projects per year doubles or triples.

The actual increase in the project completion rate will be different for each implementation. Nevertheless, the calculation for the value of the additional completed projects is universal, and same form of the equation is used whether the increase is 1 or 100 additional projects over the existing rate.

It is important to note that the improvement does not require additional investment of personnel and resources in the development area – it comes from tapping into existing capacity of your organization that is currently being lost through the use of conventional deterministic single project management systems.

Key to evaluating the impact of completing more projects per year is to understand the value of the current projects you complete annually. There are two types of extremes in industry. First is the "job shop" example where virtually all projects result in new custom products or for our discussion, new money pumps.

An excellent example of this type of company is the custom software house where each project must be completed in order for the sale of the new software to occur. In this case the ability to complete projects on time is critical to the existence of the income for the company, and the value of completing a project is directly related to the profit realized by the new related product. In this case, the increase in revenue is tempered by the additional operating expense of the additional manufacturing capacity.

The other extreme is a very mature business where products are extremely long lived, and few new products are created if any. In this case most projects are directed at manufacturing methods to reduce the cost of producing the product. Every successful project replaces an existing product with one that is only slightly better or slightly less expensive to manufacture. This replacement of an existing product with a new one is referred to as cannibalism. The value of the project is the differential increase in the profit of the new version of the resulting product over the old version.

Most companies are somewhere in the middle. Some products are new, some replace products at the end of their lifetime, and some are improvements needed to maintain market share due to advances by the competitor.

The calculations in this paper estimate the contribution a single project makes to the gross profit. The calculations use several easily obtained or estimated financial numbers for the business. Once the information is obtained, the Excel Spreadsheet “Project Value Calculator.xls” can be used to determine how much impact the increase in completed projects could have on a given business.

The discussion of the full model used in the spreadsheet is covered in the section “Putting it all Together” on page 9.

The First Approximation

The first simple analysis assumes that if you could double your facilities, personnel and resources, you could double the number of projects completed in a year. Even so, if your current R&D operations including salaries, building operations/depreciation and expenses are $15M per year, implementing TM^2 would be as though you created a virtual second R&D facility worth $15M annually. Thus a single investment in TM^2 would have the ongoing annual effect of having an additional $15M in research staff and facilities without the new facility construction cost and the hiring expense required to double the R&D staff.

So doubling the number of completed projects has the minimum benefit of adding the value of a second research facility with its additional capacity to complete projects. Although for most companies this would be a significant improvement in potential capabilities, the approximation does not include the impact of being able to complete projects in half the time. This ability to be more agile and responsive in the marketplace can create opportunities that in the past were out of reach.

The above analysis is the minimum benefit one would experience due to implementing TM^2 because it doesn't capture leverage you get from your current R&D efforts. The number we want to calculate is the annual contribution R&D makes to the business.

Financial Description

The calculation looks at a business as a fixed capacity organization which makes money by using its manufacturing capacity to make product. Selling 20% less product does not mean that you use an eraser to make 20% of the manufacturing line disappear that month. So the concept is to put most of the organization's *operating expense* in a term OE which is treated as a fixed annual cost. Note that since you do not hire and fire people on a monthly basis, all salaries are also included in the OE term.

The second concept is that we separate *revenue* R into the *contribution rate* Θ and *variable cost rate* V. The *variable cost rate* V only includes the raw materials and direct costs incurred, such as outside vendors, and the annualized cost to modify the production line to manufacture the new product. It typically does not include manpower costs either for development or manufacturing because these are included in *operating expense* OE. Variable cost is expressed by some percentage of total revenue, e.g. $V = 28\% * R$. Remember we are accounting for the manpower for manufacturing in the OE term. So our first equation is:

$$\Theta = R - V * R \qquad \text{Eqn. 1}$$

So *contribution rate* Θ is the amount of revenue that remains after the variable costs are removed.

The second calculation is the simple calculation of gross *profit* P (before taxes). The profit is the amount of value left after you subtract the operating expense from the *contribution rate* Θ:

$P = \Theta - OE$ Eqn. 2

With these two equations it is obvious that the ideal goal is to increase profit by increasing *contribution rate* Θ.

Although decreasing *operating expense* OE will also increase *profit* P, OE can only be reduced to zero while there is no real limit to increasing *contribution rate* Θ. Few companies today are run with surplus people and resources so reducing *operating expense* OE usually has the long term effect of further disabling a company in its quest to improve its financial health. Because of this Velocity Pointe is dedicated to delivering *contribution rate* Θ increasing solutions.

So let's look at some numbers. Assume a business we will call Alpha, Inc. has about $230M in annual sales *revenue* R. If *variable cost* V is 40% of the product's *revenue* R on average, then the *contribution rate* Θ is:

$\Theta = R - V * R = 240 - (40\% * 240) = 144$.

Now most companies have different *variable cost* V for different products. The net variable cost across all products averaged across the entire product line is easily calculated. The table below shows an example for 3 products. The right column "V Contribution" is the multiplication of "Percent of Sales" times "Variable Cost".

	Percent of Sales	Variable Cost	V Contribution
Product A	25%	25%	6.25%
Product B	40%	45%	18.00%
Product C	35%	45%	15.75%
Total Sales	100%	Effective V	40.00%

Once the effective *variable cost* V is determined it is used in the *contribution rate* Θ equation described above.

The next calculation is the important one – *profit* P. In this example we estimate that our total cost to run the company excluding the expenses captured in our variable cost as $130M. This is the *operating expense* OE. It is now evident why we captured the salaries and the production line's fixed expense as part of the operating expense. As we examine the possibility of increasing or decreasing sales, we will not be artificially hiding or inflating costs if we only use 80% of production capacity or improve the workforce output to 180%.

So using the numbers we have so far the *profit* P is:

$P = \Theta - OE = 144 - 130 = 14$

Our Alpha Inc.'s $14M profit on $240M in sales is not a stellar performance. The problem at this point is that management would love to increase sales, but has no method for doing so. The end result is a continuous attempt to reduce *variable cost* V and *operating expense* OE.

TM[2] offers another option - the ability to increase *revenue* R in a manner that can cause an outrageous increase in *profit* P and shareholder value. This is done by increasing the speed and number of projects that are completed annually by the business while keeping the fixed costs, *operating expense* OE, constant. To determine the impact we need to look at how projects are currently impacting the business.

Connecting Projects to Profit

In this section we calculate the impact projects have on the profit of an organization. We will initially ignore the effect of replacing existing products (often referred to as cannibalism). This issue is covered in the next section.

For any company in the steady state, the *revenue* R is due to the long term contribution of projects. The calculation makes two assumptions:

1. Although some projects are product related, and some are internal, the assumption is that the mix is constant over time.
2. The second assumption of the steady state is that the number and complexity of projects is fairly constant from year to year.

In this steady state case the *revenue* R is the sum of the sales of all products from those at the end of their lifetime and those just released. The flow of projects replenishes the products that disappear due to the end of their lifetime.

In the steady state the contribution this year's new products makes over the next several years can captured by looking at the sum of all current product contributions for this year. Thus the contribution from the total set of projects is equal to the annual *revenue* R for this year (only true because we are assuming that there is no cannibalism).

This ongoing contribution of projects to the business is a very important concept. If you were to stop all projects you will not see business end, but you would see a continuous erosion of sales. On the other hand, if you were to double the number of projects from this time forward, you would by definition double revenue when the new number of projects reaches the new steady state. This assumes that you can sell all of the new products.

The average product lifetime determines how quickly the annual doubling of projects will result in the doubling of the *revenue* R. The key understanding is that without cannibalism, doubling the project completion rate from the current level N to $2N$ doubles the *revenue* R.

The theoretical value one project brings to the company is then estimated as:

$$\Theta_{PT} = \Theta / N = (R - V * R) / N$$

In the new steady state the *revenue* R is will increase as the number of projects increase. So if we increase the number of projects by I the additional theoretical new *contribution rate* Θ_I is:

$$\Theta_I = I * \Theta_{PT} = \Theta(I / N)$$

Refering to our example company Alpha, Inc., increasing the number of projects completed annually by 70% should theoretically increase the contribution rate by:

$$\Theta_{I=N} = \Theta(70\% * N / N) = 70\% * \Theta = 101$$

This predicts that the contribution rate in this case would increase by $101M from $144M to $245M. This calculation has ignored the effect of cannibalism or product replacement which is covered in the next section. The remaining question is how much of the increase contribution rate flows to *profit P*.

There can be an increase in *operating expense OE* to create sales of new products. This occurs because new products need modifications to the production line, and if there are enough new products added, additional production capacity will have to be added. This is taken into account by estimating the increase in *operating expense* OE_{PT}. This is expressed as a percentage of the *contribution rate* Θ_{PT}. The *expense factor* ρ is the portion of the increase in *contribution rate* Θ_{PT} required to cover the increase in *operating expense* OE_{PT}. For a single project:

$$OE_{PT} = \rho * \Theta_{PT}$$

So the increase in profit due to adding I new projects is:

$$P_I = \Theta_I - OE_I = \Theta_I - \rho\Theta_I = \Theta_I(1-\rho) = \Theta(1-\rho)(I / N) \qquad \text{Eqn.3}$$

For Alpha, Inc. additional new products have an *expense factor* ρ of 35%. So increasing the number of projects for Alpha, Inc. by 70% can increase *profit* P_I by:

$$P_I = 144(1-35\%)(70\% N / N) = 45.5\% * 144 = 65.5$$

Thus if TM^2 increases the number of completed projects by only 70%, Alpha, Inc. can expect their profit to increase from $14M annual to $79.5M.

Dealing with Replacement of Existing Products

Initially the concept of using new projects to cannibalize existing sales by replacing existing products appears to reduce the value of the new products considerably. It does lower the benefit, but the upside potential is so large, that even if only fraction of the benefit is retained, the impact on the bottom line is often quite significant.

The discussion at hand is the cannibalism of an existing product's income when the new product is launched. An interesting tradeoff occurs. When the existing product is replaced, the capacity of the manufacturing system that it releases is used by the replacement product. So other than upgrades to the existing line, cannibalism typically implies relatively low roll-out costs or low *expense factor* ρ.

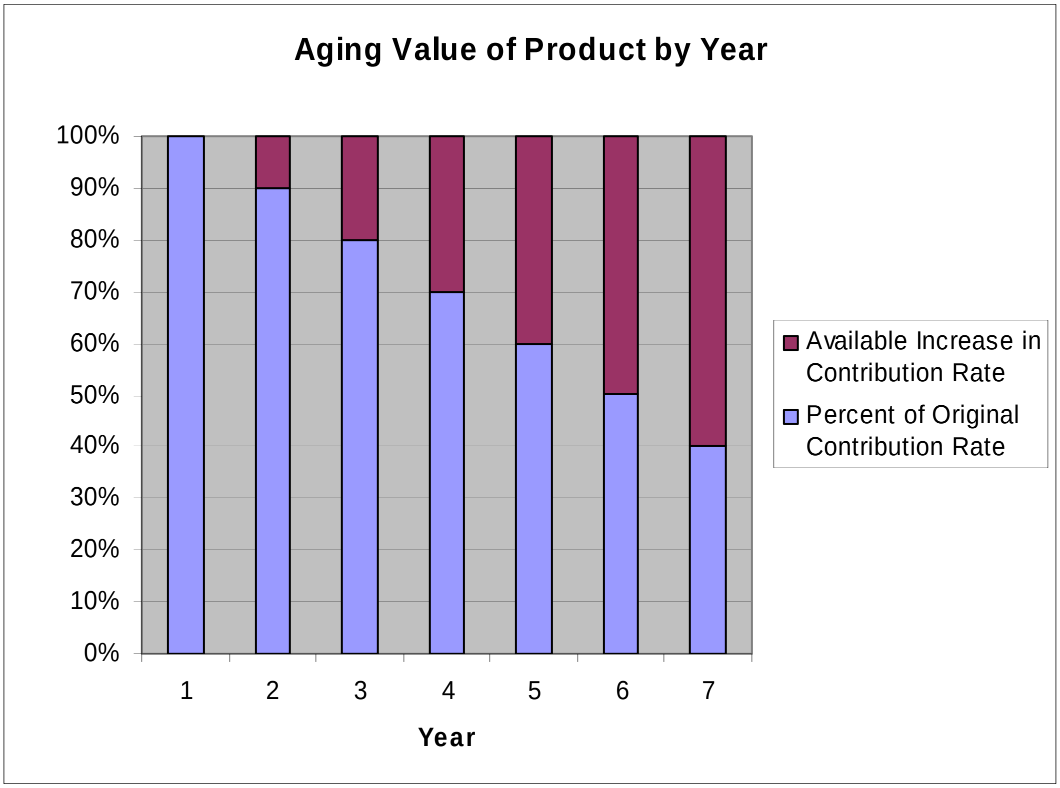
Let's assume that the new product mix is on average the same as the old product mix when considering *variable cost V* and average *product lifetime L*. This is a reasonable assumption and allows us to use average numbers rather than having to examine each product individually.

We are going to consider that the additional new products will replace all of the products evenly across the product lifetime spectrum. This means that if the average product lifetime of a company is 7 years, then 1/7 of the added products replace products in their first year, 1/7 replace products in their second year… This is a very conservative view, since it assumes a much larger amount of cannibalism than is typically experienced. Usually the cannibalism is concentrated on the oldest products where the effect is smallest.

Our income model allows us to estimate the amount of contribution a product makes as it ages. There are two factors at work: loss of market share, and commoditization of the product. The first factor is due to the fact that you have competitors, and they are like you releasing products which compete with your old product. Thus even though the quality of the old product is maintained, the related revenues are reduced due to lower market share. The second factor is that pricing for an older product tends to be pushed lower because the expectation is that the *variable cost V* has been lowered. This is often observed in high-tech industries. Unfortunately as the *variable cost V* is lowered, the *revenue R* is often reduced at the same time, resulting in lower rather than higher *contribution rate* Θ for the older products.

Regardless of the cause, we model the reduced income by showing a reduction in *contribution rate* Θ on an annual basis for each year the product is sold throughout its lifetime. The model only needs two numbers: the average *product lifetime L*, and the *final value FV* - a percentage of the products' *contribution rate* Θ in their final year expressed as of their initial *contribution rate* Θ. With our current assumption that all products are replaced evenly, we will find that the product lifetime drops out of the equation. This is shown below.

For a 7-year lifetime and a *final value FV* of 40%, the *contribution rate* Θ by year used in the model looks like this:



Thus replacing a product in its third year on average only increases *contribution rate* Θ by 20%. An analysis of the plot shows that if we replace every product in the pipeline with new products, the net *contribution rate* Θ increase will be 30%. This is just a simple average of the list of potential increase in *contribution rate* Θ from Year 1 to Year 7: 0%, 10%, 20%, 30%, 40%, 50%, 60%.

The general equation to calculate this number uses two inputs: the average *product lifetime L*, and the *final value FV* of the product in its last year expressed as a percentage of the original *contribution rate* Θ value. First we calculate the *step size S* in the example above:

$$S = \left(\frac{1-FV}{L-1}\right) = \left(\frac{1-40\%}{6}\right) = 10\%$$

Next we calculate the sum of the potential increase in value (this is the list in the paragraph above) and then divide by *product lifetime L* to get the average potential increase across the product lifetime range due to cannibalistic product replacement and call this the *product efficiency* ε:

$$\varepsilon = \frac{\sum_{i=0,L-1} i * S}{L} = \frac{S * \sum_{i=0,L-1} i}{L}$$

Solving for the sum of *i*:

$$\varepsilon = \frac{S}{L} * \frac{L(L-1)}{2} = \frac{S(L-1)}{2}$$

Then substitute for *S* and calculate for our example:

$$\varepsilon = \frac{(1-FV)(L-1)}{(L-1)*2} = \frac{(1-FV)}{2}$$

Note that if an even replacement of all products occurs, the result is independent of the product lifetime. If we look at our Alpha, Inc. this shows a contribution efficiency factor below the ideal 100% due to cannibalism of existing product revenues:

$$\varepsilon = \frac{(1-FV)}{2} = \frac{(1-40\%)}{2} = \frac{60\%}{2} = 30\%$$

The additional *contribution rate* Θ_I due to *I* additional new projects when cannibalism occurs is:

$$\Theta_I = I * \Theta_{PE} = I * \varepsilon * \Theta_{PT} = \varepsilon * \Theta(I / N) \qquad \text{Eqn 4}$$

To see how the 70% increase in projects increases *profit* P_I we redo the calculation assuming a *expense factor* ρ of 5% because we are using released manufacturing capacity (using Eqn. 3 and Eqn. 4 above):

$$P_I = \Theta_I - OE_{PE} = \Theta_I(1-\rho) = \Theta_I(1-5\%) = 95\% * \Theta_I$$

$$P_I = 95\% * \Theta_I = 95\% * \varepsilon * \Theta(I / N) = 95\% * 30\% * 144(70\% N / N) \cong 20\% * 144 \cong 29$$

Thus we still see an over 2 times profit increase from \$14M to \$43M.

Putting it all together

The final estimate of bottom line impact which is due to increasing the number of projects requires only a few financial numbers. The estimate deals with new products and replacement products separately. The factor %N is the percent of the additional projects that are new rather than replacements. We then use the notation of *I* for the additional new products, and *J* for the number of additional replacement products over the steady state current levels.

The list of inputs which are required are (values for Alpha, Inc. are in parentheses):

R – Revenue ($240M)
V – Variable cost rate (40%)
%*N* – Percent of the new projects which create new business rather than replacements (40%)
ρ_I , ρ_J – Expense factors for the investment in adding production capabilities (35%, 5%)
FV – Final value of product at end of life cycle in percent of original contribution rate (40%)
$\%N^+$ - Percent increase in the completed project rate. (70%)

Two additional inputs are used only to verify consistency in the estimates of *R*, *V*, and Θ.

OE – Current operating expense ($130M)
P – Current profit ($14M)

Calculated terms:
Θ – Contribution rate
ε – Product efficiency which captures the effect of cannibalism
I – Relative number of projects which create new business
J – Relative number of projects which create replacement products
P_I – Added profit from increased business in new sales
P_J – Added profit from increased replacement products
P_T – Total added profit due to the increase in projects

We used the *revenue R* and *variable cost rate V* to calculate the current *contribution rate* Θ using equation 1 above. This is a critical calculation because it is the foundation of all of the increased contribution rate estimates. So the current *contribution rate* Θ is:

$$\Theta = R - V * R$$

The additional *profit* P_I resulting from increased business in new sales is:

$$P_I = \%N^+ * I * \Theta(1-\rho_I)$$
Where $I = \%N$

The additional *profit* P_I resulting from increased replacement products is:

$$P_J = \%N^+ * J * \varepsilon * \Theta(1-\rho_J)$$
Where $J = (1-\%N)$ and $\varepsilon = (1-FV)/2$

Now using our sample company Alpha, Inc. we can calculate the total increase in profit when half of the projects go to creating new product sales, and TM^2 only increases the total number of projects by 70%.

$$P_T = \%N^+ * [I * \Theta(1-\rho_I) + J * \varepsilon * \Theta(1-\rho_J)]$$

$$P_T = 70\% * [40\% * 144(1-35\%) + 60\% * 30\% * 144(1-95\%)] \cong 43$$

The projected new steady state profit for Alpha, Inc. which is the result of increasing the number of completed projects by 70% is $14M + $43M = $57M. This is a 3 times increase in annual profit due to the increase in completed projects.

One final issue occurs with companies with long product lifetimes. If we assume the simple case that each year N new products are created, and N disappear, a 7 year product pipeline has 7N products creating its revenue. Even if we increase the number of new products in one year by 70%, the total number of products will increase from 7N to 7.7N. It isn't until the increase in new product creation rate extends the full 7 years that the full impact of the increase will be felt.

Conclusion

The typical result of implementing TM^2 - creating a major increase in the annual number of completed projects without increasing staff - will create a major immediate increase in profit and shareholder value. Even when there is significant cannibalism of existing products, the impact on the bottom line is rarely less than an increase equal to 30% of the existing *contribution rate* Θ. For companies who experience a profit equal to about 10% of their sales, this can mean a step increase in profit of 3X or more.

TM^2 brings another major benefit – the ability to complete projects in half the normal time and to be able to make plans which have commitment dates which are met over 90% of the time. The business advantage this gives the TM^2 user is the ability to out bid and be quicker in delivering new solutions to the marketplace. This often translates into increased market share and the ability to take a leadership role in defining the marketplace.