HOW MUCH PROFIT
Is Your Current Plan Leaving
ON THE TABLE?

Enterprise Master Plan Can Show You...and Assure it Never Happens Again

WHITE PAPER WITH CASE STUDY

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Arkonas is a management consulting firm specializing in Performance Management. Through years of unparalleled experience in various industries, Arkonas helps companies of all industries maximize their profitability by using state of the art methodologies. Contact John Miller, President; 832 628 7630 or jmiller@arkonas.com

Dybvig Consulting is a boutique firm specializing in the integration of two analytical approaches: predictive analytics and prescriptive optimization techniques with activity-based costing data to create an EMP model. The client's EMP model maximizes the ROI of its total sales and marketing expenditures by simultaneously optimizing the forecast for maximum profit and the supply chain for optimal feasibility. Contact Alan Dybvig, Managing Partner; 609 947 2565 or alan@enterprisemasterplan.com

The authors wish to thank Glenn Sabin, Managing Principal of **ZS Associates**' office in Princeton, N.J., for his essential contribution to our effort—specifically, the technical practicality of enterprise response functions. Mr. Sabin can be reached at glenn.sabin@zsassociates.com.

Table of Contents

1. Summary

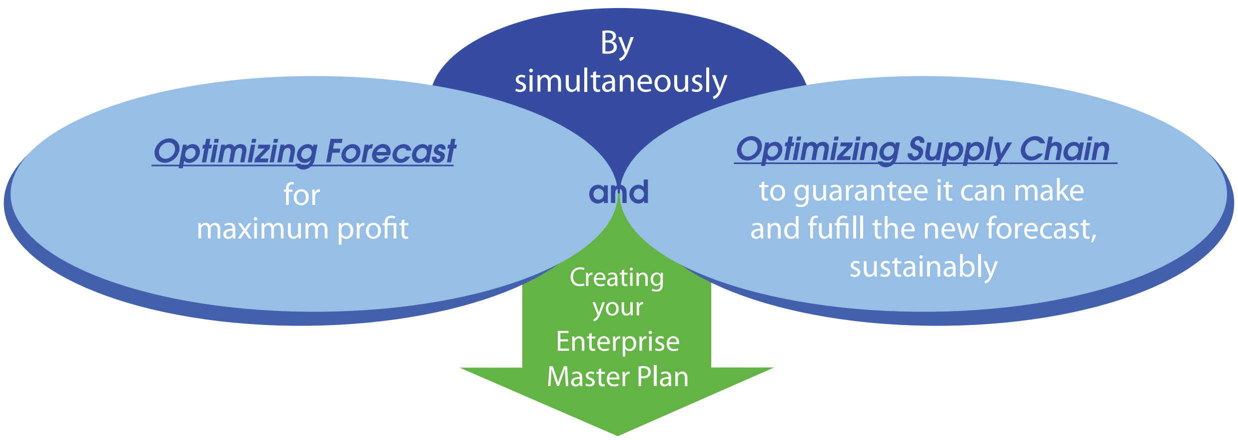
a. EMP Value Proposition

This white paper elaborates considerably on an article published in the May/June issue of Wiley's *Journal of Corporate Accounting and Finance* titled "Enterprise Master Plan (EMP): Next Generation Planning with Activity-Based Costing."

The elaborations include:

i. A more complete explanation than available in the Wiley article of the EMP value proposition; specifically that of creating **an optimized projected income statement.** This is accomplished by designing, simultaneously, both:

1. **An enterprise forecast that is maximally profitable**, identifying the profit that the current forecast is leaving on the table, **something never before possible**. See Exhibit 1 below for how an EMP is created.



Creating an EMP: Exhibit 1

Further, by optimizing the traditionally developed projected income statement, the Enterprise Master Plan (EMP) assures all the enterprise's other annual planning applications are executing to the maximally profitable forecast with the optimally feasible supply chain. This includes financial (FP&A), operational (S&OP) and marketing & sales (marketing mix-modeling and sales resource optimization) applications. In so doing, the EMP also assures all the functional silos are harnessed to the maximally profitable forecast.

2. **The optimally feasible and sustainable supply chain required to make and fulfill the new forecast.**

ii. More details of the EMP "proof of concept" (POC) case study. The authors built a "proof of concept" EMP model using data from an earlier ABC engagement and demonstrated the firm had left an additional 25-150% profit opportunity on the table, depending on the scenario. See Appendix V.

b. EMP's Activity-based Costing Value Proposition

This white paper describes three dynamics that are of unique importance to both activity-based costing software providers and activity-based costing consultants. Specifically:

i. First, the Enterprise Master Plan (EMP) value proposition. It is simple; it assures all the enterprise's annual planning applications are executing to the maximally profitable forecast with the optimally feasible supply chain. This includes financial (FP&A), operational (S&OP) and marketing & sales (marketing mix-modeling and sales resource optimization) applications. In so doing, the EMP also assures all the functional silos are harnessed to the maximally profitable forecast.

ii. Second, as the authors discovered, to their very pleasant collective surprise, the cost data architecture of an enterprise master plan model (EMP model) and an ABC model are the same. Thus, EMP models are much more easily built, given a previous ABC model exists. Specifically,

activity consumption rate (acr) x resource consumption rate (rcr) x the cost factor (cf) = slope of the requisite EMPmodel cost function curves.

This significantly extends the usefulness of many existing, as well as future, activity-based cost models, as is described in more detail below.

iii. Finally, EMP models work. They do so by determining, mathematically, how much profit the firm left on the table because the projected income statement, as traditionally developed, assumed a fixed forecast and a fixed supply chain. Using data from an earlier ABC engagement, the authors built a "proof of concept" (POC) EMP model and demonstrated the firm had left an additional **25-150%** profit opportunity on the table, depending on the scenario.

c. Action Plan

The proposed action plan for interested ABC software providers and consultants is:

i. They become partners with INSIGHT, the software company whose product, INSIGHT Enterprise Optimizer, creates an EMP model.

ii. The first EMP model to be built will use either last year's actuals or the most recent activity-based model data. Further, it will be either:

1. A simplified POC model like the case study described in more detail below, if the client isn't completely persuaded of the EMP value proposition, or
2. A full blown EMP model calibration model if the customer decides to bypass the POC model. This model can use either qualitatively developed enterprise response functions or ones developed quantitatively by an outside service provider. As described in more detail below, response functions are the means by which the assumption of a fixed forecast is relaxed.

iii. The next model after the calibration model will be the calibration model updated with *next* year's planned forecast and supply chain (i.e., projected income statement), as well as next year's enterprise response functions quantitatively developed. This model will then be optimized.

iv. The optimized forecast and supply chain developed by the optimization will be used to update the software containing the original projected statement. From here, everything proceeds normally. The only difference is now the projected income statement contains the maximally profitable forecast and the optimally feasible supply chain required to make and fulfill the new forecast. The EMP model is in effect, a "back office" activity that the customer's financial and operations staffs never see. Thus, it leaves all the customer's installed financial, operational and marketing/sales applications in place.

v. The EMP model gets rerun either:

1. Current year when

   i. Customer changes the forecast during the year (e.g., with a rolling forecast) and/or

   ii. Variance analyses of the response function(s) determine they need to be updated

2. The following year when the client's planning process develops that year's projected income statement with a new forecast and updated supply chain data if required.

2. Current Generation Applications

a. Forecasting

Beyond Budgeting Round Table is at the heart of a movement that is searching for ways to build lean, adaptive and ethical enterprises that can sustain superior competitive performance.The BBRT is an international shared-learning network of member organizations with a common interest in transforming their performance management models to enable sustained, superior performance. For more details, see **BBRT**.

One of the central performance management tenants of BBRT is that a *quality forecast process* is essential. Steve Player, chairman of BBRT NA and co-author of *Future Ready: How to Master the Business Forecast*, has very succinctly described just such a process (See Appendix 1). Included are the important distinctions between strategic and execution forecasts , business as well as clarifications between goals, budgets and forecasts. "Business forecasting takes place when it is possible to steer the business within the constraints of existing goals, scope and structure of the business."

A forecast process approach the BBRT has emphasized is that of the **Rolling Forecast**.

Our concern in this white paper is with business forecasts. Business forecasting is described by Morlidge and Player, *Future Ready: How to Master the Business Forecast*, (p. 67). We chose this name, business forecast, because, while the short term or execution forecast primarily concerns those that are required to deliver goods and services, and strategy is primarily the job of senior management, the **business** horizon usually involves the **entire organization** in some fashion."

Given a high quality forecast process, what are the various techniques by which a forecast can be created? Referencing *Future Ready*, (pages 87-124),

There are three types of models can be used to produce a forecast...

1. Despite the disapproval of professional forecasters in academia, the majority of business forecasting and budgeting processes rely on **judgment techniques**....
2. The second type of forecast model is the **mathematical model**...Many businesses use sophisticated mathematical modeling to forecast volume, perhaps factoring in the effect of weather on the size of the market or advertising on market share...
3. Given a reasonable amount of historical data, we can use the third type of model: the statistical (i.e., extrapolation) model. Statistical models employ **extrapolation** techniques to generate forecasts.

Another characterization of the differences between **mathematical models and extrapolation models** can be found in Hanssens, Parsons, Schultz, *Market Response Models*, pages 377-378, 386-389. Quoting:

"**Extrapolative forecasts** use only the time series of the dependent variable. Thus, a sales forecast is made only on the basis of the past history of the sales series...**Explanatory (i.e. mathematical) forecasts** go beyond extrapolative by including causal factors thought to influence the dependent variable of interest."

In addition to Morlidge & Player and Hanssens et al, explanatory forecasting is also discussed in Charles Chase's *Demand-Driven Forecasting*, second edition, 2011. The process described below, relaxes the assumption of a fixed forecast by employing what the author characterizes as "demand-sensing" techniques, more typically referred to as response functions. The solution is not optimal, however, because descriptive techniques (what will happen if we do "X?") and not prescriptive techniques (i.e., what is best "X?") are used to develop the new forecast.

Demand-driven Forecasting Process
1. Demand Sensing: *Uncover market opportunities and key business drivers (sales and marketing)*
2. Demand Shaping: *Using what if scenarios, demand planners shape future demand based on sales/marketing plans* a) optimize sales and marketing tactics and strategies (sales and marketing) b) assess financial impact (finance) c) finalize unconstrained demand forecast (sales and marketing)
3. Demand shifting: *Match unconstrained demand to supply* a) consensus planning meeting (sales, marketing, finance and operations) b) rough cut capacity planning review (operations)
4. Demand Response: *Constrained demand used to develop supply plan* a) revised demand response (sales and marketing) b) create supply response (operations)

Forecasting Process from *Demand-Driven Forecasting*: Exhibit 2

Another explanatory forecast process is described in Hanssens et al, ibid, pages 16-17 and 390-396.

Finally, explanatory or mathematical "business" forecasts have also been used for decades **within the sales and marketing functions** to size and allocate their respective resources, optimally.

A comparison of **explanatory and extrapolative forecasting techniques is illuminating** (next page).

Application	Marketing Mix Modeling	Sales Resource Optimization	Business Forecast Extrapolative	Business Forecast Explanatory
Planning issue	Size and allocate all or a portion of planned marketing budget	Size and allocate all or a portion of planned sales force budget	Develop a product(s) forecast	Develop a product (s) forecast
How forecast developed	Multiple time series	Multiple time series	One time series	Multiple time series
Marketing plans drive forecast (i.e., they are independent variables)	Yes	Yes	No	Yes
Marketing response functions required	Yes	Yes	No	Yes
Forecast's use	Within marketing	Within sales	Within enterprise	Within enterprise
How forecast optimized	Prescriptively	Prescriptively	n/a	Descriptively (i.e., scenario analysis)
Objective function	Profit proxy: contribution margin by product	Profit proxy: contribution margin by product	n/a	Profit proxy: contribution margin by product
Best possible forecast, financially	No	No	n/a	No
Best possible forecast, operationally (e.g., observe constraints)	No	No	n/a	No
Reference Articles	Hanssens, Parsons, Schultz, *Market Response Models*, "Integrating Market response Models in Sales Forecasting at Polaroid," pages 391-393	Sinha and Zoltners, "Sales-Force Models: insights from 25 Years of Implementation, *Interfaces 31:3*, Part 2 of 2, May-June 2001	Morlidge and Player, *Future Ready*, pages 110-112 Hanssens, Parsons, Schultz, ibid, pages 316-316, 377-378, 386-389	D.M.Hanssens, "Order Forecasts, Retail Sales and the Marketing Mix for Consumer Durables", *Journal of Forecasting*, June-July 1998

Statistical Forecasting Applications: Exhibit 3

This comparison indicates very clearly the shortcomings of current **explanatory and extrapolative** forecasting applications; most significantly, the absence of an **enterprise-wide** forecast **that is optimal** (i.e., maximally profitable). As described below, that shortcomings are eliminated with an **Enterprise Master Plan**. Next generation forecasting and planning is here. Now.
Right now.

b. Activity-based Costing

"Activity-based costing was first clearly defined in 1987 by Robert Kaplan and W. Bruns in a chapter in their book *Accounting and Management: A Field Study Perspective*… During this time, the *Consortium for Advanced Management-International*, now known simply as *CAM-I*, provided a formative role for studying and formalizing the principles that have become more formally known as Activity-Based Costing." Wikipedia.

The adoption of ABC techniques was not without its challenges, however.

"Companies rejected ABC on the basis of its perceived administrative and technical complexity and its need for new systems continuously generating activity data. While ABC model is feasible for initial pilot studies, it is difficult to extend to company-wide applications. Even after the initial model has been built, updating the model requires essentially re-estimating through a new round of interviews and surveys to reflect changes in company's operations. Consequently, ABC models are often not maintained and their cost estimates soon become obsolete (Kaplan 2003)." Velmurugan, *Journal of Performance Management*, May 1, 2010.

However, a subsequent development, *time-based* activity based costing, addressed many of these issues and has been successfully commercialized by Acorn Systems Pilbara. Today, there a variety of commercial ABC offerings available from both larger performance management vendors (e.g., Cognos, Infor, Oracle, SAP, SAS) as well as standalone firms (e.g., Acorn Systems, Decimal, Prodacapo).

c. Activity-based Planning

i. Overview

It didn't take long, after the initial promulgation of ABC concepts, for academics and practitioners to turn their attention from the use of ABC techniques to define customer and product profitability more accurately using last year's results (metaphorically, the back of the planning boat) to turn their attention to applying the same concepts and data to planning the next year's results (i.e., the bow of the planning boat). The essential ABC planning factors, activity consumption rates, resource consumption rates, and cost factors remained the same. The only difference was that data in the model flowed in the opposite direction: from products and customers through activities to resources rather than from resources through activities to products and customers.

A variety of books were published describing this "reverse flow" (sometimes, also, referred to as activity-based budgeting) Examples include Kaplan and Anderson, *Time-Driven Activity-Based Costing* (Chapter 5), 2007; Kaplan and Cooper, *Cost & Effect* (Chapter 15), 1998; Cokins, *Activity-Based Cost Management* (Chapter 8), 2001; and, finally, Hansen and Torok, editors, *The Closed Loop, Implementing Activity-based Planning and Budgeting.* CAM-I, 2004.

Of all these books, CAM-I's *The Closed Loop* is the most detailed. (See Appendix II for a summary of *The Closed Loop's* process). Thus, its formulation of activity-based planning will be used for the remainder of this white paper to represent "best practices" for the current generation of activity-based planning efforts.

The activity-based planning model the book describes, the Closed Loop model (CL model), will be used in comparison with the next generation activity-based planning model described in the remainder of the white paper, the Enterprise Master Plan model (EMP model).

Summarizing, editors, authors and contributors of *The Closed Loop* held that:

> "The Closed-Loop and the Activity-Based Budgeting and Planning Process are the most significant development in the field of Planning and Budgeting in the last thirty years."
>
> Also, "We have developed a planning and budgeting approach that extends activity-based logic into a new domain: planning and budgeting."
>
> And, "In the long run, a successful organization will switch from a primary focus on generating budgets to a more fruitful focus on planning."

ii. Limitations in the Current Practice

However, as recognized by the editors, authors, and contributors, **"While the concepts are straightforward, performing the necessary calculations is fairly intricate."** Examples include:

- a. Too many options ("moving parts") within several of the 7 steps (See Appendix II).
    - i. 12 options in Step 3: Balance Resource Requirements with Resource Supply
    - ii. 13 options in Step 6: Balance Financial T Results with Financial Targets
- b. Many options repeat themselves across the steps
- c. Too many sequential steps in the overall process: 7
- d. No simultaneity since "calculation engine" of the CL model cannot consider any of the steps or options at the same time

e. No standard software existed to build the CL model calculation engine and store the associated data.

f. “The practical difficulty in comparing resources supplied and resources required occurs when the unit of measure used for supply of a resource differs from the unit of measure in which the resource is used. (e.g., requirements for people are often expressed in hours whereas people are generally acquired in FTEs.)”

As will now be demonstrated, all these shortcomings have been eliminated with the **Enterprise Master Plan**. Next-generation activity-based forecasting and planning is here.

3. Next Generation Forecasting and Activity-based Planning: *Enterprise Master Plan*

a. Overview: Optimized Forecasting and Planning

There are five factors necessary for developing a maximally profitable annual plan (i.e., projected income statement):

1. **Forecast** must be a variable in the activity-based plan model
2. **Supply chain** must be variable in the activity-based plan model
3. **Objective function** (i.e., what you're trying to optimize) must be profit
4. **Solver** must be prescriptive ("what is the best X?") and not scenario analysis (what will happen if we do "X"?) (See Appendix IV for an illustration)
5. **Solution** must be developed with a simultaneous consideration of all the variables.

One or more of these factors are used in most planning software available today. The EMP model is the **only** one, however, which incorporates all five factors. The EMP model accomplishes this using new planning software that integrates three planning techniques which have been commercially available for decades. The three are: i) supply chain network design, ii) activity-based costing and iii) marketing-mix modeling.

- The supply chain software relaxes the assumption of a fixed supply chain (details below), uses profit as the objective function and has a simultaneous prescriptive solver.
- The activity-based costing software provides the data for the cost functions in an EMP model by which the assumption of a fixed supply chain are relaxed.
- Finally, the assumption of a fixed forecast is relaxed by the EMP model employing enterprise response functions, developed in traditional marketing-mix modeling software.

b. Building an EMP model requires the following:

i. EMP model "calculation engine"

The software used to create an EMP model is that described by Jeff Karrenbauer, President of INSIGHT, at the Fall, 2013 CAM-I meeting held Naperville, IL on September 10, 2013. A copy of the presentation is available upon request. The Agenda was

i) Supply Chain Management- Myth vs. Reality,
ii) Supply Chain Management-An Analytic Perspective,
iii) Strategic Sourcing,
iv) Sales and Operations Planning (S&OP),
v) Unification of Marketing and SCM
vi) SCM and the Green Movement

ii. Data required for an EMP model

a. Structure

As is true of any supply chain network design (upon which an EMP model is based), the model structure of the projected income statement is a series of geographically-located nodes connected by links arranged in a hierarchy, procurement to customer. The nodes contain facilities and within the facilities, activities and products. These nodes and links are appropriately constrained (e.g., capacities).

However, the flows within the network (e.g., across a node, within a facility, through an activity) are not known because they are the answer to the question: "What is the optimal supply chain configuration to make, fulfill and service the forecast?" Thus, the essential requirement for optimized planning is an understanding of unit costs and how they vary with volume. As will be described below, these relationships are referred to as cost functions.

In addition to structure, the key data elements of an EMP model are: cost functions, capacity and related constraints, and demand, all of which can be are obtained from an ABC model or CL model. The final elements, enterprise response functions, are provided by outside experts.

b. Cost functions

As described above, all the network costs in any EMP model must be represented as cost functions.

Cost functions are defined by Dr. Charles Horngren as "*descriptions of how a cost changes with changes in the level of an activity or volume relating to that cost.*" Cost functions describe, mathematically, the relationship between activity changes (units, weight or volume) and the cost changes driven by the activity changes.

Cost functions must be a combination of fixed and/or linearly variable volumes, given the mathematical programming techniques that are used to optimize the EMP model. These include:

- linearly variable with increases or decreases in activity

- Fixed costs that don't change with activity at all.

- Stepwise fixed

- Any combination of fixed and linear

Thus, plotting the cost function with changes in cost on y axis (dependent variable) and changes in units of volume on x axis (independent variable) yields the following: **cost = slope x activity**. The slope is expressed as cost/activity and is the key mathematical factor in the cost functions.

Traditionally, there have been 3 different approaches used by the supply chain community to develop cost functions: i) accounting, ii) statistical and iii) engineering. (For more details, see Appendix III)

However, fortunately, (though not well understood), two analytic techniques of interest (activity-based costing and supply chain network design) have exactly the same costing data architecture. This, in a nutshell, is why EMP models can be easily created from ABC data.

Reviewing, activity consumption rate (acr = activity/product) and resource consumption rate (rcr = resource/activity) and the associated cost factor (cf = $/resource) when multiplied are, in fact, precisely the slope of the variable cost functions required in an EMP model. Thus:

slope = activity/unit of product x resource/activity x $/resource = $/unit of product = slope of cost function curve.

Below is a graphic describing the use of the three ABC factors in The Closed Loop planning process flow. Reiterating, activity-based *planning* flows products/customers through activities to resources; activity *based-costing* processes flow in the opposite direction.

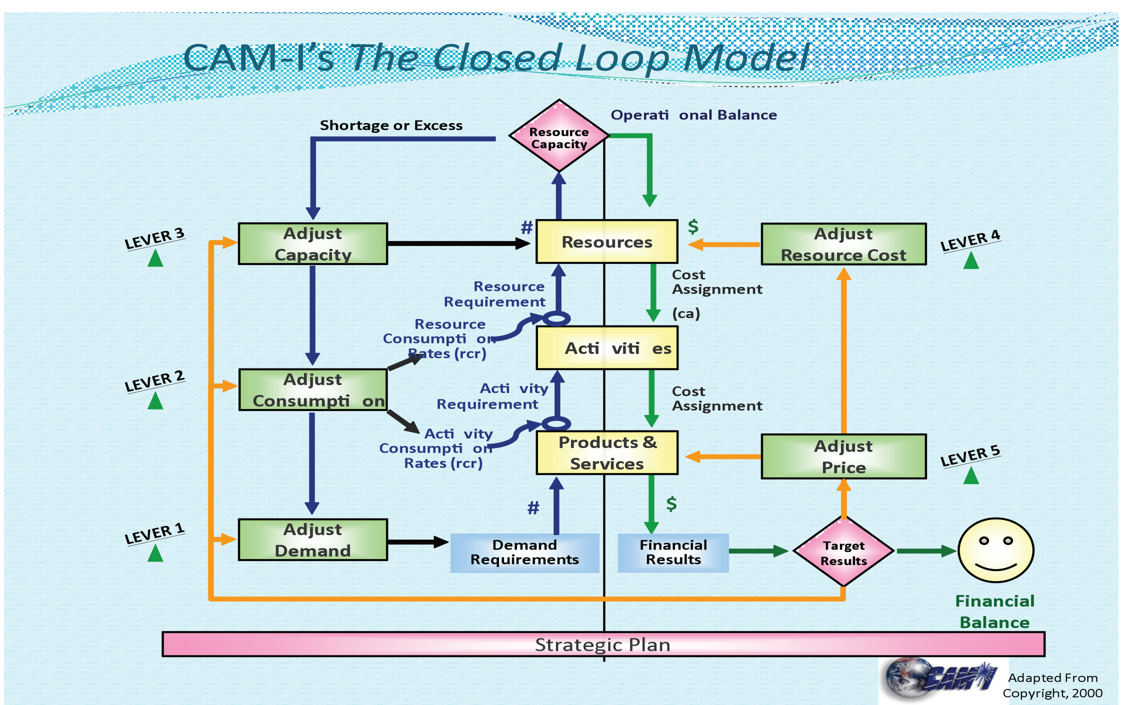


Exhibit 4

Obviously, as illustrated above, the three essential factors of *The Closed Loop* are exactly those developed by traditional activity-based costing techniques: the activity consumption rate (acr), the resource consumption rate (rcr) and cost assignments (ca). They are also sometimes referred to as cost factors (cf).

In *The Closed Loop*, this is illustrated in Chapter 8 with an example; that of an outbound call center. All the costs in the example are fixed except those of the reps making the calls and the telecom costs/call.

Using data from the call center example in *The Closed Loop*, below is an illustration of **the arithmetic identity of the slope of the cost function curve required in an EMP model and the multiplication of the three factors developed in the activity-based costing analysis: acr x rcr x cf= EMP model cost function slope**.

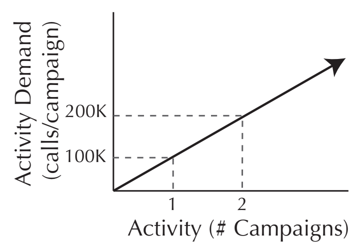
Mapping Call Center Consumption Rates to Cost Functions:

LABOR

Cost Object = Campaign
Activity = Create Campaign

1. Activity Consumption Rate (ACR)

ACR = 100K calls/campaign

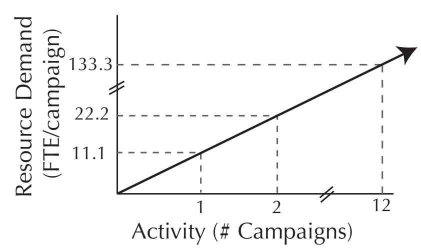


2. Resource Consumption Rate (RCR)

RCR = 10 min./call

Assume: FTE = 1500 hrs.

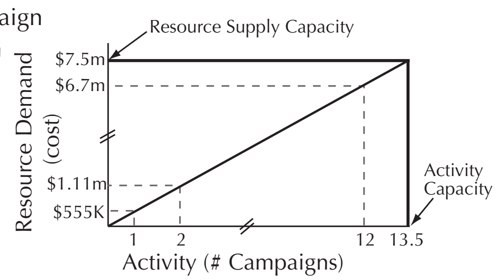
FTE/Campaign = 10 calls/campaign
x 10 min./call
x 1 hr./60 min.
x 1FTE/1500 hours
= 11.1 FTE/campaign



3. Assume: FTE = $50K

Campaign cost = $50K/FTE
x 11.1 FTE/campaign
= $555K/campaign

COST FUNCTION (LABOR)



Developing an EMP model Cost function from *Closed Loop* ABC Data: Exhibit 5

c. Capacity and Other Constraints

All constraints, including capacities, must be identified as they are an explicit requirement for optimization. Further, in most cases, these constraints can be relaxed. Examples include:

- Limits on procurement availability
- Manufacturing capacity
- Sales and marketing expenditure limits
- DC throughput, storage
- Energy consumption
- Carbon emissions
- Targets for inventory and customer service
- Transportation link restrictions
- Supply/demand imbalances (e.g., inventory build ahead vs. over time)

d. Enterprise Response Functions

Response functions have been around for decades and link sales or marketing activities to forecast/revenue results. Specifically, they relax the assumption of a fixed forecast by predicting volumes/revenues at different levels of sales or marketing effort. Sales response functions are used to size and allocate the sales force resource (sales resource optimization (SRO))while marketing response functions are used to size and allocate the marketing budget (marketing- mix modeling (MMM))

Response functions are the reverse of cost functions because the independent variable is not units but rather sales and marketing expenditures. The dependent variable is units. Units are, also, frequently multiplied by price to yield revenues as the dependent variable.

These relationships have been traditionally used to inform critical resource allocation decisions including how big the sales or marketing budget should be, and to which products and/or customers should these resources be allocated. As a result, this process can lead to changes in individual product or customer expenditures.

In these approaches, the supply chain is fixed and the objective is to maximize the contribution of the sales and marketing efforts after accounting for the costs of these promotions and a fixed product margin. It is not common to account for changes in margin as a function of the expected product demand.

There are a broad range of methods that can be used to estimate response functions, which differ in the time/ effort involved and the precision that can be achieved. A partial list of these methods includes:

- In-market tests to isolate the impact of individual promotions
- Econometric methods that rely on statistical analysis to estimate the sales impact of prior sales and marketing activities
- Expert sessions that provide a structured process to solicit and refine estimates of the impact that a promotion will have

Regardless of how the response functions are derived, they can be compared to actual results and re-calibrated as needed. This is analogous to the financial variance analysis process.

In conclusion, it is the extension of sales and marketing response functions to enterprise response functions that enables the development of an optimal forecast that is maximally profitable, something never before possible.

c. Activity-based Plannng Functionality: A Comparison

Comparison Factors	CL model	EMP model
1. Steps in Activity-Based Planning Process		
Step #1	Develop demand statement	Same
Steps #2, #3, #4, #5, and #6	Performed sequentially	Performed simultaneously
Step #7	Create plan	Same
2. Data	Traditional ABC planning factors of acr, rer, cost factors, demand and capacities	Same (80+%) plus response functions
3. Solver	Scenario analysis (what will happen if we do X?)	Prescriptive (What is the best possible X?)
4. Results	Sub-optimal forecast, supply chain and profit	Maximally profitable forecast and optimallyfeasible supply chain, assured
5. Modeling software	"calculation engine" didn't exist when *Closed Loop* published	INSIGHT's INSIGHT Enterprise Optimizer (IEO)
6. Additional software functionality	None	Sustainability (energy and carbon emissions)

Comparison: EMP model and CL model Functionality: Exhibit 6

4. EMP model Works

a. Proof of Concept case study (See Appendix V for details)

It started out as a simple comment six years ago, "Imagine relaxing the assumption of a fixed forecast to solve for the optimum level of sales and marketing investment that provides the highest profit and ROI." Planning and Budgeting, Arkonas One Eighty Newsletter, February, 2008

The software required to accomplish this, INSIGHT Integrated Enterprise Optimizer (IEO), was already under development at INSIGHT, a provider of software used for optimizing a supply chain network. The concept was simple: Using IEO, create an EMP model of the current projected income statement as traditionally developed and, then, optimize the ROI of its total sales and marketing expenditures. The resulting Enterprise Master Plan (EMP) produces the maximally profitable forecast that the projected income statement's resources are capable of making and fulfilling. Simultaneously, enterprise-wide, IEO resizes and reallocates these same resources to support the manufacture, fulfillment and support of the new forecast; i.e., the supply chain is assured to be optimally feasible.

But would it work? Would it actually demonstrate a substantial profit improvement? It was a difficult question since no firm had been found willing to proceed without credible proof that it would deliver what it promised. In other words, a "proof of concept" (POC) model was required. Rather than inventing data, it made more sense to find an existing set of actual data and use it to create the POC model.

The modeling results most readily available were of a previous ABC engagement conducted by one of the authors. Fortunately, the data incorporated the entire income statement. So, an investigation was made into the match between the ABC data developed and the data requirements for an EMP model. Specifically, whether the EMP model POC cost function slopes could be developed from the ABC data.

Using data from the call center example from CAM-I's *The Closed Loop*, what was learned was very important. (See page 13) The two seemingly unrelated, activity-based analytic techniques — activity-based costing and an EMP model — share common activity-based costing data architecture. Both techniques build their model with fixed and linearly variable relationships between costs and activity (units, weight or volume).

b. Results

Table 1: McCoy Company Results (Far East 20%)

Scenarios	Maximize Revenue	Maximize Profit	Sales/Marketing	Sales/Marrketing ROI	Activity capacity exceeded
Baseline	$136.3 m	$12.7m	$28m	45%	None
Revenue max	$143.8m (6%)	$16.3m (28%)	$28.6m	27% improvement	1 (labor)
Profit max	$140.9m (3%)	$19.8m (56%)	$23.6m	87% improvement	1 (labor)

Table 2: McCoy Company Results (Far East 200%)

Scenarios	Maximize Revenue	Maximize Profit	Sales/Marketing	Sales/Marrketing ROI	Activity capacity exceeded
Baseline	$136.3 m	$12.7m	$28m	45%	None
Revenue max	$173.4m (6%)27	$30.0m (136%)	$34m	96% improvement	5 (labor) 2 machine
Profit max	$170.5m (25%)	$33.5m (164%)	$39m	158% improvement	4 (labor) 2 machine

5. Conclusion

As described above, an EMP model solves the two biggest impediments limiting the commercial success of activity-based planning.

- It eliminates the "intricacies" of the Closed Loop process and CL model's "calculation engine"
- It assures the forecast is maximally profitable **and** the supply chain optimally feasible.

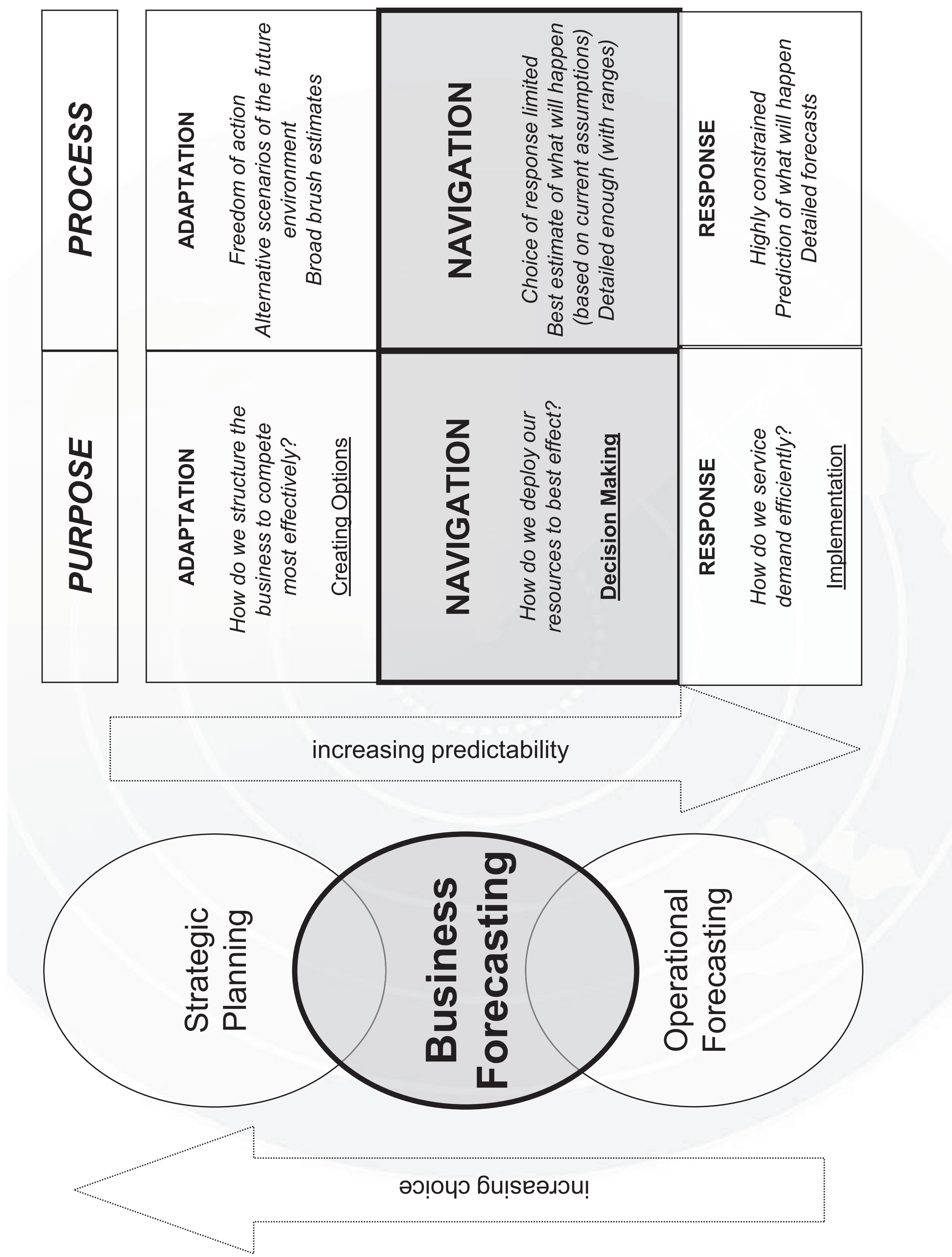
It accomplishes this by simultaneously and optimally balancing supply, demand, profitability and the supply chain.

Thus, EMP model's functionality truly represents the next generation ABC-based planning, both financially and operationally. Further, it does not employ "new" or "untested" analytics. Rather, it is simply the integration of three different and robust sets of analytics (i.e., mixed integer and linear math programming, predictive analytics and activity-based costing) that have been commercially successful for decades.

Also, for firms and consultants whose experience is with ABC modeling, the EMP model is a platform that extends the operational uses of ABC data **from** efforts focused on process improvements and customer/product profitability (i.e., the back of the boat) **to** planning applications like forecasting, finance, operations and sales/marketing (i.e., the bow of the boat).

Finally, an ABC EMP model can be built with relatively little additional data gathering, as described above. This introduces the client to next generation activity-based forecasting and planning while simplifying the EMP model build effort significantly.

Appendix I: Forecast Process from *Future Ready*



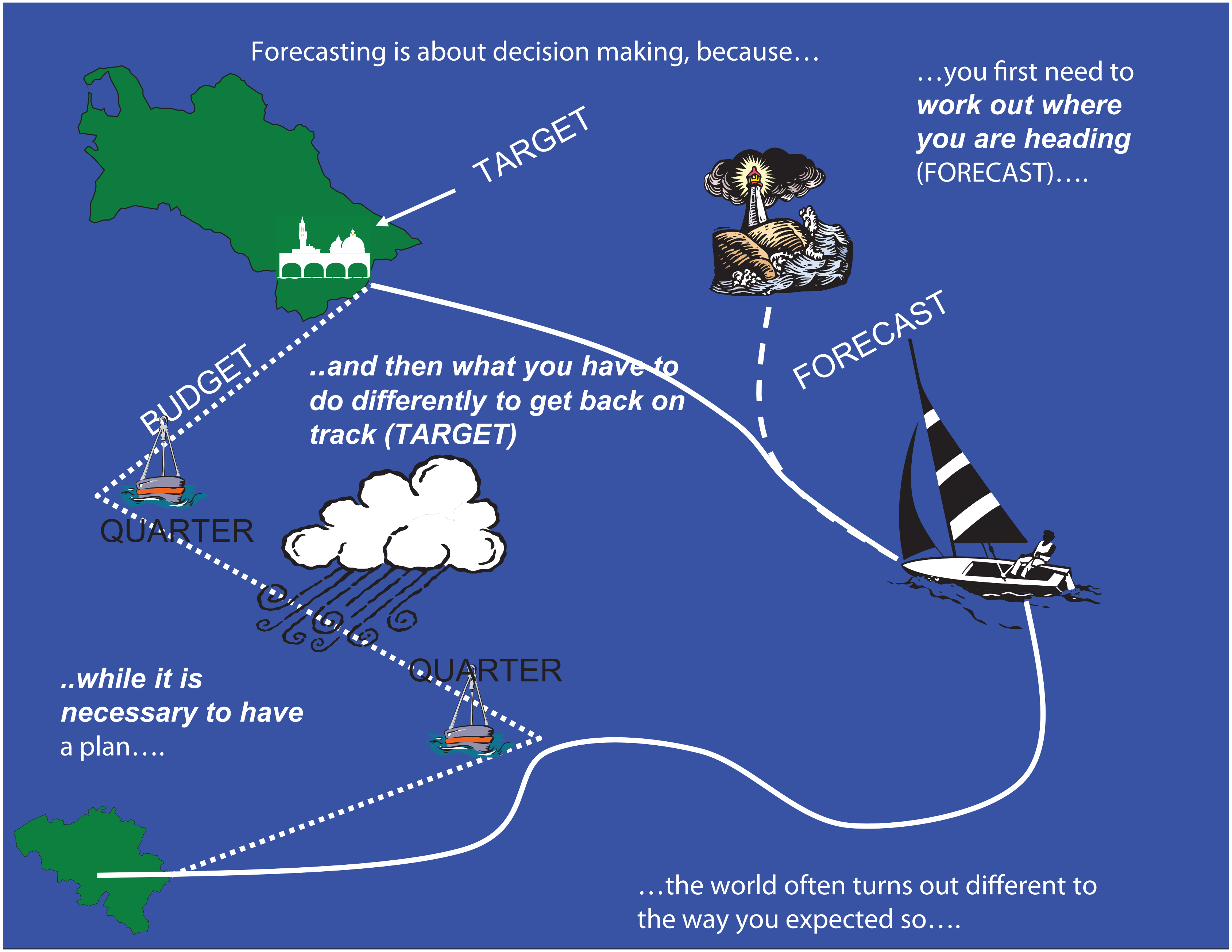
Key concepts

A target is what we would like to happen
which we achieve by producing
A forecast - what we think will happen
based on:
A set of plans : what we intend to do,
which we change to achieve our target

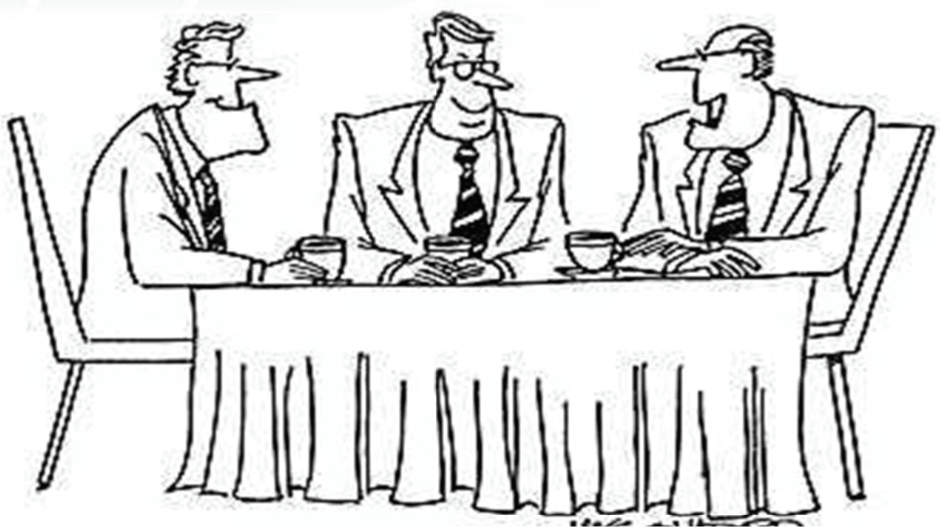
Specification for a forecast

TARAC → CARAT

- T = timely
- A = actionable
- R = reliable
- A = aligned
- C = cost Effective


Forecasting is about decision making, because…
…you first need to ***work out where you are heading*** (FORECAST)….
TARGET
FORECAST
BUDGET
QUARTER
QUARTER
..and then what you have to do differently to get back on track (TARGET)
..while it is necessary to have a plan….
…the world often turns out different to the way you expected so….

Don’t treat forecasting as a “special event” instead of an on-going part of monitoring the business



We haven’t forecasted in a while, maybe we should try that again….

Appendix II: Details of activity-based planning process

What follows for the rest of the Overview are direct quotes from The Closed Loop

The book contains the editors, authors and contributors "recommended approach:"

- The **CAM-I ABPB Closed-Loop**, (referred to as "the Closed-Loop), a new approach to calculating the activity, resource and financial requirements of an organization and it units.
- The **CAM-I ABPB Closed-Loop Process**, (which contains the business processes and techniques needed to support the Closed-Loop and
- The **CAM-I ABPB Implementation Program**, a structured approach to introducing the Closed-Loop and ABPB Process into an organization

Benefits of the ABPB "recommend approach" included:

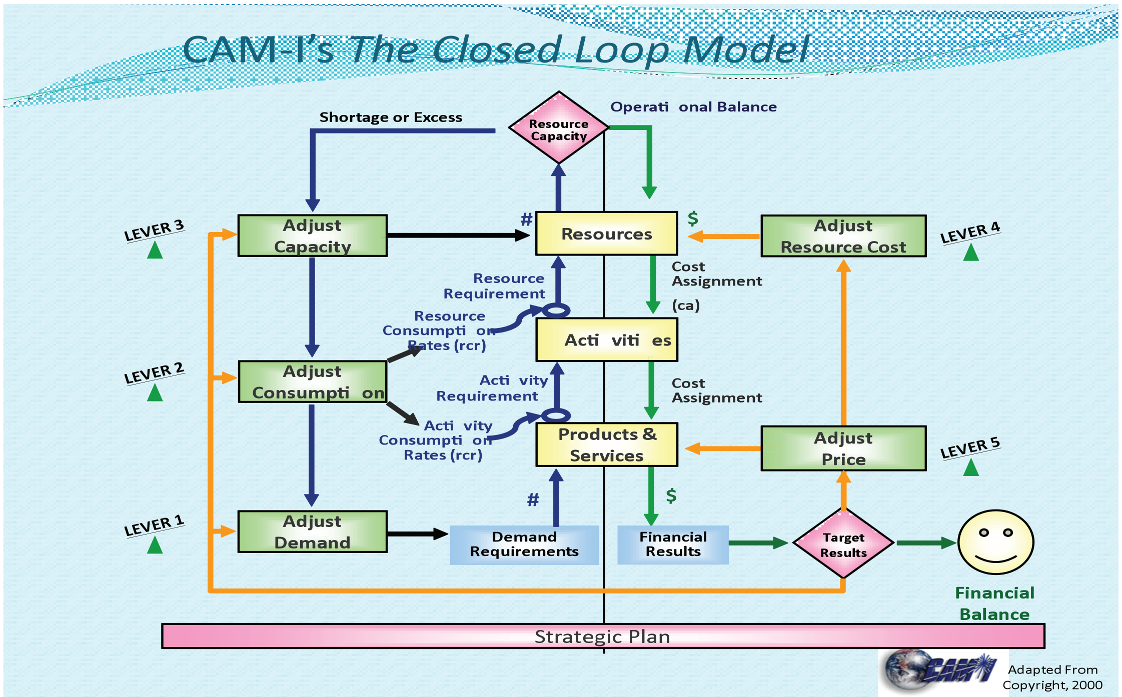
1. *Reduction in the time and cost of generating a budget (and a plan, authors' addition)*
2. *More accurate costs and better decision making*
3. *More specific and cohesive link with the strategic plan*
4. *Added ability to adjust activity and resource consumption rates*
5. *Additional methods to adjust capacity*
6. *Reduced time to collect information*
7. *Disagreements become more transparent*
8. *Decrease in political gaming*
9. *Easier to communicate and increased buy-in*
10. *Improved understanding by managers*
11. *Improved justification for budget requests*
12. *Superior response to last minute changes in assumptions*
13. *Improved cash flow forecasts*
14. *Improved 'what if" analysis*
15. *Easier integration with other processes*

The heart of the recommended approach is a budget (or planning, authors' addition) calculation engine; the ABPB Closed-Loop …The Closed-Loop has three important features:

- It is activity-based
- It explicitly matches resource demand and resource capacity and
- It achieves operational balance and then confirms financial balance

The Closed-Loop has two stages. The first, the operational loop, balances the demands on organizational resources and their supply in purely quantitative (but, non- financial) terms… Balancing resource demand and supply is the most difficult step in any plan and is valuable even without the inclusion of costs in the planning process.

The second stage, the financial loop, adds costs of resources and the value (i.e., revenue) of output to generate feasible financial plans.



The detailed calculations of stage 1 and 2 involved in the Closed- Loop (CLM) are shown in Figure 1, above.

Steps in the Closed Loop Process utilizing the Closed-Loop include:

1. **Set quantitative demands.** Using the organization's strategy, the quantity of demand in the upcoming period is estimated for each product or service. This estimation is done purely in quantitative terms, such as number of units, tons, accounts, customers, shipments, and so on.

2. **Determine resource requirements (CLM).** Step two in the CLM consists of two distinct actions:
   a. First, the quantity of demand is converted into activity requirements, expressed in operational terms, using activity consumption rates. Activity consumption rates are defined as: *the number of occurrences of an activity required to generate a single unit of output.*
   b. Second, the activity requirements are converted into the individual resource requirements using resource consumption rates. Resource consumption rates are defined as: the quantity of each resource required to undertake a single occurrence of an activity.

3. **Balance resource requirements with resource supply (CLM).** The most critical aspect of the CLM is establishing operational balance by matching resources requirements with resource capacity in a given time period.

The practical difficulty in comparing resources supplied and resources required occurs when the unit of measure used for supply of a resource differs from the unit of measure in which the resource is used. (e.g., requirements for people are often expressed in hours whereas people are generally acquired in FTEs).

Once a common capacity measure is determined, management ***compares each resource's supply with its corresponding requirement***. This comparison results in one of three situations:

a. Too much capacity: Too much capacity can be operationally feasible, but is only operationally balanced if the amount of excess capacity is needed as a buffer. If this is the case, the situation needs to be analyzed to see if it meets financial balance.
b. Too little capacity: Demand requirements cannot be met because there is a shortage of resources. This situation is not operationally balanced and therefore cannot be operationally balanced.
c. Exact balance of capacity and demand: This situation is operationally feasible and, by definition, in operational balance. The situation needs to be analyzed to see if it meets financial balance.

Armed with the knowledge of any imbalances, management must ***assess capacity*** by determining whether or not:

d. A surplus or shortage of resources is large enough to justify action or if it should just be accepted.
e. The surplus or shortage is expected to last for a long time. Shortages that continue for a long period of time can cause excessive costs for overtime or decreased performance or service levels.
f. The capacity cannot be changed in the time period being addressed,given prevailing economic conditions.

With a ***capacity assessment*** in hand, there are three distinct ways that the organization can achieve operational balance (see Fig. 1, operational balance on left side of graphic):

g. A surplus or shortage of resources is large enough to justify action or it should be accepted. NOTE: The CLM is a calculation algorithm. As such, it will treat a situation where resources required exceed resources supplied as infeasible and therefore the organization could theoretically not meet its demand requirements. In extreme cases, this may be true. However, in many cases, the use of overtime, tEMP model labor, or extremely high machine utilization-especially for short time periods-may be EMP model loyed to meet demand. This case is, in effect, a new plan with greater capacity and higher costs.

h. The surplus or shortage is expected to last for a long time. Shortages that continue for a long period can cause excessive cost for overtime or decreased performance or service levels.

i. The capacity cannot be changed in the time horizon being addressed, given prevailing economic conditions.

With a capacity assessment, there are three distinct ways that the organization can achieve operational balance:

j. *Adjust capacity or improve usage of resources.* With operational balance, the demand requirements can be met and there is either no excess capacity or an acceptable quantity of idle or buffer capacity.

k. *Adjust the activity and/or resource consumption rates to resolve or at least reduce the magnitude of the problem*. Management usually seeks to implement any available economic effectiveness or efficiency opportunity.

l. *Change the absolute mix of products/services demanded*. A well planned product change may either absorb the excess or reduce the shortage or resources without affecting the organization's overall strategy.

4. Determine resource costs and derive financial results (CLM).

To determine resources costs, two elements are required:

a. the unit cost of each resource required and
b. the quantity of each resource as determined from the operational plan.

The financial elements need to complete this step are:

c. Unit cost of each resources, such as the hourly wage or annual salary and
d. Revenue (price) per unit of demand

The cost of each resource is assigned to the resource and using the relationship between resources and each activity these costs are assigned to the activities requiring or consuming tat resource. These activity costs are then assigned to products to derive product and service costs.

5. Add non-activity-based costs to obtain the total financial result

Certain organizational costs may not have a direct or tangible correlation with activity volume and therefore are better handled through a more traditional budgeting approach than the CLM . These types of costs are sometimes referred to as "business sustaining" costs. Examples include directors' fees, certain building leases, SEC filing fees, etc. Ultimately, all costs (activity-based and non-activity-based) that apply to the organization must be considered to generate a financial plan.

6. Balance Financial Results with Financial Targets

When a financial plan has been prepared, an assessment is made of whether or not the total projected financial results meet the required targets of the organization. If these targets are not achieved, three options can be pursued either individually or in combination with one another. These options are:

a. Adjust demand pricing, assuming that the new pricing is compatible with the market. An organization must estimate the impact of an increase or decrease in price on the quantity of demand.

b. Modify resource costs including the possibility of outsourcing. The second option is to adjust or eliminate shift premiums or overtime. Options include:

i. Re-calibrating shifts to reduce or eliminate current shift premiums or overtime

ii. Adopting a two-tier wage structure where new EMP model loyees are paid less than existing ones

iii. Adjusting compensation plans to allow for incentive pay to be more closely tied to organization results

iv. Increasing or decreasing wages to encourage EMP model loyees to join or leave the organization

v. Paying for skill rather than seniority

vi. Outsourcing to obtain lower costs from more efficient suppliers or reducing ecess capacity costs by paying only for what is used

vii. Negotiating more favorable energy and other supply contracts

viii. Substituting less expensive materials, providing that other costs (e.g., processing effort or waste) are not increased. As with the approach of changing prices for products and services, chaning resource unit costs might also affect resource quantity.. If that is the case, the operational plan must be reviewed to ensure the new level of resource quantity continues to provide operational balance.

c. Change one or more of the operational parameters directly:

i. Quantity of demand including mix

ii. Activity and/or resource consumption rates

iii. Available capacity

At some point, a satisfactory operational and financial balance will be achieved that meets the strategic requirements for the organization. At this point, a formal budget (or plan, authors' addition) can be generated in the appropriate format and structure for the organization.

7. Create a Formal Plan

When both operational and financial balance have been achieved, a more formal line-item budget can be created.

In some organizations it may not be necessary to go to this level of detail. The operational and financial plans generated by the CLM may be sufficient to run the business. Alternatively, the formal budget detail may be required but on a less frequent basis. For example, the CLM could be used on a quarterly basis and the detailed formal budget generated annually.

We view the APBP Process as having more to do with planning than budgeting.

In the long run, a successful organization will switch from a primary focus on generating budgets to a more fruitful focus on planning."

Appendix III: Traditional Cost Function Curve Development

1. Accounting Approach

The most popular approach to facility data preparation is based on a detailed analysis of historical cost accounting records. The basic idea is to assemble all relevant cost accounting records, remove extraneous information, ensure comparability, separate fixed and variable costs, perform consistency checks, and prepare final model inputs. If you choose the accounting approach, we recommend that you follow the step-by-step procedure outlined below.

Step Action

1 Identify all accounts that contain facility operating costs.

2 Obtain historical data for each account identified in Step 1 for each facility active during the base period of the study.

3 Identify and remove from each account any costs that are not related to facility operations.

4 Carefully study reporting standards and practices by facility location. Attempt to identify discrepancies that would yield misleading results. The basic idea is to ensure later *apples-to-apples* comparisons across facilities.

5 Identify and *temporarily* remove cost differences between facilities which are due to regional influences (for example, labor and utility rate differentials). You may wish to use the Regional Cost Indices included in SAILS to facilitate this effort. This is done to ease Steps 6-8.

6 Separate facilities by generic type and mission. For example, distribution centers should, at a minimum, be segregated into owned, leased, and public categories. Use additional subdivisions as required to account for important operating differences: dry vs. refrigerated, bulk vs. bin, etc. Review the discussion of noncomparable facilities, as necessary.

7 Analyze carefully the results from Step 6 for consistency across facilities. Within a given facility type, perform ratio tests such as those described earlier. If discrepancies are present, you must attempt to explain them. Remember that you have already accounted for extraneous costs (Step 3), reporting practice inconsistencies (Step 4), regional influences (Step 5), and mission differences (Step 6). If discrepancies persist, then you are likely faced with the delicate (and potentially explosive) matter of managerial and/or labor force performance deficiencies. Unless you have *compelling* evidence to suggest that such problems are *inherent*, we recommend that you do not represent them in your model. Choose a representative set of costs and ignore substandard operating practices. From a strategic point of view, such variances should not be the basis for a network redesign.

8 Categorize each account as either fixed or variable. (Refer to our earlier definitions of fixed and variable costs, if necessary.) This step will almost

certainly involve some judgment calls on your part.

9 Reintroduce regional differences removed at Step 5.

10 Prepare final inputs for your model.

2. Statistical Analysis Approach

One of the most difficult challenges that you must face when analyzing historical facility costs is the segregation of accounts into fixed and variable categories. The statistical approach circumvents this problem because it is completely independent of the nature of individual cost accounts. The basic idea is to derive a mathematical function that best describes the observed relationship between total cost and facility volume. The statistical technique that you will normally use is single variable linear regression.

The statistical approach to facility data preparation is summarized next:

Step Action

1-7 Follow steps 1-7 from Accounting Approach, earlier.

8 Perform regression analysis of total facility costs (dependent variable) and volume (independent variable). Interpret resulting equation coefficients as follows:

y-intercept: fixed cost

slope: variable costs

9-10 Follow steps 9-10 from Accounting Approach.

These cost coefficients probably will bear little resemblance to those you derive via the accounting approach. Nevertheless, if the equation fits observed historical data reasonably well, it is equally valid. Furthermore, you are relieved of the difficult task of attempting to classify accounts as fixed or variable. Rather, you are simply asserting that the total cost function for a given facility type behaves in a predictable, justifiable way; the underlying components of total cost are unimportant to the solver.

3. Engineering Approach

Suitable historical facility operating costs may not be obtainable from your accounting records. Even if they are available, you may be unwilling to use them as the basis for your analysis for several reasons, including

a. base period that contains abnormal events such as strikes or national disasters;

b. reporting discrepancies that are so severe they cannot be reconciled, and

c. missing information from one or more facilities

In such instances, you may conclude that standard costs should be used instead of accounting data. If your firm has recently built, or plans soon to build a new manufacturing or distribution center facility, it is virtually certain that the planning phase involved detailed estimates of facility operating costs. Assuming that the facility size specified in the analysis represents those you wish to evaluate, you can incorporate these values in your IEO model. Alternatively, you can commission special studies to develop such estimates. Following is the recommended step-by-step procedure:

Step Action

1 Obtain engineering cost estimates for each facility type to be evaluated.

2 Identify and temporarily remove regional influences built into the estimates (for example, labor and utility rate differentials). You may wish to use the Regional Cost Indices to facilitate this effort. You should perform this step even though you will almost immediately reintroduce such factors in Step 4. Remember that most engineering studies are confined to few sites. If you wish to use this data to evaluate a larger number of candidates, then the base cost estimates must be region neutral.

3 Ensure that your standard costs are divided into fixed and variable components. Obtain the assistance of the engineering design group responsible for the estimates, if required, to perform the required segregation.

Appendix IV: Prescriptive Solutions; A numerical illustration of their necessity

An EPM POC case study model relaxes two fundamental constraints in traditional planning models: that of a fixed supply chain and that of a fixed forecast. Adding response functions to a POC model to relax the assumption of a fixed forecast increases the number of scenarios that would have to be run if the solution was to be determined by scenario analysis (i.e., descriptively) (NOTE: These scenarios are in addition those required to evaluate the supply chain scenarios.)

That is the only way to determine, descriptively, which of the various scenarios (which answer the question: "What would happen if we do X?") answers the much more important question: "What is the best X?"

There are three factors in the model which determine the answer to the question. They are Products (P), Objective functions (OF) and Customers (C).
The number of products and objective functions increases the number of scenarios multiplicatively. Unfortunately, the number of customers increases the number of scenarios exponentially. This is because every customer has 2 possible "states:" that of having more demand purchased for them by the model or not having had demand purchased. Thus, the total number of customer demand configurations is 2 to the number of customers.

Two examples demonstrate, overwhelmingly, when descriptive solutions MUST yield to normative for anything like a realistic, actionable model.

1. This yields for the McCoy POC model where P=2, OF = 2 and C = 9, 2 x 2 x 2 to the 9th (= 512) or 2048 scenarios.

2. For a more realistic model where P = 10, OF = 2 and C = 50, the answer is 10 x 2 x 2 to the 50th (= 10 to the 15th) or 2 x 10 to the 16th.

3. When the numbers of possible solutions are expanded to include relaxing the assumption of a fixed supply chain, the case for scenario analysis becomes just that much more absurd. In this case, the integer variables are not absence of presence of a customer responding to a response function. Rather it is the absence of presence of a facility, product, activity, etc in the solution. This increases the possible solutions to, literally, more stars than there are in the universe which is 10 to the 24th.