feature article

Optimizing the Income Statement With Integrated Advanced Analytics To Truly Maximize Profit … and More: Reimaging the Enterprise Master Plan

Alan Dybvig

The author of this article suggests that an optimized income statement (OIS) is the very embodiment of "advanced analytics" and, as such, represents the next generation of financial planning. Further, an OIS assures all the related annual planning application (e.g., Financial Planning and Analysis, Sales and Operations Planning, and Marketing Mix Modeling) are harnessed to the maximally profitable forecast supported by the optimally feasible and sustainable supply chain required for the forecast's fulfillment. Finally, the chief financial officer (CFO) is being increasingly seen as the appropriate person responsible for the employment of advanced analytics. The CFO (1) owns the data, (2) normally uses analytics, and (3) serves as the primary guardian of "representational faithfulness" of reported data.

In the May/June 2014 issue of this journal, an article was published entitled "Enterprise Master Plan: Next-Generation Planning With Activity-Based Costing." The tag line to the article was:

> Imagine relaxing the assumption of a fixed sales forecast to solve for the optimum level of sales and marketing spending that will provide the maximum profit and return on investment. This article and case study explains how. (© 2014 Wiley Periodicals, Inc.)

Since then, two things have conspired to warrant a follow-on article.

1. The article has been honored as one of the top 12 all-time articles published in the *Journal of Corporate Accounting & Finance (JCAF)* and was featured in the "Best of JCAF" May/June 2015 issue.
2. This author realized, since publication, that there were a number of related issues unaddressed in the original article that the *JCAF* readership would probably find informative. Four of them will be detailed in this article:

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2.1. *Advanced analytics*. There is a growing consensus that "advanced analytics" are becoming increasingly critical to effective planning and analysis. An optimized income statement (OIS) is the very embodiment of using advanced analytics for planning, integrating, as it does, predictive analytics with mathematical programming techniques.
2.2. *Responsibility for analytics*. The CFO is the C-level executive who is emerging as most likely to have responsibility for the employment of advanced analytics.
2.3. *Additional OIS benefits*. Beyond *truly maximizing profit*, an OIS has a variety of additional benefits.
2.4. *OIS "proof-of-concept" model results*. Details will elaborate on how effectively an OIS can identify profit opportunities that the traditional planning process is ill-equipped to identify because of its lack of "advanced analytics."

Finally, the author would like to address two clarifications with regard to the first article. The first is that activity-based costing is not an analytic prerequisite for an OIS, as was implied in the original article. The second will explain why the author has changed from describing this next-generation planning capability as an enterprise master plan to that of an OIS.

However, before elaborating on the four issues cited above, for those unfamiliar with the first article, "Enterprise Master Plan: Next-Generation Planning With Activity-Based Costing," a summary of it follows.

The defining book on activity-based planning was the Consortium of Advanced Manufacturing International's (CAM-I) book, *The Closed Loop*. The book described a complicated methodology to reconcile the costs of activities with their financial results in the income statement; no mention was made of maximizing profit or creating an optimal supply chain.

The article then describes the five factors necessary for optimization and how three existing planning techniques, when integrated, can accomplish optimization. They are supply chain network design, marketing mix modeling, and activity-based costing. The supply chain model relaxes the assumption of a fixed supply chain in the income statement, and marketing mix modeling techniques relax the assumption of a fixed forecast. Finally, in a surprise to the authors of the first article, it was discovered that activity-based costing data can provide the costing data required for the network design model.

However, the question remained: Would optimizing an income statement actually work? Would it actually demonstrate *maximum* profitability?

Fortunately, one of the original authors of the article, John Miller, had participated in an activity-based engagement at the McCoy Belt Buckle Company (disguised) recently and still had the data. The article describes the McCoy income statement in some detail, including capacities and other constraints. The results were very revealing, demonstrating that McCoy had left a profit upside on the table of between 25 and 150%, depending on the assumptions in the model.

The article concludes by observing that an OIS:

> … answers the question: "What is the best X?" rather than the descriptive question: "What will happen if X is done?" Thus, the future of financial and operational planning is about solving for what is the *best* X by looking *at every single combination of* sales, costs, constraints (e.g., capacities) and sales and marketing spending that affect the maximum profit, sales and marketing ROI and optimally feasible supply chain.

For those interested, the entire article it is available in the Wiley Online Library at onlinelibrary.wiley/journal/10.1002/(ISSN)1007-0053.

Following is a discussion of the four issues that have come to light since the publication of the first article as well as the two clarifications.

ADVANCED ANALYTICS

Analytics cover a broad spectrum of techniques from simple to complex. One way to characterize the analytics spectrum was the schema used by Brenda Dietrich, IBM Fellow and VP, Emerging Technology, a while back at an Institute for Operations Research and Management Sciences (INFORMS) practitioner conference (Exhibit 1).

A second way is that of Wikipedia's "Business Analytics" article, which adds a fourth characterization to Dietrich's three: descriptive,

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Exhibit 1

ANALYTICS SPECTRUM — Ms Dietrich

• Robust solvers for nonlinear models	Prescriptive
• Computationally efficient methods to respond to new data	
• Use of predictive relationships generated from data	
• Detecting nonlinear predictive relationships	Predictive
• New methods for massive data sets/Parallel Hardware	
• Establishing methods for creating and utilizing meta-data to document assumptions and limitations of models and methods	
• Analysis of streaming data from sensors	Descriptive
• Massive data sets from the "mobile web"	
• Extensions of statistical techniques from manufacturing to other domains	

Source: Brenda Dietrich, 2009

predictive and prescriptive, and decisive (see http://en.wikipedia.org/wiki/Business_analytics#Types_of_analytics).

Finally, a third way to characterize the analytics spectrum is the schema used by Jonathan Hornby, formerly with SAS, one of the foremost analytics companies in the world (Exhibit 2).

The solution technique OIS uses is the one all three schemata agree is the most powerful of the various analytic techniques available, whether described as optimization (Hornby) or by its more precise analytical characterization, mathematical programming (Dietrich and Wikipedia). This is the *only* way to answer the question as phrased by Hornby: "What is the *best* thing that can happen?"

And while Dietrich, Wikipedia, and Hornby describe a variety of other suboptimal analytic techniques, it is critically important to remember that they are just that: suboptimal. Unfortunately, these techniques are all too often described in the trade press as optimal or maximum.

It is the *integration*, then, of optimization with predictive analytics that creates the combination of advanced analytics used by OIS. Optimization allows the relaxation of the assumption of a fixed supply chain in the income statement, and predictive analytics allows the relaxation of the assumption of a fixed forecast.

Historically, these two techniques have always been applied separately and have yielded necessarily suboptimal results. Or as Principia Cybernetica describes it, "Optimizing each subsystem independently will not, in general, lead to a system optimum" (see http://pespmc1.vub.ac.be/ASC/PRINCI_SUBOP.html).

In summary, all three schemata affirm the truly analytically advanced nature of an OIS, which produces *mathematically demonstrable results never before possible:*

1. A truly maximally profitable forecast.
2. An optimally feasible and sustainable supply chain, the one required to make and fulfill the new forecast.

RESPONSIBILITY FOR ANALYTICS

The immediately related question that presents itself is: Which C-level executive should have responsibility for these advanced analytics? Appropriately presaged by Exhibit 2's title, there is a growing consensus that it should be the CFO. This view was first brought to

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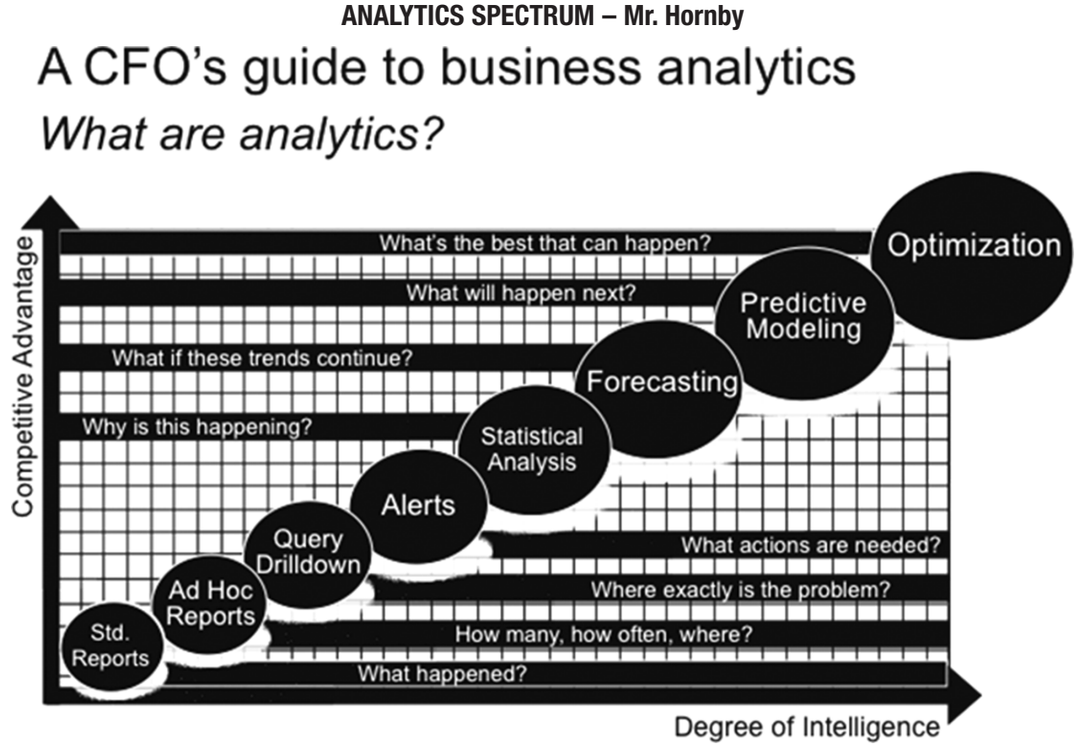
Exhibit 2

ANALYTICS SPECTRUM – Mr. Hornby



the author's attention by an article in the October 29, 2014, issue of *CFO* magazine. It was titled "Why CFOs Should 'Own' Analytics" and was written by Frank Friedman, CEO and former CFO of Deloitte LLP (see http://ww2.cfo.com/analytics/2014/10/cfos-analytics/).

Friedman cites three reasons why analytics, advanced or otherwise, should be under the CFO's leadership:

> First, CFOs "own" most of the unprecedented quantities of data that companies are collecting from their own operations, supply chains, production processes and customer interactions. Many CFOs are already using analytics to better understand where the business is strong and where it needs improvement, and how to allocate limited resources more effectively. Analytics empowers CFOs to exercise more centralized control of operational business decision-making. As profit can fall between the operational cracks, analytics can be a game changer by leading to improved operational discipline.
>
> Second, many CFOs are already using analytics to address their organization's strategic issues. By owning analytics, they can continue to expand their strategic leadership role in growing the top line, strengthen their ties throughout the business and expand their influence outside the finance function.
>
> Third, CFOs' position as the steward of value and impartial guardian of truth across the organization

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gives them the credibility and trust that is needed when analytics produces insights that debunk some of the myths or accepted wisdom that can reside within the business, or about constraints on business performance. When people are provided observations that do not align with their thinking, there is a tendency to say, "That can't be right," and it can be challenging to convince them that the results and the data they're based on are accurate. If they don't trust the messenger, they are unlikely to trust the message.

This author finds all three reasons compelling and agrees with Friedman's conclusion.

ADDITIONAL OIS BENEFITS

In addition to *actually, factually* maximizing profit and creating the optimally feasible and sustainable supply chain required to make and deliver it, other benefits accrue for the firm. To illustrate these benefits, the author assembled the table displayed in Exhibit 3. The CFO performance objectives contained in the exhibits were compiled after reviewing the CFO Compensation Discussion and Analysis section of a number of companies' proxy statements, including Citigroup, IBM, DuPont, Discover, BNY Mellon, Pfizer, GE, and Snap-On.

Finally, for an understanding of how an OIS is created, see Exhibit 4.

OIS "PROOF-OF-CONCEPT" MODEL RESULTS

As described above, a thorough discussion of the company, McCoy Belt Buckle, its financials, and the proof-of-concept model data requirements was provided in the May/June article. However, only passing mention was made of how much the optimization improved actual performance: "When optimized (and depending on the specific scenario), *profit improvements of 25 to 75 percent* would have been possible."

What follows is a clarification of those results, including:

- An actual profit improvement range of 6 to 164%.
- A revenue improvement range of 3 to 28%.
- A sales and marketing ROI improvement range of 27 to 158%.

A significantly simplified model structure was used to create the proof-of-concept model. It included:

- Two products: Custom and standard belt buckles.
- Nine customers:
  - North America area (NA): NY, Dallas, Chicago, Atlanta, and Los Angeles.
  - Europe/Middle Eastern area (E/ME): Rome and Dubai.
  - Far East area (FE): Tokyo and Beijing.
- Two objective functions (i.e., that which is being optimized):
  - Revenue: Volume added if it is profitable but not eliminated if it is not.
  - Profit: Volume is added if it is profitable and eliminated if it is not.
- Response functions (how quantity varies as a function of total sales and marketing spend):
  - One for each of the two products and three areas; +/– 20% sales and marketing spend above/below the baseline expenditures (see note below) for a total of six.
  - It was decided, for reasons outlined below, to add a seventh and eighth to accommodate increasing FE's sales and marketing spend on the upside by +200% for both products.

NOTE: It is important to observe that McCoy, as an iconic brand, was just expanding into the Far East when the activity-based costing engagement was conducted. Further, it had attained very high market share in the other two areas: North America and Europe/Middle East. This is reflected in the sales and marketing expenditures for the three areas and two products: (1) NA standard: $14m and custom: $5m; (2) E/ME standard: $3m and custom: $3m; and (3) FE standard: $2m and custom: $1m.

Thus, it is reasonable to suspect McCoy was continuing to overinvest in the "saturated" markets and underinvest in the "new" markets, particularly in light of the Far East's openness to strong U.S. and European brands such as McCoy. So it is very unlikely the McCoy results are typical of what could be expected. Nonetheless, they are illustrative of an OIS's ability to improve profit, remembering that these are percentages, not basis points!

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Exhibit 3

ADDITIONAL OIS BENEFITS

CFO Performance Objectives Finance-related	*How OIS Allows the CFO to Drive Value*
Financial: 1. Achieve profit plan 2. Achieve revenue plan 3. Evaluate the projected income statement by other criterion other than profit 4. Ability to determine the "sensitivities" of various courses of action 5. Ability to "audit the audit" 6. Ability to answer the unanswerable question: "How much profit is the current income statement leaving on the table?"	1. **OIS** redesigns the projected income statement, as traditionally developed, creating the truly ***maximally profitable one.*** 2. Thus, if unprofitable demand exists, revenue will he reduced (unless **OIS** is forced to accept the unprofitable demand). 3. **OIS** can maximize other financial criteria than just profit including, for example, revenue, economic value, and customer lifetime value. Thus, should these results differ significantly, the firm can then select the criterion that is most suitable for planning purposes. 4. **OIS** uses the most powerful mathematical approach possible to determine the ***truly maximum profitable*** income statement. It answer the question **"What is the best X?"** All other approaches to "sensitivity analysis" answer a very different question. **"What will happen if we do X"** Thus, all such analyses are suboptimal in the face of even a trivial number of different courses of action. 5. **OIS** requires that a baseline model be created from last year's income statement's results. The process of collecting the necessary OPERATIONAL data frequently uncovers errors with the audit. 6. **OIS** answers that question explicitly. As it does, also, were the question, revenue, economic value, or customer lifetime value.
Cross-Functional Leadership: 1. Drive cooperation and collaboration, across the corporation, focused on profit including improvements in: a) Operations b) Sales/Marketing c) Sustainability 2. Concern that the OIS planning application will disrupt all the cross-functional currently installed	1. a) **OIS** is a **process-based operational** model. Thus, unlike financial model (e.g., cash flow, balance sheet) it develops, simultaneously, i) by function (e.g., manufacturing sales, marketing) and ii) by process within function ALL the cross-functional income statement resources required to make and fulfill the new ***maximally profitable forecast.*** This includes, for example, budgets and also any capacity increases required by the new forecast (e.g., capital investments, OT, additional shifts) In summary, all the functions are collectively harnessed to making and fulfilling the ***maximally profitable forecast*** with the optimally feasible operational support (i.e., supply chain). This "optimally feasible operational support" includes addressing simultaneously not only ***truly maximizing profit,*** but also issues such as: • Facility issues for supplier, manufacturing, DC, cross-dock, pool, and port including number, size, location, and ownership. • Facility mission issues including raw material supplier procurement volumes, cost, and limits; manufacturing volumes, costs, capacities, and inventory requirements; distribution center throughput & storage level, operation costs, throughput & storage capacities, and inventory requirements; and port, cross-dock, and pool throughput levels, operating costs, and throughput limits. • Major policy issues including strategic sourcing, target market expansion, international expansion, and supply chain vulnerability.

(Continues)

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Exhibit 3

ADDITIONAL OIS BENEFITS *(Continued)*

CFO Performance Objectives	***How OIS Allows the CFO to Drive Value***
Finance-related	
	b) **OIS** maximizes simultaneously: i) whatever financial criterion was selected (e.g., profit) and ii) maximizes the Sales/Marketing **ROI** by the same criterion. c) **OIS** has the ability to add constraints on both **CO**2 usage and energy consumption. 2. It is very important to understand **OIS** leaves ALL the firm's other annual planning applications (e.g., Financial Planning and Analysis, Sales and Operations Planning, Budgeting, Forecasting) in place. It, simply, assures they are all executing the maximally profitable forecast supported by the optimally feasible and sustainable supply chain.
Strategic: 1. Drive the longer term financial strategies of the corporation with emphasis on long term sustainable financial performance	In a nutshell, the only two differences between a strategic and an annual OIS are: 1. the time horizon: (2-4 years) vs. next year. This obviously means the supply chain can have many more optimization opportunities available since the lead time for supply chain options are much greater at longer planning horizons. 2. the granularity of the model (years vs. months). Thus, there is one enterprise planning model driving the strategic decisions and the tactical; the two are integrated.

Exhibit 4

HOW AN OIS IS CREATED

Integrate the Planning Capabilities of Two Advanced Analytics Companies to Create an *Optimized Income Statement (OIS)*

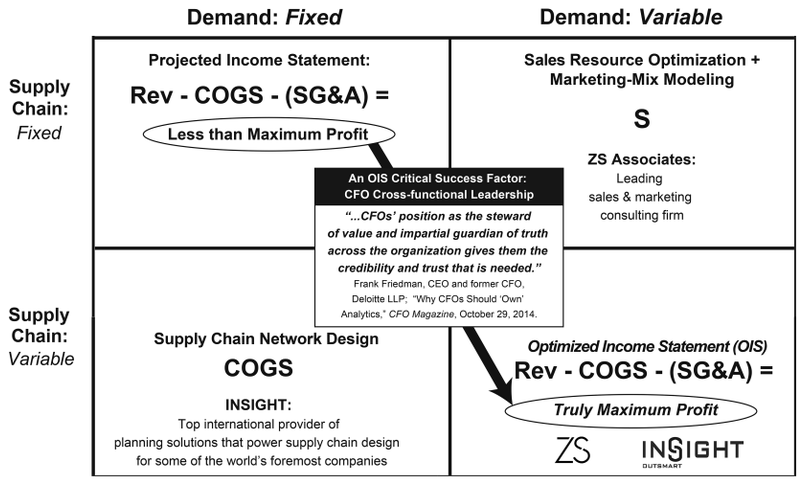

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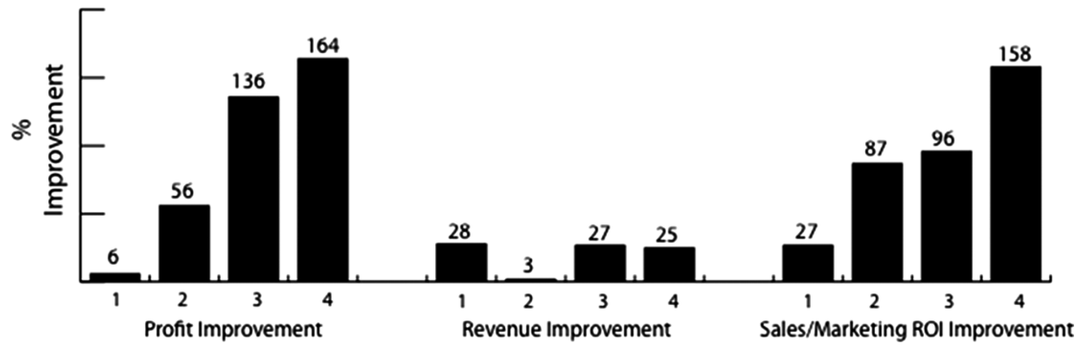
Exhibit 5

RESULTS FROM THE MCCOY PROOF OF CONCEPT OIS MODEL



The results are described in Exhibit 5.

The four cases are defined by what is being optimized and which response functions are used, as follows:

Case 1: Revenue maximized with NA, E/ME, and FE all having the same range of sales and marketing expenditures.

Case 2: Same as Case 1 with profit maximized.

Case 3: Revenue maximized with NA and E/ME having the same range of expenditures as Cases 1 and 2 but with FE having a bigger upside expenditure range (+200%).

Case 4: Same as Case 3 with profit maximized.

CLARIFICATIONS

1. *Activity-based costing*. The first article implied that activity-based costing experience was an analytical prerequisite, along with supply chain network design and marketing-mix modeling.

   This is not the case. An OIS's benefits are available to *all* firms whether or not they have adopted activity-based costing techniques.

   There are a variety of other ways to develop the necessary costing data for an OIS model. They have been used for decades well before the activity-based costing synergy with supply chain network design was unearthed by the authors. Other approaches include:

   - *Accounting*. It is the most popular approach to facility data preparation and is based on a detailed analysis of historical cost accounting records.
   - *Statistical analysis*. One of the most difficult challenges faced 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.
   - *Engineering*. Obtaining engineering cost estimates for each facility type to be evaluated ensures that the standard costs are divided into fixed and variable components.

2. *Updated terminology*. It is now the author's opinion that an OIS more clearly characterizes the value proposition than does an "enterprise master plan," communicating its appeal and usefulness more quickly and succinctly.

That doesn't mean, however, that the concept of an enterprise master plan is irrelevant to the OIS value proposition. Rather, it is just another way to think about next-generation, optimized planning; just another facet to the OIS

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jewel. As was described in the first article:

> The resulting Enterprise Master Plan mathematically assures that the enterprise's other relevant planning applications—e.g., financial planning and analysis (FP&A), sales and operations planning (S&OP) and marketing mix modeling—are aligned to a maximally profitable forecast and an optimally feasible supply chain.

Elaborating, it is also possible to think of the OIS value proposition from a demand standpoint—as an optimized, demand-driven plan. This is because, while the cost functions describe cost of goods sold (COGS) and general and administrative (G&A) costs as a function of quantity, the response functions describe quantity as a function of the *S* of SG&A. So the entire income statement is driven by those sales and marketing expenditures. This elevates the importance of the sales and marketing data used because they are used to create the response functions that are of *critical* importance to the OIS model and thus the annual planning process. (Interested readers are referred to L. M. Cecere and C. W. Chase Jr (2013), *Bricks Matter*, Hoboken, NJ: Wiley.)

Because these demand-driven considerations are central to the OIS's value proposition and, further, will substantially change the dynamics of the annual planning process, it is the author's intent to submit for publication a follow-on article to Wiley, which will elaborate on demand-driven planning considerations. Included will be an elaboration on something the author believes to be near and dear to a CFO's heart: that of quantifying sales and marketing's ROI (see Figure 6).

CONCLUSIONS

As described above, "In summary, all three schemata affirm the truly analytically advanced nature of an OIS, which produces *mathematically demonstrable results never before possible:*

1. The truly maximally profitable forecast.
2. An optimally feasible and sustainable supply chain, the one required to make and fulfill the new forecast."

Further, as observed in the first article:

- An optimized income statement truly represents "next-generation" planning functionality, financially as well as operationally. This article has elaborated on how an OIS provides the CFO with first-time-ever opportunities to take the lead in driving additional value within the firm beyond *truly* maximizing profit (see Exhibit 3).
- OIS "… is not 'new' or 'untested' science." It is simply the integration of two different and robust sets of analytics that have been commercially successful for decades (see Exhibit 4), albeit, as noted earlier, with suboptimal results as they have been applied separately, never integrated as they are in an OIS.

Finally, OIS works (see Exhibit 5).

Readers interested in more details should contact either Jeff Karrenbauer or Alan Dybvig (see below for contact information).

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