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MISSOURI PUBLIC SERVICE COMMISSION

CASES NO. HC-2012-0259 and HC-2010-0235

REBUTTAL TESTIMONY

OF

NADA R. SANDERS, Ph.D.

ON BEHALF OF

KCP&L GREATER MISSOURI OPERATIONS COMPANY

Kansas City, Missouri
June 2013

" [redacted] **" Designates "Highly Confidential" Information Has Been Removed Pursuant To 4 CSR 240-2.135.**

REBUTTAL TESTIMONY

OF

NADA R. SANDERS, Ph.D.

Cases No. HC-2012-0259 and HC-2010-0235

Q: Please state your name and business address.

A: My name is Nada R. Sanders and my business address is 312 Saucon View Drive, Bethlehem, Pennsylvania 18015.

Q: On whose behalf are you testifying?

A. I am testifying on behalf of KCP&L Greater Missouri Operations Company ("GMO" or the "Company").

Q: Please state your educational background and describe your professional training and experience.

A: I am Professor of Supply Chain Management in the Department of Management at Lehigh University, Bethlehem, Pennsylvania where I hold the Iacocca Chair in Supply Chain Management. I hold a Bachelor of Science degree from Franklin University, and an M.B.A. and a Ph.D. from Ohio State University. A copy of my curriculum vitae is attached as Schedule NRS-1.

Q: Have you previously testified before the Missouri Public Service Commission ("Commission") or other utility regulatory agencies?

A: No. However, I have provided deposition testimony as an expert witness in a proceeding filed in the United States District Court for the Central District of California, Southern Division.

Q: What is the purpose of your Rebuttal Testimony?

A: The purpose of my testimony is to respond to the criticisms offered by Donald E. Johnstone on behalf of Ag Processing, Inc. ("AGP") in his Supplemental Direct Testimony (May 15, 2013), as well as his earlier Direct and Rebuttal Testimony in both Cases No. HC-2010-0235 and HC-2012-0259 regarding the forecasting efforts of GMO and its predecessor Aquila, Inc. ("Aquila"). Such forecasting related to the expected steam usage by the industrial customers of the Lake Road Plant in St. Joseph, Missouri, and the use of the forecasting data in the operation of the natural gas hedging program for steam operations ("hedging program").

Q: What does AGP contend?

A: AGP contends through Mr. Johnstone that there is an "area of silence" in the record in regard to "Aquila's forecast of its natural gas usage and the related uncertainty. There is no forecast witness, only witnesses that provided input or accepted the output." See Johnstone Rebuttal at 3:9-11 (HC-2010-0235) (Nov. 5, 2010). My testimony is intended to provide for the Commission a better understanding of the role of forecasting principles and practices. Mr. Johnstone contends that "it was Aquila's responsibility to develop a credible forecast of customer load … [and] fuel requirements." Id. at 19:19-21. However, it was the responsibility of AGP and the other steam customers to provide accurate estimates of their steam demand to their supplier. In this case, it was prudent for Aquila to attempt to satisfy the volumetric forecast of its customers through the hedging program that mitigated costs flowing from customer over-estimates.

Q: Based upon your study of the record, what are your conclusions?

A: I have concluded that:

(1) Forecasts relying on customer information are generally prudent. Aquila's reliance on customer steam demand projections in preparing fuel budgets is consistent with forecasting industry standards and best practices. The opinion of AGP that Aquila should have second-guessed the demand projections of its customers would have placed Aquila in an untenable position. Moreover, such opinions are inconsistent with academic literature and best industry practices.

(2) Forecast errors do not mean that the forecasting was imprudent. Virtually all forecasts include errors. Based upon my review of the record, Aquila's forecasting practices were prudent.

(3) The One-Third Hedging Strategy Program ("One-Third Strategy") employed by Aquila was a prudent method to mitigate price volatility. The design of the One-Third Strategy is consistent with forecasting literature and best industry practices.

Q: Based on your experience and expertise, what is forecasting?

A: Forecasting is the process of predicting future events.[1] Any time we try to predict future events we are forecasting. Forecasts are rarely perfect.[2] Forecasting the future involves uncertainty. Therefore, it is almost impossible to make a perfect prediction. In this case, forecasting has been used to predict the volume of natural gas needed to provide estimates of steam use. Hedges were placed based on this forecasting and used to average the price of natural gas purchases.

[1] *See generally* NADA R. SANDERS, SUPPLY CHAIN MANAGEMENT: A GLOBAL PERSPECTIVE (2011).

[2] *See generally* R. DAN REID & NADA R. SANDERS, OPERATIONS MANAGEMENT (5th ed. 2012).

Q: Does forecasting play a proper role in Aquila's fuel budget design?

A: Yes. The ability to accurately forecast future demands has always been an important organizational capability for suppliers such as Aquila. In current business environments, supply chains are characterized by high uncertainty and short response times, making forecasting a more critical function than ever for suppliers. Today forecasts drive entire supply chains and enterprise resource planning systems. Increasing the accuracy of forecasting requires the use of composite methodologies that incorporate a range of information from multiple sources. Forecasting according to industry best practices played a key role in Aquila's preparation of fuel budget estimates and the design of its hedging program to dampen the price volatility of natural gas.

I. FORECASTS RELYING ON CUSTOMER INFORMATION ARE GENERALLY PRUDENT

Q: Should a company rely on customer estimates as the primary source of information for forecasting and demand planning?

A: Yes. Suppliers depend on customer estimates in large part—if not exclusively—to make procurement decisions.

Q: What is your view of Mr. Johnstone's testimony that the estimates of the steam customers contained problems that were known by Aquila in that they over-estimated steam demand?

A: While it appears that Aquila employees were aware of some problems with customer estimates, this knowledge was always after-the-fact. There was apparently a lack of integrity on the part of the customers' steam demand estimates at various times. However, Aquila was forced to rely on this imperfect information and to take the estimates at face value when planning for future usage. "While the physical volumes did

not always tie out to the budgeted forecasts, there was never any intention to use inaccurate data nor would Aquila have any incentive to use volumes other than those that were best available at the time." See Gottsch Direct Testimony at 13:16-20 (HC-2010-0235) (Oct. 22, 2010). Indeed, "Aquila employed its reasonable steam hedge program with the expectation that the forecasted volumes supplied to it by its steam customers were accurate." Id. at 16:2-4.

Mr. Johnstone contends that Aquila ignored "known problems" associated with "customer forecasts of their own load." See Johnstone Direct at 3:31-32 (HC-2012-0259) (June 1, 2012). However, that is not the case. Aquila could only know that customer estimates were inflated after-the-fact, yet Aquila nonetheless prudently factored the risk of customer over-estimates into its One-Third Strategy.

Additionally, in the situation of a regulated public utility like Aquila, where insufficient supply could result in significant threats to system reliability and costly business interruptions for its customers, it is more prudent to assure a sufficient supply of gas at a reasonable cost that is adequately hedged. "Because Aquila had a duty to provide reliable service to its steam customers, it was bound by the steam load information that its customers provided to it." See Gottsch Direct at 13:16-20 (HC-2010-0235) (Oct. 22, 2010). Therefore, the only prudent course for the supplier in such a situation is to make certain that there is sufficient supply, while mitigating price volatility, to ensure that none of its customers experiences a costly supply disruption. Whatever costs are associated with assuring the supply of gas may be considered an investment into the avoidance of business interruption resulting from insufficient supply at an un-hedged or under-hedged price.

Q: Between a corporate customer and a utility provider, who is in a better position to determine future demand?

A: The customer. Mr. Johnstone admits that "new or expanded loads are difficult to predict," yet he assumes that the utility supplier will somehow know better than the customer what actual loads will be. See Johnstone Direct at 3:33 (HC-2012-0259) (June 1, 2012). This is an unreasonable assumption. If an industrial customer cannot accurately predict how much steam it will consume, the utility supplier is in no better position to do so. Furthermore, Mr. Johnstone offers no opinions regarding how Aquila could have successfully accessed confidential intelligence about the future business operations of its customers.

Q: Given that it is reasonable to rely on customer demand estimates, did Aquila appropriately engage its customers on the question of steam demand?

A: Yes. From what I have reviewed in the record, there were multiple points of contact between Aquila the supplier and its customers. See Rush Direct at 11:3-9 (HC-2010-0235) (Oct. 22, 2010); Fangman Direct at 5-7 (HC-2010-0235) (Oct. 22, 2010); Fangman Rebuttal at 4-6 (HC-2012-0259) (July 2, 2012). Such contacts between supplier and customer are common in industry to ensure that customer information and feedback is internalized by the supplier. Aquila's practices for sharing information and collaborating with customers on future needs are supported by the academic literature on forecasting and supply chain management.

Q: What does the pertinent academic research say about sharing demand information?

A: There has been an active stream of research on the value of information sharing.[3] When customers have an incentive to provide accurate information about demand, then relying on customer information is the best way to reduce the uncertainty of forecasting. A combination of information sharing between supply chain partners and order postponement, such as the One-Third Strategy's use of option contracts and spot prices for a portion of its natural gas procurement portfolio, is a viable method to improve the performance of the supply chain.[4]

The benefits of information sharing have been demonstrated through sophisticated modeling.[5] Customers must provide the supplier with accurate information; customers that provide bad information to their suppliers without accountability cause inefficiencies in supply chains. Suppliers must be able to trust customer estimates of demand.[6] Trusting customer estimates is necessary to reduce transaction costs and to effectively coordinate a supply chain.

Research consistently supports information sharing as being integral to a firm's performance.[7] Multiple research efforts have associated buyer/supplier collaborative strategies, including information sharing on the part of buyers, with increased firm

[3] Hau L. Lee, V. Padmanabhan, S. Whang, *Information Distortion in a Supply Chain: The Bullwhip Effect*, 43 Management Science 546-58 (1997).

[4] Li Chen & Hau L. Lee, *Information Sharing and Order Variability Control Under a Generalized Model*, 55 MANAGEMENT SCIENCE 781, 781-97 (May 2009).

[5] Yossi Aviv, *Gaining Benefits from Joint Forecasting and Replenishment Processes: The Case of Auto-Correlated Demand*, 4 MANUFACTURING & SERVICE OPERATIONS MANAGEMENT 55, 55-74 (Winter 2002).

[6] Jeffrey K. Liker & Thomas Y. Choi, *Building Deep Supplier Relationships*, 82 HARVARD BUSINESS REVIEW 104, 104-22 (Dec. 2004).

[7] Antony Paulraj, Augustine A. Lado, Injazz J. Chen, *Inter-Organizational Communication as a Relational Competency: Antecedents and Performance Outcomes in Collaborative Buyer–Supplier Relationships*, 26 JOURNAL OF OPERATIONS MANAGEMENT 45, 45-64 (Jan. 2008).

operational performance. Trust improves operational performance, which is manifested in reduced transaction costs for buyers and suppliers, and increased supply chain efficiencies that benefit both buyers and suppliers. It is imperative that suppliers are able to rely on information provided by buyers in order to meet buyers' projected needs, especially where the supplier does not have the option to decline service.[8]

Q: Was Aquila's forecasting process consistent with these principles?

A: Yes. The forecasting process that went into the development of each annual steam budget is consistent with forecasting best practices. They were based on historical data and customer projections. See Fangman Direct at 4:12-15 (HC-2010-0235) (Oct. 22, 2010); Fangman Rebuttal at 3:16-20 and 9:4-13 (HC-2012-0259) (July 2, 2012); Nelson Rebuttal at 3-5 (HC-2012-0259) (July 2, 2012). "Forecasts were periodically revised to reflect changes in steam customer anticipated load requirements." See Fangman Direct at 3:9, 19-20 (HC-2010-0235) (Oct. 22, 2010). "It is in GMO's and its customers' interest to assure that new loads can be served reliably, safely, timely, and cost effectively. GMO has to be prepared to provide energy when customers need it at the volumes needed." See Fangman Rebuttal at 9:8-10 (HC-2012-0259) (July 2, 2012). "[I]t is the customers who have the detailed information on these [expansion] projects, which allows them to determine their monthly load projections and in-service dates …. While customer forecasts of their own loads are not always perfect, the industrial Lake Road Plant customers are the experts regarding their steam needs. Steam utilities such as GMO are not. GMO's steam customers are familiar with their own operations and either have the expertise in house or hire expert contractors to determine their steam needs. GMO relies

[8] Gérard P. Cachon & Martin A. Lariviere, *Contracting to Assure Supply: How to Share Demand Forecasts in a Supply Chain*, 47 MANAGEMENT SCIENCE 629, 629-46 (May 2001).

on that expertise regarding the activities on the customer side of the meter." See Fangman Rebuttal at 9:12-22 (HC-2012-0259) (July 2, 2012). Such reliance is reasonable and consistent with industry best practices.

Q: Was Aquila's use of customer estimates for forecasting and demand planning consistent with best industry practices?

A: Yes.

Q: If customers provide bad estimates and bear no responsibility for the outcome, does this diminish their incentive to provide accurate projections of demand?

A: Yes. The complaints brought by AGP, to the extent accepted by the Commission in its prior Report and Order, shift the cost of customers' inaccurate demand projections to the utility supplier, thereby removing any incentive for the customers to provide accurate projections and unfairly punishing Aquila for prudently relying upon its customers' projections.

This situation is analogous to the "prisoner's dilemma" in economic game theory in which two entities might not cooperate, even if it is in their best interests to do so. When there is no contractual obligation for the customer to purchase what it has forecasted, the customer has no incentive to provide accurate forecasts.[9] "Fearing inflated forecasts, the supplier might prefer to delay its actions to a point in time when the buyer is willing to commit to its forecast. This setup shares many similarities with the classical prisoner's dilemma."[10] According to empirical studies, suppliers tend to penalize buyers for unreliable forecasts by providing lower service levels, whereas buyers

[9] Gérard P. Cachon & Martin A. Lariviere, *Contracting to Assure Supply: How to Share Demand Forecasts in a Supply Chain*, 47 MANAGEMENT SCIENCE 629, 629-46 (May 2001).

[10] Mohammad M. Ali, John E. Boylan, & Aris A. Syntetos, *Forecast Error and Inventory Performance Under Forecast Information Sharing*, 28:4 International Journal of Forecasting 830 (2012).

tend to penalize suppliers with a history of poor service by providing them with overly inflated forecasts.[11] In a free market this tendency is reasonable. If the seller cannot depend upon the buyer to make good on its projected needs, then the seller will reduce its risk of over-stock by providing less than what is forecasted. However, Aquila is a regulated public utility, responsible for providing adequate steam to its customers and no less. Aquila did not have the option of providing lower service levels.

On the other hand, if the buyer cannot depend upon the seller to fulfill its order volume, then it will inflate its needs to ensure that the seller comes prepared. There is no indication that Aquila has ever failed to provide an adequate supply of steam, therefore, it is not likely that customers would provide inflated forecasts as a matter of compensating for supply risks. Instead, it appears that the over-inflation which came from customers was the result of optimism bias.

Business did not grow as much as certain customers had optimistically forecast, but it is not fair for Aquila to bear the cost of this optimism bias. The complaints brought by AGP are an attempt to shift the cost of the customers' business uncertainty to their utility provider. Aquila chose honorably in the prisoner's dilemma and is now being "punished" by the accusations of imprudence in these complaints.

Aquila prudently accepted its customers' estimates at face value rather than discounting their steam demand projections and risking an interruption to their business. Buyer/supplier forecasting cooperation is necessary to avoid the prisoner's dilemma. Buyer/supplier coordination and cooperation is characterized by the buyer sharing

[11] Id.

accurate information and the supplier being able to trust that forecast.[12] Unless the buyers are required to pay for the consequences of the amounts that they predicted they would need from the supplier, the buyers will continue to externalize the risks created by their unreliable forecasts, causing waste and inefficiency.

II. FORECAST ERRORS DO NOT INDICATE IMPRUDENT FORECASTING

Q: Do forecast deviations from actual values contribute to imprudence?

A: No. Mr. Johnstone contends that forecast deviations from actual values are a contributing factor toward imprudence. See Johnstone Direct at 3:23-25 (HC-2012-0259) (June 1, 2012). This is simply not the case. The prudence of a forecasting method cannot be evaluated solely based on the accuracy of its results. Indeed, it is typical, common, and expected for actual values to be different than forecasted values.

In this case "volume uncertainty is one of the risks that is managed by GMO's One-Third Strategy natural gas hedging program." See Blunk Rebuttal at 15:20-21 (HC-2012-0259) (July 2, 2012). Indeed, the variation between forecasted and actual demand were not unreasonable. "In fact, for 2009, final natural gas usage for the steam customers was 1,051,497 mmbtus versus the April 2008 budget forecast of 1,465,837 for calendar year 2009. This is 71% of forecast, hardly far from the mark when one considers all the variables at play." See Gottsch Rebuttal at 11:9-12 (HC-2012-0259) (July 2, 2012).

Mr. Nelson notes: **[redacted]

[12] Id.

[redacted]** See Nelson Rebuttal (HC) at 9:6-9 (HC-2012-0259) (July 2, 2012). If anyone had a problem with forecasting accuracy, it was not Aquila, but rather AGP.

Furthermore, in reference to 2009 volumes, GMO witness Wm. Edward Blunk states: "GMO ended up hedging about 74 percent of its actual natural gas requirement. Considering the uncertainty in burn projections, that is quite close to its target of 66 percent." See Blunk Rebuttal at 16:20-22 (HC-2012-0259) (July 2, 2012). "The volume of GMO's hedges are a mere 10 percent off from what they would have been with perfect clairvoyance." Id. at 17:2-3.

The timing of two environmental factors beyond the control of GMO/Aquila must also be considered, specifically: (1) the disruption of offshore natural gas production by Hurricanes Katrina and Rita in 2005, and (2) the technology breakthrough of high-volume horizontal hydraulic fracturing that unlocked tremendous amounts of natural gas from shale formations throughout the United States.[13] These are more likely causes of AGP's losses than Aquila's forecasting.

Q: How accurate should forecasts be?

A: The question of how accurate forecasts should be does not have a universal correct answer. The reason is that there are many factors that impact variability. According to George Palmatier, author of Demand Management Best Practices, how accurate a given forecast should be is not a simple proposition. "This is not an easy question to answer because there are many variables which need to be taken into consideration in answering that question (e.g., volume of business, number of items for sale, number of customers, average order size, frequency of ordering, number of options and permutations of

[13] For industry reporting on these two environmental factors, refer to Schedules GLG-4, GLG-5, GLG-6, and GLG-7, attached to the Direct Testimony of Gary L. Gottsch (2010).

products, number of distribution centers, pricing policy, numbers of new products, etc.)."[14]

"Previous research has shown that the forecast accuracy is to be distinguished from the performance of the forecasts when utility measures are employed. This is particularly true in an inventory management context, where the interactions between forecasting and stock control are not yet fully understood."[15] A forecast may well perform its intended purpose of reducing risk or uncertainty, even if it is not accurate. It would be inappropriate to second-guess the prudence of Aquila's sophisticated forecasting methodology when the literature on the subject admits that forecasting and inventory management dynamics are "not yet fully understood." In other words, companies must do their best to forecast customer needs based on available information, but companies are not expected to be clairvoyant. The use of forecasting for demand planning is a hallmark of prudent supply chain management. This is so even when forecasts produce inaccurate results.

Q: Why can't forecasts be perfect or near-perfect?

A: A fundamental principle of forecasting is that forecasts are almost never perfect because of natural variations in any data set.[16] The goal of forecasting as a strategic and risk management business function is to generate acceptable average predictions over time, not necessarily to make accurate predictions every time. Further, the risks of under- or over-forecasting depend upon what is being forecasted.

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[14] George E. Palmatier, *Forecast Measurement and Evaluation* at 4 (The Oliver Wight White Paper Series, 2010), available at: http://georgepalmatier.com/white-papers/whitepapers_forecast_measurement_evaluation_white_paper.pdf.

[15] Mohammad M. Ali, John E. Boylan, & Aris A. Syntetos, *Forecast Error and Inventory Performance Under Forecast Information Sharing*, 28:4 International Journal of Forecasting 830 (2012).

[16] *See generally* Reid & Sanders, *supra* note 2.

Q: Which is the prudent forecasting distribution: zero error (just enough supply at the average best cost); negative error (insufficient supply on average), or positive error (more than sufficient supply at a higher cost on average)?

A: A positive forecasting error, whereby Aquila assures an adequate volume of natural gas, is indisputably the most prudent forecast distribution given the costs of insufficient supply. While some procurement situations call for forecasts that average zero errors, others call for a more conservative approach whereby the lowest quartile values are still above zero. In the case of steam supply, any volume forecast error less than zero could lead to damaging business disruptions on the part of Aquila customers that depend on adequate steam supply for critical operations. "Reliability [of steam supply] is one of the most critical factors for the steam customers …. [I]f the steam service is interrupted for any reason, even for a moment, it can cause significant problems for their operations, both in time and production costs." See Rush Rebuttal at 8:17-20 (HC-2012-0259) (July 2, 2012).

In such a situation the goal of forecasting is not to assure a supply of only so much gas as needed and nothing more because the lowest quartile of procurement installments would be below zero, disrupting the supply chain. Rather, for Aquila, a prudent forecasting methodology will result in an average forecasting error above zero, whereby adequate volumes of gas at a higher cost are virtually certain to meet actual customer requirements. Because of the risk of business interruption resulting from insufficient steam supply, it was more prudent for Aquila to err on the side of caution, even if this meant assuring gas supply at a greater volume or cost than what was actually

required by its customers. See Rush Direct at 11:16-19 (HC-2010-0235) (Oct. 22, 2010) ("Customers do not have an alternative if the Company is unable to meet their needs.").

That being said, it is impossible to claim that there is an ideal forecast error in all situations. Forecast errors vary based on numerous factors. One is the level of aggregation. Statistically speaking, highly aggregated data (formed by a collection of entities) is less variable than disaggregated data (data from a single entity). Forecasts for aggregated data, such as predicting the GDP of nations representing millions of entities, have much lower variability than forecasts for disaggregated data, such as the steam load of five or six customers.

Another factor in forecast accuracy relates to the nature of the item being forecasted, and the number and variability of exogenous variables that have an impact on it. Aquila was tasked with making predictions under relatively extreme informational constraints, and what information was available to predict both natural gas prices and the volume of actual steam demand was highly variable, disaggregated data. Asking for less conservative and more accurate forecasts under these circumstances is asking for heroics.

Q: Is it reasonable to expect the Company's forecasts to be perfectly accurate?

A: No. Arguments that Aquila should have planned for the supply of less gas than that suggested by its forecasting methods, but not so much less than would be necessary to provide adequate steam to all of Aquila's customers begs the question: How much gas is needed?

How is Aquila supposed to predict how much gas to purchase? It does so by using forecasting methods. Are forecasting methods perfect? No. How are imperfect forecasts remedied? One way is through a hedging program that manages for forecast

uncertainty. This is precisely the strategy taken by Aquila. Moreover, the One-Third Strategy hedging program was prudently designed to mitigate price volatility.

III. THE ONE-THIRD STRATEGY HEDGING PROGRAM WAS PRUDENT FOR PRICE AVERAGING

Q: Was the One-Third Strategy hedging program prudent?

A: Yes. Aquila's market-neutral One-Third Strategy hedging plan created a tripartite portfolio whereby the volumetric forecast is fulfilled by procuring gas in equal portions of NYMEX swaps, options, and real-time spot prices. "The hedging plan is executed by purchasing one-third of the monthly forecast quantity, for each month over a 28 month period, proportionally procured in fixed price financial contracts. An additional one-third of the monthly forecast quantity is proportionally procured using options (primarily participatory collar) form and the remaining one-third of the monthly forecast quantity will be purchased at the then prevailing daily market indexes (i.e., floating with the market)." See Blunk Direct, Schedule WEB-5 at 2 (Feb. 25, 2005) (HC-2010-0235) (Oct. 22, 2010).

The One-Third hedging approach is designed to "result in an average market cost over an extended period of time." Id., Schedule WEB-4 at 1. "This approach dampens the effect of rapidly rising or declining markets on the system fuel, specifically natural gas, and on-peak purchased power costs." See Blunk Direct, Schedule WEB-5 at 1 (HC-2010-0235) (Oct. 22, 2010). "When prices are rising the hedge program will reduce costs by producing offsetting gains. When prices are falling, the hedge program will produce offsetting costs." See Gottsch, Direct at 5:5-7 (HC-2010-0235) (Oct. 22, 2010). The "program can best be identified as a dollar cost averaging hedge program used to mitigate price volatility at the time of an unstable market." Id. at 9:17-18.

Aquila's method of averaging the cost of natural gas utilized three distinct transaction types (fixed price futures contracts, option contracts, and the spot price), at equal volumes priced according to these three distinct approaches, and realized at three distinct time periods. This composite pricing method is consistent with the classical combined approach for averaging prices. As will be demonstrated, this approach is consistent with academic literature on forecasting and forecasting industry best practices.

Q: Is the design of the One-Third hedging strategy supported by academic literature?

A: Yes. Standard forecasting takes place on a piecemeal basis, whereby one value is forecasted based on a limited universe of information. The 1/3 approach to hedging natural gas prices is analogous to forecast combining, which is both more sophisticated and more accurate than relying on one approach alone. Forecast combining has a long history in the forecasting literature, represents well-documented best practices, and is considered a prudent way to forecast.[17]

The key principles for combining forecasts, which is analogous to combination of approaches used in the One-Third Strategy, are as follows:

- Combining is most useful when each value is derived through different methods;
- Combining is needed when there is uncertainty as to the best approach;
- Combining is appropriate where uncertainty and volatility characterize the situation;
- Combining is prudent when there are high costs for large forecast errors.

As discussed below, all of these key principles apply to the One-Third Strategy used by Aquila.

[17] *See generally* PRINCIPLES OF FORECASTING: A HANDBOOK FOR RESEARCHERS AND PRACTITIONERS 417-40 (J. Scott Armstrong ed. 2001).

Q: What is the benefit of forecast combining, and how is it analogous to the One-Third Strategy?

A: To improve accuracy, forecasters can combine forecasts derived from methods that differ substantially and draw from different sources of information.[18] Combining, sometimes referred to as composite forecasts, refers to averaging of independent forecasts. These forecasts can be based on different data or different methods or both. The averaging is done using a rule that can be replicated, such as taking a simple average. The One-Third Strategy used by Aquila to procure natural gas (consisting of one-third fixed price futures, one-third option contracts, and one-third spot price) is known as the ***equal-weight rule***, and it offers a reasonable solution.

Combining is especially useful when one is uncertain about the situation, uncertain about which approach is most accurate, and when large errors would be especially costly. Compared with errors of the typical individual approach (which would be the case had Aquila relied solely on the natural gas spot market, for example), combining reduces errors. Under ideal conditions, combined forecasts were sometimes more accurate than their most accurate components.

Using different approaches (such as the One-Third Strategy's use of fixed price futures contracts, option contracts, and the spot price) is a good rule. Combined forecasts based on diverse assumptions reduce errors.[19] High uncertainty calls for combining forecasts.[20] Combining is especially useful when you are uncertain which method is best.

[18] Id.

[19] Id.

[20] Id.

Combining is also best when it is important to avoid larger errors. Thus, combined forecasting is useful when large errors might have especially serious consequences.

Combined forecasts are more accurate than the typical component forecast in almost all studies to date. Sometimes the combined forecast even surpasses the best model. In a seminal forecasting study, the accuracies of three models were compared with that for combined forecasts, revealing consistent improvements with combining.[21]

The practice of combining has become a standard in the forecasting literature and continues today. In summary, the foregoing literature supports the notion that averaging achieved through combining or composite approach such as that employed in Aquila's One-Third Strategy, is prudent.

Q: Is the design of the One-Third Strategy consistent with best industry practices for dampening volatility?

A: Yes.

Q: Is the implementation of the Company's natural gas procurement strategy consistent with best industry practices for reducing price volatility?

A: Yes. In addition to hedging the price of natural gas, Aquila also adjusted its volumetric forecasts to account for real-time information changes. "If there are significant changes in key inputs to the volumetric forecast for natural gas and on-peak purchased power such as the cost of natural gas, the cost of on-peak purchase power, scheduled unit availability or whenever directed by the Commodity Risk Management, Energy Resources will re-run the fuel budget model. These re-runs of the model will be done no less frequently than three months of the prior (re)run. The resulting new forecasted natural gas and on-peak

[21] Spyros Makridakis & Robert L. Winkler, *Averages of Forecasts: Some Empirical Results*, 29 MANAGEMENT SCIENCE 987, 987-96 (Sept. 1983).

purchase power natural gas equivalent quantities will then become the new-targeted procurement quantities. Energy Resources will then adjust its purchasing to meet the new target quantities." See Blunk Direct (HC-2010-0235) (Oct. 22, 2010), Schedule WEB-5 at 2-3 (Feb. 25, 2005). These implementation practices are consistent with best industry practices and are prudent.

Q: Does that conclude your testimony?

A: Yes.

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

Ag Processing, Inc., Complainant,	)	
	)	Case No. HC-2010-0235
v.	)	Consolidated With
	)	Case No. HC-2012-0259
KCP&L Greater Missouri Operations Company, Respondent.	)	

AFFIDAVIT OF NADA R. SANDERS, Ph.D.

STATE OF Florida)
) **ss**
COUNTY OF Palm Beach)

Nada R. Sanders, Ph.D., being first duly sworn on her oath, states:

1. My name is Nada R. Sanders, Ph.D. I have been retained by KCP&L Greater Missouri Operations Company ("GMO") to serve as an expert witness to provide testimony on behalf of GMO.

2. Attached hereto and made a part hereof for all purposes is my Rebuttal Testimony on behalf of GMO consisting of twenty three (23) pages, having been prepared in written form for introduction into evidence in the above-captioned docket.

3. I have knowledge of the matters set forth therein. I hereby swear and affirm that my answers contained in the attached testimony to the questions therein propounded, including any attachments thereto, are true and accurate to the best of my knowledge, information and belief.

Nada R. Sanders

Nada R. Sanders, Ph.D.

Subscribed and sworn before me this 13 day of June, 2013.

Georgette Quick

Notary Public

My commission expires: Oct 11, 2016

GEORGETTE QUICK
Notary Public - State of Florida
My Comm. Expires Oct 11, 2016
Commission # EE 842832

NADA R. SANDERS

IACOCCA CHAIR AND PROFESSOR OF SUPPLY CHAIN MANAGEMENT

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College of Business and Economics
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EDUCATION

Ph. D., The Ohio State University, Fisher College of Business, l986.
Major: *Operations Management*
Minor: *Logistics*
Dissertation Title: *Forecasting Short Term Demand in the Physical Distribution Environment*

M.B.A., The Ohio State University, Fisher College of Business, l981.

B.S., Franklin University, l978.
Major: *Mechanical Engineering*

ACADEMIC EXPERIENCE

Lehigh University.
Iacocca Chair and Professor of Supply Chain Management, 2009 – Present

M. J. Neeley School of Business, Texas Christian University.
Professor and James L. and Eunice West Chair in Supply Chain Management, 2007 – 2009
Research Director, Supply and Value Chain Center (SVCC), 2007 – 2009

Raj Soin College of Business, Wright State University.
Professor of Operations Management, l997 - 2007
Associate Professor of Operations Management, 1992 – 1997
Assistant Professor of Operations Management, 1988 - l992

AWARDS, HONORS AND RECOGNITIONS

• Best Paper Award *Decision Sciences*, "Managing Differentiation-Integration Duality in Supply Chain Integration," (with S. Terjesen and P. Patel), 2012

• Recipient, Beidelman Research Award, Lehigh University; for highest quality research, 2012

• MBA Professor of the Year, Lehigh University, 2012

• Fellow, *Decision Sciences Institute*, 2008- Present

• *Senior Legacy Professor*, M.J. Neeley School of Business, TCU; honor given for providing significant impact on students, 2008

• Invited participant at *The Gordon Cook Conversations* at Windsor Castle;
This retreat brought together a small diverse group of international leaders identified to have 'star quality' in order to develop strategies to impact society in the coming decade;
Windsor Castle, Windsor, UK, May, 2008 (*www.gordoncookconversations.com*)

• Ranked in the *top 8 percent* of individuals in the field of operations management from a pool of 738 authors and 237 different schools by Young, Scott T., Baird, Brad C. and Pullman, Madeleine E. "POM Research Productivity in U.S. Business Schools," *Journal of Operations Management*, Volume 14, l996, 41-53

• Co-Founder and Associate Editor, *Foresight: The International Journal of Applied Forecasting*, a journal of the *International Institute of Forecasters* (www.forecasters.org), 2004 – 2010.

• General Chair, *Production and Operations Management Society (POMS)*, 19th annual conference, La Jolla, CA, 2008

• Program Chair, *Production and Operations Management Society* (*POMS*), 17th annual conference, Boston, MA, April 28 – May 1, 2006

• Board of Directors, *International Institute of Forecasters*; 2006-2010

• Board of Directors, *Production Operations Management Society*, 2007-2010

• Board of Directors and Executive Committee Member, *Decision Sciences Institute*; 2003-2006

• Facilitator in donation and naming of the Raj Soin College of Business, by providing pro bono consulting services to MTC Corporation (with R. Premus; Dayton, Ohio), l998-l999.

• Distinguished Research Award for "Differentiating Purchasing Practices of Firms Based on Information Technology Use," (with R. Premus), from *Allied Academies*, April, 2004

• Outstanding Scholarship Award, Raj Soin College of Business, Spring, 2004

• Distinguished Research Award for "A Framework for Strategic Sourcing," (with R. Premus), from *Allied Academies*, April 2003

• Distinguished Research Award for "Supply Chain Management Practices of Firms: A Function of IT Capability," (with R. Premus), from *Allied Academies,* April, 2002

• Outstanding Scholarship Award, Raj Soin College of Business, Spring, l998

• *Women's Advancement Award Certificate of Recognition* from Wright State University, l997

• *Belinda Burns Outstanding Scholar Award*, Raj Soin College of Business, Wright State University, l995-l997

• Outstanding Teacher Award, ISOM Department, Raj Soin College of Business, 2007

• Outstanding Teacher Award, Raj Coin College of Business, l992

• Outstanding Teacher Award, ISOM Department, Raj Soin College of Business, l991

• Outstanding Teacher Award, Raj Soin College of Business, l998

• Doctoral Dissertation Award, Council of Supply Chain Management Professionals (CSCMP), formerly Council of Logistics Management (CLM) and the National Council of Physical Distribution (NCPD), l984

• Member of the *Phi Kappa Phi* Honor Society

• Member of the *Beta Gamma Sigma* Honor Society

RESEARCH

RESEARCH INTERESTS

Forecasting, decision making, and analytics; Supply chain strategy and innovation; Supply chain collaboration; Sustainability; Interdisciplinary research.

BOOKS

• *Fundamentals of Sustainability* (with John D. Wood), John Wiley & Sons, forthcoming, 2013.

• *Supply Chain Management: A Global Perspective,* John Wiley & Sons, 2011.

• *Operations Management* (with R. Dan Reid), John Wiley & Sons, 5th edition, 2012.

BOOK CHAPTERS

• Autry, C. W. and **Sanders, N. R.** "Supply Chain Security: A Dynamic Capabilities Approach to Business Continuity," in *Supply Chain Risk: A Handbook of Assessment, Management, and Performance,* George A. Zsidisin and Bob Ritchie (eds), (Springer Science), 2008, 307-328.

- **Sanders, N. R.** and Ritzman, L.P. "Judgmental Adjustment of Statistical Forecasts," in *Principles of Forecasting: A Handbook for Researchers and Practitioners*, J. Scott Armstrong (ed), (Kluwer Academic Publishers), 2001, 405-416.

- **Sanders, N. R.** "Forecasting: Guidelines and Methods," *Encyclopedia of Production and Manufacturing Management*, Paul M. Swamidass (ed), (Kluwer Academic Publishers), 2000, 228-235.

- **Sanders, N. R.** "Forecasting Theory," in *Encyclopedia of Electrical and Electronics Engineering*, John G. Webster (ed), (John Wiley & Sons), Volume 7, l999, 664-675.

REFEREED JOURNAL PUBLICATIONS

1. **Sanders, N.R.,** Zacharia, Z.G. and B. Fugate, "The Interdisciplinary Future of Supply Chain Management Research," *Decision Sciences*, 2013, forthcoming.

2. Zacharia, Z. G., **Sanders, N. R**., Fugate, B. S. "The Evolving Role of Disciplines within Supply Chain Management" *Journal of Supply Chain Management*, 2013, forthcoming.

3. Johnson, D. and **N.R. Sanders**, "Benchmarking: Success Producer or Failure Preventer?" *Journal of Business Excellence*, 2013, forthcoming.

4. Browning, T. and **N.R. Sanders**, "Can Innovation Be Lean?" *California Management Review*, Volume 54, No. 4, 2012, 5-19.

5. Terjesen, S., Patel, P. and **N.R. Sanders**, "Managing Differentiation-Integration Duality in Supply Chain Integration," *Decision Sciences*, Volume 43, No. 2, 2012, 303-339.

6. **Sanders, N.R.** and S. M. Wagner, "Multi-Disciplinary and Multi-Method Research for Addressing Contemporary Supply Chain Challenges," *Journal of Business Logistics*, Volume 32, No. 4, 2011, 317-323.

7. **Sanders, N.R**., Autry, C. and D. Grigor, "The Impact of Buyer Firm Information Connectivity Enablers on Supplier Firm Performance: A Relational View," *International Journal of Logistics Management*, Volume 22, No. 2, 2011.

8. Zacharia, Z. G., **Sanders, N.R.** and N.W. Nix, "The Emerging Role of the Third-Party Logistics Provider (3PL) as a Supply Chain Orchestrator," *Journal of Business Logistics*, Volume 32, No. 1, 2011.

9. Graman, G. and **N. R. Sanders**, "Modeling the Tradeoff Between Postponement Capacity and Forecast Accuracy," *Production Planning and Control*, Volume 20, No. 3, 2009, 206-215.

10. **Sanders, N. R.** and G. Graman, "Quantifying Costs of Forecast Errors: A Case Study of the Warehouse Environment," *Omega*, Volume 37, No. 1, 2009, 116-125.

11. **Sanders, N. R.**, "Pattern of Information Technology Use: The Impact on Buyer-Supplier Coordination and Performance," *Journal of Operations Management*, Volume 26, No. 3, 2008, 349-369.

12. Premus, R. and **N.R. Sanders,** "Information Sharing in Global Supply Chain Alliances," *Journal of Asia-Pacific Business*, Volume 9, No. 2, 2008, 174-192.

13. **Sanders, N. R.,** Locke, A., Autry, C. and C. Moore, "A Multi-Dimensional Framework for Understanding Outsourcing Arrangements," *Journal of Supply Chain Management*, Volume 43, No. 4, 2007, 3-15.

14. **Sanders, N. R.,** "An Empirical Study of the Impact of E-Business Technologies on Organizational Collaboration and Performance," *Journal of Operations Management*, Special Issue on the Impact of e-Business Technologies on Supply Chain Operations, Volume 25, No. 6, 2007, 1332-1347.

15. **Sanders, N. R.,** "The Benefits of Using e-Business Technology: The Supplier Perspective," *Journal of Business Logistics*, Volume 28, No. 2, 2007, 177-207.

16. **Sanders, N. R.**, "IT Alignment in Supply Chain Relationships: A Study of Supplier Benefits," *Journal of Supply Chain Management*, Volume 41, No. 2, 2005, 4-13.

17. **Sanders, N. R.** and A. Locke, "Making Sense of Outsourcing," *Supply Chain Management Review*, Volume 9, No. 2, 2005, 38-45.

18. **Sanders, N. R.** and R. Premus "Modeling the Relationship between Firm IT Capability, Collaboration, and Performance," *Journal of Business Logistics*, Volume 26, No. 1, 2005, 1-23.

19. Premus, R. and **N. R. Sanders** "Differentiating Purchasing Practices of Firms Based on Information Technology Use," *Academy of Strategic Management Journal*, Volume 4, 2005, 9-22.

20. **Sanders, N. R.,** and L. P. Ritzman "Using Warehouse Workforce Flexibility to Offset Forecast Errors," *Journal of Business Logistics*, Volume 25, No. 2, 2004, 251-269.

21. **Sanders, N. R.** and L. P. Ritzman "Integrating Judgmental and Quantitative Forecasts: Methodologies for Pooling Marketing & Operations Information," *International Journal of Operations and Production Management*, Volume 24, No. 5, 2004, 514-529.

22. Neureuther, B. D., Polak, G. G., and **N. R. Sanders** "A Hierarchical Production Plan for a Make-to-Order Steel Fabrication Plant," *Production Planning and Control*, Volume 15, No. 3, 2004, 324-335.

23. **Sanders, N. R.** and K. Manrodt "The Efficacy of Using Judgmental Versus Quantitative Forecasting Methods in Practice," *Omega*, Volume 31, 2003, 511-522.

24. Premus, R. and **N. R. Sanders** "A Framework for Strategic Sourcing," *Academy of Strategic Management Journal*, Volume 2, 2003, 49-60.

25. **Sanders, N. R.** and K. Manrodt "Forecasting Software in Practice: Use, Satisfaction, and Performance," *Interfaces*, Volume 33, No. 5, September-October, 2003, 90-93. (also available at www.forecastingprinciples.com)

26. Premus, R., **Sanders, N. R.** and R. Jain "Role of the University in Regional Economic Development: the US Experience" *International Journal of Technology and Commercialization*," Volume 2, No. 4, 2003, 369-383.

27. **Sanders, N. R.** and R. Premus "Supply Chain Management Practices of Firms: A Function of IT Capability," *Academy of Information and Management Sciences Journal*, Volume 5, No. 1, 2002.

28. Premus, R. and **N. R. Sanders**, "Outsourcing of Core and Non-Core Competencies in U.S. Corporations," *Supply Chain Forum: An International Journal*, Volume 3, No. 2, 2002.

29. **Sanders, N. R.** and R. Premus "IT Applications in Supply Chain Organizations: A Link Between Competitive Priorities and Organizational Benefits," *Journal of Business Logistics*, Volume 23, No. 1, 2002, 65-84.

30. **Sanders, N. R.** and R. Dan Reid "Competitive Strategies of High Growth Manufacturers: Survey Results," *Production & Inventory Management Journal*, Volume 42, No. 4, 2001, 64-69.

31. **Sanders, N. R.** "The Impact of Task Properties Feedback on Time Series Judgmental Forecasting Tasks," *Omega*, Volume 25, No. 2, l997, 135-144.

32. **Sanders, N. R**. "Measuring Forecast Accuracy: Some Practical Suggestions," *Production & Inventory Management Journal*, Volume 38, No. 1, l997, 43-46.

33. **Sanders, N. R**. "Status of Forecasting in Manufacturing Firms," *Production & Inventory Management Journal*, Volume 38, No. 2, l997, 32-36.

34. **Sanders, N. R.** "Management Forecasting: Survey Findings & Business Implications," *Mid-American Journal of Business*, Volume 12, No. 1, l997, 35-39.

35. **Sanders, N. R.** "Status and Implementation of Total Quality Management (TQM) Programs in US Hospitals," *Quality Progress*, Volume 30, No. 2, l997, 47-49.

36. **Sanders, N. R.** and Ritzman, L.P. "Bringing Judgment into Combination Forecasts," *Journal of Operations Management*, Volume 13, l995, 311-321.

37. **Sanders, N. R**. "Managing the Forecasting Function," *Industrial Management and Data Systems*, Volume 95, No. 4, l995, 12-18.

38. **Sanders, N. R.** and Manrodt, K. "A Survey of Current Forecasting Practices in U.S. Corporations," *Interfaces*, Volume 24, No. 2, March-April, l994, 92-100.

39. **Sanders, N. R.** and Reid, D. R. "Achieving Success in Global Operations: A View From the U.S. Food Service Industry," *OM Review*, Volume 9, No. 3, l993, 51-60.

40. **Sanders, N. R.,** Owen, C. L. and Scherer, R. "A Behavioral Approach for Small Business Consultants: Implementing Forecasting Techniques," *Journal of Business and Entrepreneurship*, Volume 4, No. 3, l992, 1-12.

41. **Sanders, N. R.** "Accuracy of Judgmental Forecasts: A Comparison," *Omega,* Volume 20, No. 3, l992, 353-364.

42. **Sanders, N. R.** "Corporate Forecasting Practices in the Manufacturing Industry," *Production & Inventory Management Journal,* Volume 33, No l. 3, l992, 54-57.

43. **Sanders, N. R**. "The Dollar Considerations of Forecast Combinations," *Production & Inventory Management Journal,* Volume 33, No. 2, l992, 47-50.

44. **Sanders, N. R**. "Merging EDI with JIT: The Impact on U.S. Manufacturing," *Journal of Applied Business Research,* Volume 8, No. 2, l992, 133-137.

45. **Sanders, N. R.** and Ritzman, L. P. "The Need for Contextual and Technical Knowledge in Judgmental Forecasting," *Journal of Behavioral Decision Making,* Volume 5, No. 1, l992, 39-52.

46. **Sanders, N. R**. and Manrodt, K. "Northeast Electronics, Inc.," *Case Research Journal,* Autumn Issue, l991, 181-192.

47. **Sanders, N. R**. and Ritzman, L.P. "On Knowing When to Switch from Quantitative to Judgmental Forecasts," *International Journal of Operations & Production Management,* Volume 11, No. 6, l991, 28-37.

48. **Sanders, N. R.** and Ritzman, L. P. "Improving Short-Term Forecasts," *Omega,* Volume 18, No. 4, l990, 365-373.

49. **Sanders, N. R.** and Ritzman, L.P. "Some Empirical Findings on Short-Term Forecasting: Technique Complexity and Combinations," *Decision Sciences,* Volume 20, No. 3, l989, 635-640.

PUBLISHED COMMENTARIES

50. **Sanders, N.R**., "Improving Judgmental Adjustments in Supply-Chain Planning: A Comment on Fildes, Goodwin, Lawrence, and Nikolopoulos," *International Journal of Forecasting*, Volume 25, Issue 1, 2009, 24-26.

51. **Sanders, N.R**., "Bridging the Gap Between Methodological Camps in SCM," Forum on the Modeling Empiricism Gap, *Journal of Supply Chain Management*, Volume 45, Issue 1, 2009, 693-696.

52. Carter, C.R., **Sanders, N.R**. and Y. Dong, "Paradigms, Revolutions, and Tipping Points: The Need for Using Multiple Methodologies within the Field of Supply Chain Management," *Journal of Operations Management*, Volume 26, No. 6, 2008.
(also posted on http://jom.typepad.com, May 2008).

NON REFEREED PUBLICATIONS

53. **Sanders, N.R**., "Combating Poor Forecasts: Simple Rules for Better Forecasts in Times of Change," *DBMA Journal*, Volume 14, No. 1, September, 2012, pp. 10-13.

54. **Sanders, N. R.**, "Getting the Best Forecast by Combining Judgmental and Statistical Methods," *APICS Magazine*, Volume 16, No. 10, November/December, 2006, pp. 29-32.

PUBLICATIONS REVIEWED AS RESEARCH OF SIGNIFICANCE

Reviewed as research of significance in the field of forecasting, in the *International Journal of Forecasting*, Volume 10, No. 3, l994:

"A Survey of Current Forecasting Practices in U.S. Corporations," (with Karl B. Manrodt), *INTERFACES*, Volume 24, No. 2, March-April, l994.

Reviewed as research of significance in the field of forecasting, in the *International Journal of Forecasting*, Volume 9, No. 3, l993:

"The Need for Contextual and Technical Knowledge in Judgmental Forecasting," (with Larry P. Ritzman), *Journal of Behavioral Decision Making*, Vol. 5, No. 1, l992, 39-52.

Reviewed as research of significance in the field of forecasting, in the *International Journal of Forecasting*, Volume 6, No. 2, l990:

"Some Empirical Findings on Short-Term Forecasting: Technique Complexity and Combination," (with Larry P. Ritzman), Decision Sciences, Volume 20, No. 3, l989.

PUBLICATIONS UNDER REVIEW

Li, M., T. Choi, and N.R. Sanders "The Role of Intra-firm Collaborative Orientation on Inter-firm Collaborative Strategies," *Journal of Operations Management*, 2013.

Terjesen, S., Patel, P. and N.R. Sanders, "New Product Development: The Role of Servitization Breadth and Depth," *Decision Sciences*, 2013.

WORK IN PROGRESS

"Sustainability Potential: Measuring Operational and Supply Chain Sustainability Performance" (with John D. Wood, *Natural Resource Defense Council* and *American Conservation Association*)

"Strategic Drivers of Supply Chain Sustainability" (with Greg Graman, *Michigan Technological University*)

"Supply Chain Disruptions: Anticipation, Preparation and Response" (with Martin Starr, *Rollins College* and Sushil Gupta, *Florida International University*)

"The Moderating Effect of Information on the Impact of Product Variety on Supply Chain Inventories," (with Xiang Wang, University of Tennessee)

"The Role of Information Feedback in Improving Group Forecasting and Decision Making" (with Dilek Onkal, *Bilkent University*).

"The Impact of Forecast Bias Propagation on the Supply Chain," (with Greg Graman, *Michigan Technological University*).

"Qualitative System Dynamics and the Bullwhip Effect" (with John E. Boylan, *Buckinghamshire New University*, UK, and Aris A. Syntetos, *University of Salford*, UK).

"Forecasting and Inventory Management in the Context of System Dynamics: Bridging the Gap" (member of a global team of eight academic/industrial collaborators).

"How Organizations Develop Dynamic Capabilities" (Dana M. Johnson, *Michigan Technological University* and Brian Fugate, *Colorado State University*; paper is slated for *Journal of Supply Chain Management*).

PUBLICATIONS IN PROCEEDINGS

1. Cooper, M.C., Santosa, J., Hurst, D. C. and N.R. Sanders, "2012 Career Patterns of Women in Logistics and Supply Chain Management," *CSCMP* (www.cscmp.org), 2012.

2. Cooper, M.C., Santosa, J., Hurst, D. C. and N.R. Sanders, "2011 Career Patterns of Women in Logistics and Supply Chain Management," *CSCMP* (www.cscmp.org), 2011.

3. Cooper, M.C, Santosa, J., Hurst, D.C. and N.R. Sanders, "2010 Career Patterns of Women in Logistics," *CSCMP* (www.cscmp.org), 2010.

4. Premus, R. and N. R. Sanders, "Differentiating Purchasing Practices of Firms Based on Information Technology Use," *Proceedings of the Academy of Strategic Management*, New Orleans, 2004.

5. Sanders, N. R. "Judgmental Adjustment of Statistical Forecasts," *Proceedings of the International Symposium on Forecasting, l999 Annual Conference*, June, l999, Washington D.C.

6. Weinstein, L. and N. R. Sanders "Operations Management: Are Colleges of Business Teaching What Industry Wants?" *Proceedings of the l997 Annual Meeting of the Decision Sciences Institute*, San Diego, Cal., November, l997.

7. Sanders, N. R. "Evaluating Factors Which Impact Judgmental Forecasting," *Proceedings of the l993 Annual Meeting of the Decision Sciences Institute*, Washington D. C., November, l993, 1182-1184.

8. Sanders, N. R. "Accuracy of Judgmental Forecasts: A Comparison," *Proceedings of the l992 Annual Meeting of the Decision Sciences Institute*, San Francisco, l992, 1158-1160.

9. Sanders, N. R. and Owen, C. L. "Overcoming Organizational Barriers to Using Quantitative Forecasting," *Proceedings of the l991 Annual Meeting of the Decision Sciences Institute,* Miami, Fla., November, l991, 272-273.

10. Sanders, N. R. and Manrodt, K. B. "Corporate Sales Forecasting," *Proceedings of the l991 Annual Meeting of the Decision Sciences Institute,* Miami, Fla., November, l991, 1727-1729.

11. Reid, R. D. and Sanders, N. R. "Successful Global Operations in the U.S. Food Service Industry: A Case in Point," *Proceedings of the Decision Sciences Institute First International Meeting,* Brussels, Belgium, June, l991, 185-187.

12. Sanders, N. R. "The Dollar Considerations of Forecasting Technique Combinations," *Proceedings of the Twenty-Second Annual Meeting of the Midwest Decision Sciences Institute,* Indianapolis, Indiana, May, l991, 164-166.

13. Sanders, N. R. and Manrodt, K. B. "Corporate Forecasting Practices in the Manufacturing Industry," *Proceedings of the Twenty-Second Annual Meeting of the Midwest Decision Sciences Institute,* Indianapolis, Indiana, May, l991 297-299.

14. Sanders, N.R. "Accuracy of Judgmental Forecasts: A Comparison," *Proceedings of the l990 Annual Meeting of the Decision Sciences Institute,* San Diego, Cal., November, l990, 564-566.

15. Sanders, N. R. and Ritzman, L. P. "An Evaluation of Forecast Errors in Service Operations," *Proceedings of the l989 Annual Meeting of the Decision Sciences Institute,* New Orleans, November, l989, 402-404.

16. Sanders, N. R. and Ritzman, L. P. "Improvements in Forecasting Due to Expert Knowledge: A Comparison," *Proceedings of the l988 Annual Meeting of the Decision Sciences Institute,* Las Vegas, November, l988, 399-401.

17. Sanders, N. R. and Ritzman, L. P. "An Empirical Study of Judgment Versus Quantitative Techniques in Forecasting," *Proceedings of the Midwest Decision Sciences Institute Nineteenth Annual Meeting,* May, l988, Louisville, Kentucky, 292-294.

18. Sanders, N. R. and Ritzman, L. P. "The Value of Judgment in the Forecasting Process: An Empirical Study," *Proceedings of the l987 Annual Meeting of the Decision Sciences Institute*, Boston, Mass., November, l987, 185-187.

19. Sanders, N. R. and Ritzman, L. P. "Judgment and Forecasting Techniques: An Empirical Study," *Proceedings of the Eighteenth Annual Meeting of the Midwest Decision Sciences Institute*, April/May, l987, Toledo, Ohio, 158-160.

20. Sanders, N. R. and Ritzman, L. P. "Forecasting Short-Term Demand Levels in the Physical Distribution Environment," *Proceedings of the l986 Annual Meeting of the Decision Sciences Institute*, November, l986, Hawaii, 701-703.

PRESENTATIONS

1. "Teaching OM & SCM," New Faculty Consortium, Annual Conference of the Decision Sciences Institute, San Francisco, California, November, 2012.

2. "SCM Disruptions: Research Agenda," 23rd Annual POM Conference, Chicago, Illinois, April 2012.

3. "Extending the State of the Art in Logistics Research," 23rd Annual POM Conference, Chicago, Illinois, April, 2012.

4. "Multi-Disciplinary and Multi-Method Research for Addressing Contemporary Supply Chain Challenges," Annual Conference of the Decision Sciences Institute, Boston, Mass, November 2011.

5. "The Challenge of Meeting Sustainability Requirements," CVCR Fall Symposium, Bethlehem, PA, November, 2011.

6. "Teaching Supply Chain Management: Getting Students to See the Bigger Picture," Wiley Faculty Network Webinar Series, November and December, 2011.

7. "2011 Career Patterns of Women in Logistics and Supply Chain Management," CSCMP Conference, Philadelphia, PA, October 2011 (*evaluation score: 3.29/4 with 3 exceeding expectations*).

8. "Publishing in Multiple Disciplines: Interdisciplinary Research," CSCMP Educators Conference, Philadelphia, PA, October, 2011.

9. "2010 Career Patterns of Women in Logistics," *CSCMP Conference*, San Diego, CA, September, 2010.

10. "The State of Forecasting Research," Rutgers University, September, 2010.

11. "The State of Empirical Research in Logistics," Vancouver, BC, *POMS Conference*, May, 2010.

12. "Improving Forecast Accuracy to Achieve Competitive Advantage," *CVCR Symposium*, Lehigh University, Bethlehem, PA, November, 2009.

13. "Improving Business Intelligence through the Integration of Managerial and Quantitative Forecasts," Keynote Speaker, *SAS Institute Annual Conference*, Cary, NC, May, 2008.

14. "Qualitative System Dynamics and the Bullwhip Effect," *SD Conference*, Athens, Greece, July, 2008.

15. "Combining Judgmental and Statistical Forecasts," *Forecasting Summit*, Orlando, Florida, February, 2007.

16. "Improving Forecast Accuracy: Combining Managerial and Statistical Forecasts," *Forecasting Summit*, Boston, Mass, September 2006.

17. “25 Years of Progress in Combining Forecasts,” Chair of Feature Panel Presentation, 25th International Symposium on Forecasting, San Antonio, Texas, June 2005.

18. “25 Years of Judgmental Forecasting,” Member of Feature Panel Presentation, 25th International Symposium on Forecasting, San Antonio, Texas, June 2005.

19. “Effectively Combining Managerial and Statistical Forecasts,” Forecasting Summit, Boston, Mass, September 2003.

20. “Judgmental Versus Quantitative Forecasting in Practice: Understanding User Differences and Benefits,” Annual Meeting of *Informs*, San Jose, California, November 2002.

21. “IT Issues in Supply Chain Organizations: A Link Between Competitive Priorities and Organizational Benefits,” The 12th Annual Meeting of the Production and Operations Management Society, April 2001, Orlando, Florida.

22. “The Future of Statistics and Forecasting in Schools of Business,” 30th Annual Meeting of the Decision Sciences Institute, November l999, New Orleans, Louisiana.

23. “Judgmental Adjustment of Statistical Forecasts,” International Symposium on Forecasting Annual Conference, June l999, Washington D.C.

24. “Making Better Forecasts in a Changing Environment,” 2nd Annual Southwestern Logistics Conference, May l999, Dayton, Ohio.

25. "Manufacturing Strategy in OM," Presented to College of Business Faculty, Wright State University, May l996.

26. "Balancing Personal and Professional Obligations," 14th Annual Doctoral Student Consortium, 27th Annual Meeting of the Decision Sciences Institute, November l996, Orlando, Florida.

27. "Interviewing Strategies and the Campus Visit," 13th Annual Doctoral Student Consortium, 26th Annual Meeting of the Decision Sciences Institute, November l995, Boston, Mass.

28. "Evaluating Factors Which Impact Judgmental Forecasting," 24th Annual Meeting of the Decision Sciences Institute, November l993, Washington, D. C.

29. "Accuracy of Judgmental Forecasts: A Comparison," 23rd Annual Meeting of the Decision Sciences Institute, November l992, San Francisco, California.

30. "Overcoming Organizational Barriers to Using Quantitative Forecasting," 22nd Annual Meeting of the Decision Sciences Institute, November l991, Miami, Fla.

31. "Corporate Sales Forecasting," 22nd Annual Meeting of the Decision Sciences Institute, November l991, Miami, Fla.

32. "The Dollar Considerations of Forecasting Technique Combinations," 22nd Annual Meeting of the Midwest Decision Sciences Institute, May l991, Indianapolis, Indiana.

33. "Corporate Forecasting Practices in the Manufacturing Industry," 22nd Annual Meeting of the Midwest Decision Sciences Institute, May l991, Indianapolis, Indiana.

34. "Accuracy of Judgmental Forecasts: A Comparison," 21st Annual Meeting of the Decision Sciences Institute, November l990, San Diego, California.

35. "An Evaluation of Forecast Errors in Service Operations," 20th Annual Meeting of the Decision Sciences Institute, November l989, New Orleans, Louisiana.

36. "Improvements in Forecasting Due to Expert Knowledge: A Comparison," 19th Annual Meeting of the Decision Sciences Institute, November l988, Las Vegas, Nevada.

37. "An Empirical Study of Judgment Versus Quantitative Techniques in Forecasting," 19th Annual Midwest Decision Sciences Institute Nineteenth Annual Meeting, May l988, Louisville, Kentucky.

38. "The Value of Judgment in the Forecasting Process: An Empirical Study," 18th Annual Meeting of the Decision Sciences Institute, November l987, Boston, Mass.

39. "Judgment and Forecasting Techniques: An Empirical Study," 18th Annual Meeting of the Midwest Decision Sciences Institute, April-May l987, Toledo, Ohio.

40. "Forecasting Short-Term Demand Levels in the Physical Distribution Environment," 17th Annual Meeting of the Decision Sciences Institute, November l986, Honolulu, Hawaii.

PUBLISHED BOOK REVIEWS

Demand Management Best Practices by Colleen Crum with George Palmatier, J. Ross Publishing, Inc., 2003, in *Foresight: The International Journal of Applied Forecasting*, Vol. 1, No. 1, 2005, 49-50.

Quantitative Forecasting Methods by Nicholas R. Farnum and Laverne W. Stanton, PWS-Kent, l989, in *International Journal of Forecasting*, Vol. 6, No. 2, l990.

PUBLISHED RESEARCH REVIEWS

Barber, B. M. and T. Odean, "Boys Will Be Boys: Gender, Overconfidence, and Common Stock Investment," *The Quarterly Journal of Economics*, February, 2001. Reviewed for *The International Journal of Forecasting*, Vol. 19, No. 3, 2003, 544.

J. Scott Armstrong and Fred Collopy, "Integration of Statistical Methods for Judgment for Time Series Forecasting: Principles from Empirical Research," Forecasting with Judgment, Edited by G. Wright and P. Goodwin, John Wiley & Sons, Ltd., l998. Reviewed for *The International Journal of Forecasting* 15, l999, 345-346.

RESEARCH GRANT ACTIVITY

Lehigh University for $3,000 annually, 2009 and 2010 (with Zach Zacharia and Brian S. Fugate) to fund research interviews for our study "State of Supply Chain Management: A Visionary Perspective."

Council of Supply Chain Management Professionals (CSCMP) for $32,000, 2008-2009; Principal co-investigator (with Chad Autry, Curtis Moore, and Nancy Nix) to study supply chain management practices of large versus small-medium sized enterprises.

Naval Postgraduate School for $50,000, 2000-2001; Principal co-investigator (with Robert Premus) to study supplier management practices in U.S. industrial firms.

Naval Postgraduate School for $50,000, l999-2000; Principal co-investigator (with Robert Premus) to study procurement strategies and outsourcing in U.S. industrial firms.

Wright State University, Research Challenge Grant for $12,000, l999; Principal co-investigator (with Robert Premus) to study best practices in procurement strategies.

Wright State University, Research Grants from COBA, in years l988, l990, l994, l997, and l998.

Wright State University, Research Challenge Grant for $11,000 in l988.

Council of Logistics Management (formerly NCPDM), Doctoral Dissertation Award for $5,000 in l983.

PROFESSIONAL MEMBERSHIPS

Council of Supply Chain Management Professionals (CSCMP)

Decision Sciences Institute (DSI)

International Institute of Forecasters (IIF)

Production and Operations Management Society (POMS)

TEACHING

CURRICULUM DEVELOPMENT

Chair of MBA Curriculum Committee (2009 – Present): Responsible for redesigning curriculum and course content to include global perspectives, sustainability, ethics, and leadership throughout the MBA Core Curriculum at Lehigh University.

Program Co-Developer (2003 –2006): Responsible for curriculum design and course content of MS Logistics and Supply Chain Management, a graduate distance learning program, Raj Soin College of Business. Responsible for ensuring appropriate content and teaching method for a distance learning teaching mode.

MBA Curriculum Development Committee (2004-2005): Providing direction on curriculum design, course content, and greater implementation and use of the case method.

Chair of OM Curriculum Committee (2002): Responsible for complete curriculum and course redevelopment for the undergraduate OM Program The program has been modified to increase focus on service operations and supply chain management. As a result of these changes the program has seen a significant growth in the OM major.

Chair of OM Curriculum Committee (1993): Solely responsible for complete curriculum development and implementation of changes in the OM major. The program was restructured from an operations research (OR) to an operations management (OM) focus. Due these changes the number of students in the OM major had more than doubled.

COURSES DEVELOPED AND TAUGHT AT LEHIGH UNIVERSITY

Graduate courses*: Managing Products and Services* in MBA Core; multiple sections delivered in three modes: traditional classroom, web-based classroom, and distance learning mode; co-taught with Marketing. **(*Average student evaluation 4.5 on a 5.0 scale*)**

Undergraduate courses: *Supply and Demand Planning* **(*Average student evaluation 4.9 on a 5.0 point scale*)**

COURSES DEVELOPED AND TAUGHT AT THE M.J. NEELEY SCHOOL OF BUSINESS

Received highest student evaluation in department and highest score ever received for first semester faculty member; given the honor of ***Senior Legacy*** for significant impact on student life.

Graduate courses*: Operations Management*; Executive MBA ***(Average student evaluation 3.55 on a 4.0 point scale).***

Undergraduate courses: *Procurement and Supply Chain Management (**Average student evaluation 3.85 on a 4.0 point scale).***

COURSES TAUGHT AT WRIGHT STATE UNIVERSITY

Graduate courses taught: *Introduction to Operations Management; Introduction to Supply Chain Management; Operations Strategy; Strategic Supply Chain Management; Global Supply Chain Management (distance learning); Forecasting Methods and Applications.* ***(Average student evaluation 4.62 on a 5.0 point scale)***

In addition, I had developed and led MBA team projects in analyzing operations and SCM issues in companies including *Procter & Gamble, Iams Foods, Kodak, Emery Freight, Mead Data Central, Wal-Mart, Dayton Power & Light, Robbins & Myers Inc.*, and others.

Undergraduate courses taught: *Service Operations; Operations Strategy; Global Operations Management; Introduction to Operations Management; Introduction to Supply Chain Management, Forecasting and Decision Making; Inventory Systems; Just-in-Time & Lean Systems.* ***(Average student evaluation 4.68 on a 5.0 scale).***

SERVICE ACTIVITIES

PROFESSIONAL SERVICE

BOARD AND EDITORIAL ACTIVITY

Co-Editor (with Z. Zacharia and B. Fugate), *Journal of Business Logistics*, Special Issue "Using Interdisciplinary Research to Address Contemporary SCM Problems," 2013.

Associate Editor, *Decision Sciences Journal*, 2010 – Present.

Associate Editor, *International Journal of Forecasting*, 2011 – Present.

Associate Editor, *Journal of Business Logistics*, 2010- Present.

Board of Directors, *International Institute of Forecasters*; 2006-2010.

Board of Directors, *Production Operations Management Society*, 2007-2009.

Board of Directors and Executive Committee Member, *Decision Sciences Institute*; 2003-2006.

Co-Founder and Associate Editor, *Foresight: The International Journal of Applied Forecasting*, a journal of the *International Institute of Forecasters* (www.forecasters.org), 2004 – 2010.

Editorial Review Boards: *Journal of Operations Management (JOM), Production and Operations Management (POM), Operations Management Research (OMR), Journal of Supply Chain Management (JSCM), International Journal of Integrated Supply Management (IJISM), International Journal of Information Systems and Supply Chain Management (IJISSCM)* and *OM Review* (l992-1997).

Regular reviewer for the following journals, reviewing an average of twenty papers per year:

Journal of Business Logistics; International Journal of Operations and Production Management; International Journal of Forecasting; Journal of Forecasting; International Journal of Production Research; OMEGA; Industrial Management & Data Systems.

Regular reviewer of papers for the following conferences:

Decision Sciences National Meeting; CSCMP Educators' Conference; Midwest DSI Regional Meeting; DSI International Conference; International Institute of Forecasters; Academy of Management.

Regular participant as Session Chair/Paper Discussant for the following conferences:

Decision Sciences National Meeting; Midwest DSI Regional Meeting; *International Institute of Forecasters.*

NATIONAL ORGANIZATIONS

Member, Fellows Committee, *Decision Sciences Institute*, 2010 – present.

Track Co-Chair for IT Track (with Xiang Wang, Marquette University), *Decision Sciences Institute Annual Conference*, 2011 - present.

General Chair, *Production and Operations Management Society (POMS)*, 19th annual conference, La Jolla, CA, 2008.

Program Chair, *Production and Operations Management Society* (POMS), 17th annual conference, Boston, MA, April 28 – May 1, 2006.

Track Chair for Manufacturing Track, *Decision Sciences Institute Annual Conference*, 2007.

Member, Innovative Education Committee, *Decision Sciences Institute*, 2007-present.

Chair, Innovative Education Committee, *Decision Sciences Institute*, 2005-2006.

Coordinator, Instructional Innovation Award, *Decision Sciences Institute*, 2005-present.

Member, Program Planning Committee for the 2007 Annual Meeting, *Decision Science*s *Institute*, 2005-present.

Member of Development Committee for Excellence, *Decision Sciences Institute*, l998-2002.

Track Chair for Demand Management, *Decision Sciences Institute*, November, 2005.

Track Chair for Combining Forecasting, *International Institute of Forecasters*, June, 2005

Track Chair for Forecasting and Planning, *Production and Operations Society (POMS*), April, 2005.

Track Chair for Forecasting and Planning, *Council of Logistics Management*, October, 2004.

At-Large Vice President, *Decision Sciences Institute*; April, l997 - l999.

Cluster Chair for the Forecasting Topic Area, *INFORMS*, Spring l999, Cincinnati, Ohio.

Annual Meeting Track Chair for the Statistics, Decision Analysis and Forecasting Track; l996 Meeting of the *Decision Sciences Institute*, Orlando, Florida.

Past-President of the Midwest Region of the *Decision Sciences Institute* (l996 - 1997).

President of the Midwest Region of the *Decision Sciences Institute* (l995-1996).

President-Elect of the Midwest Region of the *Decision Sciences Institute* (l994-l995).

Professional Development Coordinator for the l994 *Decision Sciences Institute* Meeting, Honolulu, Hawaii.

Vice-President for Member Services of the Midwest Region of the *Decision Sciences Institute* (l988-l994).

Member of the Member Services Committee of the *Decision Sciences Institute* (l988-1997)

Member of the Executive Board of the Midwest Region of the *Decision Sciences Institute* (l988 - 1997).

Member of the Planning and Development Committee of the Midwest Region of the *Decision Sciences Institute* (l988 – 1998).

Member of the Ad Hoc Committee for Common Membership Data Structure of the *Decision Sciences Institute* (l992 - l995).

Chair and Member of the Stan Hardy Award Committee of the Midwest Region of the *Decision Sciences Institute* (l993; l995).

Reviewer for the *National Science Foundation* of research proposals in the field of Decision Sciences and Forecasting (l994; l995; l996).

DOCTORAL DISSERTATION AND MASTERS THESES

External Advisor and Reader for Cuneyt Eroglu, Department of Marketing and Logistics, The Ohio State University, Dissertation Title: "An Investigation of Accuracy and Learning Effects in Judgmental Adjustment of Statistical Forecasts" (Summer, 2004 – 2005).

Masters Theses Reader for Ishita San, Department of Economics, Raj Soin College of Business, Wright State University, Theses Title: "Outsourcing" (Spring, 2003).

Member of Masters Theses Committee for Debbie Dimidak, College of Nursing, Wright State University; Theses Title: "Assessing Patient Utilization and Nursing Care Needs of an Emergency Room Department," (Fall, l994).

SELECT INSTITUTIONAL SERVICE

Chair, MBA Core Curriculum Committee (2009 – Present), *Lehigh University*
Member, College Policy Committee (2011 – Present), *Lehigh University*
Member, Committee for New Direction of Iacocca Institute (2010 – Present), *Lehigh University*
Member, International Grants Committee (2010 – Present), *Lehigh University*
Member of CVCR Board (2009 – Present), *Lehigh University*
Chair, SCM Search Committee (Fall 2010), *Lehigh University*
Member of Dean Search Committee (2007-2008), *TCU*
Member of College Promotion & Tenure Committee (l994 -2006), *TCU*.
Chair and Member, Professional Development Committee of MS & IS Department (l999-2007),*WSU*
Chair and Member, Department Promotion & Tenure Committee (l993-2007), *WSU*
Member of Chair Search Committee for MS & IS Department (Fall, 2002), *WSU*

Chair and Member, University Awards Committee (l999), *WSU*
Member Phi Kappa Phi Scholarship Committee (l993-2007), *WSU*
Member By-Laws Committee of MS & IS (l999-Present), *WSU*
Chair and Member of Department Chair Review Committee (l995), *WSU*
Member of University Academic Council (l996 -l998), *WSU*
Chair of Operations Management Curriculum Committee (l993 - l995), *WSU*
Member of Operations Management Curriculum Committee (l988 - 2007), *WSU*
Member of Logistics Management Subcommittee (l988-Present), *WSU*
Member of University Agenda Committee (l991-1992), *WSU*
Chair of the United Way Campaign for the College of Business & Administration (Fall, l988), *WSU*
Member of Search Committee for Chair of Department of Management Science & Information Systems (l989-l990), *WSU*
Member of Search Committee for Assistant Professor of Management Science (l987-l988), *WSU*
Served as Student Awards and Scholarship Coordinator (l996-2007), *WSU*

SELECT CONSULTING AND EXECUTIVE TRAINING

International Data Group (Boston, Mass; 2009, 2010, 2011; 2012): Provided training for analysts on how to forecast markets of information, communication, and emerging technologies at the global, regional, and local levels, developing an understanding of impact and trends of such technologies on society. Medium of delivery was on-site training and webinar format.

Quinn, Emanuel, Urquhart & Sullivan, LLP (Los Angeles, CA); 2010, 2011): Provided expert testimony in the Mattell vs. MGA case regarding forecasting process, including information technology use and impact of data presentation on decision making.

Universitas 21 Global (Singapore): As a subject matter expert (SME) developed and designed material for distance learning courses (Global SCM and Information Technology), 2003 – 2005.

ATT Business Services Division (Columbus, Ohio): Development of product and service demand forecasting in the telecom market, 2000 - 2004.

MTC Corporation (Dayton, Ohio): Assistance in strategic sourcing, l998-l999. *The project was cited as contributing to a multimillion dollar donation given to the WSU College of Business.*

Schottenstein Stores Corporation (Columbus, Ohio): Provided expertise, evaluation and use of forecasting and inventory management software, l998-l999.

CIBA Corning (Boston, Mass.): Developed forecasting and production planning process, l994.