國立雲林科技大學
九十二學年度研究所博士班招生考試試題
所別：工業工程與管理研究所、管理研究所
科目：統計學

I. Multiple Choice Questions (5 points each): Choose one correct answer

1. Let X and Y be two random variables, with Cov(X,Y) their covariance and ρ_{xy} their correlation. Which of the following statement is FALSE?

(a) ρ_{xy} may be zero in setting in which X and Y have an association.

(b) If repeated measurements on (X,Y) are perfectly aligned on a line with either a negative or positive slope, the magnitude of ρ_{xy} will be one.

(c) If X and Y are independent, $\rho_{xy}=0$.

(d) $-1 \leq Cov(X,Y) \leq 1$.

(e) $Cov(X,Y)=0$ if and only if $\rho_{xy}=0$.

2. Let X be a population random variable. $X_1,\ldots,X_n$ is a random sample corresponding to X, and $x_1,\ldots,x_n$ the observed values of that random sample. Which of the following statement is TRUE?

(a) The sample mean, $\overline{X}$, is a parameter.

(b) The sample median is the best measure of central tendency if the probability distribution of X is skewed.

(c) The method of moments estimate of the population variance is unbiased.

(d) A histogram is a graphical display constructed from the observed values of the random sample that reflects the shape of the cumulative distribution function of X.

3. An outdoor concert is scheduled on a day where the forecast indicates it might rain. The forecast says the probability of light rain is 0.3 and the probability of heavy rain is 0.2. There are three possible conditions:

- If it does not rain, the concert will go on as scheduled and the producer will take \$20,000 in ticket sales.
- If it rains lightly, the concert will go on as scheduled and the reduced attendance is speculated to produce \$12,000 in ticket sales.
- If there is heavy rain, the concert will be canceled, resulting in \$0 in ticket sales.

Suppose that the cost of the producing the concert is \$10,000, what is the expected profit in ticket sales that the producer would make?

(a) \$ 0

(b) \$ 3,600

(c) \$ 10,000

(d) \$ 13,600

(e) \$ 20,000

4. Suppose that P(x,y,z) the joint probability mass function of the random variables X,Y, and Z, is given by

   P(1,1,1)＝1/8 P(2,1,1)＝1/4
   P(1,1,2)＝1/8 P(2,1,2)＝3/16
   P(1,2,1)＝1/16 P(2,2,1)＝0
   P(1,2,2)＝0 P(2,2,2)＝1/4

   Compute E(X|Y＝2)＝?

(a) 9/7
(b) 9/6
(c) 9/5
(d) 9/4

5. A weight-loss clinic wants to use regression analysis to build a model for weight-loss, y, of a client (measured in pounds). Two variables thought to affect weight-loss are client's length of time on the weight-loss program and time of session. The interaction model below is used to fit the collected data.

   $E(y) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_1 x_2 + \beta_5 x_1 x_3$, where
   y = Weight-loss (pounds)
   x_1 = Length of time in weight-loss program (months)
   x_2 = 1 if morning session, 0 if not
   x_3 = 1 if afternoon session, 0 if not (Base level = evening session)

   What null hypothesis would you test to determine whether the slope of the linear relationship between weight-loss (y) and time in the program (x_1) varies according to session time?

(a) $H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$
(b) $H_0 : \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$
(c) $H_0 : \beta_4 = \beta_5 = 0$
(d) $H_0 : \beta_2 = \beta_3 = 0$

6. Based on the interaction model in previous problem, give the change in weight-loss (y) for every one month increase in time in program (x_1) when attending the evening session in terms of the β's in the model.

(a) β_1
(b) $\beta_1 + \beta_4$
(c) $\beta_1 + \beta_5$
(d) $\beta_4 + \beta_5$

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II. Problems (10 points each)

1. Let $X_1, X_2, \ldots, X_5$ be a random sample of size 5 from $N(0, \sigma^2)$. Find the constant k so that $k(X_1-X_2)/\sqrt{X_3^2+X_4^2+X_5^2}$ has a t-distribution.

2. Suppose that $Y_1, Y_2, \ldots, Y_n$ denote a random sample size n from a Poisson distribution with mean 2λ. Consider two point estimates for λ : $\hat{\lambda}_1 = (Y_1+Y_2+Y_3)/6$ and $\hat{\lambda}_2 = \overline{Y}/2$.

   Derive the efficiency of $\hat{\lambda}_1$ relative to $\hat{\lambda}_2$. Which estimate is more efficient?

3. For the simple linear model $Y = \beta_0 + \beta_1 x + \varepsilon$, with $E(\varepsilon) = 0$ and $V(\varepsilon) = \sigma^2$,

   (a) Show that $V(\hat{\beta}_0 + \hat{\beta}_1 x_0) = \left[\frac{1}{n} + \frac{(x_0-\bar{x})^2}{\sum(x_i-\bar{x})^2}\right]\sigma^2$

   (b) For what value of x_0 will the confidence interval for $E(Y)$ attain its minimum length?

4. Consider the following model for the response measured for a randomized block design containing b blocks and p treatments:

$$Y_{ij} = \mu + \beta_i + \tau_j + \varepsilon_{ij}$$

   where Y_{ij} = response taken on treatment j in block i

   β_i = nonrandom additive effect due to the ith block, $\sum_{i=1}^{b} \beta_i = 0$

   τ_j = nonrandom additive effect due to the jth treatment, $\sum_{j=1}^{p} \tau_j = 0$

   and ε_{ij}, i =1,2,…,b and j =1,2,…,p, are independent normal random variables, with $E(\varepsilon_{ij}) = 0$ and $V(\varepsilon_{ij}) = \sigma^2$.

   (a) Give the expected value and variance of Y_{ij}.

   (b) Let T_j and $\overline{T}_j$ be the total and mean of all observations receiving treatment j. Find the expected value and variance of $\overline{T}_j$.

5. Let X_1 and X_2 be independent normal random variables, each with mean 0 and variance σ^2. Define $U_1 = X_1 + X_2$ and $U_2 = X_1 - X_2$. Show that U_1 and U_2 are independent.

6. Suppose that $Y_1, \ldots, Y_n$ are independent normal random variables with $E(Y_i) = \beta_0 + \beta_1 x_i$ and $V(Y_i) = \sigma^2$, i = 1,…,n. Find the maximum-likelihood estimators of β_0 and β_1.

7. A density function sometimes used by engineers to model lengths of life of electronic components is the Rayleigh density, given by

$$f(y) = (2y/\theta)e^{-y^2/\theta}, y \geq 0 \quad \text{and} \quad f(y) = 0, \quad \text{elsewhere.}$$

If Y has the Rayleigh density, find the probability density function for $U = Y^2$.

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The following questions are based on the attached paper entitled "PROMISE AND PROBLEMS OF SIMULATION TECHNOLOGY IN SCM DOMAIN" by Sam Bansal (*Proceedings of the 2002 Winter Simulation Conference*). Read through the paper and answer the following questions in either English or Chinese.

1. (10%) Outline the organization of this paper.

2. (20%) What are the *domains* and *contents* of supply chain optimization? What are the interrelations among these domains?

3. (20%) What are the supply chain optimization issues addressed by the author? What are your comments or solutions?

4. (20%) What are the *basis* and *contents* of supply chain opportunity assessment?

5. (20%) According to this paper, what is the promise and role of simulation in supply chain management (SCM)?

6. (10%) Although the literature associated with this paper is short, what can you find with respect to the author's background?

Proceedings of the 2002 Winter Simulation Conference
E. Yücesan, C.-H. Chen, J. L. Snowdon, and J. M. Charnes, eds.

PROMISE AND PROBLEMS OF SIMULATION TECHNOLOGY IN SCM DOMAIN

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ABSTRACT

This paper begins by identifying the potential Promise of Simulation domain. It also provides a brief review of this domain and modeling methodologies as applied to supply chain optimization. Problems and solutions of this area are discussed forming the rationale behind most of the industrial practice of this author. As a result most of the deterministic Business Process Reengineering and Opportunity Assessment work that needs to be done resorts to the "a priori methods". Building the simulation models costs more time and effort than implementing an equivalent solution from SAP such as APO or any part thereof in the domain of Supply Chain Management and Optimization. Against this environment and e-Supply Chain Management as a domain of the focus, this paper describes the methodology of doing Business Cases with Case Studies to illustrate how the Supply Chain Opportunity Assessment through the Blue Printing process is carried out.

1 PROMISE OF SIMULATION

Industry experts on manufacturing technology have recognized the importance of simulation and visualization. Simulation and modeling have been identified as one of two breakthrough technologies that will accelerate the grand challenges facing manufacturing in 2020. Fulfillment of the recommendation would provide fundamental building blocks for the dynamic models and 'real-time' simulations of 2020. It has been recognized by researchers and practitioners that techniques such as variation simulation analysis (VSA) and factory floor layout simulation can improve product performance. Assembly modeling can be used to complement simulations to determine if changing the order of steps in the assembly of a complex product can lead to labor savings and reduce variation. Combining three-dimensional product modeling with simulation techniques can help determine the cost of alternative manufacturing processes. Even the Semiconductor Research Corporation's (SRC) Factory Sciences board has also identified manufacturing simulation as a high payback area. Examples of current manufacturing simulation applications include: modeling and verification of discrete and continuous manufacturing processes (machining, injection molding, sheet metal forming, semiconductor fabrication, refining, etc.), offline equipment programming (robots), system layout planning, material flow analysis, process and system visualization, ergonomic analysis of work areas and manual tasks, evaluation of schedules, and business process modeling.

However while the manufacturing simulation software domain has huge future the present does not appear to be a robust market like ERP. Hundreds, if not thousands, of commercial simulation software products are currently marketed to support these and other areas. It is likely that the number and types of simulation applications will continue to grow rapidly in the coming years. For the most part, these software applications do not interoperate with each other, or with other manufacturing systems that need to share data. Independent economic studies have estimated the size of the manufacturing simulation and visualization software market in the range of $650 million dollars by the 2001 time frame.

Although studies have recognized the potential of manufacturing simulation and visualization, there are a number of technical and economic barriers that hinder the use of this technology. Industry expense for implementing simulation technology is much greater than the cost of computing hardware, peripheral devices, software licenses, and maintenance. Typically companies must factor in the cost of salaries and training for simulation and support staff, translation of existing company data, systems integration of applications, and development and maintenance of models. These costs are likely to be much greater than the initial acquisition costs for the simulation software and hardware.

2 FUNDAMENTALS OF SIMULATION AND MODELING FOR SUPPLY CHAIN OPTIMIZATION

2.1 Simulation Models

There are two types of modeling domains recognized for Simulation studies as applied to Supply Chains. These are:

1. Descriptive Models and
2. Normative/Optimization Models

Descriptive Models are of following types:

1. Forecasting Models
2. Cost Relationship Models
3. Resource Utilization Relationship Models
4. Simulation Models

Simulation Models describe how all or parts of the company's Supply Chain will operate over time as a function of parameter and policies.

Normative/Optimization Models on the other hand are mathematical models that are developed to make better decisions. The term normative refers to processes for identifying norms that the company should strive to achieve. Hence Normative Models are same as Optimization Models as the Optimization I the norm that every company strives to achieve. Further according to Operation Research Scholars these are considered same as Mathematical Programming Models. The construction of optimization models requires descriptive data and models as inputs.

Simulation Models have 2 more categories

1. Deterministic Simulation Models
2. Stochastic Simulation Models

Deterministic Simulation Models describe a system's dynamic behavior assuming there are no random effects. Stochastic on the other hand describe a system's dynamic behavior when there are random effects. It is also known as Monte Carlo Simulation Models.

2.2 Taxonomy of Supply Chain Optimization Modeling Domains

These are:

1. Strategic Optimization Modeling
2. Tactical Optimization Modeling
3. Logistics Optimization Modeling
4. Production Planning Optimization Modeling
5. Distribution Scheduling Optimization Modeling
6. Demand Forecasting and Order Management
7. Distribution Requirements Planning
8. Materials Requirements Planning
9. Enterprise Resource Planning

Of the above domains the first 2 specially are relevant to Business Planning for decision making with respect to whether

1. To go in Retail Distribution Business or Not
2. Or How to set up the overall Demand and Supply Network so that the Return on Investment is maximized

Hence the following description giving their salient features is described:

2.2.1 Strategic Optimization

This domain is concerned to analyze the resource acquisition and other strategic decisions faced by the company such as the construction of a new manufacturing facility, the break-even price for an acquisition, or the design of a supply chain for a new product. Its goal may be to maximize net revenue or return on investment.

2.2.2 Tactical Optimization

Here one determines an integrated supply/manufacturing/distribution/inventory plan for the company's entire supply chain over the next 12 months, or greater if desired. Its goal may be to minimize total supply chain cost of meeting fixed demand or to maximize net revenues if the product mix is allowed to vary. Raw materials, intermediate products and finished products are aggregated into product families. Similarly markets are aggregated into market zones.

2.2.3 Linkages Exist between

1. MRP and Production Scheduling Optimization Modeling
2. DRP and Logistics Optimization Modeling
3. Production Scheduling, Logistics and Tactical Optimization Modeling and
4. Strategic and Tactical Optimization Modeling

2.2.4 Strategic and Tactical Optimization Modeling

It will be described below as it is of importance to the present context:

The Strategic Optimization assists Sr Management in determining the most effective long-term conFigureuration of the company's entire supply chain network, existing in reality or being envisioned. It helps to analyze about major resource acquisitions and divestments and the manufacture and distribution of new and existing products over the coming years. The implications of these decisions to next year's tactical plans are passed to the tactical optimization considerations, as shown below. Such data might include new facilities that will be available or products to be manufactured, distributed, and sold during that time frame. The tactical optimization models provide detailed feedback to the strategic system about how these facilities will be used and how market demand will be met over the first year of a strategic planning horizon.

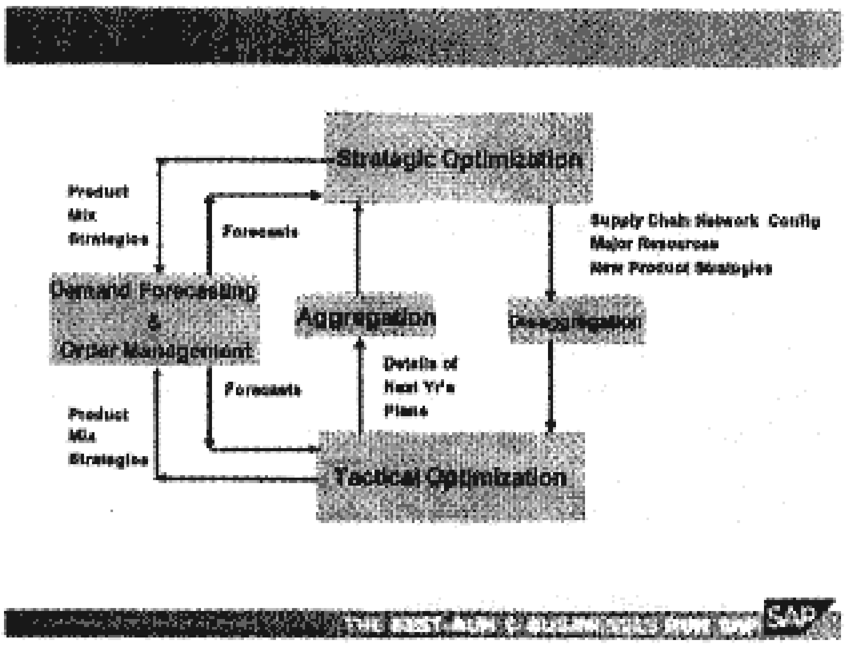

Figure 1: Strategic and Tactical Optimization Modeling

The demand forecasting and order management system provides medium and long-term demand forecasts to the tactical and strategic optimizer. Conversely, the strategic optimization provides the demand forecaster with feedback about the profitability of existing and new product lines. This information can be used to develop marketing strategies for increasing sales of profitable products. In fact the demand forecasting might well be extended to include marketing models to achieve this end.

Scenarios are created and used to analyze the impact of various future conditions to determine their effects on the objective functions.

The core of a case, along the above lines, developed some time ago, is described below. It core was a:

1. For decision making as to which technology to support and which to kill
2. Selected Technology's Initial Design was predicted by the Technical Model to cut the Product Design time

This was used:

1. For decision making as to which technology to support and which to kill
2. Selected Technology's Initial Design was predicted by the Technical Model to cut the Product Design time

Advantages were:

1. Reduction in exploratory cost
2. Reduction in Product Development time

Their interaction was as given in Figure 2:

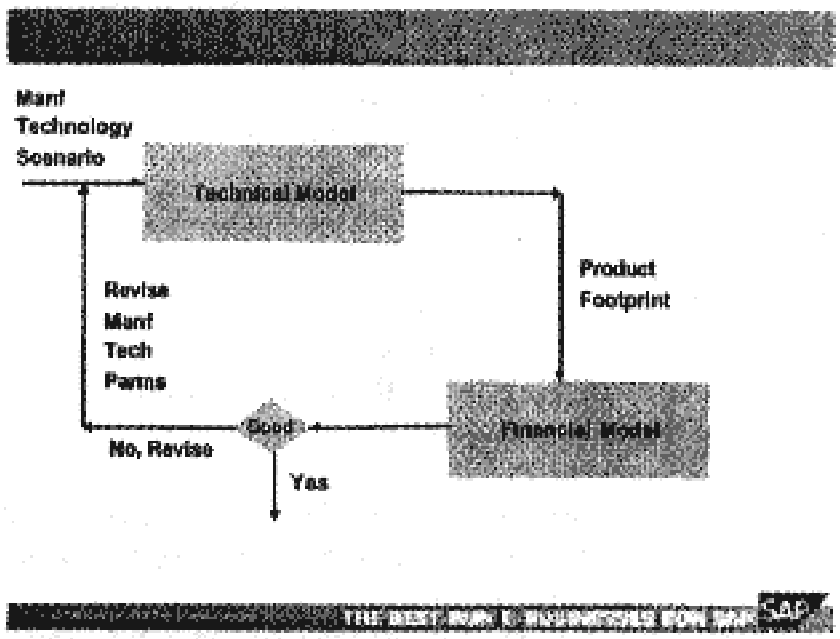

Figure 2: Cost Performance Modeling Paradigm

The point to be stressed is that Strategic and Tactical models must be integrated with Financial Models to get the Optimized Business Decisions.

2.3 Problems

In practice both types of models are used but the common problems that can be cited are:

1. The modeling experts are very few and far in between
2. The construction and usage when left to pseudo trained managers and analysts lead to far worse results than a priori methods
3. Even with the trained modelers the effort to construct good Descriptive or Optimization models is huge that most companies are unwilling to spend
4. Then the input data problem, be it static or dynamic, is as much time consuming as the construction and validation of the model itself

2.4 Solutions

Because of the problems mentioned above and in the interest of time the SOA methodology is adopted. Its basis is as follows:

1. Study the " As Is" scenario of the Supply Chain Performance with respect to Cost and Profitability
2. Also study the methods used in the company from Demand Forecasting to Distribution and all levels

of planning, Strategic, Tactical, Operational, Production Scheduling etc.

3. Construct the "To Be" Cost, Profitability vision against the company vision and bench marks
   a. Construct the "To Be" methods supporting the "To Be" cost and profit targets
   b. Fix the gaps between "As Is" and "To Be" by
      i. Process Improvement Initiatives and
      ii. Enabling Technology
   c. Business Blue Printing fro Enabling Technology
   d. Execute recommendations
      i. Process Improvements
      ii. Technology Solution Implementation

3 SUPPLY CHAIN MANAGEMENT

Supply Chain Management has caught more attention than did Artificial Intelligence in the early eighties. Like AI there in no other domain today, which gets more, talked about than Supply Chain in the boardrooms. Supply Chain's beginning can be traced to the early eighties when MRPII was being extended into ERP. At that time all the manufacturing planning and scheduling was still infinite model based. To alleviate the problems inherent in the infinite capacity based MPS etc. Finite Capacity model based techniques such as Factrol was introduced by Factor, an affiliate of Pritsker. Dynamic Scheduling was talked but not practiced. Early nineties began to see an awareness of holistic management of both the Capacity and the Inventory management. Some of the popular packages that have been introduced in this space to manage, Inventory, Capacity, Planning and Forecasting are from I2, Tyecin/Manugistics, Red Pepper/Peoplesoft, Paragon, SAP and most recently from Oracle. The essentials of this domain seem to have been lumped together in the "Supply Chain Management". These 3 words tend to embody the planning, management and optimization of Inventory, Capacity, Planning and Forecasting.

Supply Chain Council has put forward a supply chain model. This model SCOR stands for Supply Chain Operations Reference model. The Supply Chain is comprised of your supplier's supplier and your customer's customer. And each node of this chain must look at the enterprise functions such as Plan, Make, Purchase and Distribute, with respect to planning, managing and optimization. Thus, a well managed Supply Chain system will not only manage its own Plan, Make, Purchase and Distribute functions but it will Transmit and Receive, Planning and Inventory information with its supplier's suppliers and customer's customers.

3.1 Financial Impact of Supply Chain Costs

The importance of this domain can best be understood from the fact that depending upon the company and the sector, the SCM costs may range anywhere from about 4-22 % of the revenue or higher. If the reduction of 25% is achieved, it is annual and can contribute to almost 100% more bottom line profit for an average company running the SCM costs in the neighborhood of 20%, which is not uncommon. Studies have been made to establish the impact of glitches in Supply Chains and their impact on the Stock Prices of the companies. Accordingly it has been found that a glitch rumor influences the stock value by 19% within 2 days of the rumor on Wall Street and to a total of 23% within 4-5 days. With such an important area which corporate chief will not want his supply chains to be running smoothly?

For example this author studied 4 companies of the Silicon Valley engaged in the communications semiconductor business. All had high inventory, however the one with highest inventory was least profitable and the Wall Street was punishing the subject company most harshly, as is illustrated in the following graph:

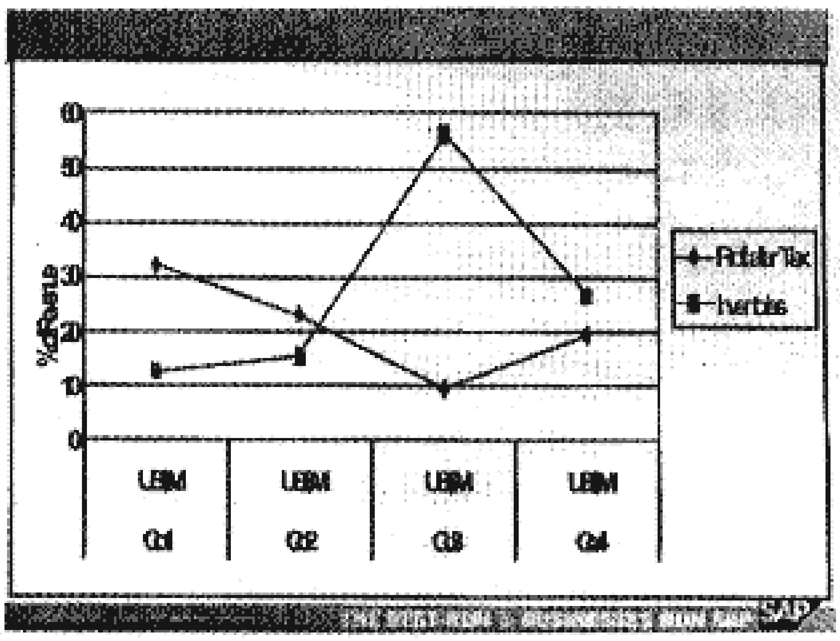

Figure 3: Adverse Impact of High Inventory on Profits

It is not only Inventory that creates profits. The entire value chain from value drivers to stock holders value is shown on Figure 4.

3.2 Opportunity Assessment

Opportunity Assessment or Supply Chain Opportunity Assessment is an age old cost benefit study but with a modern twist of formalism and lot of extensions. It essentially comprises of Fiscal Data Collection, Data Rationalization, Developing Understanding of the Problem, Developing Total Supply Chain Management Costs, Benchmarking SCM Costs, Estimating the Opportunities for Improvement and finally linking them to the enabling Tools and Technologies. OAs can be done at 2 levels as shown in Figure 5.

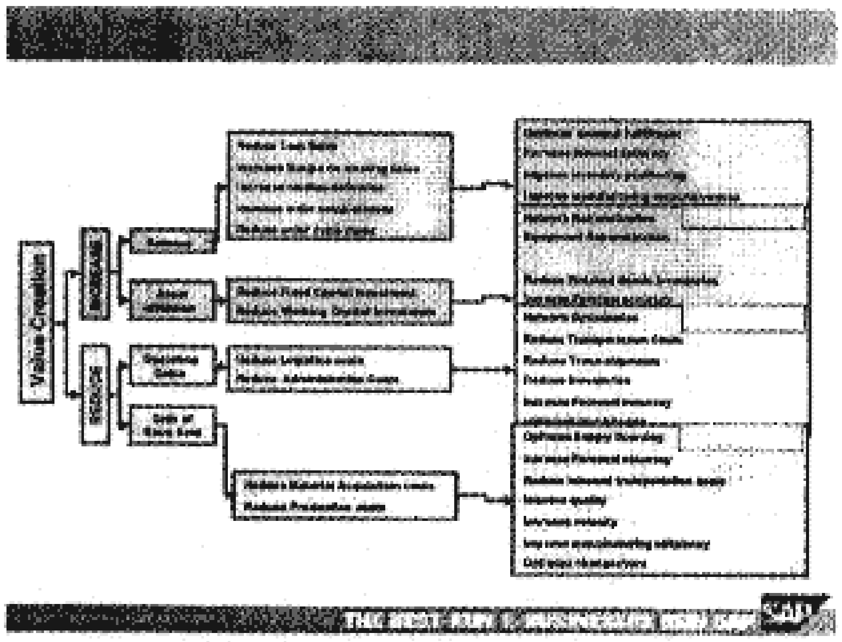

Figure 4: How Stock Holder Value is Created

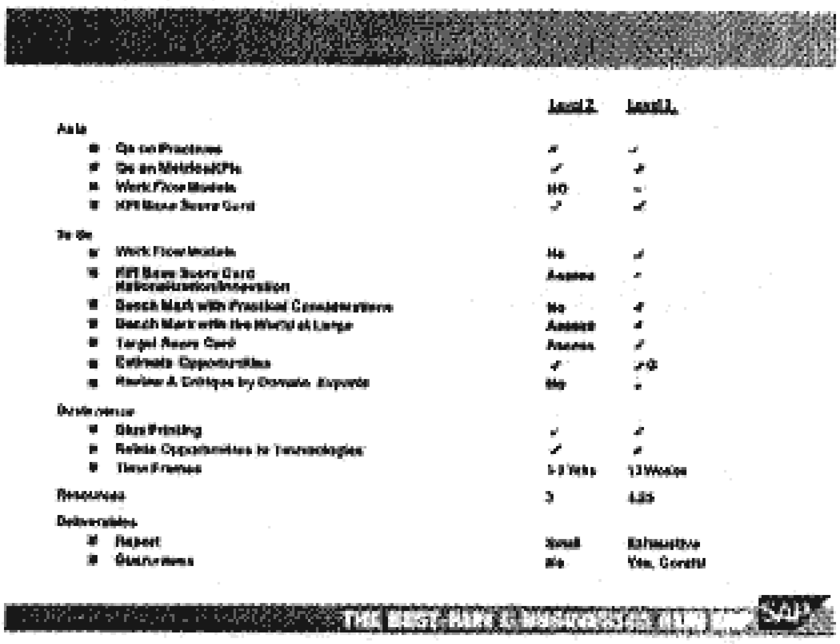

Figure 5: 2 Levels of Opportunity Assessment

At the enterprise level the KPIs of concern are Inventory Turns, Asset Utilization etc where as at the Process Levels the KPIs of attention become the Inventory Accuracy, Forecast Accuracy, BOM Accuracy, Schedule reliability, Drawing Accuracy, Routing, Accuracy, Supplier Reliability, and Information Availability etc. This relationship is as illustrated in Figure 6.

Upon close study one finds that the reason supply chain problems exist is because of the difference between the plans vs. the actuals, as is illustrated in Figure 7.

This delta is the root cause to create bad process level KPIs, which eventually transcend to bad enterprise, level KPIs such as high inventory, turn over and lower asset utilization. The enabling technology would be the one that can eliminate or minimize the effect of the difference between the plan and the actual.

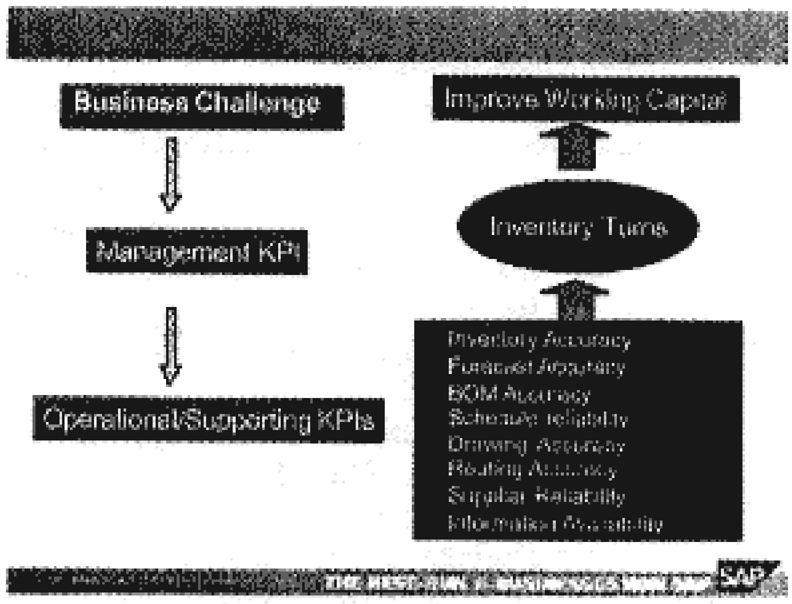

Figure 6: KPI Hierarchy

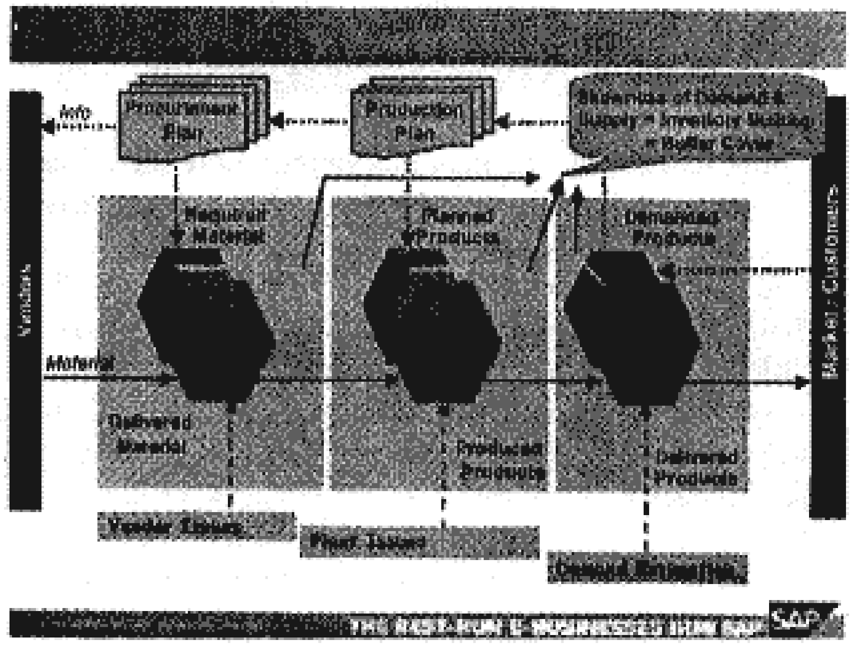

Figure 7: Supply Chain Paradox

3.3 For Example- Case Study

This client wanted and posed an interesting challenge:

1. We want you to study our three problems and give us the solution for them
   - During scoping and objective setting the client was completely unwilling to let us do a Business Case but as the project began, it was abundantly clear that what they needed most was the Business Case with ROI analysis
2. Hence the strategy that was adopted was to:
   - Study the causes of the problems
   - Measure the bottom line impact of the problems, benchmark the costs establishing the enabling technologies and
   - Create the solution

Figure 8 shows the causes creating the 3 problems

Theme	3 Problems		
	[illegible]	[illegible]	[illegible]
Demand planning: Forecast accuracy	✓✓	✓✓	✓
Demand planning: Option forecasting	✓✓	✓✓✓	✓✓
Collaboration with suppliers	✓✓	✓✓	✓✓✓
Capacity planning as an integral part of the planning process	✓	✓	✓✓✓
Alert systems to enable rapid response to variances	✓	✓✓	✓✓✓
Decision support tools, what if capabilities	✓	✓	✓✓
Integration of support planning with production planning			✓✓✓

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Figure 8: Causes of the 3 Problems

The quantification and benchmarking effort leads to Figure 9, which clearly establishes the bottom line impacts. These are very high as compared against the competition. So they offer the opportunities to improve. Figure 8 establishes the causes creating the problems; Figure 9 establishes the magnitude of the problem.

Figure 10 once again shows the linkage from the 3 problems to the benefits, as quantified in Figure 9.

The target reductions and the reduction modeling are given in Figure 11.

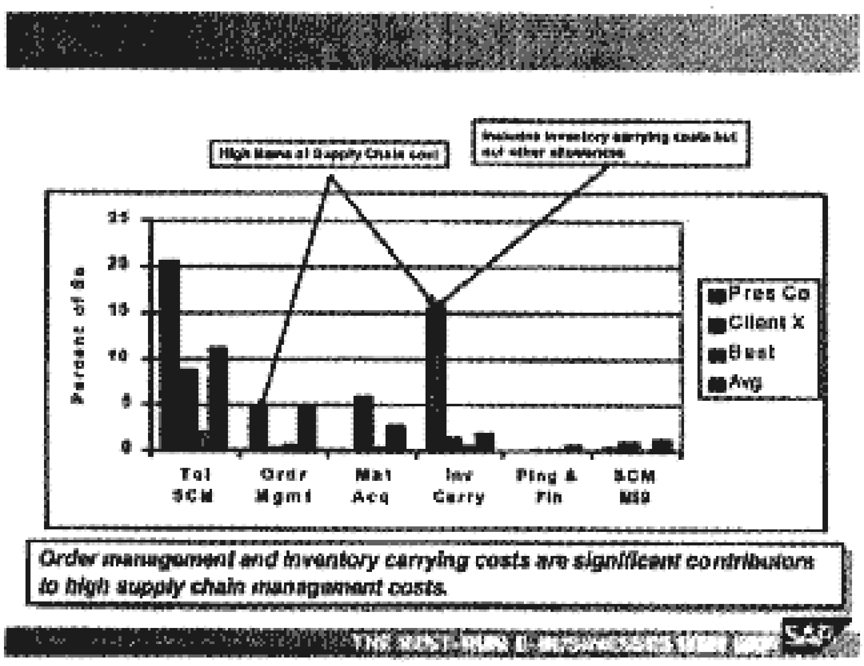

Figure 9: Benchmarking the Supply Chain Management Costs

3 Problems	Strategies	Capabilities	Solution Enablers
Reduced Inventory (Finished, WIP, Raw)	Improved visibility of demand Advanced material supply [illegible] Improved collaboration From push to pull Improve tracking capabilities	Leverage internet for connectivity Collaborative demand planning Statistical forecasting Global ATP Check	Forecasting tools including collaboration capabilities Consumption scenarios Sequenced JIT management Tracking server Action handler
Increased Asset Utilization	Steady state sequenced manufacturing Reduced planning cycles Optimized fill rate of execution cycle	Sub daily planning and variance propagation Trigger material replenishment based on assembly sequence & variations in production (push/pull)	Sequenced JIT management Action handler Planning & sequencing tools Action handler
Reduced Production Costs	Optimized process design Tighter connection between APS & execution system	Improved supply [illegible] & [illegible] Capacity constrained planning	Collaboration scenarios Supply Network Planning tool Sequenced JIT management

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Figure 10: Solution Enablers

				Present Client		SAP Target	
	Asis Value Dollars	Rate Percent	Asis Cost Dollars	Reduction Amount Dollars	Reduction Percent	Reduction Amount Dollars	Reduction Percent
Total Factory Inventory	130.36	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dealer Side Inventory	402.10	[illegible]	[illegible]	[illegible]	[illegible]	211.1[illegible]	[illegible]
Manufacturing Efficiency improvement by [illegible] dollars per tractor			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Capacity Increase Due Cycle Time [illegible] percent [illegible] used for additional market share, will create minimum of today's profit of 3.09 percent on additional capacity				no credit		[illegible]	
Supply Network Optimization, Industry Practice of 2.5 Percent/year cost reduction, due Contracts & SCC			[illegible]	no credit		[illegible]	
Improved Delivery Performance							
Total Net Improvement				[illegible]		[illegible]	

Note: Reduction Amounts for Inventories in Both cases, Present Client as well as Study Target, are Dollar Values, their carrying cost (only) is included in the Total Net Improvement line

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Figure 11: Total Benefits

4 CONCLUSIONS

State of the art practice of Business Consulting focused in the Supply Chain domains has been discussed. Opportunity Assessment methodology starting from investigation of the problems to establishing and benchmarking their impact on the bottom line as well as the reduction modeling has been discussed and amplified by the case studies. It should be stressed that the correlation between the qualitative assessments of the problem's impact to quantitative assessment has been found to be extremely close.

5 RESEARCH ISSUES

Research issues that can be cited based on the above work are:

1. New Departments have to be formed that would be dedicated to integrating the Analytic IT, doing

Model Based Optimization with the Transactional IT the ERP etc.

2. Financial Planning Models themselves, that are pretty descriptive of the companies' Supply Chain Performances
3. Integration of Financial Planning Models with the Supply Chain Models dealing with the Strategic and Tactical optimization of the Supply Chains
4. Usage of Supply Chain and Financial Planning Optimization Models for Business Planning such as to go in this business or not, build the new infrastructure or not

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AUTHOR BIOGRAPHY

SAM BANSAL has 36 Years of full Life Cycle Business Transformation Services experience, involving Diagnosis, Solutioning and Implementation focused at delivering identified benefits. He is a World Class Expert at Opportunity Assessment to Blue Printing unleashing quantum improvements in cost reduction and value creation. Sam has led numerous Mega Global projects in the Supply Chain Optimization area of High Tech, Automotive and Manufacturing sectors.

Sam is currently working as a Director of Business Transformation Services of SAP Americas. His previous roles have been Principal Research Fellow, CIO, Managing Director, President etc of several MNCs in the Asia Pacific and North American region.

Sam's degrees are in Chemical Engineering, has Published over 80 papers in refereed international journals and has been a frequent invited key note speaker. He authored a book on Computer Integrated Manufacturing, was a contributing editor of a Controls magazine and created methodologies for Manufacturing and Business Transformation consulting practices.

Sam has been advising on the Business Transformation for over 9 years to the who's who of the Semiconductor/High Tech and Automotive companies in Value Modeling and Value Driven Future Architectures in the Supply Chain Management Domain. His email address is `<satya.bansal@sap.com>`.

國立雲林科技大學
九十二學年度研究所博士班招生考試試題

所別：工業工程與管理研究所、管理研究所
科目：生產管理

1. A manufacturing company plans to use a transportation model to solve the short-term aggregated planning problem. The following information should be considered: (1)Three planning periods are included in this model. (2)Demands for three time periods are known and given (i.e. D_1, D_2, and D_3). (3)Capacities for each time period involves the normal time capacity (i.e. N), over time capacity (i.e. O), and subcontract capacity (i.e. S). All capacities are fixed and given. (4)Unit manufacturing costs include normal time cost (i.e. r), over time cost (i.e. s), and subcontract cost (i.e. t). (5)Unit inventory cost per period (i.e. i) and unit backorder penalty per period (i.e. b) are fixed and given. (6)Beginning inventory (i.e. P) is given and known. Ending inventory (i.e. Q) is also required.

(a)Construct a transportation tableau using the given symbols. (十分)

(b)Formulate this linear programming problem including the objective function and the required constraints. Define all decision variables if necessary. (十分)

2. The historical sales quantities of product M indicate a typical curve of life cycle. Three significant periods can be identified, i.e. Growth period, Saturation period, and Decline period. Suggest an appropriate forecasting model for each period and explain the reason why it is chosen. (十分)

3. A single plant location decision has been made using a popular, subjective decision-making tool as indicated in Table 1 and Table 2. This tool may be called as the "Weighted Scoring Method". Construct a stepwise solution procedure based on the approach used in Table 1 and Table 2. (十分)

Table 1

Weight	Factor	Score: Minneapolis	Winnipeg	Springfield
0.25	Proximity to customer	95	90	65
0.15	Land and construction prices	60	60	90
0.15	Wage rates	70	45	60
0.10	Property taxes	70	90	70
0.10	Business taxes	80	90	85
0.10	Commercial travel	80	65	75
0.08	Insurance costs	70	95	60
0.07	Office services	90	90	80

Table 2

Factor	Weighted Score: Minneapolis	Winnipeg	Springfield
Proximity to customers	23.75	22.50	16.25
Land and construction prices	9.00	9.00	13.50
Wage rates	10.50	6.75	9.00
Property taxes	7.00	9.00	7.00
Business taxes	8.00	9.00	8.50
Commercial travel	8.00	6.50	7.50
Insurance costs	5.60	7.60	4.80
Office services	6.30	6.30	5.60
Sum of weighted scores	78.15	76.65	72.15

4. Show that an exponential smoothing forecasting method is a special type of weighted moving average forecasting method. (十分)

(Hint: $F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1})$ and $F_t = \sum_{i=t-n}^{t-1} w_i * A_i$, $\sum_{i=t-n}^{t-1} w_i = 1.00$)

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5. A company has started selling through its online channel along with its retail stores. Management has to decide which products to carry at the retail stores and which products to carry at a central warehouse to be sold only via the online channel. The company currently has 900 retail stores across the country. Weekly demand for product A at each store is normally distributed with a mean of 800 and a standard deviation of 100. Each product A costs $30. Weekly demand for product B at each store is normally distributed with a mean of 50 and a standard deviation of 50. Each product B costs $100. The Company has a holding cost of 25 percent of product value. The Company manages all inventories using a continuous review policy and the supply lead-time for both products is 4 weeks. The targeted cycle service level is 95 percent. Assume demand from one week to the next to be independent.

(1) How much safety Inventory reduction in holding cost per unit sold can the company expect on moving each of the two products from the stores to the online channel? (10%)

(2) Which of the two products should the company carry at the stores and which at the central warehouse for the online channel? Why? (15%)

6. Assume you are the production manager of a manufacturing company.

(1) What are the appropriate procedures of generating production plan of your company? (10%)

(2) In above production plan, what factors and procedures you need consider in order to generate a good production schedule. (15%)