INDUSTRIAL & OPERATIONS RESEARCH ENGINEERING (IND)

IND199701   ARICO, Ruby Socorro M. (MS Ind. Eng'g)
Development of a Composite Environmental Quality
Index for the Power Industry. 1997

This study describes the use of decision analysis in the development of a composite environmental quality index to provide decision makers an operational and simple basis for analyzing the progress and performance in managing environmental quality in the power industry.

Value judgments of a panel of experts in the field of energy and environmental management on major environmental indicators such as air quality, water quality, terrestrial ecology, aquatic ecology, and socioeconomics and land use were prioritized and carefully evaluated. Using the Simple Multiattribute Rating Technique (SMART), value judgments were assessed individually and as a group. SMART is a multiattribute extension of the direct rating technique for riskless value or utility measurement. All single attribute utility functions were assumed to be linear. Five types of power plants were considered in this study and these are: coal-fired, oil-fired, hydropower, geothermal, and combined-cycle. Evaluation was divided into two parts: holistic and component, to compare and verify whether expert judgments will be significantly affected. Weights and single attribute utilities were aggregated using the most common weighted additive model. The outcome of experts' judgments in the holistic evaluation reveals that the most environment-friendly type of power plant is geothermal since it has the lowest value of composite environmental quality index. The component evaluation reflected that hydropower is the best environmentally-benign type of power plant. Consistently, coal-fired thermal power plant is considered as the worst or the most environment-unfriendly as it has the highest value of composite environmental quality index.

IND 199802   AYROSO, Roberto S. (MS Ind. Eng'g)
A   Productivity   Measurement   Methodology   for Engineering Research and Development Institutes Employing   the   Analytic   Hierarchy   Process   and Multiattribute Utility Function. 1998

The study was an attempt to develop a productivity measurement methodology for Research and Development Institutes. The methodology can serve as a baseline information for future undertaking and decision making such as allocation of resources and budgeting.   Thirteen (13) attributes were evaluated to comprise total productivity: number of completed projects, number of projects with patent applications and grants, number of in-process projects, number of scientists and engineers in R & D staff, number of scientists and engineers sent abroad, number of scientists and engineers locally trained, number of R & D staff with advanced degrees, R & D staff sent abroad, R & D staff locally trained, cost efficiency, % budget spent on R & D, technologies in practice, and machine cost rate.

Construction of the model was confined to Analytic Hierarchy Process (AHP) and multiattribute utility function. Statistical treatment of data was limited to analysis of Variance employing the randomized complete block design.   Results of the study derived a four (4) variable model indicating that productivity of R & D institutions are influenced by primarily Completion Rate, secondly, by % Budget spent on R & D and thirdly, by the number and quality of training of scientists and engineers in the R & D staff.

IND 199803 CIUBAL, Melchor Vergel L. (MS Ind. Eng'g)
Achieving Quality, Cost-Efficiency, and Consistency in Blending Products Using Enumerative with Heuristic Methods. 1998

This paper shows that some medium to large-scale blending problems can be modeled as pure-integer multiobjective mathematical programs. Blending problems have usually been solved to optimality with cost-efficiency as the main driving factor.   However, these optimal solutions are not always practical since certain   properties   like better

quality, and consistency with previous blends must be present in blends if they are to be useful. In addition, there may be a minimum number of batches to be met before proceeding with actual blending. Hence, there is a need for alternative solutions.

This paper claims that enumerative with heuristic methods provide more achievable and realistic alternative solutions than mathematical programs that simply obtain single optimal solutions. A decision support system which implements such a method to solve some real-world blending problems is provided. Comparisons of this proposed method with a manual method and with a relevant operations research technique are also supplied to give proof to the claim.

IND 199904   LUGAY, Carlos Ignacio P., Jr. (MS Ind. Eng'g)
A Predictive Model of Loss Time Due to Low Back Pain
Among Garment Sewers in Bulacan. 1999

Filipinos have been used to seeing small tailoring and ladies garment shops in almost every corner of the street. And in almost all households, there is usually a manually-operated sewing machine in one corner of the house. In fact, to emphasize how skilled the Filipinos are in garments assembly, garments export has been the country's number two expert since the early 80's.

In this line, quite a number of enterprising Filipinos have put up small-sized garment companies as a means of livelihood. However, given the increasing competition from neighboring Asian countries, such as China and Vietnam, which has been offering cheaper labor rates, an obvious pattern of dwindling garment exports is being seen.

Thus, the government has been looking for means of increasing productivity of the said sector. As a contribution to this effort, this study will help owners/production supervisors determine the loss time of garment sewers due to low back pain (LBP). Through equation models, this study will be able to approximate the number of minutes that a sewer will render to recover from LBP. This will be a substantial assistance to the production planners since they will be able to approximate the possible output per day and hence do any remedial measures if it need be.

IND 199905   MACATANGAY, Leah A. (MS Ind. Eng'g)
An Application of Quality Function Deployment to Improve Service Quality in a Cellular Mobile Telephone Company. 1999

The thesis sought to design the service quality rendered by a cellular mobile telephone company using Quality Function Deployment, a structured methodology, in order to measure and improve service quality. A Customer Satisfaction/Quality of Service Enhancement Survey was conducted among subscribers of three cellular phone companies in order to derive the importance they gave to previously identified customer wants and needs, and to assess their present level of satisfaction with the service they currently receive from their service provider. The respondents of Company A rated 'Always have a signal' the most important need, followed by 'Accurate billing', 'Can reach many places' 'Pay for calls made', 'Clear and continuous reception', and so on. For Company A's cellular service, a design model called the House of Quality was constructed. The results of the survey served as inputs to the first four columns of the Planning Matrix of the House of Quality. The rest of the columns, as well as the other parts of the House of Quality, such as the Priorities, Competitive Benchmarks, and Targets were filled in with computed values as well as decisions made by the development team.

Simultaneously, apart from QFD, statistical tests were performed: Analysis of Variance tests were performed to verify the significance of the differences in the means of the importance ratings and those of the satisfaction ratings of the 18 variables. Duncan Multiple Range tests were conducted to identify which relationships among the three companies were significant. Factor Analysis was used to identify five common underlying factors among the importance variables and among the satisfaction variables. The Importance vs. Satisfaction Grid was constructed to identify the variables that 'need attention': Coverage and Customer Service.

Following the QFD methodology and the ranked Priorities, and supported by the results of the Factor Analysis, Importance vs. Satisfaction Grid, and Customer Complaints, further deployment was carried out in four main areas of investigation and improvement. Billing/Customer Care System, Customer Service, Use of QFD, and Others.

The acquisition of a Billing/Customer Care software program was recommended, which featured Process Control Plans for four main processes: Billing and Collection, Customer Service, Market Intelligence, and Churn Management. Customer Service recommendations included the increase in number of CSRs, the introduction of quality circles, and the review of performance measures. Another recommendation was the use of QFD on a regular basis, as a way of concretizing Company A's service mission. Finally, various recommendations bases on common complaints included greater use of the Internet, education of the general public on the features of cell phone service, and the re-design of the company's Instruction Manual and quarterly newsletters.

It can thus be concluded that QFD is a very applicable and effective tool for design that was successfully used on the cellular phone service of Company A, in order to measure service quality, to identify areas for improvement, and to make recommendations in these identified areas.

IND 199706   MALAZARTE, Darwin S. (MS Ind. Eng'g)
BMB: Bernhard's Model-Based Expert System for Project Selection Problems. 1997

An Expert System was developed and built around Bernhard's Generalized Horizon Model (BGHM) that rendered the model easy to use and practical to employ.

BGHM is a mathematical programming tool for project selection. It is used to solve a class of project selection problems that assumes imperfect capital market condition, complete certainty in all relevant data, independent projects, and indivisible projects, within a prespecified time horizon. It has one objective function which seeks to maximize the firm's discounted dividend payments and terminal wealth, and has eight sets of constraint functions consisting of restrictions on; cash balance and liquidity, scarce resources, paybacks, terminal wealth, bounds on borrowing, wealth's horizon posture, multiple projects, and bounds on dividend payments. Among the models in its class, Bernhard's model is the most comprehensive and complete because it is a general formulation of all the deterministic models in its class and it takes into account more relevant monetary and nonmonetary issues in project selection.

Using Bernhard's model in its current form, however, is not easy and fast because being a generally large formulation, numerous types of input data have to be processed. A lot of precalculations of the coefficient and right-hand-side values of the objective and some constraint functions involved during the construction of the formulation are toilsome. Instead of hastening, using it manually will slow down the project selection process.

This research aimed to render Bernhard's model easy to use and practical to employ in real-world applications. The means taken to accomplish the objective was by building an Expert System around Bernhard's model and its solution computer code (which employs Simplex algorithm for Linear Programming formulations). The whole project selection process using Bernhard's model was computerized, from the inputting of raw data to the construction of the linear formulation until the display of solutions. Concepts of two recent computer methodologies, Decision Support Systems and Expert Systems, were adopted in the computerization process. Computer programs were developed using Fortran 77 to automate every procedure necessary to render Bernhard's model easy to use. These programs were clustered to form one computerized system, driven and controlled by a batch file. The system is activated by invoking the batch file, and a user communicates and interfaces with the system through menus.

The resulting Bernhard's Model-based Expert System (BMB) is fully interactive and user-friendly. The system can even be used by a decision maker or user who is not an expert in using Bernhard's model but is dealing with and is knowledgeable about project selection processes. BMB's solution is easy to understand because it consists of numeric values with descriptions as to what a value is and with explanations as to why a value is. A comparative study conducted between BMB and a system of User-with-LINDO software revealed that BMB's overall relative speed is about thirteen times faster than the system of User-with-LINDO. BMB can also be used to conduct "what if" analysis on the input side of the problem's parameters, and it can save, retrieve, and print files it produces.

The positive and noteworthy results displayed by BMB indicate that the construction of an expert system around Bernhard's Generalized Horizon Model has indeed rendered Bernhard's model easy to use and practical to employ.

IND 199707   MARQUEZ, Charlie A. (MS Ind.   Eng'g)

An Assessment of the Impact of ISO 9000 Certification on Company Performance in Philippine Manufacturing Companies. 1997

This study presents an evaluation of the effectiveness of ISO 9000 standards as applied in the Philippine setting. It is based on the assessment of quality managers and quality management representatives who were directly involved in the process of obtaining ISO 9000 certification. A comparison on the performance of companies before and after certification was performed and companies certified to ISO 9000 were profiled to be able to assess the impact of ISO 9000 certification in the Philippine manufacturing companies.

Twenty indices of quality were identified and classified. The first four (4) are the **Financial measures** namely: manufacturing costs, sales, profit, and start-up costs. The second are sixteen (16) **Nonfinancial measures** which was further classified as *employee related*: employee involvement, absenteeism rate, employee turnover, employee satisfaction and employee morale; *operations related*: number of rejects/defects, inventory turnover, productivity, manufacturing cycle time, product reliability, on-time-delivery, service response time, order processing time, and machine breakdown; and *customer related*: customer complaints and market share.

Thirty (30) firms from a total list of 52 ISO 9000-certified companies responded to the survey conducted. These firms are based in the Philippines and were certified to ISO between 1992 and 1995. On-site interview was conducted for some companies who preferred to be interviewed rather than submit written answers.

The final results of the survey showed that these companies achieved numerous benefits as a direct result of implementing ISO 9000 standards. Among the benefits achieved were increased productivity, reduction in manufacturing costs, number of rejects, and production cycle time, establishment of a formal quality system, a consistent method of documentation, and improved teamwork. The survey also showed that companies certified to ISO 9000 are generally satisfied with the standards.

IND 199808   NGO, Joehanna K. (MS Ind. Eng'g)
            The Application of Statistical Process Control in the Academe. 1998

The research looks on the applicability of statistical process control (SPC) tools, commonly used in manufacturing, to the academic process in the case of the Faculty of Engineering of the University of Santo Tomas. Specifically, it answers the problems. What are the present controls used by the University? and How effective are the present controls used by the University? It seeks to test the hypothesis: the traditional controls used in the present academic system do not provide for an effective means of controlling the quality of input students, the instruction process and evaluation process. In addition, it also seeks to test that: applying SPC tools in the academic system can improve the process of ensuring the quality of input students and its instruction and evaluation aspects.

The methodology used in the conduct of this study begins by describing the system pictorially, i.e., by constructing process flow diagrams of the academic processes. Control points are then identified and the performance of the system measured before a stability study is performed. Causes for an unstable process are identified and eliminated prior to the conduct of the process capability study. Monitoring and implementation of the solutions and improvement measures are carried out once the process is capable of meeting customer's specifications. Primary and secondary data used were sourced out from different offices of the University in addition to outside sources. SPC tools applied in the three academic processes include the process flow diagram, trend chart, Ishikawa Diagram, Pareto Chart, Scatter Diagram, p-chart and process capability. Moreover, Regression Analysis and ANOVA were utilized for an in-depth analysis.

The conclusion drawn is: The traditional controls used in the present academic system do not provide for an effective means of controlling the quality of input students, the instruction process and evaluation process. And recommends that: applying SPC tools in the academic system can improve the process of ensuring the quality of input students and its instruction and evaluation aspects.

IND 199709   ONG, Victoria D. (MS Ind. Eng'g)
Design and Development of a Microcomputer-Based Productivity Diagnostic Prototype Utilizing Embedded Rule-Based Expert System. 1997

In response to the pressing need to provide productivity expertise to small and medium-sized enterprises (SME), the study presents a prototype system called Productivity Advisor. It serves as an automated diagnostic tool that acts as a decision-support system for managers, owners, and analysts.

The study covers the design and development of the microcomputer-based productivity measurement and advising prototype system for manufacturing firms. In general, it attempts to demonstrate the viability of enabling knowledge-based interpretation of database indices using *expert systems* technology.

The software design is comprised of two modules: a *productivity measurement module* that prompts users of the system to encode financial data into the system. The second is a *productivity diagnostic module* that allows interpretation of the measured ratios. The design automates the decision-making process using the expertise of selected human experts in the field of productivity measurement and evaluation.

The rule-based expert system program is encoded using the Windows-based expert systems development tool, **CLIPS 6.0.** To allow heuristic programming on the ratios, the expert system in embedded as part of the front-end **FoxPro 2.6** database application. The database system passes these ratios to the expert system in exchange for the diagnosis through an interface program written in **Visual C++ 4.1** that uses the dynamic data exchange (DDE) concept.

The computer prototype was successfully developed on an IBM-compatible Pentium personal computer. Testing was conducted on the prototype by using ISO 9241 software guidelines and was found to conform to the minimum requirements of the set specifications. In summary, the study displayed the viability of embedding an expert system program into a database application.

IND 199710   PASCUAL, Kathleen M. (MS Ind. Eng'g)
            **An MCDM Model for Facilities Location for the Float
            Glass Industry in the Philippines. 1997**

Facilities Location is a vital aspect of distribution management. It plays a vital role in the distribution management of manufacturing firms as well as the service sector. In this paper, it is applied to the float glass industry in the Philippines.

Similar to any decision making endeavor, cost always play a major role. In this study an integrated distribution cost model was developed. The Total Distribution Cost (TDC) takes into account the interdependence between facilities location, transportation, inventory levels. In reality however, decision makers do not solely decide based on the cost effectiveness of alternatives. Often, multiple and conflicting objectives need to be simultaneously considered. Thus a goal programming model is developed and solved using sequential linear programming through the STORM software.

The developed models were applied to the search of RAGC for an external warehouse. Initially, the distribution costs were computed for all the defined external warehousing strategies. The values are assigned as the cost coefficients of the first objective that is to minimize cost operations. The other objectives such as: minimization of capital expenditures, maximization of accessibility coefficients and strength of structure as well as the proximity coefficients are all algebraically translated into mathematical equations. Furthermore, these objectives were simultaneously considered using a goal programming model.

The model is solved using the sequential linear programming capability of STORM. Various scenarios are depicted to determine the sensitivity of the model developed and for each of these, an optimum facilities site location is identified.