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Resolution of a quadratic programming problem with an M-matrix

K. Hassaini*, M. Ouamer

BIBI L.A.M.O.S., Laboratory of Modelization and Optimization of Systems, University of Bejaia, 06000 (Algeria)

*E-mail address of the corresponding author: hassaini@gmail.com

Keywords: Convex quadratic programming, M-matrices, Chandrasekaran method, Projection Newton method, Support method.

Abstract

In this paper, a method of resolution of a quadratic programming problem with an M-matrix and simple constraints is presented. It is based on the algorithms of Chandrasekaran, Luk and Pagano. These methods use the fact that an M-matrix possesses a nonnegative inverse which allows to have a sequence of feasible points monotonically increasing. Introducing the concept of support for an objective function, our approach differs by a more general condition which allows to have an initial feasible solution, close to the optimal solution. The programming of our method under MATLAB and that of Luk and Pagano have allowed us to make a comparison between them, in the illustration of two practical examples.

Berth allocation and scheduling problem at dedicated marine container terminals with excessive demand

A. Dulebenets*, M. Golias, M. Sabya

Department of Civil Engineering, The University of Memphis, 302A Engineering Admin. Bldg.,
3815 Central Ave Memphis, TN 38152, USA

*E-mail address of the corresponding author: mdlbnets@memphis.edu

Abstract

International seaborne trade significantly increased during the last years. Productivity of marine container terminals needs to be improved in order to satisfy the growing demand. In this study we propose and model a new berth scheduling strategy for a dedicated container terminal (DCT) operator. We consider a port, which has two container terminals, located in close proximity to each other: a) a dedicated (or private) terminal, and b) a public (or multi-user) terminal (MUT). The DCT exclusively serves vessels of a particular liner shipping company, while the MUT is responsible for handling vessels from different liner shipping companies. In order to improve throughput, the DCT operator has entered into a contractual agreement with the MUT. Based on the contractual agreement the DCT can divert vessels to the MUT for service. Diverted vessels can be handled during particular time windows (TWs), predefined by the MUT. The charge for a vessel service at the MUT varies with the requested service rate (i.e., faster handling for higher price) and period (i.e. peak VS off peak period). The charge for a vessel service at the DCT is constant (\$/TEU), since the service rate is fixed. The MUT operator won't make any changes in the service schedule of its other customers to better serve the diverted vessels. The DCT operator is able to request a certain service rate for each diverted vessel, which is a function of QCs that the MUT operator can employ during a given TW to that vessel. The MUT operator provides the DCT operator with a set of QC rates for each time window. It is assumed that a vessel cannot be diverted to the MUT if it cannot complete service within the allocated TW. The main objective of the paper is to provide the DCT operator with the optimal service schedules for its vessels (i.e. vessel to berth to order assignment at the DCT, vessel to TW and QC rate at the MUT). The problem is formulated as an optimization problem with the objective to minimize the overall service cost of the DCT. These costs include total container handling cost, and

penalties/premiums from vessel late/early departures. A stochastic search algorithm is proposed to solve the resulting problem and numerical examples are provided to evaluate the proposed berth scheduling policy.

Multicriteria decision support for financing Greek agricultural units

A. Valiakos, Y. Siskos

University of Piraeus, 80, Karaoli & Dimitriou Street, GR-18534 Piraeus, Greece

Authors' e-mail addresses: avaliakos@unipi.gr, ysiskos@unipi.gr

Keywords: Multicriteria decision analysis, Common agricultural policy, Data envelopment analysis, Ordinal regression, Robustness.

Abstract

The European Agricultural Guarantee Fund (EAGF) finances direct payments to farmers in Member States of European Union with specific implementation rules. This is done based on the entitlements, which derived from the total production during the historical reference years. European Union rendered this decoupled financial aid as a Single Direct Payment (SDP) scheme, and the total production in Greece is significantly decreased. In view of Common Agricultural Policy's reform the evaluation of agricultural units is proposed using robust ordinal regression (ROR) approach. In this paper, a case study of farmers in the industry of the juicing citrus is conducted. A method is proposed as an evaluation tool for financially aid to the farmers towards the new policy, granting the production based approach more effective and more objectively allocating the direct payments. An additive evaluation model is proposed based on a consistent family of criteria composed by DEA's input and output criteria. The phenomenon of "Sofa Farmers" could be eliminated, since farmers would be financially aided after been evaluated. The preference information used in UTASTAR method is given in the form of a partial pre-order on a subset of farmers (reference set). In order to obtain robust conclusions, post-optimality analyses are applied by computing complementary robustness measures as well as a goal programming type regression model. Competitiveness is also measured as an index by applying Data Envelopment Analysis (DEA) on the assessed multicriteria additive value functions.

Financial distress prediction using a robust multicriteria approach

D. Niklis, M. Doumpos, C. Zopounidis

Technical University of Crete School of Production Engineering and Management Financial Engineering Laboratory University Campus, 73100 Chania, Greece

Authors' e-mail addresses: dniklis@isc.tuc.gr, mdoumpos@dpem.tuc.gr, kostas@dpem.tuc.gr

Keywords: Multiple criteria analysis, Robustness, Financial distress, European firms.

Abstract

Within the current highly volatile macroeconomic environment, the adverse effects of the crisis have a direct impact on the performance and viability of firms, leading to an increasing number of business failures. In this context, models that analyze and predict the risk of financial distress are important tools for managers of firms and financial institutions as well as for policy makers. Financial distress prediction models are commonly developed through a variety of analytic techniques, including statistical and operations research methods. Multicriteria decision aid (MCDA) techniques have been shown to be particularly effective in this domain, enabling the development of models that are accurate, transparent, and comprehensible. The objective of this paper is to explore the applicability of recently introduced robust MCDA methods to the development of reliable financial distress prediction models. The analysis is based on a large sample of firm from major EU markets (UK, Germany, France, Belgium, Netherlands, Italy and Spain) over the period 2003-2012. A comparison with other frequently used methods is also presented.

Modeling supply chains using simulation with regard to customer satisfaction

E. Gavriel, P. Chrysochoidis-Trantas, T. Kalotychos, A. Bimpos, Ch. Papadopoulos*

Department of Economics, Aristotle University of Thessaloniki, Greece

*E-mail address of the corresponding author: hpap@econ.auth.gr

Keywords: Supply chain simulation, Customer level-of-service, Holding-Cost minimization, Simulation/Simul8.

Abstract

The aim of this paper is the simulation of different supply chains in order to satisfy customers' demand and to optimize other objectives such as the maximization of profit, the minimization of holding and transportation costs. This paper addresses both the immediate satisfaction of demand from the retailers and the satisfaction of demand after a short time from the distributors. Moreover, it is considered that seasonal variation exists. We assume that demand follows the Poisson distribution for six months and the normal distribution the other six months. According to that we assumed four different scenarios, one for each retailer.

We studied a general multi-criteria supply chain model. The supply chain consists of four echelons before the final customer: One supplier, one manufacturer, two distributors and four retailers. The supplier of raw material focuses only on the execution and delivery of the orders that receives from the manufacturer and not the procedure of production of raw materials. We assume only one final product which needs three items of raw material in order to be produced. The manufacturer is responsible for inventory replenishment of the distributors and of the retailers, through the distributors. Moreover it has a production department to produce the products that are necessary for its inventory replenishment. Each distributor serves two retailers. The distributors receive the non executed orders from the retailers which are their immediate customers to serve.

In order to achieve this target we study two different scenarios that can be applied in different industries. At the first scenario, the 60% of the demand is satisfied immediately from the retailers and the 40% from the distributors. At the second scenario, the 30% of the demand is satisfied immediately from the retailers and the other 70% from the distributors. At the first alternative we

observe that the retailers keep more inventory than the distributors in order to fulfill the demand, whereas, at the second alternative the distributors keep more inventory than the retailers due to the fact that the demand shifts from the retailers to the distributors. So the holding cost at retailers is higher in the first alternative compared to the second one and the holding cost at distributors is less in the first alternative than in the second one. Moreover, the capacity of transportation vehicles at the first alternative is lower than in the second one. To solve this model we use the simulation software SIMUL8 (the educational version).

The contribution of this research is the simulation of a general model of supply chain with the main objective to fulfill the customer demand. The model is generic and can be extended by adding more products to make the supply chain more realistic. In addition, the transportation part of the model may be enriched by adding more vehicles and checking the transportation cost that may occur and how it can be optimized.

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Modeling supply chains using a linear and a non-linear optimization model with regard to customer satisfaction

P. Chrysochoidis-Trantas, T. Kalotychos, E. Gavriel, A. Bimpos, Ch. Papadopoulos*

Department of Economics, Aristotle University of Thessaloniki, Greece

*E-mail address of the corresponding author: hpap@econ.auth.gr

Keywords: Optimization of supply chains, Customer level-of-service, Profit maximization, Holding-Cost minimization, GAMS.

Abstract

Companies are trying to maximize their profits by optimizing their transportation processes and by minimizing their storage costs. Nowadays, it is well recognized, that the most important link in the supply chain is the final customer as he is the main reason which keeps the production alive. As a result, lately, many research studies try to optimize the supply chain operations with regard to demand satisfaction.

The main focus of this research is to satisfy the demand and based on that to achieve all the other targets which may be the maximization of profit, the minimization of holding and transportation costs, among others. We managed to develop a multi-criteria, supply chain model. The supply chain consists of four main echelons before the final customer: The suppliers, the manufacturer, the distributors and the retailers. Each one of these four echelons has three goals to fulfill: the maximization of profit, the customer satisfaction and the minimization of holding cost. The capacity limitation of the transportation vehicles and the warehouses of each echelon are also taken into consideration. The model tries to minimize the holding cost, for each of the two products that are being produced, in every echelon. Through the minimization of the holding cost it is believed that the profit is maximized, while the customer satisfaction is guaranteed. Two models are examined: a linear and a non-linear. In the linear model, the consequences are studied in each one of the three criteria, mentioned earlier, when only a part of the demand (60&30%) is satisfied immediately while the rest of the demand is served afterwards in a specific time. By comparing the two policies we managed to determine the exact inventory each echelon must keep in order to satisfy the customers completely. The nonlinear model has the same, basic structure as the linear model. Our supply chain consists of four echelons, having the same targets as the linear

model. The main difference in the non-linear model is that we assumed that the probability that some of the products transported from the distributors to the retailers, are defective in a way that the final customer is not able to use them. A nonlinear penalty cost has been added in the objective function of the retailers. Both models were solved using the GAMS (edition 23.5) software package, which is used for solving linear, nonlinear and mixed integer models. Because of the limitations of the demo version of the GAMS software we used, some simplifications were necessary to be made. We didn't consider the capacity of the transportation vehicles and tried to optimize the holding cost. The contribution of this research is the development of a general model with the main objective to fulfill the customer demand in a supply chain. The model is generic and may be further extended to various different directions by considering more products, among others.

***Acknowledgement:** In this research, Mr. Chrysochoidis-Trantas Panagiotis, Mr. Kalotychos Thomas, Ms. Gavriel Eleni and Professor Chrissoleon T. Papadopoulos have received a grant from THALES, a project co-financed by the European Union (European Social Fund – ESF) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) - Research Funding Program: Thales is investing in knowledge society through the European Social Fund.*

Internet and agro-tourism sector for regional development in Crete: A multicriteria ranking

Z. Andreopoulou(1), C. Lemonakis(2), C. Koliouka(3), K. Zopounidis(4)
(1),(3) Laboratory of Forest Informatics, School of Forestry and Natural Environment, Aristotle University of Thessaloniki, Box 247, 54124, Greece

(2) School of Management & Economics, Technological Educational Institute of Crete, Agios Nikolaos Branch

(4) Department of Production Engineering and Management, Technical University of Crete

Authors' e-mail addresses: randreop@for.auth.gr, culemon2004@yahoo.gr,
kostas@dpem.tuc.gr, ckoliouka@for.auth.gr

Keywords: Agrotourism, regional development, internet, website assessment, total ranking, multicriteria analysis, promethee II, business model, e-commerce.

Abstract

Nowadays, effective use of Internet provides an opportunity to identify successful practices and policies for innovative business models in order to promote regional development through agro-tourism. Agro-tourism sector can exploit natural and rural resources in the context of employment, growth and competitiveness. In Crete, agro-tourism entrepreneurs have developed commercial activities in the Internet where customers and firms are linked up together in the exchange of agro-tourism services. This paper aims to assess websites of commercial purpose within agro-tourism sector in Crete and rank them according to multiple criteria. Initially, qualitative and quantitative features were identified in the collected websites. Further, the websites were ranked according to these features to be used as criteria using the multicriteria analysis method of PROMETHEE II. Findings confirm that Internet adoption in agrotourism sector in Crete is in satisfactory level. The findings lead to policy implications for agrotourism firms' entrepreneurs to use internet technologies and social media as a powerful marketing tool. Since internet adoption can effectively contribute in the viability and the efficiency of an enterprise, the websites of agro-tourism sector ranked in higher places will help benchmark the design of effective agro-tourism firms' websites aiming to initially expand in the Internet or to further expand and improve existing e-commerce activities.

Optimally planning the use of railcars by a large railcar fleet management company

A. Belenky*, G. Fedin, N. Klimova, O. Lebedeva, A. Yunusova

National Research University Higher School of Economics, Moscow, Russia

*E-mail address of the corresponding author: abelenky@mit.edu

Abstract

Currently, there are three groups of players in the market of cargo transportation services in Russia. The first group is formed by a set of railcar owners, and there are two large companies, which control almost 40% of all the railcars available in Russia, along with hundreds of small railcar owners competing with these two for cargoes to move. The second group is comprised by numerous cargo owners who are interested in moving their cargoes timely and the most economically. Finally, the third group is a set of divisions of Russian Railroads, a monopoly that own and exclusively operates railroads, train stations, and locomotives throughout the country.

To move a cargo, the cargo owner should choose a company (a railcar owner) from the first group, and the chosen company is to make arrangements with the Russian Railways to supply empty railcars of the chosen railcar owner to the cargo owners to move their cargoes and to return the unloaded railcars from their destination points to the railcar owner at a specified geographic location. The existing practice of the interaction between the cargo owners and the railcar owners implies putting the order for supplying the railcars in several days in advance, and in many cases, at the time of receiving a request for railcars from a particular cargo owner to move a cargo, the railcar owner may not know the destination point of this cargo, which complicates the problem of managing the fleet, especially for the above two largest railcar owners.

Three parts of the problem of managing the fleet of railcars by one of the above two large railcar owners are considered. In the first one, the company first searches an optimal set of routes for a part of the fleet that will become available at all the locations by a particular calendar day, and it does this proceeding from the set of orders that have been received from the cargo owners by that day. Then, based upon the found optimal routing for the above day, the company searches the same for the next day, proceeding from the orders that have been received by the next day and honoring the previous assignments of

the railcars. The second part of the problem consists of finding an optimal assignment of unloaded (at the destination points) railcars that are to be return either to the company's service centers to be prepared for further operations or directly to new destinations, and this optimal assignment is searched for each particular calendar day, similar to what is done in the first part of the problem. The third part of the problem consists of bringing into step decisions obtained in the first two parts.

Mathematical models in the form of systems of linear constraints with mixed variables are proposed for both solving the first two parts of the problem separately and for solving the problem as a whole. Features of all the three problems, which are formulated both in scalar and in vector-matrix form, including the quasi-block structure of their systems of constraints, are researched, and the deployment of standard software packages for solving optimization problems in solving these problems is discussed. The proposed models can be used, in particular, for calculating competitive tariffs for cargo transportation for all the types of cargo in the marketplace under consideration. Finally, remarks on a possible use of the models in any railroads in which both the railcars and locomotives are owned by the same legal entity (which is a particular case of the problems under consideration) are made, and illustrative examples of the models and problem solutions are offered.

Single machine just-in-time scheduling problems with two competing agents

E. Gerstl, G. Mosheiov*

School of Business Administration, The Hebrew University, Jerusalem 91905, Israel

*E-mail address of the corresponding author: msomer@huji.ac.il

Abstract

In scheduling problems with two competing agents, each one of the agents has his own set of jobs to be processed and his own objective function, and both share a common processor. In the single-machine problem studied in this paper, the goal is to find a joint schedule that minimizes the total deviation of the job completion times of the first agent from a common due-date, subject to an upper bound on the maximum deviation of job completion times of the second agent. The problem is shown to be NP-hard even for a non-restrictive due-date, and a pseudo-polynomial dynamic program is introduced and tested numerically. For the case of a restrictive due-date (a sufficiently small due-date that may restrict the number of early jobs), a faster pseudo polynomial dynamic program is presented. We also study the multi-agent case, which is proved to be strongly NP-hard. A simple heuristic for this case is introduced, which is tested numerically against a lower bound, obtained by extending the dynamic programming algorithm.

Project resource leveling using ELECTREE III

K. Koulinas*, A. Ioannidou, P. Vavatsikos

Democritus University of Thrace, School of Engineering, Dept. of Production and Management Engineering, 12 Vas. Sofias st., Xanthi, Greece

Keywords: Project Management, Multiattribute Decision Models, Resource Leveling, ELECTRE III.

*E-mail address of the corresponding author: gkoulina@pme.duth.gr

Abstract

Resource leveling is classified among the biggest challenges faced by project managers as the success of a project largely depends on it. Given that the existence of peaks in the resource usage histogram is responsible for cost overruns, due to the necessary recruitment, dismissal and training of the personnel. Moreover issues arise regarding the efficient management of the available resources since large peaks correspond to the existence of fluctuations in the allocation of resources during projects life cycle or construction period.

Resource leveling aims to provide procedures and frameworks that ensure the efficient management of resources to obtain smooth resource usage profiles. Basically these procedures attempt to identify activities that should be delayed to resolve resources over allocations under time and cost constraints. Given that a variety of rules exists for the selection of the activities that should be considered as candidate for delay, a framework which is based on the prioritization of the activities to employ the constraint resources, is proposed using multi attribute decision models. ELECTREE III is a widely known method for classifying alternative activities and/or scenarios with respect to a variety of criteria. The proposed framework combines ELECTRE III and MS-Project's built-in procedures to construct the schedule based on the activities priorities which are estimated using ELECTREE III. The proposed framework is implemented in a real world construction project in Katerini, Greece.

Finally the results of the proposed framework are compared with those of the initial state as well with those derived by the performance of the standard algorithm of the MS-Project. The evaluation objective is the resource moment around the time axis. The derived results show that the proposed framework performs better than the standard MS-Project algorithm. Granted that, the generalization of the frameworks' performance in bigger and more complex projects presents particular interest.

On the way to a reference model for supply chains in the construction industry

I. Tatsiopoulou, D.-R. Stamatiou,

National Technical University of Athens, School of Mechanical Engineering, Sector of Industrial Management and Operational Research, HeroonPolytechniou 9, 15780 Zografou, Greece

Authors' e-mail addresses: itat@central.ntua.gr, drstam@mail.ntua.gr

Abstract

The construction industry is a project based industry with many particularities that differ in regions, projects and/or cultures. The fact that there are many actors involved at different levels in the construction process, with low quality information exchange caused by restricted use of communication channels, makes it inefficient. In this paper we examine the literature on supply chain reference models for the construction industry. The search demonstrates that there are no universally accepted reference models for the construction supply chain. The lack of findings is probably due to the small amount of research on supply chain management in construction when compared to manufacturing. In order to cover this gap, we propose the adoption of the Supply Chain REMEDY* reference model for the project based construction industry. We believe that the efforts construction companies make towards *customer delight*, one of their basic objectives in every project, could be supported by the existence of a reference model that takes into consideration the particularities of the sector. In the first stage, a generic reference model for the construction industry will be developed, tested and informed. In the second stage, partial models will be developed for groups of construction projects described in the paper. The article presents a brief literature review, followed by the presentation of the current literature on reference models in the literature and the construction industry literature. Conclusions make the final part of the paper.

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The problem of robustness in the MUSA method: theoretical developments and applications

Y. Politis(1), E. Grigoroudis(2), I. Pologgiorgi(3)

(1) School of Science and Technology Hellenic Open University Parodos Aristotelous 18, GR26 335, Patra, Greece

(2),(3) School of Production Engineering and Management Technical University of Crete University Campus, 73100 Chania, Greece

Authors' e-mail addresses: dniklis@isc.tuc.gr, mdoumpos@dpem.tuc.gr, kostas@dpem.tuc.gr

Keywords: MUSA extension, robustness improvement, Greek mobile service providers, satisfaction analysis.

Abstract

The MUSA method is a collective preference disaggregation approach which has been developed in order to measure and analyze customer satisfaction. It follows the main principles of ordinal regression analysis under constraints using linear programming techniques and it is used for the assessment of a set of marginal satisfaction functions in such a way that the global satisfaction criterion becomes as consistent as possible with customer's judgments. Thus, the main objective of the method is to assess collective global and marginal value functions by aggregating individual judgments. Considering that the MUSA method is based on a linear programming modelling the problem of multiple or near optimal solutions appears in several cases. This has an impact on the stability level of the provided results. The data collected to measure customer satisfaction (satisfaction questions) can have such characteristics that make it impossible to find a feasible solution consistent with customers' preferences. Incapability to interact with customers further complicates the task of finding stable solutions. For this reason actions are required in order to improve the stability of the results. These actions may relate to either the decision makers (customers) or the analysts that model and analyze the problem. Such actions may include asking customers to give additional information (e.g. information about the importance of the criteria along with the usual satisfaction questions) or introducing additional constraints in the basic LP of the method which will reduce the polyhedron of feasible solutions. This study presents the implementation of an extension of the MUSA method in a real case study concerning the evaluation of customer satisfaction from

Greek mobile service providers. More specifically, additional constraints regarding special properties of the assessed model variables and additional customer preferences about the importance of the criteria have been incorporated in the LP of the original MUSA method and have been modelled as a Multiobjective Linear Programming (MOLP) problem. The main aim of the study is to show how the introduction of these additional constraints and information can improve the stability level of the estimated results. Different stability and fitting measures have been used in order to analyze and compare the provided results. The application showed that the introduction of the additional constraints and information in the original MUSA method has improved the method's robustness, still without affecting the conclusions drawn by the implementation of the basic MUSA model, enhancing thus the proposed conclusions and improvement actions.

A combined MCDA approach for facilitating maritime transportation policies evaluation

E. Gagatsi*(1), G. Giannopoulos(2), C. Pyrgidis(3), G. Aifandopoulou(4)

(1),(3) Aristotle University of Thessaloniki, Faculty of Engineering, Civil Engineering Dep., Thessaloniki, Greece

(2),(4) Centre For Research and Technology Hellas, Hellenic Institute of Transport, Thessaloniki, Greece

*E-mail address of the corresponding author: lgagatsi@certh.gr

Abstract

This paper presents a methodology developed at the frame of an on-going PhD research, for supporting decision making in maritime transportation, based on a combination of two different MCDA methods.

Being a strong analytic tool that supports decision making in an under uncertainty environment and at the same time facilitates the building of consensus among all involved actors in a well explicit way, MCDA became a popular evaluation method with numerous recorded applications in complex problems. The lack of one single & central goal, common to all integrated policies—such as those in maritime transport, combined with a great number of impacts that cannot always be monetized, regards MCDA methods more suitable for supporting policy evaluation than other widely used financial-economic evaluation methods (e.g. CEA, CBA) that fail to capture the holistic view of a problem that requires incorporating both tangible & intangible (or ‘fuzzier’) aspects.

The most popular among the various techniques to conduct a MCDA, applied in the field of transport are multi-attribute theory variants (AHP, MAUT, MAVT, SMART, SMARTER), outranking methods (PROMETHEE, ELECTRE) & regime analysis. Recently, the combination of various MCDA methods starts gaining ground facilitated by the advancing technologies that ease their use. This paper proposes an operational synergy of two MCDA methods, namely PROMETHEE & AHP, in a multi-actors environment, to improve their applicability and decrease both methods’ deficiencies. The evaluation mechanism is structured around 3 building blocks:

- The stakeholders’ analysis used as an aid to properly identify the range of stakeholders which needs to be consulted and views should be taken

into account in the evaluation process. The different stakeholders' priorities are 'translated' into evaluation criteria, while the policy proposals of each stakeholder group leads to the formulation of the evaluation alternatives.

- The combination of 2 MCDA methods namely the AHP and the PROMETHEE. AHP supports the structuring of the problem hierarchy and the definition of the criteria weights, eliminating the main disadvantage of PROMETHEE, the lack of a structured way of defining the criteria weights. PROMETHEE, on the other hand is used for the final analysis since AHP's requirement of criteria and alternatives independency does not allow its use in the particular case of maritime transport policies evaluation.
- The exploitation of 2 independent mechanisms in the evaluation process those of an experts' group that is consulted for the selection of the evaluation criteria (through a DELPHI process) and the stakeholders' group that provides the final ratings of the alternatives vs the evaluation criteria. Both groups are also providing weights to the criteria (by an AHP application), supporting the examination (by means of the PROMETHEE method) of different scenarios leading to useful conclusions and results.

The combination of the above elements provides key advantages in the policy evaluation process:

- stakeholders' & independent experts' involvement throughout the process, ensures the identification of policy measures that are realistic and the employment of assessment criteria that correspond to their actual needs.
- a major part of the vagueness usually characterising policy formulation is removed as the method provides a structured, step-wise approach for identifying and selecting policy measures based on transparent and easy to use (ie PROMETHEE) methods
- it facilitates consensus building among stakeholders with conflicting objectives, as it provides a transparent process for commonly reaching conclusions on the policy measures to be employed
- the stakeholders participation improves the 'ownership' of results leading to the stakeholders engagement, necessary component for a successful policy implementation

- it encourages policy formulation accountability, as one can in retrospect assess whether the policy measures employed had actually resulted in the expected impacts.

An application of the methodology to the evaluation of policies to support the viability of the Greek coastal transportation is also presented along with the main messages deriving from this exercise.

Acknowledgement: This research has been co-financed by the European Union (European Social Fund-NSF) & Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework(NSRF)-Research Funding Program: Heracleitus II. Investing in knowledge society through the European Social Fund.

Composition of Web services for scaling using finite states machines

N. Halfoune

Bejaia University Algeria

Keywords: Business protocols, composition of Web services, compatibility of Web services, finites states automats.

Author's e-mail address: n_halfoune2011@yahoo.fr

Abstract

The main goal of our work is to ensure a precise composition of business services. We use business protocols to model the exchanges between the different entities (supplier, consumer, intermediaries). Our work is based on the technology of Web services and the finite state automats to define our approach of services composition. In this work, we present an improvement of an existing algorithm of consumer-server composition. Then, we develop two new algorithms of composition: series composition and parallel composition of Web services.

Optimal strategic design of flexible supply chain networks

M. Kalaitzidou(1), P. Longinidis(2), P. Tsiakis(3), M. Georgiadis*(4)

(1),(4) Department of Chemical Engineering, Aristotle University of Thessaloniki, University Campus 54124, Thessaloniki, Greece

(2) Department of Engineering Informatics & Telecommunications, University of Western Macedonia, Karamanli & Lygeris Street, 50100 Kozani, Greece

(3) Wipro Consulting Services, 3 Sheldon Square, London W2 6PS, United Kingdom

*E-mail address of the corresponding author: mgeorg@auth.gr

Abstract

In order to ensure sustainability in the worldwide economy of enterprise and trade and their highly competitive environment, researchers are motivated to build optimization models with supporting decision makers involving the strategic design of Supply Chain Networks. SCN design literature deals with models that are aiming to optimize supply chain network's operation and design by taking strategic and tactical decisions under criteria like uncertainty in product demand (You and Grossmann, 2008), suppliers' selection (Thanh et al., 2008), reverse flows and demand uncertainty (Cardoso et al., 2013) and financial management aspects (Lainez et al., 2007). The vast majority of this relevant works on the research stream of SCN design assumes a structure of the network with distinct and consecutive echelons, constituted of nodes with predetermined function, where product flow moves from an echelon's nodes to subsequent echelon's nodes. To the best of our knowledge, very few contributions in the process systems engineering community have appeared to implement material flow connection among same levels while, at the same time, deciding about the function of the main echelons.

The proposed model presents an innovative configuration to network's structure by entering a level consisted of generalized production/warehousing nodes (P/W) whose function is not a priori assumed, as in mainstream fixed echelon SCNs. These nodes can receive material from any potential supplier or any other P/W node and deliver material to any customer zone or any other P/W node (intra-layer material flow connection). The model aims to minimize the overall capital and operational cost of the network and to determine the optimal structure of the network. Moreover, defines: suppliers, generalized node's location and role, material flow among SCN's levels and functional elements (capacity, material flow, providing raw materials etc.).

The mathematical model proposed in this paper is a Mixed-Integer Linear Programming (MILP) problem. The model presented is a deterministic model, solved with product demand being stable. The applicability of the SCN design and operation model is illustrated by using a real case study in the European area while sensitivity analysis reveals valuable managerial insights for decision making in strategic SCN level.

***Acknowledgement:** This research has been co-financed by the European Union (European Social Fund – ESF) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) - Research Funding Program: Thales. Investing in knowledge society through the European Social Fund.*

An integrated multi-regional long-term energy planning model incorporating autonomous power systems

N. Koltsaklis (1), P. Liu (2), M. Georgiadis* (3)

(1), (3) Aristotle University of Thessaloniki, Department of Chemical Engineering, 54124 Thessaloniki, Greece

(2) State Key Laboratory of Power Systems, Department of Thermal Engineering, Tsinghua University, 100084 Beijing, China

*E-mail address of the corresponding author: mgeorg@auth.gr

Keywords: Mixed integer linear programming; Generation expansion planning; Autonomous power systems' interconnection, Renewable energy sources, Power sector.

Abstract

This paper addresses the long-term generation expansion planning problem of a large-scale, central power system incorporating the possible interconnection with various autonomous power systems. A multi-regional, multi-period, linear mixed integer programming model was developed to determine the optimal power capacity additions per time interval and region and the power generation mix per technology and time period. The study focuses also on the uncertainty characterizing some crucial input parameters such as the projected electricity demand, fuel prices, CO₂ emissions price as well as the operational availability of the power generation units, both thermal and renewable. The model is tested on the Greek power system taking also into consideration the scheduled interconnection of the mainland power system with those of some autonomous islands (Cyclades and Crete), and aims at providing full insight into the composition of the long-term energy roadmap at a national level.

Comparison of GA-ANN and traditional Box-Jenkins methods for railway passenger flow forecasting

N. Glišović*(1), M. Milenković(2), N. Bojović(3), R. Nuhodžić(4)

(1) Department for Mathematical Sciences, State University of Novi Pazar, Serbia

(2),(3) Division for Management in Railway, Rolling stock and Traction, The Faculty of Transport and Traffic Engineering, University of Belgrade, Serbia

(4) Railway Infrastructure of Montenegro, Podgorica, Montenegro

*E-mail address of the corresponding author: natasaglisovic@gmail.com

Keywords: Genetic algorithm, Artificial neural network, Box-Jenkins, Time series.

Abstract

The exact prediction of the railway passenger traffic conditions has become more and more significant due to the vital role in the basic functions of the management of the railway processes. Although the transport related literature, which deals with the prediction on the basis of the neural networks, is numerous, the uncertainty that is dominant in the functioning of the transport systems degrades the performances of the prediction very much on the basis of the neural networks. In this paper, the issue of railway passenger flow forecasting is tackled by a hybrid method based on integration of genetic algorithm (GA) and artificial neural network (ANN). The results of comparison of the developed model with traditional Box-Jenkins methodology are presented for the case of railway passenger demand on a railway line of Serbian Railways.

Inspection of power grid by periodic vehicle routing formulation

V. Spathis, I. Forlidas, E. Skordilis, G.K.D. Saharidis

Mechanical Engineering, University of Thessaly, Leoforos Athinon, Pedion Areos 38334 Volos, Greece

Authors' e-mail addresses: vspathis@gmail.com, gforlidas@yahoo.gr, erskordi@gmail.com, saharidis@gmail.com

Abstract

The inspection of unattended power substations by trained personnel has been surprisingly important regardless of the enhanced remote supervision today's technology offers. In this paper, we present a mixed integer linear programming formulation that examines the optimized scheduling of these inspections with respect to the particularities and the nature of the inspection, taking also into consideration the multiple origins of the inspections and the scattered facilities to be inspected.

FindMyWay: A prototype web-based platform for journey planning in Athens city, Volos city and Crete island

Konstatzos G. (1), Emmanouilidis G. (2), Mpizas L. (2), Tsoutsanis N. (2), Moza Z. (2), Pechak O. (3), Saharidis G.K.D. (2)

(1) innovECO, 76, Kourtidou Str., 111 45, Athens, Greece

(2) Mechanical Engineering, University of Thessaly, Leoforos Athinon, Pedion Areos 38334 Volos, Greece

(3) School of Chemical Engineering, National Technical University of Athens, Greece

Authors' e-mail addresses: info@innoveco.gr, george.emman@gmail.com, lampizas@gmail.com, nest.oras.07@hotmail.com, zoigr79@gmail.com, opechak@gmail.com, saharidis@gmail.com

Keywords: Journey planner, transport, web platform

Abstract

The objective of the proposed research is to develop a Decision Support System (DSS) for a web based platform which will help individuals to move in Greece using public transportation means. The developed platform includes mainly three prototype platforms corresponding to three different regions of Greece. The first platform provides journey planning using public transport means in the region of Athens as well as the connection between city of Volos and Athens. The second platform provides journey planning in the city of Volos using the local buses and the third platform provides journey planning between the cities of Crete island using intercity buses. The final outcome of this research will be the development of a journey planner for the entire Greece.

***Acknowledgement:** This research has been co-financed by innovEco P.C. and the department of Mechanical Engineering, University of Thessaly.*

Touristic Guide: A prototype software for touristic journey planning

Mpizas L. (1), Tsoutsanis N. (1), Moza Z. (1), Pechak O. (2), Pantelis D.(1), Saharidis G.K.D. (1)
(1) Mechanical Engineering, University of Thessaly, Leoforos Athinon, Pedion Areos 38334 Volos, Greece
(2) School of Chemical Engineering, National Technical University of Athens, Greece

Authors' e-mail addresses: lmpizas@gmail.com, nest.oras.07@hotmail.com,
zoigr79@gmail.com, opechak@gmail.com, d_pandelis@uth.gr, saharidis@gmail.com

Keywords: Touristic guide, Journey planning, Software, Multi criteria optimization.

Abstract

Given a user profile, a well-defined network of sites and activities, and the availability of (real-time) information, Touristic Guide software will return to the user a collection of sites and activities that maximizes their preferences while respecting budget and time constraints at real time. "Real-time" is practically translated to the possibility of the system to take into account changes in real-time that affect the proposed plan (such as e.g. more time or cost spent in a site, a site is closed etc.) and require re-calculation. The user profile will be processed to eventually define a set of weights/preferences associated to each candidate site/activity that the system will make available. For instance a certain user may be a family man who loves ancient history and is interested in agritourism and tours offering cultural and heritage experience. The prototype software would then favor places and activities that authentically represent the stories and people of the past, would promote visits to regions famous for their history, art, architecture, religion(s), and assign high score of preference to touristic elements of peoples' way of life and lifestyle.

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Mapping of higher education specialties through the implementation of a decision support system

N. Ploskas(1), V. Kostoglou(2), M. Vassilakopoulos(3)

(1) University of Macedonia, Department of Applied Informatics 156 Egnatia st., P.O. Box 1591, 540 06, Thessaloniki, Greece

(2) Alexander Technological Educational Institute of Thessaloniki, Department of Informatics, P.O. Box 141, 574 00, Thessaloniki, Greece

(3) University of Thessaly, Department of Electrical and Computer Engineering, 37 Glavani – 28th October st., 382 21, Volos, Greece

Authors' e-mail addresses: ploskas@uom.gr, vkostogl@it.teithe.gr, mvasilako@inf.uth.gr

Keywords: Decision support system, Higher education, Specialty of studies, Vocational orientation.

Abstract

The vocational orientation of lyceum graduates, higher education students and fresh university graduates present particular interest for the majority of each country's youngsters. These issues have not been investigated extensively, especially in the field of decision sciences. Nevertheless, they have important practical implications because they are directly connected to the decrease of the youth unemployment, one of the top priorities in all European countries. The most used tools in vocational orientation and career planning are the job profiles. These tools include a description of the different professions through information systems. The description of a profession includes any type of information about it, such as statements, roles & responsibilities, expected results, required skills & qualifications, experience etc.

In previous work, the authors presented the analysis and design of a digital guide; a web based Decision Support System (DSS) aiming to assist its users in getting thoroughly informed and eventually choosing the most appropriate for them higher education studies. The digital guide has a twofold goal: i) support youngsters that aim to choose the most appropriate for them higher education studies, and (ii) inform students or graduates searching for information about their specialty's vocational prospects. To the best of our knowledge, this is the only DSS in Greece that presents the departments of all Technological Educational Institutions. These departments are categorized according to their specialty, their vocational prospects and HE institutions.

In this work, the implementation of the proposed web-based DSS is presented. This DSS has been implemented using PHP, MySQL and Ajax techniques to create a synchronous web application. Special versions of the web application have been created for smart mobile devices, to deal with the limited screen size and the touch-screen capabilities of these devices. The implementation of the features that are presented in this paper include:

- The development of the user-friendly interfaces, whatever the type (e.g. desktop PC, tablet, smartphone) of the device the user uses.
- The SQL queries to the Database Management System.
- The implementation of a Data Warehouse that includes job profile database historical data and helps to answer aggregate queries.

The implementation of a service that can use criteria provided by the user to form recommendations.

A holistic approach for smart cities energy assessment

I. Papastamatios, H. Doukas*, S. Androulaki, J. Psarras

Decision Support Systems Laboratory, School of Electrical & Computer Engineering National Technical University of Athens, Athens, Greece

*E-mail address of the corresponding author: h_doukas@epu.ntua.gr

Abstract

Energy is an essential component of life in cities, since it supports the whole spectrum of economic activities and provides high living standards to residents. Nowadays, cities tend to become “smarter”, usually disregarding the issues of energy efficiency and sustainability. This study provides City Authorities with a holistic approach, based on a Smart City Energy Assessment Framework (SCEAF), in order to assess the behavior and performance of a city, reflecting clearly quantifiable energy related indicators, but also the related policy context performance and the integration of smart infrastructure. Its main purpose is to direct Smart Cities to energy optimization by highlighting the strengths, the vulnerabilities and the opportunities arising. SCEAF’s indicators have been structured on the following major assessment axes: Political Field of Action, Energy and Environmental Profile and Related Infrastructures – Energy and ICT.

The framework is accompanied by an effective web based software, titled Online Multidisciplinary Information Management Software (OMIMS), a powerful Decision Management tool, which is used to assess the exported multidisciplinary indicators of the SCEAF framework. The multiple criteria methodology is based on computing with words and the final output is a linguistic term.

The software accepts as input multiple energy indicators of three different types (numerical, interval-valued, linguistic) and implements successfully the three phases of the Herrera F. aggregation process for dealing with heterogeneous contexts (unification, aggregation, transformation into 2-tuple). OMIMS is developed using various open source tools and it contains a set of dynamic web pages, forms, visualization mechanisms and a MySQL database. Web pages are built using PHP language and are equipped with JavaScript in order to provide responsive context.

Concerning the user management module, the system allows the users to create a new account (including an authentication process) and to safely reset any lost password via an e-mail notification system, if needed. Regarding the visualization module, the creation and thus the solution of each problem, is enhanced by the dynamic creation of various graphs, which provide the user with a visualized ability to present solutions.

OMIMS assists users in dealing with multidisciplinary DSS Smart City problems by allowing them to unify non-homogenous information in a fast and ground breaking way. Hence, along with SCEAF it provides an integrated solution, for the assessment not only of the activities spectrum of a city, but also of a customized assessment per sector, providing more focused information.

An additional benefit is that based on OMIMS open architecture and visualization tools, it can depict the stability intervals of each examined case and thus enhance the robustness of the final solution.

An IFE model for multi-criteria decision-making

B. Rouyendegh*, Y. Rouyendzagh

Department of Industrial Engineering, Atılım University, Ankara, Turkey

*E-mail address of the corresponding author: babekd@atilim.edu.tr

Keywords: Multi-Criteria decision-making, IFE, DM's.

Abstract

The aim of this study is develop and describe a new methodology for Multi-Criteria Decision-Making (MCDM) problem with using IFE (Elimination Et Choix Traduisant La Realite (ELECTRE) model. The propsed models enable Decision Makers (DMs) on assessment and use Intuitionistic Fuzzy numbers (IFN). A numerical example is provided to demonstrate and clarify the proposed analysis procedure. An empirical experiment was conducted for validation the effectiveness, and reported in this paper.

Environmental performance evaluation using a fuzzy aggregation-disaggregation approach

Z. Sbokou, E. Grigoroudis, M. Neofytou

School of Production Engineering and Management, Technical University of Crete University Campus, Kounoupidiana, GR73100 Chania, Greece

Authors' e-mail addresses: sbokou.lina@gmail.com, vangelis@ergasya.tuc.gr, micneophytou@gmail.com

Keywords: Environmental performance evaluation, Fuzzy UTASTAR, Environmental management systems, Aggregation-disaggregation approach.

Abstract

An important tool for the evaluation and the documentation of a successful environmental management system is the Environmental Performance Evaluation (EPE). The EPE is defined as a continuous internal process and a management tool that uses indicators in order to evaluate the environmental management system of a business organization and to compare past and present environmental performance. International standards ISO 14031-14032 describe the categories of performance indicators; however they do not determine a specific framework for the development and measurement of these indicators. The main aim of this study is to present an EPE methodology based on a fuzzy multicriteria analysis approach. In particular, the fuzzy UTASTAR method is applied in order to evaluate the environmental performance of a mill industry. It is an extension of the well-known UTASTAR method capable to handle both ordinary (crisp) and fuzzy evaluation data. To evaluate the environmental performance of the industry, the production processes are analyzed and the environmental indicators related to the environmental impact of the industry are defined. The environmental indicators are related to the products of the industry, the material consumption, the consumption of natural resources and waste management. The five groups of the indicators are: air emissions, solid waste, natural resources and energy, environmental education and third parts, recycling, and improvement measures. The main steps of the presented approach include the following: Criteria assessment (definition of the final set of indicators and their measurement units), Definition of fuzzy sets (fuzzy values that reflect the low, medium and high performance of each indicator), Development and ranking of alternative scenarios for each group of

indicators, Application of the fuzzy UTASTAR model (estimation of fuzzy utility functions, overall utilities for scenarios). The actual value of each indicator is used in the estimated utility function of the corresponding indicator and the result is normalized in order to calculate the environmental performance of the industry. The environmental performance of the industry can be measured per dimension (group of indicators) or per total. The applied method is an easy to handle and flexible tool for evaluating the environmental performance of a business organization. Also, the results are able to determine the strong and the weak points, as well as potential improvement action regarding the environmental management system. Another important advantage is that the proposed approach may take into account the decision maker's preferences (environmental strategy of the organization). Finally, the method is able to give a clear picture of the rate of the environmental objectives and targets achieved from the total environmental objectives and targets set by the senior management.

Rationalizing electricity production investments from renewable energy sources in Greece using a synergy of multicriteria methods

E. Siskos*, D. Peronikolis, G. Psarras

National Technical University of Athens, 9, Iroon Polytechniou str., 15780, Zografou, Athens, Greece

Keywords: Multicriteria decision support, Renewable energy sources, energy policy, electricity production investments.

*E-mail address of the corresponding author: lsiskos@epu.ntua.gr

Abstract

The necessity for disengagement from conventional energy sources, along with the increasingly strict measures of the European Union (EU) towards this direction, lead to the promotion of the renewable energy sources (RES). In particular, Greece, although having high potential in electricity production from RES, mainly hydroelectric, wind and solar, is still behind in comparison to other EU countries in the area of RES adoption. Nevertheless, the incentives provided by Europe and the Greek government, during the last few years, for investing on electricity production from RES, are significant and great in number. The aim of this paper is to evaluate and rank possible medium-scale investments on electricity production from RES, of approximately 10MW. Specifically, a multicriteria evaluation system is elaborated, based on four points of view: (i) techno-economic, (ii) social, (iii) environmental, and (iv) political. The investments assessed are categorized with respect to the type of RES invested upon (i.e. solar, biomass, geothermal, etc.) and the area of implementation (mainland, islands or offshore). The selection of best investments is achieved through the implementation of the ELECTRE IS method, which takes into account the presence of pseudo-criteria through the proposed evaluation system. The criteria weights are elicited with the aid of the revised Simos methodology. The overall objective of this research work is to support energy policy decision making in Greece and trigger sustainable development.

Optimizing long term fleet wide crew assignment

T. Varelas*, S. Archontaki, M. Livadioti

Danaos, Piraeus Greece

*E-mail address of the corresponding author: drc@danaos.com

Keywords: Crew assignment, Binary integer programming, Multi criteria analysis

Abstract

We present the unique long term maritime crew planning and assignment optimization that Danaos Corporation envisaged, Danaos Management has implemented and Danaos Shipping deployed as an enrichment of its ORISMA (Operation Research in Ship Management) toolkit. The major novelty in this system is the extension of the two coordinates, the number of vessels from one to whole fleet and the time horizon from couple of weeks to several months. Another initiative is the addition of a third dimension the teamwork index of the vessels' management team. As assignment optimization problem the definition of an objective assignment function that should be optimized is required. We analyzed the problem and found out the formulas and the variables that are needed for the calculation of coefficients in the identified individual objectives that are combined in a weighted multi-objective assignment penalty function. The extension of coordinates and the team-working dimension increases the problem complexity and is hard to achieve optimal solution with conventional heuristics. So we combine operation research genetic and multi-index axial integer models, efficient assignment algorithms and, new developed ones into one model adjusted to specific problem requirements.

System also supports strategic decisions regarding the depth determination of the availability officers' pool, the entries' attributes such as rank, performance, availability and nationality avoiding in one hand unfeasible solutions and keeping on the other the safety pool level as less as possible. Furthermore an alert mechanism generates the appropriate triggers for actions whenever safety levels are reached and suggests mitigation plan.

From design point of view the most important novelty of the ORISMA approach is the usage of ship officers' quadruplet as the monitoring entity instead of the individual ship officer.

Developing stability indices for group and collective decision approaches

P. Delias(1), N. Matsatsinis(2), E. Grigoroudis(3)

(1) Department of Accounting and Finance, Eastern Macedonia and Thrace Institute of Technology, Greece

(2),(3) School of Production Engineering and Management, Technical University of Crete, Greece

Authors' e-mail addresses: pdelias@teikav.edu.gr, nikos@ergasya.tuc.gr, vangelis@ergasya.tuc.gr

Keywords: Group decision support, Robustness, Multiple criteria decision aid.

Abstract

In group and collective decisions, where multiple actors are involved, due to different ethical and/or ideological beliefs, different specific objectives, or even different roles within an organization, decision makers' opinions often conflict.

In this context, MCDA methods and in particular UTA methods have been used in numerous studies in order to represent the multiple viewpoints of the problem, to aggregate the preferences of the multiple DMs, or to organize the decision process (group decision or negotiation support systems, conflict resolution etc.). While group decision approaches aim to achieve consensus among the group of DMs or at least attempt to reduce the amount of conflict by compensation, collective decision methods focus on the aggregation of the DMs' preferences. Therefore, in the latter case, the collective results are able to determine preferential inconsistencies among the DMs, and to define potential interactions (trade-off process) that may achieve a higher group and/or individual consistency level. The final decision may appear as the outcome of different objectives (minimize the sum of errors for all decision makers, minimize potential individual deviation from the inferred group preference system, minimize the number of violated pairs in DMs' rankings, or minimize the maximum sum of violated judgments for every DM). In this work we consider all the above cases and we calculate the pertinent stability indices. We also discuss the potential of a general stability index to measure the robustness of the final decision for virtually any case.

Acknowledgement

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Hybridized genetic algorithm for energy and performance-aware task scheduling in a cloud computing environment

K. Sellami*(1), P. Tiako(2)

(1) Applied Mathematics Laboratory, A/Mira University of Bejaia Route de Targua Ouzemour, 06000, Bejaia, Algeria

(2) Langston University & CITDR, Tiako University ,Oklahoma, 73050, USA

*E-mail address of the corresponding author: Khaled.sellami@univ-bejaia.dz

Keywords: Cloud computing, Workflow scheduling, Optimization, QoS, Energy efficiency.

Abstract

Cloud computing is viewed as a major logical step in the evolution of the Internet as a source of remote computing services driven by economies of scale, whereby a pool of computation resources, usually deployed as a workflows tasks.

In this paper, we investigate the problem of scheduling workflow applications on cloud computing infrastructures. The cloud workflow scheduling is a complex optimization problem which requires considering various scheduling criteria. Traditional researches mainly focus on optimizing the time and cost without paying much attention to energy consumption. We propose a new approach based on the hybridization of a CSP with a genetic algorithm heuristic to optimize the scheduling performance by (a) formulating a model for task-resource mapping to minimize the overall energy consumption using the dynamic voltage scaling (DVS) technique; and (b) designing a heuristic that uses hybridization of a CSP with a genetic algorithm to solve task resource mapping based on the proposed model. Our approach is validated by simulating a complex workflow application.

How much energy and environmentally efficient is the EU agriculture? Some initial evidence

G. Vlontzos*(1), S. Niavis(2), B. Manos(3)

(1) University of Thessaly, Dep. of Agriculture Crop Production and Rural Environment, Fytoko, 38446 Volos, GREECE

(2) University of Thessaly

(3) Aristotle University of Thessaloniki

*E-mail address of the corresponding author: gvlontzos@agr.uth.gr

Abstract

This study attempts to evaluate the energy and environmental efficiency of the primary sectors of the EU member state countries. The Data Envelopment Analysis (DEA) methodology tool was used for this evaluation. As inputs, were selected the energy consumption, the labour, and the capital used. As outputs, were selected as desirable one the economic output, and as undesirable the CO₂ emissions, and the Gross Nutrient Balance. The 2001-2008 time period was selected for this research. One of the most important findings is that countries like Germany, Sweden, or Austria, with strong environmental protection standards, appear to be less energy and environmentally efficient, compared with countries like Denmark, Belgium, Spain, France, or Ireland. Additionally, a series of eastern European countries achieve low efficiency scores, which can be characterised as expectable, due to low technology level being implemented in the primary production process. There are also two sub-periods for this research. The first one (2001-2006) covers the fully coupled with specific cultivations period for subsidy administration, and the second (2007-2008) where the new decoupled subsidy scheme was implemented. There are significant hints for considerable changes of energy and environmental efficiency after the implementation of the new CAP, with the new member states significantly differ of both energy and environmental efficiency compared with the older ones.

Resource availability modeling and optimization in a car park management problem

V. Vassiliadis (1), C. Salagaras (2), V. Koutras(3), N. Thomaidis(4), A. Platis (5), G. Dounias(6), C. Kyriazis(7)

(1),(2),(3),(4),(5),(6) University of the Aegean Department of Financial and Management Engineering, 41Kountouriotou Street, Chios 82100, Greece

(4) Aristotle University of Thessaloniki School of Economics University Campus, NOPE building 54124 Thessaloniki, Greece

(7) CPS Athens S.A. 401 Messogion, 15343 Ag. Paraskevi, Greece

Authors' e-mail addresses: v.vassiliadis@fme.aegean.gr, fmem08001@fme.aegean.gr, v.koutras@fme.aegean.gr, nthomaid@econ.auth.gr, platis@aegean.gr, g.dounias@aegean.gr, ck@central-parking.gr

Keywords: Resource availability, Parking management, Markov model, Resource reservation, Integer optimization.

Abstract

This paper addresses the modeling and optimization of resource availability in car parkservingdifferent classes of customers. We examine various formulations of the problem centered around two general objectives: a) increasing availability for clients of high priority and b) maximizing the aggregate service level. In the current context, priority classes are specified according to different space reservation options provided by the parking management company (monthly parking, hourly parking, parking on demand, etc).Based on actual historical traffic data and under certain methodological assumptions, we calculate the arrival and service rates for each class of customers. These are subsequently used as inputs in a Markov model for the number of available parking spaces given that some of them are reserved for higher priority classes. A variety of optimization techniques and OR heuristics are applied to deal with numerical aspects of the associated reservation planning issues. Further experimentation is currently in progress mostly concerning the composition of a finely-grained stochastic model which takes into account periodicity and seasonality of parking space demand.

Simulation analysis of a pilot handling system for the rail transport of conventional semitrailers

A. Ballis

Department of Transportation Planning and Engineering, National Technical University of Athens, 5, Iroon Polytechniou, GR-15773, Athens, Greece

Author's e-mail address: abal@central.ntua.gr

Abstract

The European Intermodal transport is facilitated by use of four main freight systems: the ISO container based system, the inland container and the swap body based transport system as well as the semi-trailer based transport system. Semi-trailers are essential components of the road traffic and thus also of the pre- and post-haulage parts of the intermodal/combined transport chains. The use of semi-trailer as a loading unit in the railway transport has a long record, either as cranable semi-trailers (that are loaded on special wagons by cranes or reach stackers) or as conventional (non-cranable) semi-trailers that are loaded on trains using various horizontal handling techniques (rolling motorways, the Modalohr system or the ISU system).

The system ISU ("Innovativer Sattelanhänger Umschlag") was designed to allow the transport of existing (non-cranable) semi trailers by picking them from their wheels, e.g. by applying the same forces as when they are sitting-on during road transport. A prototype has been developed and demonstrated in the Wien Nordwest terminal as well as in Wells terminal in Austria. The pilot run of the system has been performed on the Austria –Turkey route as a part of activities performed within European CREAM project. In parallel effort was given to the analysis and improvement of the operations and the configuration of the ISU system aiming to develop the "next generation" of this equipment.

The handling system of ISU deviates a lot from the known conventional handling operations. It consists of a number of wheel-packer elements, a transverse beam and an adapter with hoisting ropes that is mounted to a Reach Stacker spreader. The wheel-packer elements are located in a special ramp (ISU-ramp). The service cycle of ISU is largely dependent on the initial conditions (wheel grippers in ramp slots or in a wagon, reach stacker near the ramp or near the railway line, tractor waiting to attach or detach a semi-trailer) and the sequence of handling requests (loading or unloading operations).

In order to analyse the above complex operating conditions a simulation based analysis has been performed by the NTUA research team participating in the CREAM project consortium. A simulation model with animation capabilities has been developed and calibrated (handling and service cycle times) using video recordings of the pilot ISU system in operation in Wells. The scope of the current presentation is to outline the methodological framework used for the above simulation analysis and the functionalities of the simulation model, as well as to present the results of the research work.

All-node information asymmetry and the potential of supply chain coordination

D. Zisis(1), G. Ioannou(2), A. Burnetas(3)

(1),(2) Department of Management Science and Technology Athens University of Economics and Business

(3) Department of Mathematics University of Athens

Authors' e-mail addresses: dzisis@aueb.gr, ioannou@aueb.gr, aburnetas@math.uoa.gr

Abstract

We consider a firm with two distinct business units interacting similarly to a two-node supply chain. One business unit (or node) can be thought of as a supplier (or manufacturer) that produces a single product in a lot-for-lot fashion since he does not own a warehouse facility, nor can he accommodate inventory at other premises; thus, completed lots are directly forwarded to the second business unit (or node), who acts as a retailer, ordering items to satisfy market demand.

Both nodes are rational, base their decisions on sound utility functions, and have setup costs (production-related for the supplier and order-related for the retailer). A crucial assumption in the literature is that all the players have complete information (knowledge) for the chain. In this work, we consider that the two nodes have their own private information: the supplier about the production cost (which can take a high or a low value) and the retailer about the holding cost (which can take a high or a low value as well).

The business relationship can be modeled via a game with asymmetric information (Bayesian game). The information asymmetry reflects the two levels of production cost (that the supplier is aware of) and the two levels of warehousing cost (that the retailer knows when opting for it). In order to model this information asymmetry, each node assumes a probability function for the actual value of the other node's cost; i.e. the supplier assumes a probability function for the holding cost (retailer's private information), while the retailer assumes a probability function for the production cost (supplier's private information).

Our goal is to examine how coordination of the decisions in this internal supply chain can be reached so that the individual gains of each node are (at least) slightly increased. The supplier prefers the largest possible orders from the retailer, since this would reduce his set-up costs. The retailer is responsible for

the quantity ordered, and must consider both storage and set-up costs when he determines the preferred quantity levels, in addition to all other problem parameters.

In our model each node makes his decisions in order to maximize his own utility function, without thinking about the global optimal. We propose mechanisms which can force the retailer to opt for larger orders, without restricting his freedom in deciding the quantity ordered; in general our model although does not include any contracts or other forms of explicit agreements between the two nodes, leads to coordination because of individual increased gain expectations. To affect the retailer's decision we use quantity discounts; this mechanism in contrast to others such as returns' policies, quantity flexibility, back-up agreements etc., requires no additional flow of information or logistics between the two nodes (i.e., it requires only the initial statement of the prices and the discount levels, and then the players either opt to enter or reject the business relationship). The underlying optimization problem for this asymmetric information game is complex and multi-parameter dominated; thus analytical results are not always achievable, although specific cases can be handled and will be presented.

Stochastic modeling of multistage supply chain, with Poisson external demand, exponential lead times, lost sales and (S_i, s_i) continuous review replenishment policies

M. Vidalis(1), V. Angelis(2), S. Koukoumialos(3), M. Geranios(4)

(1),(2),(4) Department of Business Administration, University of Aegean

(3) Assistant Professor, Department of Business Administration, T.E.I. of Thessaly

Authors' e-mail addresses: mvid@ba.aegean.gr, v.angelis@aegean.gr, skoukoum@teilar.gr

Keywords: Supply chain management, Inventory control, Continuous review policy, performance measures.

Abstract

In this work a multistage discrete flow serial supply chain with an arbitrary number of $K \geq 2$ nodes (retailer, wholesaler, manufacturer, supplier, etc.) is examined. Each node i , ($2 \leq i \leq K$) feeds its single downstream node $i-1$, is replenished by its upstream node $i+1$ ($1 \leq i \leq K-1$) and faces supply uncertainty (except for the most upstream node) in both aspects: length of replenishment time and quantity delivered. The last downstream node (retailer) faces external Poisson demand with rate λ . Each node, -except for the most upstream, who is assumed saturated - follows a continuous review (S_i, s_i) , $i = 1, 2, \dots, K-1$ ordering policy. If an upstream node has insufficient stock, then the orders are partially satisfied and the rest lost.

The performance of the supply chain, is influenced by the system's parameters: K (number of stages), S_j (upper level of inventories) s_j , (reorder levels), μ_i (replenishment rates), $i, i=1, 2, \dots, K-1$ and λ (demand rate). The supply network is modeled as a continuous time Markov process with discrete states. The structure of the transition matrices of these specific systems is explored and a computational algorithm is developed to generate stationary probability distribution for different sets of the system parameters. The proposed algorithm is used as a design or optimization tool to determine the optimal values of $S_j, s_j, j=1, 2, \dots, K-1$ to maximize fill rate or minimize WIP.

Theory of attractive quality and multicriteria analysis: Analyzing customer preferences on smartphone attributes

I. Pologiorgi, E. Grigoroudis, N. Matsatsinis

School of Production Engineering and Management, Technical University of Crete University Campus, Kounoupidiana, GR73100 Chania, Greece

Authors' e-mail addresses: ipologiorgi@yahoo.gr, vangelis@ergasya.tuc.gr, nikos@ergasya.tuc.gr

Keywords: Kano model, MUSA method, WORT method, Ordinal regression.

Abstract

In a highly competitive, fast-changing, and customer-oriented market, proactively and defectively delivering product/service quality is the key for enhancing corporate profits and competitiveness. To maintain market advantages, enterprises must understand customer requirements and provide satisfactory product/service quality. However, customer requirements are varied and can be both explicit and implicit. Thus, while trying to satisfy the explicit requirements of customers without unnecessarily wasting expenditure, enterprises must also explore implicit customer requirements to make them feel satisfied and surprised. The one-dimensional service quality model evaluates the sufficiency of certain quality attributes. Sufficiency leads to satisfaction, while insufficiency leads to dissatisfaction. In fact, this measure is not applicable to all quality attributes and has limited explanatory power. In this case, fulfilling the individual product/service requirements does not necessarily imply a high level of customer satisfaction (or the opposite). The theory of attractive quality was inspired by Herzberg's Motivator-Hygiene Theory, which assumes that sufficiency of certain attributes does not necessarily lead to satisfaction. It is a theory intended to better understand different aspects of how customers evaluate and perceive quality attributes. It explains how the relationship between the degree of sufficiency and customer satisfaction with a quality attribute can be classified into five categories of perceived quality. Using a specific questionnaire, quality attributes can be classified into one of five quality dimensions: (i) attractive; (ii) one-dimensional; (iii) must-be; (iv) indifferent; and (v) reverse. Understanding the quality attributes in each category of two-dimensional quality model and determining appropriate actions help to effectively improve product/service

quality and business operations. The Kano's model may give insight into the relationship between the importance of quality attributes and the customer requirements for these attributes. Customers may be communicating different levels of importance in their explicit judgments of importance. In simple words, the theory of attractive quality suggests that the importance of a quality attribute is not constant, but it is affected by the category in which this attribute is assigned, as well as its performance level. The main aim of this study is to present a methodological approach for classifying customer requirements based on the Kano's model. The approach is based on multicriteria analysis and adopts the principles of ordinal regression techniques. The main objective is the comparison between derived and stated importance for the satisfaction criteria, as expressed by a set of customers. Stated importance is defined as the straightforward customer preference for the weight of a satisfaction criterion, while derived importance is estimated by a regression-type quantitative technique using customer judgments for the performance of this set of criteria. Both stated and derived importance are estimated using ordinal regression techniques and these results are comparatively examined through a dual importance diagram that defines different quality levels in agreement with Kano's approach and gives the ability to classify customer requirements. The applicability of the proposed approach is illustrated by a real-world application in the mobile phone industry. The results can give valuable information about the quality attributes of smartphone's, since they may identify unspoken motivators or even expected or cost of entry attributes. Using this approach, customer requirements are better understood, since the product/service criteria that have the highest impact on customer satisfaction or dissatisfaction can be identified.

Conflict management in small decision making groups, utilizing robustness analysis of individual preference models: A Case Study

D. Yannacopoulos, A. Spyridakos, G. Mouriadou, N. Tsotsolas

University of Piraeus, 80, Karaoli & Dimitriou str., GR-18534 Piraeus, Greece

Authors' e-mail addresses: dgian@teipir.gr , tspyr@teipir.gr , ntsotsol@unipi.gr

Abstract

This research work presents an interactive, methodological frame for the management of conflicts, into a negotiation process for small decision making groups' situations.

We use the results of robustness analysis of individual preference models, which are estimated by disaggregation - aggregation approaches.

These results intend to highlight the fields of convergence, among the decision makers, which can trigger compromising feedbacks for the estimation of preference models, with higher robustness and convergence. The whole process is illustrated through a real world case study.

Assessing current and future uptake of ICT in construction supply chains: A multi- criteria approach

K. Zografos(1), M. Madas(2), C. Tsanos(3)

(1) Lancaster University Management School, Department of Management Science, Lancaster, United Kingdom, LA1 4YX

(2),(3) Athens University of Economics and Business, Department of Management Science and Technology, Transportation Systems and Logistics Laboratory (TRANSLOG), Evelpidon 47A & Lefkados 33, 113 62, Athens, Greece

Authors' e-mail addresses: k.zografos@lancaster.ac.uk, translog@aueb.gr

Keywords: Information and communication technologies (ICT), Construction project management, Small and medium enterprises (SMEs), Analytic hierarchy process (AHP).

Abstract

Construction supply chains involve a wide range of value-adding activities with the participation and close interaction of multiple actors (e.g. contractors, subcontractors, suppliers, engineering/management consultants, public authorities) orchestrated by a "system integrator" (usually large companies acting as the main/general contractor) within the framework of a building construction project. Multiple business relationships within construction projects result in increased communication intensity and amplify coordination needs among various (sub) contractors, remote suppliers, consultants, as well as relevant supervising/licensing authorities. Furthermore, the lifecycle of a building construction project includes several feedback loops (e.g. design adjustments, renovation / refurbishment activities), which further intensify the data/information exchange among various supply chain actors involved in multiple lifecycle phases.

Increased needs for collaboration and data/information exchange in construction supply chains can be efficiently handled through the deployment of ICT (Information and Communication Technologies) solutions. Despite the increased ICT needs and the broad offering of ICT solutions, the construction industry - and especially SMEs - exhibits one of the lowest ICT uptakes among various economic sectors in EU. The objective of this research work is to analyse the current and future ICT uptake in the building construction sector in EU. The analysis of current ICT uptake was based on a pan-European online survey including 305 responses from construction supply chain actors of all sizes and various types of business activity in 20 countries in the EU-28. The survey

aimed to obtain evidence on the current use and level of ICT adoption and elicit the stakeholders' perceptions of the main benefits and key barriers to ICT adoption. For the assessment of future ICT up take with view to the Year 2020, a multi-criteria assessment method (Analytic Hierarchy Process - AHP) was applied using judgments elicited from a panel of 20 experts representing policy makers, branch organisations, construction companies, and ICT vendors. A comparative analysis of future vs. current ICT uptake in the construction industry is performed, while the stakeholders' perceptions of the impacts from ICT uptake on the efficiency and competitiveness of construction supply chain enterprises are assessed.

Research on internet sufficiency of websites concerning women agricultural co-operatives in Greece: A multicriteria approach

A. Batzios(1), T. Bournaris*(2), Z. Andreopoulou(3), C. Batzios(4), B. Manos(5)

(1),(2),(5) Lab. of Agricultural Informatics, School of Agriculture, Faculty of Agriculture, Forestry and Natural Environment, Aristotle University of Thessaloniki, Greece

(3) Lab. of Forest Informatics, School of Forestry and Natural Environment, Faculty of Agriculture, Forestry and Natural Environment, Aristotle University of Thessaloniki, Greece

(4) Laboratory of Animal Production Economics, School of Veterinary Medicine, Faculty of Health Sciences, Aristotle University of Thessaloniki

*E-mail address of the corresponding author: tbournar@agro.auth.gr

Keywords: Women agricultural co-operatives, Websites, Website evaluation criteria, Multicriteria analysis.

Abstract

This paper deals with the research of the internet sufficiency of websites concerning women agricultural co-operatives, through empirical research for the assessment of criteria/characteristics of relative websites. Towards this direction, the basic criteria/characteristics of a website were identified and then, an empirical research was performed in a sample of 30 websites of women co-operatives. These websites evaluation was accomplished through specific navigation characteristics, design, interactivity, accessibility, e-services and usefulness of the information provided, that reflect the internet sufficiency of these websites. The data that derived from the empirical research were used to evaluate the fulfillment rate of the various criteria/characteristics for the internet sufficiency of the websites of women co-operatives. Multicriteria analysis was further performed aiming to hierarchically classify and rank the websites towards the total net flow of internet sufficiency. The results of the research out sketch the ‘profile’ of internet presence and promotion of women agricultural co-operatives. The conclusions of the paper can comprise useful consulting tools and contribute in a more rational organization of websites for the promotion of women co-operatives and generally in the effective development of women entrepreneurship in the agricultural production sector.

Adaptation of ITA for project portfolio selection within a group of decision makers

O. Pechak*(1), G. Mavrotas(2), D. Diakoulaki(3), J. Psarras(4)

(1),(2),(3) Laboratory of Industrial and Energy Economics, School of Chemical Engineering

(4) Energy Policy Unit, School of Electrical and Computer Engineering, National Technical University of Athens, Iroon Polytechniou, 9, 15780 Athens

*E-mail address of the corresponding author: opechak@hotmail.com

Keywords: Project portfolio selection, Multiple criteria, Integer programming, Group decision making, Consensus.

Abstract

Project portfolio selection is a problem of selecting a subset of projects from a wider set, optimizing one or more criteria and satisfying specific constraints. Unlike in financial problems, these projects are integer variables which are not divisible. Multiple Criteria Decision Analysis and mathematical programming are most common tools to model such problems. When selection process takes place within a group, preferences of multiple decision makers (DMs) are not unique and negotiations should take place to find a needed balance between different points of view. In the present work we use a version of the Iterative Trichotomic Approach (ITA) adjusted to group decision making with the focus on convergence. It can either have a predetermined number of decision rounds or until all players agree upon the final portfolio. Group-ITA provides a possibility to draw conclusions about the consensus on each individual project as well as on the final portfolio. The basic idea is a classification of projects into three sets: the green projects (selected by all decision makers in the “consensus” portfolio), the red projects (rejected by all decision makers from the “consensus” portfolio) and the grey projects which are selected by some (but not all) decision makers. Then a mathematical model is developed, where preferences of decision makers are incorporated and a process of step-by-step convergence of these preferences takes place. The criteria weights are updated from round to round. Every time, the mathematical model is updated according to the new weights and solved. As the iterative process moves from one round to the next one, green and red sets are enriched while the grey set shrinks. The iterative process terminates when the grey set becomes empty. Final outcome is the consensus portfolio of projects, as well as the degree of consensus on each project and the consensus index for the whole portfolio

according to the convergence path. We develop a measure of consensus for the final portfolio according to the degree of concordance among DMs. The Consensus Index expresses the easiness to arrive at a final conclusion within a group. The more green projects we have from early rounds the greater is the degree of concordance among DMs. This means that their preferences (expressed as weights) result in more or less the same outcome, or, strictly speaking, the consensus is easily attained. On the contrary, if the majority of green projects is identified on last rounds, it means that we need to elaborate in the convergence process in order to agree at selected projects. In other words, the consensus is hardly attained. Besides the Consensus Index, we can extract the degree of consensus for each project according to the round that it enters or exits the final portfolio. The method is illustrated with an example based on real data for renewable energy projects.

F.W Lanchester's model application for the supply chain oligopoly of two companies: Coca-Cola and Pepsi

M. Chalikias(1), M. Skordoulis(2)

(1) Applied Economic Statistics and Operations Research Lab Department of Business Administration, School of Business and Economics, Technological Education Institute of Piraeus, Greece

(2) Management Information Systems and New Technologies Lab Department of Business Administration, School of Business and Economics, Technological Education Institute of Piraeus, Greece

Authors' e-mail addresses: mchalikias@hotmail.com, mskordoulis@gmail.com

Abstract

In this paper the models of Frederick William Lanchester are examined. These models seemed particularly applicable in the battles of the U.S. Army against the Japanese during the Second World War. These mathematical models, based on differential equations, has a main objective to predict the outcome of battles. These models were applied in the Greek market for the case of supply chain oligopoly of two companies Coca-Cola and Pepsi. The results of application have led to the conclusion that the theoretical models are almost identical to the reality which means that they can be applied to companies under the right conditions.

An optimization modeling approach for the establishment of a bike-sharing network using Monte Carlo simulation and stochastic demand: a case-study of the city of Athens

E. Zygouri*(1), A. Fragkogios(2), G. Saharidis(3), G. Mavrotas(4)

(1),(2),(3) Department of Mechanical Engineering, School of Engineering, University of Thessaly, Leoforos Athinon, Pedion Areos, 38834 Volos, Greece

(4) Department of Process Analysis and Plant Design, School of Chemical Engineering, National Technical University of Athens, Zographos Campus, 15772 Athens, Greece

*E-mail address of the corresponding author: el.zigouri.haf@gmail.com

Keywords: Bike sharing network, Pure integer linear, Monte Carlo Trichotomic Approach, CPLEX, Athens.

Abstract

This study introduces a novel mathematical formulation that addresses the strategic design of a bicycle sharing network. A Pure Integer Linear Program is proposed, which is solved using CPLEX, for deciding the number, the location and the size of the bike stations that should be established in such a network, as well as the number of bikes each one should have in order to meet as much demand as possible, given a set of candidate locations of bike stations. The available budget of a city for the construction of the whole bike-sharing system is predefined and so are the costs of a single bike, a single parking slot and a single station.

As regards demand in each location, it is split into "Demand for Pick-Ups" and "Demand for Drop-Offs". The first one depicts how many users would like to take a bike from a station and the second one shows how many riders would like to leave a bike at a station. To define the values of demand the activity of an already established bike-sharing network is taken into consideration together with 11 factors, which are different for every location: Population Density, University Housing, Job Density, Retail Job Density, Tourist Attractors, Parks and Recreation, Regional Transit Stops, Local Transit Stops, Bicycle Lanes, Bicycle Friendly Streets and Topography. The demand is considered to have a uniform distribution between two values, which are different for every candidate location. Afterwards, the Iterative Trichotomic Approach is applied, which includes a number of decision rounds. In each round the problem is solved 1000 times and every time the Monte Carlo simulation is applied, where different values of demand are chosen for each

location from its uniform distribution. At the end of each round the candidate locations are categorized into “green”, “red” and “grey” depending on the number of times that each one is chosen to be established as a station. In the following round the “green” and “red” locations are set to become or not stations respectively and at the “grey” locations the range of demand is narrowed. This procedure is continued until all locations are “green” or “red” and no “grey” locations exist.

The proposed approach is implemented on the 1st Municipal District of the Municipality of Athens. The authors of this paper chose 50 candidate locations where bike-sharing stations could be constructed. These 50 locations were categorized into 4 clusters depending on their location, the cluster of “Housing” including candidate locations that are in densely populated areas, “Employment” which contains the locations close to business areas, “Subway” which includes the candidate locations where a metro station exists and “Spare Time” which contains the locations which are close to restaurants, coffee bars, shops etc. Finally, the problem was solved for 2 cases with different values of a parameter. More specifically, in the first case, the whole demand of a location where a station is not established is transferred to the closest established station while in the second case only 50% of the potential customers of these locations are willing to walk to the nearest allocated station and pick up or drop off a bike from it. The solution of the first case proposes a total number of 38 bike stations with 470 parking slots and 242 bikes. In the results of the second case the established stations are 40 with a total number of 448 parking slots and 232 bikes.

Evaluating new service development effectiveness in tourism: An ordinal regression analysis approach

F. Kitsios(1), E. Grigoroudis(2)

(1) School of Informatics, Department of Applied Informatics, University of Macedonia, P.O. Box 1591, GR54006 Thessaloniki, Greece

(2) School of Production Engineering and Management, Technical University of Crete University Campus, Kounoupidiana, GR73100 Chania, Greece

Authors' e-mail addresses: kitsios@uom.gr, vangelis@ergasya.tuc.gr

Abstract

Innovation development is an important factor for the viability and profitability of service businesses operating in modern markets. The importance of the service sector in developing economies and the specific characteristics of services compared to tangible products require further investigation in the New Service Development (NSD) process and effectiveness assessment when innovations applied. The innovation development process will be significantly improved and the contribution of innovations in company's goals will be substantial. The purpose of this study is to evaluate the effectiveness of the NSD process in the tourism economy and in particular the Greek hotel sector. For this purpose, factors influencing the process of developing new services in the hospitality sector were explored and correlated with the financial results of the hotel enterprises through an ordinal regression analysis model. The model adopts a mathematical programming (goal programming) approach in order to estimate the efficiency of this process.

In the presented study the Greek tourism industry and its importance to the national economy is discussed. The study explores in detail the factors influencing the NSD process. The questionnaire developed for the purpose of the survey included a large number of variables related to all the stages of the NSD process (from idea generation till the service launch). All variables are measured in a 5point Likert type scale and data was collected using in depth structured and questionnaire-based interviews with 77 hotel managers for 147 new services in a representative sample of 99 hotels in Greece. Several financial ratios covering different aspects of the business (e.g., profitability, liquidity, activity) are used in order to evaluate the NSD process for three years after the services innovation had been launched. The main results of the ordinal

regression model include the estimated contribution of each factor to the financial performance of the hotels studied.

New technologies & labour market

K. Nikolaidis

E-mail of author: knikola@otenet.gr

Abstract

Today the new working relationships have major changes. The new forms such as telecommuting, workers by lease, part-time employment, the fourth shift give another dimension to the workplace. Telecommuting is any form of work that includes electronic data processing and the use of media for multiple/cross communication so that the employee can produce the work he was asked in an area outside the space where the business is located. There are alternative names for telecommuting in the relevant bibliography such as teleworking at home or distance working.

Regression model selection for spectral data sets: A multi-objective genetic approach

D. Loukas, A. Ropodi, G.-J. Nychas

Agricultural University of Athens, Department of Food Science & Human Nutrition, Laboratory of Microbiology and Biotechnology of Foods, Iera Odos 75, Athens 11855, Greece

Keywords: Variable selection, Multi-objective optimization, Genetic algorithm, Spectral data, Meat quality.

Authors' e-mail addresses: d.loukas@aua.gr, aRopodi@aua.gr, george.nychas@gmail.com

Abstract

In prediction problems, the finding of the best regression model in terms of goodness-of-fit and parsimony is of great importance. It should be noted that while the large number of collinear dependent variables may result in loss of accuracy, on the other hand the exclusion of important variables may lead miscalculation of regression coefficients and biased predictions and as a consequence to loss of vital information. Thus, the selection of a subset of the most informative and uncorrelated variables (Variable Selection problem-VS) is critical for the model's performance. This is also the case for spectral data, as they consist of thousands of absorbance values per spectrum.

Various approaches for the VS problem have been proposed in the past. This work focuses on the multi-objective modeling of the VS problem especially for spectroscopic applications. The proposed methodology considers the VS for the Partial Least Squares (PLS) Regression modeling as a two objective task, minimizing the number of selected variables as well as the Mean Square Error (MSE) of prediction. The model selection is a two step procedure which combines wrapper and filter feature selection techniques. Firstly, the NSGA-II genetic algorithm is applied in order to generate the frontier of Pareto-optimal solutions (best subset of models) with respect to the multi-objective formulation of the problem. Secondly, a decision making process, based on statistical and information metrics, enables the selection of the final regression model.

The aforementioned method was applied on spectral data related to the microbiological quality of minced meat samples, which were acquired by means of a spectroscopic instrument (Fourier Transform InfraRed- FTIR).The

selected regression model was used for the prediction of microbial counts, regardless of storage and packaging conditions.

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A fleet management system for freight distribution with environmental and safety considerations

K. Androutsopoulos(1), K. Zografos(2), E. Boulazeris(3)

(1), (3) Transportation Systems and Logistics Laboratory Department of Management Science and Technology Athens University of Economics and Business, Greece

(2) Lancaster University Management School, Department of Management Science, Lancaster University, UK

*E-mail address of the corresponding author: kandro@aueb.gr

Abstract

Fleet Management Systems aim to plan, monitor, and assess the fleet operations of vehicles by collecting and processing data relevant to the location, condition, and operational characteristics of vehicles, customers' requirements, and underlying transportation network characteristics. The major objectives of the existing systems relate to the efficient utilization of the vehicles and the improvement of the level of service offered to customers. However, the increasing concern regarding the societal and environmental impacts of emissions and accidents attributed to freight transport requires the consideration of additional objectives. Therefore there is a need to develop a Next Generation Fleet Management System. The objective of this paper is to present the operational concept and the basic components of a Next Generation Fleet Management System that integrates environmental and safety considerations into all stages of fleet management decision making including trip planning and re-planning, vehicle dispatching, trip execution monitoring, and post-trip performance evaluation. The proposed fleet management system provides the following decision support capabilities.: i) route planning (for full and less than truckload shipments) taking into account explicitly vehicle emissions, transportation risk based on constraints arising from the load, the truck and the road infrastructure characteristics, ii) real-time re-planning services based on dynamic travel times predicted from vehicle data and, iii) monitoring vehicle conditions and route execution and provision of recommendations for safe and eco-friendly driving, and iv) post-assessment of drivers' driving behavior based on collecting and archiving of data relevant to their driving profile and determination of corrective actions (e.g., training) to attain eco-friendly driving.

The proposed system aims to cover a wide variety of multi-criteria routing decisions for delivering products, proposing alternative solutions capturing the

trade-off between environmental impacts, safety and travel time. The practical value of the proposed solutions is further enhanced by modeling routing criteria through time and load dependent metrics.

Moreover, the proposed system provides the capability of addressing multi-compartment vehicle routing decisions, where two or more products cannot be placed within the same storage compartment (e.g., gasoline types).

Real-time re-routing decisions play a key role in mitigating transportation risk and environmental implications potentially caused by unexpected road incidents. The proposed system aims to deal with this type of decisions by integrating: i) short-term travel time prediction models based on traffic and vehicle data collected in real time through vehicle onboard sensors, and ii) dynamic vehicle routing models and algorithms. The paper presents the proposed real-time re-routing mathematical model underlying the emerging dynamic vehicle routing problem.

This paper presents the mathematical models for the vehicle routing and scheduling problems (including trip re-planning) covered by the proposed system and analyses their basic features. Solution algorithms applicable to each problem category are also suggested.

Sustainable freight strategies for port cities

E. Sdoukopoulos*(1), M. Boile(2), S. Theofanis(3), A. Anagnostopoulou(4)

(1),(2),(4) Centre for Research and Technology Hellas / Hellenic Institute of Transport (CERTH/HIT), Aigialeias 52, 15125, Marousi, Athens

(3) Centre for Advanced Infrastructure and Transportation (CAIT), Rutgers, The State University of New Jersey, 100 Brett Road Piscataway, NJ 08854-8058

Authors' e-mail addresses: sdouk@certh.gr, boile@certh.gr, stheofan@rci.rutgers.edu, a.anagnostopoulou@certh.gr

Abstract

Urban settlements have traditionally been developed nearby safe, natural and even manmade harbors, which provide access to practical economic means of moving people and goods. As a result of the intricate relationship between city and port, both the settlements and ports grew in size and activity, becoming focal points for inland transportation systems and major commercial centers with increased population, job opportunities and handling of consumable commodities to cover the needs of both the inland areas but also the businesses and population of the port cities themselves. The port operation and the port-bound environment add several parameters and a different dimension in the urban freight distribution problem creating both additional problems to be resolved as well as significant advantages and unique opportunities to be exploited. With very little room for land and facility expansion, ports and their surrounding urban areas are struggling with the ever increasing flow of trucks, accommodating both through and intra-city freight movements. With hundreds of European port cities facing such distinct and often severe urban freight mobility issues associated with port operations, the development of sustainable freight plans proves to be a top priority for both local authorities and industry stakeholders. The above considerations form the motivation for this paper which addresses the urban freight distribution problem in port cities by (i) identifying typical inefficiencies facing the system, pointing out those associated with port operations and (ii) conducting a thorough review of best practices in urban freight distribution highlighting the ones that are most suitable to port city environments. The opportunities presented from the port activity and facilities are also considered in the analysis.

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Framework (NSRF) – Research Funding Program: THALES. Investing in knowledge society through the European Social Fund.

Optimal use of non-collaborative servers in two-stage tandem queueing systems

D. Pandelis*, I. Papachristos

Department of Mechanical Engineering, School of Engineering, University of Thessaly, Leoforos Athinon, Pedion Areos, 38834 Volos, Greece

Keywords: Tandem queues, Flexible servers, Markov decision processes.

*E-mail address of the corresponding author: d_pandelis@mie.uth.gr

Abstract

We consider two-stage tandem queueing systems with a dedicated server in each queue and a flexible server that can attend both queues. We assume exponential interarrival and service times, and linear holding costs for jobs present in the system. We study the optimal dynamic assignment of servers to jobs assuming a non-collaborative work discipline with idling and preemptions allowed. We formulate the problem as a Markov decision process and derive structural properties of the optimal policy. For larger holding costs in the upstream station we show that i) non-idling policies are optimal, and ii) if there is no dedicated server in the first station, the optimal allocation strategy for the flexible server has a threshold-type structure. We also provide numerical results that reveal that under the non-collaborative assumption the optimal policy may have counterintuitive properties, which is not the case when a collaborative service discipline is assumed.

GreenYourRoute platform

G.K.D. Saharidis

Department of Mechanical Engineering, School of Engineering, University of Thessaly,
Leoforos Athinon, Pedion Areos, 38834 Volos, Greece

Author's e-mail address: saharidis@gmail.com

Abstract

The objective of the proposed research is to develop a Decision Support System (DSS) for a web based platform which will help individuals and companies move commodities in the most environmental friendly way, minimizing environmental externalities (e.g. CO₂ emissions) and transportation costs. The developed platform which is the final outcome of an FP7 European research project, referred to as Green Route project, uses existing information systems (e.g. geographical, weather, real time traffic information systems) and emission calculation models as a basis to apply two main scientific outcomes. The first scientific outcome is the development of a function that assigns a score to each arc of a transportation network referred to as the arc environmental externalities score (EESarc). The second scientific outcome is the development of a novel approach for solving the general travelling salesman problem (TSP) whose objective is to find the most environmental friendly route.

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Sustainable energy: New challenges for urban distribution

A. Anagnostopoulou, M. Boile, E. Sdoukopoulos

Centre for Research and Technology Hellas / Hellenic Institute of Transport (CERTH/HIT),
Aigialeias 52, 15125, Marousi, Athens

Authors' e-mail addresses: a.anagnostopoulou@certh.gr, boile@certh.gr, sdouk@certh.gr

Abstract

Over the last few years, there has been an increased interest by cities on assessing energy impacts, in an effort to support the protection of the environment and promote a sustainable territorial development. City authorities share a common interest to improve the quality of life for people and seek for suitable policies that gradually decrease energy consumption and affect economic, environmental and social conditions. The existence of an efficient, sustainable and environmentally friendly freight transportation system is a vital factor for success in today's economy where markets tend to become increasingly open and competitive. Environmental concerns and management issues related to the flows of freight have become crucial concerns for stakeholders seeking to reduce energy consumption and the related production of greenhouse gas (GHG) emissions. The transport sector is responsible for 30% of the CO₂ emissions in the EU while this share reaches 40% in urban areas. For that reason, the efforts for technological improvements and innovation in transportation have been increased during the last decades and the fleet of vehicles using renewable sources is the new trend for public authorities, non-profit organizations and many private companies.

Considering the general objective of promoting innovative energy efficient solutions for urban areas, as outlined above, this paper analyzes the benefits of alternative fuels with respect to both economic and environmental aspects and identifies the most green and efficient commercial fleet solutions for urban logistics. To achieve this goal, an extended survey was conducted resulting in the assessment of the different types of alternative fuel vehicles in terms of energy consumption, availability and operational restrictions. Capitalizing upon this assessment, this paper also describes and analyzes the one-to-many-to-one vehicle routing and scheduling problem with electric vehicles (Electric Vehicle Routing Problem) developing a comprehensive mathematical formulation embedded with multiple constraints due to capacity limitations, time window restrictions and the predefined charging level of the vehicles. It is an attempt to study the use of electric vehicles for competitive urban distribution systems as well as improvements in terms of energy consumption and pollutant emissions.

Reducing waiting time at intermediate nodes for intercity bus transportation

Ch. Dimitropoulos, E Skordilis, G.K.D. Saharidis

Department of Mechanical Engineering, School of Engineering, University of Thessaly, Leoforos Athinon, Pedion Areos, 38834 Volos, Greece

Authors' e-mail addresses: xrdim8@gmail.com, erskordi@gmail.com, saharidis@gmail.com

Abstract

Time tabling of transit networks is an arising problem in the field of transportation science, especially when taking into account passenger satisfaction. Researchers have introduced various formulations to address this problem, using different objectives like bus synchronization and passenger demand. We present a mixed-integer linear programming formulation with the objective of minimizing passenger waiting times at transitional transfer nodes, taking also into consideration high passenger demand that occurs at certain times.

Innovation management strategies for organizational performance

D. Mitroulis, F. Kitsios

School of Informatics, Department of Applied Informatics, University of Macedonia, P.O. Box 1591, GR54006 Thessaloniki, Greece

Authors' e-mail addresses: tm1133@uom.edu.gr, kitsios@uom.gr

Keywords: Market-orientation, Organizational innovation, Organizational performance.

Abstract

Innovation has always been a critical factor for every kind of entrepreneurial achievement and performance. However, most of the organizations, which were supposed to innovate, have focused on better short term efficiency, ignoring the chance of getting competitive advantage over their competitors. The organization's relationship with either customers or competitors could improve its knowledge over the market conditions and gain market-oriented information. The successful management of the market-oriented inflow and organizational innovation leads to the improvement of the organizational performance. The purpose of this paper is to collocate a main framework which a business or industry could use in order to identify whether its organizational innovation could be the joint between market-orientation and organizational performance.

In order to assimilate the basic concept and the assets of this research, some definitions and explanations have been used so that the "Market-orientation-Organizational Innovation-Organizational Performance" chain could be easily understood. Moreover, the whole research focalizes on the questions that could unveil the organizational performance, by evaluating its innovation capabilities, either technical or administrative.

According to these assumptions, other studies have shown the importance of innovation in today's organizations. Furthermore, they give emphasis on market-orientation because it is a critical factor for organizational strategy, better efficiency, innovativeness and organizational performance. Therefore, in order to evaluate and examine the theoretical assumptions, a questionnaire, addressed to Greek SMEs, is cited. It is used to examine and evaluate capabilities, operations and competitive advantages which could lead SMEs to organizational performance. All variables are measured in a 5point Like rt type scale. The results of this study are examined with multicriteria methods.

Country risk evaluation methodology to support bilateral cooperation in the field of electricity generation from renewable sources

A. Papapostolou*, Ch. Karakosta, V. Marinakis, J. Psarras

National Technical University of Athens, 9, IroonPolytechniou str., 15780, Zografou, Athens, Greece

*E-mail address of the corresponding author: kpapap@epu.ntua.gr

Keywords: Country risk, Renewable energy, Multiple criteria, Robust ordinal regression.

Abstract

Renewable energy sources (RES) cooperation within the European Union, as well as with EU neighboring countries is high on Europe's political agenda. According to the EU Directive 2009/28/EC, one or more Member States could cooperate with one or more developing countries in joint projects, regarding the generation of electricity from renewable sources. This paper outlines a multicriteria methodology to evaluate country opportunities and risks for the successful implementation of the cooperation mechanisms with third countries. The proposed evaluation criteria are built on three points of view: (1) investment framework/country risk profile, (2) social, and (3) energy security. The overall evaluation of countries is obtained through a multicriteria additive value model, which is assessed using an ordinal regression approach. Five countries of North Africa are evaluated and ranked considering the latest criteria data.

Improving the reliability of wind energy generation with supplements from solar power

N. Thomaidis(1), F. Santos-Alamillos(2), D. Pozo-Vázquez(3), J. García(4)

(1) Department of Financial & Management Engineering, University of the Aegean, Chios, Greece

(1) School of Economics, Aristotle University of Thessaloniki, Greece

(2), (3) Department of Physics, University of Jaén, Spain

(2) Center for Wind Energy Research (Forwind), University of Oldenburg, Germany

(4) Department of Electrical Engineering, Universidad Carlos III de Madrid, Spain

Keywords: Renewable energy planning, Energy risk management, Multi-criteria mathematical programming, Pareto efficiency.

Authors' e-mail addresses: nthomaid@econ.auth.gr , fsantos@ujaen.es , dpozo@ujaen.es , jusaola@ing.uc3m.es

Abstract

An inherent pitfall of wind energy generation is the high degree of temporal variability which often persists over various time scales (daily, monthly, annually). A strategy to manage the risk of wind power supply is to disperse energy generation units over a large geographical region, thus taking advantage of possible differences in climate features and/or topography. However, as the experience from recent European studies dictates, the opportunities for production risk diversification on a national scale are typically limited. The reason is that climate features tend to be coherent over most European countries, leading to high similarity in generation profiles. This forces energy policy makers to think beyond a single generation technology and combine various resources (e.g. wind and solar) in a single national energy portfolio.

In this paper, we examine the possibility of increasing the reliability of wind energy production on a country scale with in-feeds from interconnected solar power plants. We formulate the problem in a bi-criteria optimization framework, where the decision variables are the regional shares of the total available wind and solar capacity. Using multi-objective mathematical programming techniques, we explicitly derive the set of Pareto-optimal power allocations, which in our case represents the energy mixes with the best trade-off between mean power supply (reward) and variability of energy production (risk). We provide some characteristic points of the Pareto efficient set: a) the

minimum variance energy portfolio, b) the capacity allocation maximizing the average delivered energy output and c) the one attaining the best risk-reward ratio.

The study was conducted for the case of Spain. In the first part, a numerical weather prediction model was used to estimate wind and solar resources for a selected geographical area. Based on these meteorological data, we subsequently derived time series of implied capacity factors for each grid point, using reference wind turbine and solar power plant models. Extensive experiments with this database show that solar energy can aid in smoothing out large fluctuations in wind power generation. Apart from the obvious advantages in reducing power supply risk, combined arrays of wind and solar generation units also deem much superior in terms of efficiency as measured by the risk-reward ratio.

Can renewables foster sustainable energy transition? A comparative cost analysis

D. Angelopoulos*, H. Doukas, G. Mouriadou, J. Psarras

National Technical University of Athens, 9, Iroon Polytechniou str., 15780, Zografou, Athens, Greece

*E-mail address of the corresponding author: dangel@epu.ntua.gr

Keywords: Energy policy, Sustainable transition, Renewable energy, Support schemes, Cost analysis.

Abstract

Promotion of Renewable Energy Sources (RES) is currently centered in the core of the ongoing European energy transition. Bidding targets have been set and extensive economic incentives have been provided for the enhanced penetration of renewables in the energy mix. Nevertheless, the existing support schemes proved to be insufficient to effectively facilitate the attainment of these objectives, since they often lead to major distortions in the electricity markets. The absence of “real” competition, the excessive societal costs for supporting energy production from RES and the rising uncertainty of revenues, due to unexpected shifts of political nature, are some of these conventional mechanisms’ drawbacks that have also identified by the scientific literature. This paper examines this critical situation, from a systemic perspective, through an illustrative example in selected EU countries. Specifically, a comprehensive cost assessment is implemented and its results are compared with those of alternative self-financing schemes. This study provides useful insights on the key parameters needed to be reconsidered towards sustainable energy transition through the implementation of renewable energy investments.

Sustainable food security: A system dynamics decision-making methodology

Ch. Keramydas*, N. Tsolakis, D. Vlachos, E. Iakovou

Department of Mechanical Engineering, Aristotle University of Thessaloniki

*E-mail address of the corresponding author: chkeramy@auth.gr

Keywords: Agrifood supply chain, Food security, Sustainability, System dynamics.

Abstract

The Declaration of the World Summit on Food Security that was issued by The Food and Agriculture Organization of the United Nations in 2009 defines that *“Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food, which meets their dietary needs and food preferences for an active and healthy life.”*. On the other hand, the rapid increase of food prices that was the main driver of the recent Food Security crisis in 2007-2008 brought food insecurity to the forefront of the global sustainable development agenda by seriously disputing the aforementioned definition. Food prices fluctuation, along with the ongoing climate change, the increase of global population, the rising of the alternative energy sources as environmentally friendly ones, the technological advances in agriculture, and the changing consumer dietary preferences are just few of the prime forces that shape the modern food management landscape around the globe. Specifically, modern food crises proved to be the end-result of the corresponding policy-making processes, developments, and technological advances within a set of miscellaneous fields including national and international governance, demographics, agriculture, trade, sustainable development, energy, environment, natural resources, health, and of course food and nutrition. Consequently, Food Security altered during the last decades into a complex and multidisciplinary issue of global sustainability that deals not only with the traditional environmental and economic aspects of sustainability, but also with the most vulnerable and critical one, i.e. that of social sustainability. The recent food crisis revealed the need for effective policy-making at a strategic global level in both the public and private sectors, including governments, international organizations, food industry, and international agrifood supply networks.

In this research work, the main future challenges and uncertainties that threaten global Food Security are recognized and systematically analyzed. Specifically, a critical taxonomy of the challenges that were initially identified through the relevant literature and international organizational practice, is provided. The corresponding research as well as the taxonomy itself was performed according to the four food security basic dimensions, i.e. availability, stability, accessibility, and utilization, in conjunction with the classification of each challenge on the basis of the prime sustainability aspects, i.e. environmental, economic, societal, and governmental. The limited relevant literature focuses more on specific food supply networks, while only a few papers discuss an integrated policy-making perspective that address the multidisciplinary nature of the problem. Moreover, this manuscript propose a System Dynamics approach so as to capture both the dynamic and the stochastic features of Food Security at the strategic policy-making level, while incorporating the critical interactions among the most important inputs. The proposed model also allows for the evaluation of alternative policy interventions incorporating key performance indicators (KPIs) that are recognized globally for their effectiveness in monitoring Food Security. Given the qualitative orientation of the existing research works, this paper highlights the employment of Operations Research methodologies into quantitatively assessing the potential real-world interventions as a most promising option. Finally, this work is the first step towards the development of a quantitative strategic decision-making support tool that could be employed by policy-makers, in both the private and public sectors, including governments, international organizations, and food industry enterprises towards the effective design and efficient operation of agrifood supply networks in a sustainable manner.

Customer equilibrium policies in queues with delay compensation and risk aversion

M. Benioudakis*, A. Burnetas

Department of Mathematics, University of Athens, Athens, Greece

*E-mail address of the corresponding author: akisbenioudakis@hotmail.com

Abstract

We consider a single server Markovian queueing system with strategic customer behavior. Arriving customers decide whether to join the queue or balk. The queue length is not observable at the time of the join/balk decision. A customer who joins earns a reward upon service completion and incurs an entrance fee plus a waiting cost per unit time of remaining in the system. Customers are not generally risk neutral, but rather maximize the expected value of an appropriately defined utility function of the net profit. In this context an important question is the identification of symmetric Nash equilibrium strategies in the game played by the customers.

In this work the service provider considers introducing a policy of complete or partial compensation for the delay each joining customer faces, and wants to identify the optimal entrance price/compensation policy that maximizes his expected profit. In the case of linear customer utility function, i.e. when the customers are risk neutral, we show that introducing compensation does not increase the service provider's profits. On the other hand, when customers are risk averse, then it is optimal for the service provider to compensate fully for the delay and charge an appropriately higher entrance fee. Furthermore, the optimal price is equal to the one maximizing the expected social welfare in the risk neutral case. Finally we perform some computational experiments, to explore the impact of several system parameters such as the arrival rate, delay cost etc, on the equilibrium arrival rate and the service provider's profits.

Heuristics for solving a discrete location-partial interdiction problem with capacitated facilities and demand outsourcing

D. Aksena*(1), İ. Çoğalb(2), N. Aras(3)

(1) College of Administrative Sciences and Economics, Koç University, İstanbul, Turkey

(2),(3) Department of Industrial Engineering, Boğaziçi University, İstanbul, Turkey

*E-mail address of the corresponding author: daksen@ku.edu.tr

Keywords: Partial facility interdiction, Multilevel programming, Electromagnetism-like algorithm, Tabu search with hashing, Matheuristics.

Abstract

The bilevel partial interdiction problem with capacitated facilities and optional demand outsourcing is a static Stackelberg game between an intelligent attacker and a system planner (defender) in a median type network of service facilities and customer nodes. The attacker's (leader's) objective is to cause the maximum (worst-case) disruption in the network subject to an interdiction budget. On the other hand, the defender (follower) is responsible for satisfying the demand of all customers while minimizing the total demand-weighted transportation and outsourcing cost in the wake of the worst-case attack. The defender should consider the capacity reduction at the interdicted facilities where the number and degree of interdictions depend on the attacker's budget. We develop a Fully Informed Particle Swarm Optimization (FIPSO) and an Electromagnetism-like algorithm (EMLA) to find the best interdiction strategy for the attacker which constitutes the worst-case scenario for the defender.

Our numerical experiments comparing these two swarm intelligence-based metaheuristics verify that EMLA is usually superior to FIPSO both in solution quality and efficiency. Although FIPSO has proven success with easy implementation in the literature, we encounter a premature convergence problem, and cannot succeed in getting favourable results even after parameter adjustment. Moreover, EMLA also outperforms the progressive grid search (PGS) and the multi-start revised simplex search heuristic (MSS) in large size instances. Both PGS and MSS have been recently proposed in the literature for the same bilevel partial interdiction problem.

Encouraged by its efficiency, we embed EMLA into a probabilistic tabu search with hashing (TSH) to seek the best facility location strategy for the defender. The problem then upgrades to a trilevel defender-attacker-defender game in which the objective of the defender in the upper level is to design a median type fixed charge service network for her customers that is as much robust as

possible against the worst-case partial or complete interdictions of the attacker. TSH is used in the upper level to locate facilities, and Cplex 12.1 is employed to determine the capacities of the opened facilities and the pre-attack customer allocations. The best interdiction strategy of the attacker is found by EMLA in the middle level. Finally, the post-attack customer-facility allocations are found again with Cplex 12.1 in the lower level. As far as we know, this kind of a trilevel formulation to solve a defender-attacker problem with the decisions of facility location, customer assignment, partial interdiction, and demand outsourcing has not been studied in the literature. We cannot compare the performance of our algorithm with any other in the literature; hence we develop a complete enumeration methodology to evaluate the quality of our results.

We observe that a successful TSH implementation contributes significantly to the overall efficiency. In TSH we employ a hash list which records the objectives and unique integer hash values of all neighborhood solutions explored. This prevents cycling in the solution trajectory of the tabu search. Hashing also boosts efficiency by minimizing the number of objective function evaluations. The use of EMLA embedded in a TSH where the lower level problem (the defender's problem involving post-attack customer-facility allocations and demand outsourcing decisions) is solved to optimality with Cplex qualifies our solution method as a hyper matheuristic.

In future research, the proposed matheuristic should be benchmarked with exact solution techniques. Typically in such techniques, the lower level problem is replaced by its Karush-Kuhn-Tucker optimality conditions provided that it involves only continuous decision variables. With this dualization technique, an originally trilevel problem can be collapsed into a bilevel programming problem. The dualization or transformation of the lower level problem may produce nonlinear terms in the objective function of the resulting bilevel problem, which need to be linearized by introducing auxiliary variables and constraints. Our best conjecture is that exact solution techniques can still not match matheuristics efficiency in solving trilevel facility location-partial interdiction problems.

Towards the implementation of optimal train loading plan in the Athens - Thessaloniki freight services

A. Ballis*(1), F. Karapetis(2), Th. Ballis(3)

(1) NTUA

(2) TRAINOSE

(3) Civil / Transportation Engineer

*E-mail address of the corresponding author: abal@central.ntua.gr

Abstract

An effective train loading plan contributes positively to the profitability of the railway services, to train safety, to energy consumption and to the efficiency of rail terminal operations.

The main goal of an optimized train loading is the proper assignment of loading units to the wagons of a train so that the utilization of the train is maximized while taking under consideration the maximum axle load restrictions imposed by the design or the condition of the railway infrastructure, operating conditions and safety regulations. The problem typically is expressed in two ways: (a) given a predefined commodity load, which is the minimum number of wagons required to perform the transportation task or (b) given a standard set of wagons (e.g. in the case of a shuttle train) which is the maximum commodity weight or volume that can be transported.

The current work describes the way that the train loading plan has been analyzed, solved and integrated in the information system that supports the new railway service of TRAINOSE for container transport in the Athens - Thessaloniki line. This new service, named ICS, was launched in December 2013 and since then operates on a daily basis.

The work includes an extensive literature review on the train loading plan, a detailed description of the actual physical system (different loading unit types used, available wagon types, restrictions imposed by loading or braking regulations etc.), an overview of the technical approach and algorithms developed and implemented in the information system of TRAINOSE as well as the validation process and the way ahead of the associated modelling aspects.

Proposing a hybrid 0-1 weighted goal programming/DEA approach for the optimal design of renewable energy production of Greece

E. Zografidou*(1), K. Petridis(2), G. Arabatzis(3), P. Dey(4)

(1),(2),(3) Democritus University of Thrace, Greece

(2),(4) Aston University, U.K

*E-mail address of the corresponding author: ezografi@fmenr.duth.gr

Keywords: Energy applications, Optimization, Multi-objective, Decision support systems.

Abstract

Traditional plants of energy production have nowadays been replaced by renewable energy production plants and in general a switch to renewable energy forms has been noticed. Being free of high levels of GHG gas emissions, renewable energy is considered to be a clean energy form, which satisfies the requirements of Kyoto Protocol and European Environmental Directives. Besides the environmental aspect, investments in renewable energy production plants are financed in order to satisfy the energy needs and accomplish social and economic goals. In this work, a 0-1 Weighted Goal Programming (WGP) model is presented for the optimal design of the renewable energy production in Greece. Greece has 52 prefectures where each renewable energy plant can potentially be installed. Constraints are imposed to exclude specific renewable plants from some prefectures based on previous studies and resource availability or weather data.

In general, the presented model takes into account economic, environmental and social criteria. The criteria are a-priori defined and concern the following: Energy production of each plant (Solar, Wind, Hydro, Geothermal and Biomass), Investment Ratio, Operation and Maintenance Costs, Tonnes of CO₂ avoided (tCO₂/y), and Jobs created. Due to different weights on the objective function, several scales of importance have been considered. Based on this fact there are $m*n!$ solutions from the WGP model, if weights are divided into n scales and m intervals. In the second stage of the analysis, Data Envelopment Analysis (DEA) approach is used in order to filter the best out of possible $m*n!$ solutions that form the Pareto front. The inputs of the study are considered the slack variables that correspond to a goal's underachievement and as outputs the slack variables that correspond to a goal's overachievement. Technical Efficiency (TE) is used to normalize solutions' efficiency.

Development of a software developed for assessing Greenhouse Gas (GHG) emissions from terminal and drayage operations

G. Konstantzos(1), G. Saharidis(2), G. Kolomvos(3), M. Loizidou(4)

(1),(3),(4) National Technical University of Athens, Department of Chemical Engineering, Unit of Environmental Science and Technology, Athens, Greece

(2) University of Thessaly, Department of Mechanical Engineering, Volos, Greece

Authors' e-mail addresses: gkonsta@gmail.com saharidis@gmail.com,
george.kolomvos@gmail.com, mloiz@chemeng.ntua.gr

Abstract

Container transportation by Heavy Duty Vehicles (HDV), is one of the most polluting elements of port operations. The main objective of this work is to present a software that was developed for the estimation of Greenhouse Gas (GHG) emissions (expressed as CO₂ equivalent) resulting from terminal and drayage operations. The software focuses on truck transportation and handling operations of containers (i.e. loading and unloading onto trucks). Furthermore it is based on a holistic approach for the estimation of CO₂ equivalent emissions considering all factors contributing to their increase, while a draft presentation of the software can be found online at <http://194-177-201-88.uth.gr>.

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An exact method for the stochastic inventory routing problem

E. Chrysochoou*, Ath. Ziliaskopoulos

University of Thessaly / Department of Mechanical Engineering
Pedion Areos, 38334, Volos Greece

*E-mail address of the corresponding author: echryso@certh.gr

Abstract

Vendor inventory management is a concept which is adapted highly nowadays where the decision maker in the process is the retailer. The combination of the inventory management with the vehicle routing problem constitutes one of the latest trends of logistics and vendor managed inventory systems. Also as new emerging technologies are introduced in the context of Freight Transportation Systems, research requires the development of new models and algorithms that can incorporate their advantages. Dynamic and stochastic inventory routing is a methodological approach that seems to be capable to account for inherent uncertainties to the freight system.

In this context, this paper aims to discuss all significant elements of dynamic and stochastic inventory routing problem. Since we are investigating the stochastic counterpart of the problem stock out are unavoidable. Following the exact method proposed by Archetti which was also extended by Coelho using transshipment we are incorporating backorder penalty costs in order to include the stock out occurrence as well. New valid inequalities are introduced which was used to the branch and cut approach that was followed. Results of the proposed approach are evaluated on the extended set of instances proposed by Archetti et al. (2007) for the single vehicle - single commodity inventory - routing problem by introducing the backorder penalty cost as well.

The overall goal of this approach is to identify new solution policies to be applied that incorporate probabilistic knowledge of future information.

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Open Governmental data sources in Europe: A comparative evaluation of semantic and technical characteristics

O. Vasileiou(1), Ch. Georgis(2), M. Petychakis(3), S. Mouzakitis(4), D. Askounis(5)

(1) National Technical, University of Athens Heroon Polytechniou 9, 15780, Zografou, Greece

(2) London School of Economics and Political Science

(3),(4),(5) Decision Support Systems Laboratory, NTUA Heroon Polytechniou 9, 15780, Zografou, Greece

*E-mail address of the corresponding author: smouzakitis@epu.ntua.gr

Abstract

This paper aims to provide a comparative study of end-user services and technical characteristics of current Open Governmental data sources in Europe. Since the late nineties there has been an explosion of activity around open data and especially open government data. Under the official recommendations and support of the European Commission (EC), national governments all over the European Union (EU), invest on the establishment of national open data portals in order to increase public access to high value, machine readable datasets generated by public agencies and organizations. In 2003, the EU adopted the Directive on the re-use of public sector information (PSI Directive) that introduced a common legislative framework regulating how public sector bodies should make their information available for re-use in order to remove barriers such as discriminatory practices, monopoly markets and a lack of transparency. During the last years, a vast number of PSI portals and open data communities that develop new ideas and apps have emerged. The proliferation of such Open Government Data initiatives and particularly Open Government Data portals during the recent years, however, has raised significant questions in terms of the variety in the interoperability, standards, services, openness and vision of each portal. A systematic analysis of these portals is only limitedly available. A comprehensive analysis of the capabilities and potential of these initiatives is currently missing from the recent research literature. More specifically, we focused on the countries of the European Union, where we intended to identify irregularities and challenges with regard to the provision of Open Data across the studied countries. The research began with a snapshot of the current situation of open data sources in Europe. Thereafter, we managed to collect, categorize, statistically analyze and comparatively assess the open government data throughout the European Union.

Within the current study, a representative number of diverse open government data sources from all the countries of the European Union were analyzed. Data was collected by means of an online research for organizations and public offices of each country that provide open public data in electronic form. The collected datasets were classified and analyzed by genre and country in view of enabling a qualitative comparison between the EU member states. In addition to this research, which targeted at covering an in-breadth analysis, we also conducted in-depth research for 3 representative countries of the European Union that have exhibited a proliferation of open data initiatives during the last years. For that purpose, we chose the United Kingdom (being a pioneer about open data amongst European countries), France (being a representative country of mainland Western Europe) and Greece (being a country of Eastern Europe). In summary, 1629 data sources were investigated and a more detailed overview of those in relation with the collected datasets is as follows: 1580 datasets came from Ministries, 904 from Municipalities, and 573 from Regions. As far as Public Services were concerned, 171 datasets were collected. 65 came from Law and Regulatory Authorities, 56 from Data Aggregators, 45 for Central Banks and 34 from National Statistical Offices.

The results of our study show that there is still no uniform policy regarding the provision of public sector information across data sources in the countries of the European Union. The quality of the government data sources varies significantly depending on the country and the data provider. In general, the majority of the datasets is not completely open, as it has been published under restricted or non-specified licenses. Nevertheless, in the recent years there is an increasing effort in the adoption of open licenses, especially in the newly launched national open data portals.

Developing an international Door-To-Door journey planning system with real time itinerary re-planning capabilities supporting travellers with special mobility needs

K. Zografos(1), K. Androutsopoulos*(2), A. Miliarakis(3)

(1) Lancaster University Management School, Department of Management Science, Lancaster University, UK

(2) Transportation Systems and Logistics Laboratory, Department of Management Science and Technology, Athens University of Economics and Business, Greece

(3) Forthnet SA, Greece

*E-mail address of the corresponding author: kandro@aueb.gr

Abstract

The complexity of itinerary planning decisions coupled with the modal, and geographical fragmentation of available journey planning systems calls for the development of integrated journey planners that can provide door-to-door itinerary planning capabilities for multimodal international trips. Advanced journey planning systems should be able to support travelers during all phases of their trip, by considering multiple-criteria for the design of itineraries. Furthermore, the availability of real-time information makes possible the development of journey planning systems able to cope with itinerary disruption and dynamic itinerary re-planning. All the above requirements, become even more important in the case of travelers that are facing mobility difficulties. We are presenting an international door-to-door journey planning system (E-WISETRIP) which is capable of addressing the above stated travelers' needs. The proposed system includes desk-top and mobile applications offered through a user-friendly interface. The system capitalizes on the availability of multi-sourced (including social media) real-time information to support dynamic itinerary re-planning decisions. The proposed system integrates information from existing uni-modal and/or multi-modal journey planners covering different geographical scales, i.e. local, regional, national, international) and uses the concept of the customized network in order to integrate modally and spatially fragmented information and reduce the computational complexity of the resulting large scale multi-criteria, time dependent, itinerary planning problems. In addition, the proposed system takes into account the accessibility properties of the various modes, terminals, and mode transfer facilities, to generate networks that can provide spatial and temporal connectivity for travelers with special mobility needs. We are presenting results related to the development of the E-WISETRIP system and we identify promising areas for future research.

Towards the development of a modular DSS supporting robustness analysis in MCDA

N. Tsotsolas, N. Christodoulakis, E. Grigoroudis

University of Piraeus, 80, Karaoli & Dimitriou str., GR-18534 Piraeus, Greece

Authors' e-mail addresses: ntsotsol@unipi.gr, nikosunipi@gmail.com, vangelis@ergasya.tuc.gr

Keywords: Decision support systems, MCDA, Robustness analysis, Linear programming, Modular software architecture.

Abstract

In several cases Decision Support Systems (DSSs) implement a significant number of algorithms to serve their role in supporting efficiently complex decision processes. These algorithms are found in a whole range of discrete steps, from input data transformation to visualization of the results. Even though different DSSs may apply different methods in implementing these steps, there is indeed a number of DSSs which they use specific techniques in certain steps belonging to the same family of methods. Our proposed design focuses on this kind of steps in DSSs, where a flexible set of generic or less generic algorithms can be built as articulated parts of these systems.

Robustness analysis is an issue which should be tackled by DSSs as a mean to provide, in an understandable way, to the analyst and to the decision maker a clear picture regarding reliability and stability of the accessed models and the produced results. Based on these measures the decision maker may accept or reject, or in some cases adapt the proposed decision model. Various robustness analysis techniques are applied in several operational research methods and among others in the ones belonging to the MCDA family of methods. One could find similar techniques when dealing with robustness analysis in different MCDA methods and consequently it should be rational to be able to reuse software modules when building the corresponding steps of a DSS.

We are proposing a modular software framework to facilitate the development of MCDA DSSs focusing on their robustness analysis steps. This framework addresses the issues of input data transformation, solving different analytical and heuristic algorithms, compute and visualise robustness measures and finally export the results in a standard format for further data processing in other steps of the DSS. The framework will include a specific protocol for data input and output and also will use well accepted formats such as MPS (Mathematical Programming System - a file format for presenting and

archiving linear programming problems) as an effort to reduce the requirements of substantial resources when building a DSS from scratch or when extending an already developed one.

Furthermore, towards this direction the proposed modular architecture will be configurable, and model independent. It will be based on a scalable object oriented approach as well as on standardized and well defined interfaces allowing the programmers to “plug in” additional layers or modules with minimal effort. The proposed framework also will adopt an open architecture approach in order to facilitate the extensibility and the flexibility of the modules by different programming teams.

This modular approach is already used for the development of a DSS, which provides the analysts with the necessary tools to apply Stochastic UTA method and proceed with an in-depth evaluation of the robustness of the inferred additive value model. The system uses several modules for the evaluation of the robustness of the assessed value functions which are calculating statistical robustness measures e.g. Average Stability Index (ASI) and graphically representing the range of all assessed utilities. The modules implement different heuristics approaches (MAX, MAXMIN) as well as analytical ones (e.g. Manas - Nedoma Hamiltonian search algorithm) for the calculation of multiple/near optimal solutions of the LP post-optimal polyhedron of Stochastic UTA. The modules use built-in code as well as external software components such as lpsolver. Visual C# was used as the programming language of the DSS which by itself supports a modular architecture by permitting the splitting of big software parts into small classes of code.

Mining movement graphs of skiers: A spatiotemporal analysis

B. Delibašić(1), P. Marković(2), P. Delias(3)

(1),(2) Faculty of organizational sciences, University of Belgrade, Serbia

(3) Department of Accounting and Finance, Eastern Macedonia and Thrace Institute of Technology, Kavala, Greece

Authors' e-mail addresses: boris.delibasic@fon.bg.ac.rs, peleplay@gmail.com, pdelias@teikav.edu.gr

Keywords: Process mining, Skier movements, Graph partitioning, Spatiotemporal analysis.

Abstract

In the largest Serbian ski resort Kopaonik, skiers are required to carry a ski pass in order to use ski lifts. These ski passes have a RFID chip on them, and since they are used every time one enters a lift, enormous amounts of location-tracking data are generated. Having such data, we can build skiers' movement maps that record the history of their transitions between locations.

In this work we discuss a method to build a graph representation out of these movements, to identify gateway nodes in such a graph and to guide a partition algorithm to split the graph into coherent clusters. An efficient partition (if exists) would not only exhibit the nodes with heavy traffic, but it would allow for handling the sporadic movements of skiers as well. In addition, we discuss the potentials to aggregate the movement graph at different levels of (spatial) abstractions according to location hierarchical concepts and ontologies.

The application of SCM in energy planning

Ch. Papapostolou(1), E. Kondili*(2), J. Kaldellis(3)

(1),(2) Optimisation of Production Systems Lab Mech. Eng. Dept., TEI Piraeus Athens 12244, Greece

(3) Soft Energy Applications and Environmental Protection Lab., TEI Piraeus Athens 12244, Greece

*E-mail address of the corresponding author: ekondili@tepir.gr

Abstract

Traditionally the concept of supply chains and its management (Supply Chain Management) was widely applied in the product and chemical industry, seeking to efficiently predict and control all the stakeholders embedded in the different levels of the supply chains. Suppliers, producers and consumers along the transportation network, as well as time-variant demand and supply characteristics should be coordinated, controlled and satisfied simultaneously, even under conditions of uncertainty, conflicting interests and challenges, in terms of economic efficiency.

Similarly in the emerging field of energy planning, SCM was widely adopted, with the main goal being the optimal allocation of resources, accounting not only economic but environmental and social criteria in some cases. Biofuels and biomass, hydrogen and natural gas SCs with the use of operational research tools such as modelling and optimisation, have been examined under their emerging performance indexes of energy consumption, technological efficiency, economic profitability and/or environmental evaluation, either in a stage-to-stage approach, or in some cases for the integrated SC, in order to demonstrate their implementation possibilities.

Operational Research methods and tools have been proved very valuable in the design, operational analysis and optimization of energy systems. Being met in various stages and a wide spectrum of projects, the operational research tools have become a very common practice for the solution of simple and mainly complex problems that would not be tackled otherwise.

On the other hand, the Supply Chain Modeling and approach, being used for many years in the production operations management, is based on valuable principles supporting the integrated consideration of many and commonly conflicting parameters. The aim of this paper is to address the planning and design of traditional supply chains in the field of energy (security and

planning) and then to model and solve the emerging problems with operational research tools, and, more specifically, mathematical optimisation. To that end different topologies, as well as operations management models of energy supply chains (ESCs) will be cited. Under the analysis made the challenges and practical implications of the proposed methodological approach will be evidenced in respect to different optimisation criteria, Supply Chain configurations and modelling approaches.

A branch and price solution algorithm for the tail assignment problem

G. Kozanidis, E. Gioti

Systems Optimization Laboratory, Department of Mechanical Engineering, Leoforos Athinon, Pedion Areos, Volos 38334, Greece

Authors' e-mail addresses: gkoz@mie.uth.gr, giotielina@yahoo.gr

Abstract

We consider the tail assignment problem, i.e., the problem of assigning a set of passenger flights, which must be carried out by a commercial fleet, to specific aircraft. Each flight has a fixed departure time, as well as an origin and a destination airport, which, combined, determine the duration of the associated trip. The aim is to schedule all the flights, while also minimizing the number of aircraft utilized for this purpose. Motivated from theory that has been developed in the past (Gabteni and Grönkvist, 2009), we develop an integer programming formulation and a branch and price solution algorithm for this problem.

The proposed solution methodology utilizes a master problem that tries to schedule the maximum possible number of flights using a set of aircraft-routes, and a column generation sub-problem that generates cost-effective aircraft-routes which are fed into the master problem. Due to the huge number of alternative aircraft-routes, the master problem minimizes the number of aircraft utilized to operate the flights, using only a small subset of these routes. At each iteration, the column generation sub-problem uses dual information obtained from the optimal solution to the master problem's linear relaxation, in order to generate the most cost-effective (the one with the minimum reduced cost) aircraft-route, out of those that have not been considered yet. This route is then added to the master problem. The optimal solution of the column generation sub-problem is obtained with an efficient network optimization solution algorithm, which outperforms existing commercial optimization software packages that can alternatively be utilized for the same purpose.

The procedure continues similarly, until the optimal solution to the linear relaxation of the master problem is obtained. This happens when no other aircraft-route with negative reduced cost can be identified. Next, the algorithm

branches on the fractional decision variables of this solution, in order to eliminate the non-integralities. Special branching rules that enable the simultaneous elimination of multiple decision variables at once, expediting this way the performance of the algorithm, are utilized for this purpose. Additional decision variables representing aircraft-routes may need to be generated during this phase, due to the integrality restrictions that are gradually introduced.

We describe in detail the steps of the proposed solution algorithm, focusing on several aspects of the problem that have an adverse effect on its performance, and we explain how the associated difficulties can be handled. We conclude with computational results demonstrating the performance of the algorithm, as well as its computational requirements and capabilities on real problem instances.

A multi-stage column generation solution approach for the bidline aircrew scheduling problem

P. Andrianesis, G. Kozanidis

Systems Optimization Laboratory, Department of Mechanical Engineering, Leoforos Athinon, Pedion Areos, Volos 38334, Greece

Authors' e-mail addresses: andrianesis@uth.gr, gkoz@mie.uth.gr

Abstract

We consider the bidline scheduling problem that typically arises in the commercial airline industry, i.e., the problem of generating anonymous duty lines, which will further be matched to specific aircrew members, according to their seniority and preferences. Each duty line consists of duty and rest periods beginning and ending at the same crew-base, typically called pairings. It must abide by certain safety and collective agreement rules, and the credited hours (i.e., the hours for which aircrew members will be paid) it contains must fall within a certain interval. The generated bidlines must collectively cover a given set of pairings; in parallel, they should also satisfy, to the greatest extent possible, a given set of quality criteria. Such criteria include purity (the degree to which the bidline contains routes of the same type), regularity (the degree to which the duties/offers are repeated in a specific pattern), hour balance (the degree to which the number of credited hours reaches a desired target), as well as several other criteria related to particular characteristics (e.g., number of single duties/offers, etc.).

For this problem, we develop an integer programming formulation, and a multi-stage branch and price solution methodology. The first stage aims at generating a large number of high quality duty lines that satisfy a certain quality threshold. The second stage aims at generating additional duty lines so as to cover the flights that remain uncovered at the end of the first stage, without any special concern for their quality. Finally, the last stage aims at further improving the quality of the combined solution obtained by the first two stages.

The proposed solution methodology utilizes a master problem that tries to optimize some appropriate measure of performance using a given set of duty lines, and a column generation sub-problem that generates cost-effective duty lines which are fed into the master problem. We describe in detail the steps of the proposed solution algorithm, focusing on novel formulations and several

techniques that are employed in order to improve its computational performance, such as stabilization, special branching rules, efficient tree search strategies, etc. We supplement our analysis with numerical results demonstrating the performance of the algorithm on a medium-sized airline company.

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Calibration tool for macroscopic traffic flow models

A. Spiliopoulou*(1), I. Papamichail(2), M. Papageorgiou(3), J. Chrysoulakis(4)

(1),(2),(3) Dynamic Systems and Simulation Laboratory Department of Production Engineering and Management, Technical University of Crete, 73100 Chania, Greece

(4) Department of Civil and Infrastructure Engineering, Technological Educational Institute of Athens, 12210 Egaleo, Athens, Greece

*E-mail address of the corresponding author: natasa@dssl.tuc.gr

Abstract

During the last decades, several mathematical road traffic flow models have been proposed. These models include a number of physical or non-physical parameters with unknown values. Thus, before employing a traffic flow model in practice, it is important to first calibrate it against real traffic data. The calibration procedure aims to appropriately specify the model parameter values, so that the representation of the network and traffic flow characteristics is as accurate as the model structure allows. The most common approach is to minimize the discrepancy between the model's estimation and the real traffic data, by use of appropriate optimization tools. The nonlinear, non-convex least-squares optimization problem of parameter calibration is known to have multiple local minima and hence derivative-free optimization algorithms should be utilized. Despite the large number of proposed macroscopic traffic flow models, there is very limited literature on works that validate and compare the corresponding models using real traffic data. Within this work, a software tool has been developed for the calibration of macroscopic traffic flow models with a user-friendly graphical interface. In particular, the user should first introduce, in the corresponding database, the network description and the real traffic data to be utilized. Then, the user may select one of the available traffic flow models and also one of the listed optimization algorithms and execute a calibration exercise by clicking on the corresponding button at the user interface. The output of the calibration test includes the optimal model parameter values, the performance index value and plots of the real traffic data and the corresponding model estimations at various network locations. This tool makes the model calibration an easy task and is very useful to both researchers and practitioners.

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Energy and environmental business activities in Greece

E. Kondili*(1), J. Kaldellis(2), T. Ktenidis(3)

(1) Optimisation of Production Systems Lab Mech. Eng. Dept., TEI Piraeus Athens 12244, Greece

(2),(3) Soft Energy Applications and Environmental Protection Lab., TEI Piraeus Athens 12244, Greece

*E-mail address of the corresponding author: ekondili@tepir.gr

Keywords: Energy and environment, business opportunities.

Abstract

The energy and the environment are amongst the most dynamic sectors of the Greek economy nowadays. New major development projects are planned or being implemented in the fields of renewable energy sources, domestic fossil fuels exploitation, clean and in environmental compliance energy production. In addition, smaller scale projects such as energy conservation, bioclimatic construction, new materials development are also emerging in all the fields of economy. Furthermore, the imperative environmental protection needs of the recent years have created significant business and professional activities in Europe and in Greece, e.g. design, construction, operation and maintenance of environmental protection works, environmental impact assessment studies, design, construction and trading of environmental protection equipment, development and implementation of environmental management systems.

All the above may be considered as excellent opportunities for the enforcement of the business activities and the entrepreneurship in these fields, especially for young engineers and scientists. However, is that the reality? Under which circumstances could this development be transformed to real professional opportunities? since these fields are complicated and need expertise not only in the energy and the environment, but also with broad knowledge in the legislation, in social and business issues. The objective of the proposed work is to identify the nature and magnitude of the energy and environment-related (research and) business activities in EU and Greece today and for the next 10 years. In its conclusions, the work highlights the challenging opportunities emerging in the energy and environmental field for business and professional development – especially in young entrepreneurship – and possibly create new data for these issues to be used in other research and implementation projects. It will also focus in the importance and significance of the suitable and specialized education that is required in order to create professionals with all the qualifications and capabilities

to expand these opportunities into real business and life career paths for the benefit of the national economy.

Air traffic management the free flight concept

J. Coletsos, Ch. Ntakolia

Department of Applied Mathematics, School of Applied Mathematical and Physical Sciences,
National Technical University of Athens, Heroon Polytechniou 9, 15780 Zografou, Greece

Authors' e-mail addresses: coletsos@math.ntua.gr, charis.nt@hotmail.com

Keywords: Operations research, Mathematical modeling, Air traffic management, Free flight, Free flight concept, Integer linear programming, Control flow chart, Air way model.

Abstract

In this paper is represented an attempt to transform the ATM (Air Traffic Management) system from 'airport-centered' to 'airplane-centered'. The motivation to develop such a demanding system is to increase the airspace capacity as well as to optimize the fuel consumption and the effective handling of the safety issues.

The objective function takes under consideration the fuel consumption for the original flight through specific waypoints as well as the increased fuel consumption due to any deviation from the original course. Costs due to airborne and ground delays and due to flight cancelation are also supported. A various number of constraints including longitudinal and lateral airplane separation are considered in order to achieve the most realistic model close to the one of the real life.

Vulnerability of the Romanian cultural heritage

C. Slave

University of Agronomic Sciences and Veterinary Medicine Bucharest Romani

Authors' e-mail address: camelia_slave@yahoo.com

Abstract

The oldest preserved monumental buildings in the Carpathian-Danubian-Pontic are churches. For centuries they have been the most representative works of ecclesiastical architecture and monuments. Specifically, they have always been typical Orthodox churches since the Romans are the only nation in Latin Orthodox religion, while all other peoples of Latin origin are Catholic. High stone and brick, these Eastern Churches Balkan-Byzantine style has always been a proof of the level of technical knowledge, responsiveness cultural and artistic sophistication achieved during their time.

To analyze the vulnerability of cultural heritage of Romania can use one of the various forms of definition of vulnerability. It can be defined as the amount of damages, loss of life according to the intensity of the area or estimating the vulnerability of a structure is to link the seismic risk and expected earthquake intensity level of structural damage if an earthquake occurs.

Fundamental concepts developed by UNDRO-1979 (United Nation Disaster Relief Co-ordinator) applied in seismic risk analysis the system developed by EAEE (European Association on Earthquake Engineering), based on the specific mathematical concepts, provides the necessary conditions on concrete analyzes seismic hazard and seismic vulnerability associated seismic risk;

Unanimously allowed the link between seismic risk (SR), seismic hazard (SH) and the seismic vulnerability (SV) can be expressed by means of formal relationship: $SR=SH \times SV$.

Comparison of pricing mechanisms in markets with non-convexities

P. Andrianesis, G. Liberopoulos

Systems Optimization Laboratory, Department of Mechanical Engineering, Leoforos Athinon, Pedion Areos, Volos 38334, Greece

Authors' e-mail addresses: andrianesis@uth.gr, glib@mie.uth.gr

Abstract

In this work, we consider markets that are characterized by non-convexities or indivisibilities, due to the presence of avoidable costs and minimum supply requirements. The motivation for our work has been the area of electricity markets, which allow the submission of multi-part bids and take into account the technical characteristics of the generation units. Such market designs, when operated under marginal pricing, may result in market outcomes where truthful bidding results in losses for some participants. To deal with this highly undesirable prospect, commonly referred to as the "missing-money problem", some approaches provide make-whole payments, or uplifts, as they are often called, whereas others modify the market-clearing prices to ensure sufficient revenues to the suppliers.

We present and compare various pricing approaches, which may take the form of marginal pricing including make-whole payments, "convex-hull" pricing that derives non-decreasing prices including uplifts, "augmented pricing" as well as a newly proposed scheme of ours, referred to as "minimum zero-sum uplift", where zero-sum uplifts are introduced in the form of internal transfers between the suppliers. In addition, we consider pricing schemes guaranteeing that no supplier incurs losses, which do not include any form of uplifts, and which use either semi-Lagrange relaxation or, recently, a so-called "primal-dual" approach for generating efficient revenue-adequate prices.

To facilitate the comparisons between the various approaches, we apply all schemes in a stylized example that appears in the literature, based on the example introduced by Scarf. We also discuss the findings and their relation to the analytical results that we have obtained in a parallel work of ours for a model with two suppliers. Emphasis is put on identifying the tradeoffs that are present in each approach.

Development of optimization models for addressing various decision and information related issues in supply chain planning

G. Liberopoulos, D Pandelis, G. Kozanidis, G.K.D. Saharidis

Systems Optimization Laboratory, Department of Mechanical Engineering, Leoforos Athinon, Pedion Areos, Volos 38334, Greece

Authors' e-mail addresses: glib@mie.uth.gr, d_pandelis@mie.uth.gr, gkoz@mie.uth.gr, saharidis@gmail.com

Abstract

We consider a discrete-period, finite-horizon planning problem for a serial supply chain model that includes 2 stages, each consisting of a raw-parts buffer, a production facility, and a finished-products buffer. The production facility has a maximum capacity of parts that it can produce in each period, and raw parts are delivered a finite lead-time after they are ordered. In each time period, each stage must plan its raw-part order quantities and production quantities, so as to meet the demand originating either from the next stage, or from the customers if no such stage exists. For this problem, we propose several alternative formulations that pertain to various decision and information related issues, such as the level of coordination/cooperation between the stages, the amount of information that is available to each of them, the characteristics of the customer demand forecasts, etc.

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Productivity changes of Greek public hospitals during the economic crisis

P. Mitropoulos(1), I. Mitropoulos*(2), H. Karanikas(3), N. Polyzos(4)

(1),(2) Department of Business Administration, TEI of Western Greece, Patras, Greece

(3) Department of Informatics and Computer Technology, TEI of Lamia, Lamia, Greece

(4) Department of Social Management, Democritus University of Thrace, Komotini, Greece

Keywords: Health care reform, Productivity, Data envelopment analysis, Malmquist index, Bootstrapping.

*E-mail address of the corresponding author: pmitro@upatras.gr

Abstract

During the recent economic crisis, Greece implemented a comprehensive reform in health care system. The 2011 health reform occurred under the constraints imposed by the Memorandum of Understanding that the Greek Government signed with its EU/IMF creditors in order to control its deficit.

The objective of our study is to investigate the impact of the reform on the efficiency and productivity of public hospitals in Greece. We employ the data envelopment approach and the Malmquist index to comparatively examine before and after the reform years. We compare productivity, efficiency and technological changes using panel data of 111 public acute hospitals operating in Greece throughout the recession period of 2009–2012. Bootstrapping methods are performed to allow for uncertainty owing to sampling error and for statistical inference for the technical productivity index and its decompositions. The analysis indicates that the productivity has been increased following the policy changes. It appears that the expected benefits from the reform have in general been achieved, at least in the short-run. Pressures for sector reform have stimulated interest in identifying and understanding the factors that can contribute to improve the hospital's performance. The results are examined in light of coexisting administrative and organizational factors, which are impeding the reform process. Therefore in a second stage, the technical productivity index is regressed on variables that may potentially be statistically associated with productivity growth.

Employee satisfaction versus student satisfaction in a Greek academic environment

N. Bouranta(1), Ch. Hurson(2), Y. Siskos(3)

(1) University of Patras, 2 G. Seferi St, Agrinio 30 100 Greece

(2) IAE, Université de Rouen, 3, Avenue Pasteur, F-76186 Rouen Cedex, France

(3) University of Piraeus, 80, Karaoli & Dimitriou Street, GR-18534 Piraeus, Greece

Authors' e-mail addresses: nbouranta@upatras.gr, christian.hurson@univ-rouen.fr, ysiskos@unipi.gr

Keywords: Job satisfaction, Multicriteria decision analysis, MUSA system.

Abstract

It has been well established in the literature that job satisfaction exerts an important influence on customer satisfaction, as satisfied employees tend to be more productive, provide better services to customers, and hence, can significantly enhance business profitability. The cycle of success, proposed by Schlesinger and Heskett, suggests that satisfied employees deliver high service quality. In a similar vein, the service-profit chain establishes a relationship between profitability and growth, due to customer loyalty and satisfaction which is, in turn, due to services provided by satisfied employees. A reformulation of the ECSI model, establishing that perceived employee satisfaction, loyalty, and commitment exerts an important impact on perceived product and service quality.

A students' satisfaction survey using Multicriteria Satisfaction Analysis (MUSA) was made at a Greek Business University. In this survey, 2,629 students participated from all the academic departments. The results revealed that global satisfaction index exceeds 84%, indicating that in the students' opinion, the quality level of the services provided by the University, is quite high. The average satisfaction indices regarding three of the five quality criteria exceed 75% (education, tangibles and image of the university). The only exception is that of Administrative Support, which has a low value (54.7%). More specifically, the sub-criteria that have to do with Speed (20%) and Friendliness of Service (28.1%) were rated very poorly. The survey, combining weights and satisfaction indices, concluded that Administrative Support should be among the first priorities for improvement in the future. Since then, subsequent student satisfaction measurements conducted by university authority at regular intervals, have revealed similar results.

Motivated by relationship between job satisfaction and service quality, and taking in to consideration the results of the aforementioned student satisfaction survey, the current paper focuses on administrative staff job satisfaction measurement. This survey was conducted at the same Business University, using the same multi-criteria method. It should be noted that Greece recently asked for the International Monetary Fund's support to fulfil its loan obligations. This resulted in public servant wage cuts and mobility and reallocation schemes. Under these circumstances, public employee job satisfaction evaluation becomes of notable importance.

Globally administrative staffers seemed to be satisfied with their jobs. The satisfaction levels of the criteria - regarding co-workers and work conditions- are very high. However, the criteria of leadership, job security and rewards, show lower satisfaction levels. The global demanding index indicates that employees are not very demanding.

The Performance/Importance analysis revealed that leadership and conditions of work criteria should be the first priorities for improvement in the future. The rewards and job security criteria are not in the university leadership's control, they can only exert influence in the same extent as government decisions.

University authorities should take the above results under consideration, in the belief that satisfied employees are productive employees. These satisfied employees, in turn, reflect the university's commitment to excellence, as they tend to student needs. As a result, the students' needs are met. Consequently, they will give the university high student satisfaction scores, they will refer others to the facility organisation for services, or they will use its services again in the future (postgraduate, doctorate). In addition, the employees will feel a sense of accomplishment and become even more satisfied with their jobs.

Identifying factors of bank service quality during economic crisis in Greece

Ath. Bouranta(1), Ch. Hurson(2), Y. Siskos(3)

(1) University of Patras, 2 G. Seferi St, Agrinio 30 100 Greece

(2) IAE, Université de Rouen, 3, Avenue Pasteur, F-76186 Rouen Cedex, France

(3) University of Piraeus, 80, Karaoli & Dimitriou Street, GR-18534 Piraeus, Greece

Authors' e-mail addresses: nbouranta@upatras.gr, christian.hurson@univ-rouen.fr, ysiskos@unipi.gr

Keywords: Service quality, Multicriteria decision analysis, MUSA system, Banks.

Abstract

In recent years, the Greek banking industry has been facing strong pressures resulting mainly from the country's economic concurrence. This crisis has led to structural changes in the banking sector, including mergers and acquisitions. In addition, competition between banks for attracting new customers or keeping the existing ones has become more intense. The unstable economic environment has a negative impact on customer confidence and trust in the banking industry, leading customers to be more demanding and careful in their bank selection. The claim that service quality is among the most important selection criteria in bank selection has been supported in the literature. Thus, delivering high-quality financial service that keeps customers satisfied is viewed as an indispensable practice for staying alive and gaining a sustainable advantage. Therefore, the financial services aim to satisfy its customers, to retain long-term relationships with them, and ensure their loyalty. The loss of a client due to the special nature of one's products and services is a critical problem, as it may have a serious impact on the financial industry's profitability.

It was pointed out that every market and every customer differs. Thus, the study of the specificities of each market and client will be considered in this case. In terms of this concept, it is worth assessing how Greek customers evaluate bank service quality during the crisis period. The main objective of this paper is to determine the factors that affect customer satisfaction in the Greek bank industry during the economic crisis period, providing managers with a more complete view of which factors determine customers' satisfaction. A satisfaction questionnaire with self-determined scales was created and distributed to a randomly selected sample of customers.

The data was processed using the MUSA system of multi-criteria satisfaction analysis. This system has been used in order to measure customer satisfaction, assuming that their global satisfaction depends on a set of criteria representing service characteristic dimensions.

The results show that, generally, bank customers seem to be satisfied with the service provided, as satisfaction index is high; even the dissatisfied customers feel that their expectations have been met to an extent. The MUSA's "performance/importance" diagram reveals that the criteria of financial products, serviceability and employees are the bank priority of improvement.