



**6th International Symposium and  
28th National Conference  
on Operational Research**

**OR in the digital era - ICT challenges**

June 8-10, 2017 | Thessaloniki, Greece

# Book of Abstracts

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## table of contents

---

<b>session 1: Multicriteria Decision Making I .....</b>	<b>7</b>
A multiple criteria approach for personnel evaluation and optimal assignment .....	8
Applying the multicriteria method Promethee II for the startup ranking during a business ideas competition .....	9
Assessing Climate and Energy Policy Scenarios based on their Socioeconomic Impacts: A Multi Criteria Approach .....	10
Robustness Improvement in UTA methods through the elicitation & exploitation of strength of preference information.....	11
<b>session 2: Metaheuristics .....</b>	<b>12</b>
General Variable Neighborhood Search methods for the efficient solution of Location Inventory Routing Problems.....	13
Application of Evolutionary Algorithms to Net Present Value Optimisation of Open Pit Mine Scheduling.....	14
Initialization methods for the TSP with Time Windows using qGVNS.....	15
<b>session 3: Data Envelopment Analysis.....</b>	<b>16</b>
Assessing The Cost-Effectiveness Of University Academic Recruitment And Promotion Policies .....	17

Semidefinite programming approach to the hyperbolic measure model in data envelopment analysis.....	18
Firm resources allocation for customer retention.....	19
Measuring efficiency of regional knowledge spillover using DEA: An application to EU regions	20
Prioritizing volatility models: A novel procedure using Data Envelopment Analysis .....	21
<b>session 4: Decision Making Applications I .....</b>	<b>22</b>
Investigating the issue of natural gas security in Europe.....	23
Exploring the Potentials of Process Analytics for Political Event Analysis .....	24
Distributed model predictive single wagonload control .....	25
Decision Making and Crisis Management in Greek Foreign and Defence Policy .....	26
<b>session 5: Logistics Optimization .....</b>	<b>27</b>
Vehicle Routing Problem for Urban Freight Transportation: A Review .....	28
A Visual Interactive Solution Method for Multi-depot Vehicle Routing Problem with Heterogeneous Vehicle Fleet & Backhauls.....	29
The Pollution Routing Problem with Time Windows and Stochastic Travel and Service Times	30
Modelling and Solving a Real-Life Fuel Distribution Problem .....	31
Shared logistics opportunities in urban areas: Assessing route sharing practices for 3PL freight distributions in the region of Attica .....	32
<b>session 6: Multicriteria Decision Making II .....</b>	<b>33</b>
Using a MACBETH based multicriteria approach for virtual weight restriction in a DEA multi-stage ranking process .....	34
Preference Classification based on Multi Criteria Decision Analysis and Preference Aggregation Methods .....	35
Wind Farms Suitability Analysis Using TOPSIS and VIKOR Approaches: A Case Study in Thrace Region .....	36
Utilising Multicriteria Decision Aid for the measurement of Project Success. The PROMITHEAS methodological frame.....	37
An application of non weight MCDM for the evaluation of GEM entrepreneurial ecosystems...	38
<b>session 7: OR in Finance &amp; Economics .....</b>	<b>39</b>
The Robustness of Portfolio Optimization Models: An Empirical Comparative Analysis .....	40
Reciprocity in Trade: An Empirical Investigation Using Experimental Economics Methods Under Real Circumstances.....	41

Income taxation from Real Estate property (physical and legal persons).....	42
Tax morale in Greece .....	43
<b>session 8: Strategy &amp; Analytics .....</b>	<b>44</b>
Strategic Tool for the Assessment of Company's Business Excellence & Competitiveness Level .....	45
A Roadmap to Social Media Analytics .....	46
The influence of social media on consumers' behavior .....	47
An Empirical Evaluation of Strategic Information Systems Planning Phases in SMEs: Determinants of Effectiveness .....	48
Measuring Leaders' Strategic Thinking .....	49
<b>session 9: Decision Making Applications II.....</b>	<b>50</b>
Multi agent based decision making framework for logistics centers development .....	51
A case study on optimizing the performance of a production company using a new mathematical model .....	52
Taxonomy for effective decision making in medium size tourist resorts .....	53
Monitoring Students' Evaluation of University Courses and Faculty Members using SPC Viewpoint.....	54
Simulation study of an adaptive decentralized approach for the optimization of traffic control systems.....	55
Demand Covering Problems with Facilities' Interaction .....	56
<b>session 10: Supply Chain Optimization .....</b>	<b>57</b>
A fairness-informed modelling extension to the single-airport slot scheduling problem.....	58
A Multi-stage Approach for Sustainable Supplier Selection and Order Allocation .....	59
The logistics role in community resilience: a case example of a community based social partnership in Greece .....	60
A Decision-Making Framework for Sustainable Supply Chain Management of Perishable Goods .....	61
The Impact of Additive Manufacturing on Pharmaceutical Supply Chain Network Configuration .....	62
<b>session 11: Digital Economy .....</b>	<b>63</b>
Adoption of Digital Currencies: The Companies' Perspective .....	64
Assessing Digital transformation obstacles in multinational firms .....	65



Utilization of Internet of Things to improve Digitization of Academic Institutions .....	66
Cloud Computing Adoption and E-government.....	67
Assessment of the Internet market in Greece; The case of Mushrooms and Truffles.....	68
<b>session 12: Business Analytics .....</b>	<b>69</b>
<b>session 13: Forecasting &amp; Maintenance Optimization.....</b>	<b>70</b>
Container flow forecasting through neural networks based on metaheuristics.....	71
Neural network based methodology for predicting energy consumption in public and environmental management .....	72
Feedforward Neural Network Model in Unemployment Rates Forecasting in Public Administration.....	73
Optimization the availability of a system subject maintenance under conditions.....	74
A method for providing joint predictive maintenance and inventory recommendations.....	75
<b>session 14: Agricultural Management .....</b>	<b>76</b>
Evaluation of agricultural productivity by using multicriteria analysis: A case study in Central Macedonia in Greece .....	77
Software design and development for spatial tillage allocation using the Revised Simos methodology combined with the Multicriteria Analysis Methods AHP and VIKOR .....	78
Technical efficiency of organic Emmer wheat in Greece .....	79
Meta-learning in Precision Agriculture: Disease detection of plants with biomimetic novelty detectors.....	80
Big Data Platforms To Support Operational Intelligence - The Precision Agriculture Paradigm .....	81
A Nexus approach for Agricultural Sustainable Management.....	82
<b>session 15: OR &amp; ICT.....</b>	<b>83</b>
Development of a framework for the assessment of technical and non-technical skills in the ICT sector.....	84
Exploring the Development of ICT Solutions for Energy Efficiency & End-Users' Engagement	85
Internet users' perceptions towards price comparison sites in greece .....	86
Accounting information systems in higher education: Assessment of graduate students' level of knowledge regarding IT technology and its applications.....	87
Performance Evaluation of Routing Protocols for Big Data applications.....	88
<b>session 16: Statistics &amp; Data Mining .....</b>	<b>89</b>

Subjective well-being in Europe: a multidimensional statistical analysis of ESS data .....	90
Predicting the quality score of a large dataset of wines using the statistical methods of SVM and NN .....	91
Redundant constraints identification in linear programming using statistics on constraints ...	92
An Optimization Algorithm for K-Means Clustering with Missing data using Simulated Annealing .....	93
An Analysis of Online Social Networks and Process Mining .....	94
A Multivariate Exploratory Approach of the Attributes of the Visitors of Greek Thermal Springs .....	95
<b>session 17: Business Process Management .....</b>	<b>96</b>
Directing business processes towards Operational Research.....	97
Towards an adaptable Enterprise Architecture based on re-configurable business processes	98
Design and optimisation of business processes: Initial experiments with PCA-II .....	99
Business Process Model Generation using Natural Language Processing.....	100
Business Process Management Integrated with Risk Management in Construction Industry	101
<b>session 18: OR in Construction .....</b>	<b>102</b>
A Lever of Development not only for Northern Greece but for the country as a whole .....	103
Proposal for an effective Decision Support System for the Pre-Selection of the Type of Concrete Highway Bridges .....	104
Construction activity in Greece during the period 2004-2014: Evaluation of the construction companies listed in Athens Stock Exchange using investment ratios.....	105
The Concept of Entropy in the Management of Construction Projects: A decision-making model of risk uncertainty .....	106
Scheduling and Risk Analysis in Large Construction Projects using Learning Curves Approach .....	107
A Combined Use of GIS, PROMETHEE and Monte Carlo Simulation Methods for Major Transportation Infrastructure Impacts Evaluation.....	108
<b>session 19: Environmental Management.....</b>	<b>109</b>
Potentials of biomass production in the region of Central Macedonia .....	110
A taxonomy survey of Life Cycle Assessment used for the evaluation of biomass production	111
A multi-criteria fuzzy AHP approach for assessing forest management sustainability: A Greek case study .....	112
Optimization Model for Irrigation Water Management under Deficit Irrigation.....	113

Integrated Water and Waste Management System in Motorways: The Case of Egnatia Odos S.A .....	114
Group decision making and consensus control in climate policy: a multiple-criteria decision support tool.....	115
<b>session 20: OR in Health.....</b>	<b>116</b>
Hospitals productivity measurement in a metafrontier framework.....	117
Prioritizing user requirements: The case of an e-health mobile application .....	118
Evaluating occupational stress and job satisfaction in health sector during the austerity: the case of Greek NHS dentists .....	119
Evaluation of Alternative Maintenance Management Information Systems for a Greek Pharmaceutical Company using the Promethee Method.....	120



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## **session 1: Multicriteria Decision Making I**

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**session chair: Evangelos Grigoroudis**

## A multiple criteria approach for personnel evaluation and optimal assignment

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### Abstract

The management of human resources aims to maximize employee performance in accordance to the strategy of a company or organization. One of the major problems of human resources management refers to the evaluation of employees, which is studied often in relation to the optimal assignment of personnel. Usually, the decision-making problem involving the assignment of individuals or groups to tasks or areas of responsibility within an organization is considered in two interrelated phases: performance prediction and assignment. The main aim of the paper is to present an integrated approach for the decision-making problem of optimal personnel assignment to specific job positions. The proposed approach is based on a multiple criteria evaluation technique in the domain of Multiattribute Utility Theory (MAUT). In this context, each employee is evaluated based on the particular characteristics of job positions, while the general evaluation framework is based on the results of an analytical job description analysis. The set of evaluation criteria combines both jobs' and employees' attributes and they are able to examine the performance of each employee to each job position. In addition, the proposed approach is able to provide an overall assignment score of all job positions and suggest an optimal assignment scheme that maximizes the overall performance of the organization. The presented evaluation and assignment problem may be additionally used in almost all HRM functions, like the determination of personnel needs, the recruitment of new employees, the determination of training needs, the personnel development and promotion process, and the personnel appraisal system. A real-world case study in a Greek municipality is also presented in order to demonstrate the validity and applicability of the proposed approach.

keywords:	Personnel assignment Personnel evaluation Multicriteria decision analysis Multiattribute Utility Theory
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## **Applying the multicriteria method Promethee II for the startup ranking during a business ideas competition**

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### **Abstract**

The “startup explosion” has raised the interest of both academics and businesses, as according to the literature it has multiple economic, employment and social benefits. The interest of academics and startup’s ecosystem (universities, business and technology centers, business incubator or accelerator, angel investors and venture capitalists) focuses on the best selection of startups (through various criteria and indicators) that will be financially feasible and scalable. This paper makes an attempt to list and describe what investors do, and other stakeholders see when evaluating a startup in the early stage (pre-seed and development) during a business ideas competition. A multi-criteria decision-making model has developed, based on previous research by three authors who analyzed the criteria used by investors (venture capitalists and angel investors) to evaluate startup funding. The multi-criteria method Promethee II, used in the evaluation process to consider both quantitative and qualitative data. The weighting of criteria is carried out according to three different perspectives, each one focusing on financial, management team and market/product benefits. In the decision support model proposed, each stakeholder can evaluate every proposal in a personal way according to its scoring on the consistent family of the evaluation criteria. After the development of evaluation model, it was applied to registered business plans of a business ideas competition, in order to test it. The obtained empirical results comparing all the registered business ideas of start-ups show that the proposed multi-criteria model could be used for evaluating the pre-seed (business idea) stage of startups, and that offers promising new perspectives in that field of research.

<b>keywords:</b>	Model Evaluation Startup Validation and Selection Analysis of Collective Decision-Making Promethee method Investment Decisions
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## Assessing Climate and Energy Policy Scenarios based on their Socioeconomic Impacts: A Multi Criteria Approach

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### Abstract

The perpetual problems due to climate change repercussions have created the urgent need to find efficient ways to tackle them. European countries have moved towards the creation of energy and climate policies in order to achieve specific targets and mitigate the consequences of greenhouse gas emissions. These targets mainly concern the CO<sub>2</sub> emissions reduction, the improvement in energy efficiency and the increase of the share of renewable energy sources until 2030. A variety of defined scenarios are comprised with a mix of different measures aiming to lead EU to counteract the increasing energy demand and its negative effects on the environment. The scope of the paper is to examine which scenario responds adequately to the European region's profile and which will positively affect living conditions. Therefore, the research focuses on the assessment of each alternative climate and energy policy scenario, when considering its socioeconomic impacts with the application of multi-criteria decision analysis.

keywords:	EU 2030 framework Climate Policy Energy Policy Socioeconomic Impacts Multi-Criteria Decision Analysis
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## Robustness Improvement in UTA methods through the elicitation & exploitation of strength of preference information

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### Abstract

UTA methods concludes to the assessment of additive value preference models based on Decision Makers (DM) global preferences expressed by rank-ordering (preranking) of a limited (reference) set of the alternative actions evaluated into a consistent family of criteria. A new adaptation of UTA methods is presented in this research work, which utilizes additional information concerning the global preferences of the DM. The strengths of preferences among the successive alternatives of the reference set, sorted by their ranking, are derived. The DM is asked to provide ranges of values  $[z_{min}, z_{max}]$ , through visual techniques, expressing the degree he/she prefers an alternative from the next one in the ranking. By this way  $n-1$  ranges of indices concerning the strength of preferences among the successive alternatives of the reference set are incorporated into the UTA methods. Adaptations of the linear program of UTA method leads to the estimation of a more robust additive value model corresponding to a richer representation of DM's preferences. The proposed adaptation of UTA method can be used a priori during the initial expression of DM's global preferences or a posteriori in the frame of post optimality and robustness analysis, constituting a new feedback of UTA methods. The above approach is presented and evaluated through an illustration case study.

keywords: Multi criteria Decision Aid  
Robustness Analysis  
Disaggregation Disaggregation Approach





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## **session 2: Metaheuristics**

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### **session chair: Angelo Sifaleras**

## **General Variable Neighborhood Search methods for the efficient solution of Location Inventory Routing Problems**

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### **Abstract**

The Location Inventory Routing Problem (LIRP) a problem of significant academic and industrial interest in the area of supply chain management and optimization. It is typically an NP-hard supply chain network optimization problem which tackles simultaneously strategic, tactical and operational decisions. Such decisions involve depots location, customers' allocation to the opened depots, inventory control and scheduling of vehicles' routes. This work presents General Variable Neighborhood Search (GVNS) methods for the efficient solution of this problem. The methods rely on systematic and deterministic neighborhoods changes while searching for an optimal solution. The results illustrate that, the proposed metaheuristic methods are computationally efficient for large-sized instances of the LIPR which cannot be solved with direct methods.

<b>keywords:</b>	GVNS Location Inventory Routing Problem Supply Chain Optimization Metaheuristic
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## Application of Evolutionary Algorithms to Net Present Value Optimisation of Open Pit Mine Scheduling

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### Abstract

Open pit mine scheduling is one of the areas where an engineer can improve significantly the value of a mining project. Scheduling is generally focused on the sequencing of excavated material between different locations of interest within a mining site. There are different types of schedules depending on the time horizon and resolution, such as life of mine, annual, monthly and weekly plans. Schedules are commonly optimised to maximise their net present value – the value being calculated by applying a number of associated costs (mining, hauling, processing, etc.) and the revenue of the produced commodities. Traditional optimisation algorithms for mine scheduling are mostly based on some form of linear, dynamic or mixed integer programming and are commonly quite time consuming to setup. Evolutionary methods such as genetic programming have been tried by various researchers in the past. This paper discusses the application of one of the first commercial products based on evolutionary algorithms to open pit mine scheduling, called Maptek Evolution. The open pit planning tools provided work off a single dataset to generate strategic scheduling, medium and long term planning across the life of an operation. Evolution consists of a hybrid system with two evolutionary and one classical optimisation algorithm. A case study based on two adjacent operational nickel surface mines from central Greece is used to assess the benefits of using this scheduling package.

keywords:	evolutionary algorithms open pit mine scheduling net present value optimisation
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## Initialization methods for the TSP with Time Windows using qGVNS

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### Abstract

Metaheuristics are higher level heuristics, that are widely used for solving optimization problems with incomplete information in a short amount of time. General Variable Neighborhood Search (General VNS or GVNS) is a well-known VNS variant which have been successfully applied for the solution of various NP-hard combinatorial optimization problems. Quantum GVNS (qGVNS) is a new variant of GVNS inspired by quantum phenomena. qGVNS differs in terms of the perturbation phase (shaking) since it achieves the perturbation movements by applying quantum computing principles. In this work, our effort is focused on applying the qGVNS method to the well-known Traveling Salesman Problem with Time Windows (TSP-TW). More specifically, our target is to construct initial, feasible, solutions for TSP-TW which is an NP-hard problem too, by using the qGVNS method. We also present preliminary experimental results of this novel method regarding the TSP-TW problem and also a comparative study between the classic GVNS and the qGVNS variants

keywords:	Metaheuristics VNS GVNS TSP TSP-TW qGVNS Optimization
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**session 3: Data Envelopment Analysis**

**session chair: Emmanuel Thanasoulis**

## Assessing The Cost-Effectiveness Of University Academic Recruitment And Promotion Policies

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### Abstract

This paper develops an approach for higher education institutions to assess the economic efficiency of their recruitment and promotion practices concerning academic staff. Research output potential is a key criterion in most academic appointments. Generally there is a long lead time between the conduct of research and its ultimate value in the form of disseminated knowledge. This means higher education institutions usually reward financially staff on the prospect of research output, albeit on the basis of research outputs achieved up to the point of recruitment or discretionary salary rise (e.g. through promotion). We propose a Data Envelopment Analysis (DEA) model which can be used retrospectively to set salary costs against corresponding research outputs achieved as a measure of the financial efficacy of past recruitment and promotion practices. The analysis can identify potential issues with those practices and lead to improvements for the future. The approach is illustrated using realistic data from a Greek University.

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\*\*The views expressed in this paper are those of the authors and no representation is made that they are shared by any funding body.

#### keywords:

Data Envelopment Analysis  
Academic Promotions  
Academic Recruitment  
Cost Efficiency

## Semidefinite programming approach to the hyperbolic measure model in data envelopment analysis

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### Abstract

Hyperbolic model is one of the data envelopment analysis (DEA) models used mainly in environmental applications. It is a non-linear model that radially decreases the inputs and increases the outputs using a single parameter. In the case of constant returns to scale (CRS) it can be transformed to a linear problem and therefore has been applied only under CRS assumption. In this presentation we show how to use this model and its modifications disregarding the type of the returns. We formulate the model as a semidefinite programming problem (SDP) that can be solved via standard convex solvers. The SDP formulation also allows the derivation of the corresponding dual model. We provide the interpretation of the dual model and illustrate the features on an example with undesirable outputs.

#### keywords:

data envelopment analysis  
hyperbolic measure model  
semidefinite programming  
undesirable outputs

## Firm resources allocation for customer retention

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### Abstract

A customer retention metric is introduced, developed and operationalized in this research. It is called Firm-Customer Relationship Efficiency and measures the effectiveness with which the firm's resources are invested compared to customer retention behaviour. The resources refer to quality and relationship marketing instruments and customers' behaviour refers to repurchases and cross-buying. This metric helps managerial teams allocate their finite resources in an accountable manner by measuring relative productivity performance at the customer level. We use Data Envelopment Analysis to measure the efficiency and present a methodology to get the levels of resources wasted, the potential on improving sales and setting attainable targets for the customer relationships.

keywords:

data envelopment analysis  
marketing performance  
marketing efficiency  
customer retention



## Measuring efficiency of regional knowledge spillover using DEA: An application to EU regions

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### Abstract

Aim of this paper is to investigate the impact of various variables like patent applications, development level, employment level and degree of technological diversity on innovative efficiency. Innovative efficiency has been estimated by relating innovative inputs and innovative outputs. Expenditures in Research and Development and Human Capital stand for innovative inputs. Technological knowledge diffusion that comes from spatial and technological neighborhood stands for innovative output. We have estimated innovative efficiency following Data Envelopment Analysis (DEA) for 192 European regions for a 12 years period (1995–2006). We have also estimated how the various predictor variables interact with innovative efficiency and with one another by following Structural equation models (SEM) analysis.

Our results indicate that regions which present high innovative activity through patents production they also present high innovative efficiency. Furthermore, our findings show that regions characterized by high levels of employment achieve to manage efficiently their innovative sources. Additionally, we find that the level of regional development has both a direct and indirect effect on innovative efficiency. More accurately, transition and less developed regions in terms of per capita GDP present high levels of efficiency if they innovate in specific and limited technological fields. On the other hand, the more developed regions can achieve high innovative efficiency if they follow a more decentralized innovative policy.

**keywords:** Technological diversity, R&D, Patents  
Data Envelopment Analysis, Structural Equation Modeling

## Prioritizing volatility models: A novel procedure using Data Envelopment Analysis

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### Abstract

Economic crisis and uncertainty in global status-quo affect stock markets around the world. This fact imposes improvement in the development of volatility models. However, the comparison among volatility models cannot be made based on a single error measure as a model can perform better in one error measure and worst in another. In this paper we propose a two stage approach for prioritizing volatility models which in the first stage we develop a novel Slacks-Based Data Envelopment Analysis to rank volatility models. The robustness of the proposed approach has also been investigated using cluster analysis. In a second stage analysis, it is investigated whether the efficiency scores depend on models characteristics. These attributes concern the time needed in order the model to be estimated, the value of Akaike Information Criterion (AIC), the number of models significant parameters, groups and bias terms and the error sum of squares (ESS). Further, dummy variables have been introduced to the regression model in order to find whether the employed model includes an in-mean affect, whether the assumed distribution is skewed and whether the employed model belongs to the fGARCH family. This enables us to assess the effect of the models characteristics on the efficiency scores, hence a beta ( $\beta$ ) regression assuming a log-log link for mean is estimated. The main findings of this research show that the number of models' statistically significant coefficients, error sum of squares and in-mean effects tend to increase the efficiency scores, while time elapsed, number of statistically significant bias terms and skewed error distributions tend to decrease the efficiency score.

keywords:	Statistical Distributions Forecasting Volatility models Data Envelopment Analysis Ranking $\beta$ - regression
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## **session 4: Decision Making Applications I**

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**session chair: Pavlos Delias**

## Investigating the issue of natural gas security in Europe

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### Abstract

The rising demand of the European countries for natural gas exceeds the supply of local production, leading to gas imports mainly from Russia, Norway, Algeria and Libya (through gas pipelines) and in a lower share from other countries (Qatar, Nigeria, Egypt) by use of LNG tankers (special ships carrying Liquefied Natural Gas). This creates a dependency of Europe from external energy suppliers (which has significant economic and political aspects) and challenges the concept of European energy security that asks for diversification among supply providers and transport routes.

The current work is dealing with the investigation of issues pertinent to European natural gas security. To this aim, a model has been developed taking into account (a) the current and potential future gas supply (local production) and demand in the European countries (b) the structure and transfer capacity of the natural gas pipeline network system and (c) the development of maritime LNG terminals in major European ports. The modeling procedure followed the minimum cost flow problem and was implemented by use of ArcGIS (for the formation of the layout of the gas pipeline network and for port locations) and TransCAD software (to solve the problem). Various future demand and supply scenarios were tested taking into account energy security policies and proposed infrastructure projects (new gas pipelines). The results revealed the role and prospect of Greece (proposed and under development gas pipeline projects and LNG port installations) as part of the gas transfer corridor from Asia to Europe.

**keywords:**

energy security  
gas pipeline network  
LNG  
minimum cost flow problem

## Exploring the Potentials of Process Analytics for Political Event Analysis

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### Abstract

Event data play an important role in analyzing interactions at a macro-level for decades. Perhaps the first systematic approach is WEIS, which allowed a departure from the idiographic study of political events, towards the use of quantitative methods. The importance of having a systematic method to listen and to record political events, was that big, that different initiatives (including projects funded by Defense Advanced Research Projects Agency, and National Science Foundation) produced systems like CAMEO, ICEWS, and recently GDELT. The holy grail of all these efforts is the discovery of regularities of events occurrences.

The aim of this work is to enrich the toolbox of analysts that look for this kind of regularities, by enabling a process perspective for event data. Lately, many event analytics techniques with appealing visualizations have been developed. However, these (rich) techniques seem to univocally focus on the pure sequentiality of events occurrences. Nevertheless, real-world news events often do not follow a linear movement that is implied by a sequence, but they have varying structures, and these may reflect elements of a larger process that has many descriptive components. In this work, the ambition is to enable the observation of the events through a process perspective. We advocate that such an enablement will contribute the following: i) Expose causalities among activities, ii) Reveal decision points by introducing gateway semantics (flow splitting and joining points), and iii) Manifest pathways to distinct outcomes.

#### keywords:

Process Analytics  
Event Analysis  
Process Intelligence  
Process Mining

## Distributed model predictive single wagonload control

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### Abstract

Single wagonload (SWL) transport represents one of the essential components of rail freight transportation system. However, on many European railways SWL transport faces with profitability and quality issues and has difficulties to keep pace with changing market requirements. This paper considers cooperative single wagonload transport planning between rail freight operators in different and interconnected service networks. Cooperative planning approach is based on Distributed Model Predictive Control (DMPC) for managing the rail freight car flows by a number of rail freight operators in their subnetworks in order to minimize the total freight car management cost. Augmented Lagrangian formulation of the planning problem is decomposed into sub problems cooperatively solved by rail freight transport operators. A case study illustrates the potential of the proposed cooperative planning approach.

**keywords:**

Single wagonload  
Railway  
Distributed model predictive  
control

## Decision Making and Crisis Management in Greek Foreign and Defence Policy

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### Abstract

The field of crisis management in international relations currently faces a number of essential and important challenges. The main purpose of this proposal is to offer a conceptual analysis of crisis management in international relations/ politics (especially in foreign and defence policy). The methodology of this proposal derives from Popper's 'Evolutionary Theory of Knowledge'. Particularly, at first level, this proposal intends to represent the Greek Foreign and Defense policy under the scope of a mixed (and new) IR approach called "neorealist constructivism". In the next stage, existing constraint modeling methods will be identified based on a comprehensive review of current administrative practices and academic researches. Finally, once the constraint classification and modeling techniques are identified, a conceptual framework for total constraint management will be outlined. At second level, this research attempts the analysis of the particular decision – making procedure, following Graham Allison's approach and testing the «weak» points of the existing procedure through simulations. At third level, the research targets to create a decision-making system, which uses the existing and provides new structures and facilities by bringing them together for working for innovation. Developing a software for training state experts and graduate students. After the development of the software the researcher intends to give it to governmental experts for testing. This project is an attempt to build up strategic steps, to establish a close and continuing inter-action between the government, ministries, military stuffs and the students and faculties in all the undergraduate and postgraduate courses. The main objective of this research is to demonstrate a methodological gearing 'instrumentarium' in crisis management. Firstly, a theoretical approach of International Relations (IR) theory will be conducted. Second, analytical and institutional framework permits the easy exploitation of existing and rich data from diverse sources and the projection of a new crisis management model.

#### keywords:

crisis management  
decision making  
foreign policy  
defence policy  
international relations theory  
newrealistic constructivism



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## **session 5: Logistics Optimization**

**session chair: Ilias Tatsiopoulos**

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## Vehicle Routing Problem for Urban Freight Transportation: A Review

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### Abstract

This paper presents a methodology for classifying the literature of the Vehicle Routing Problem (VRP) for urban freight transportation and a review of the latest bibliography. The fact that the variants of the VRP have grown and similarly have the practices and applications, made the VRP popular in the academic literature. Hence, the number of articles published, is increasing constantly and it is difficult to monitor developments. In this paper, after considering other existing research, a review in big scientific databases such as Scopus and Emeraldinsight is presented. The taxonomy of the last decade's literature of the VRP for urban freight transportation is given and critical insights are discussed. After the categorization of the articles, the trends of the VRP for urban freight transportation are featured and analyzed. This knowledge and analysis will be used in a research project in order to support with algorithms the functionality of a vehicle routing and scheduling information system, and lead to an operational solution.

keywords:	Vehicle Routing Problem (VRP) Urban Freight Transportation Literature Review
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## A Visual Interactive Solution Method for Multi-depot Vehicle Routing Problem with Heterogeneous Vehicle Fleet & Backhauls

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### Abstract

In this study, we first defined a new extension of Vehicle Routing Problem, and called Multi-depot VRP with Heterogeneous Vehicle Fleet and Backhauls (MVRPHVFB). In the classical VRP, there is a homogeneous vehicle fleet in a depot and a customer set with known demands whereas MVRPHVFB is a more complicated version of the classical VRP, since customers are divided into two groups: delivery (linehaul) and pickup (backhaul) customers. Moreover, there are more than one depot and there is a heterogeneous vehicle fleet (unlimited number of vehicles in each type) which has fixed and variable costs varies according to capacity, at each depot. This problem is modeled by combining Fleet Size and Mix VRP with Backhauls proposed by Salhi et al. (2013) and MVRPHVF proposed by Salhi and Sari (1997). We firstly reviewed the literature about MVRPHVFB, then we defined the mathematical model for MVRPHVFB, and we also proposed some restriction constraints for this model. We generated new problem instances for MVRPHVFB by using the benchmark instances of Fleet Size and Mix VRP with Backhauls and MVRPHVF. We develop a visual interactive Decision Support System (DSS), that solves the problem by GRAMPS algorithm, in order to solve MVRPHVFB.

<b>keywords:</b>	Multi-depot Vehicle Routing Problem Heterogeneous Vehicle Fleet Backhauls Heuristics Decision Support Systems
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# The Pollution Routing Problem with Time Windows and Stochastic Travel and Service Times

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## Abstract

The Vehicle Routing Problem (VRP) is one of the most studied combinatorial optimization problems. It consists to define routes for a fleet of vehicles, in such a way that each vehicle starts and ends its tour at a depot node, each customer is visited once and vehicle loads comply with vehicle capacity. The most common variant is the Capacitated VRP (CVRP), where each vehicle is limited by its capacity. Another common variant is the VRP with time windows (VRPTW) in which customers must be visited within predefined time intervals.

It is known that the transport has hazardous impacts on the environment, such as resource consumption, land use, acidification, toxic effects on ecosystems and humans, noise and the effect induced by Greenhouse Gas (GHG) emissions [1]. In particular, CO<sub>2</sub> emissions are the great concern because they have a direct impact on human health (eg, those of the pollution) and an indirect impact (eg, by the depletion of ozone layer).

The amount of pollution emitted from a vehicle depends on the load and speed and other factors. In addition, in practical situations, one may not know the travel and service times in advance. For example, weather or traffic conditions may result in the uncertainty of travel times between two vertices. Furthermore, service times may be affected by the distribution technology, the driver's skills, the parking condition and the condition of the loading area. Our goal is to introduce a new variant of the vehicle routing problem, that we call the pollution routing problem with time windows and stochastic travel and service times (SPRPTW), which takes into account the amount of pollution emitted, the time windows and the stochastic travel and service times.

keywords:	Stochastic VRP The Vehicle Routing Problem The Pollution Routing Problem
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## Modelling and Solving a Real-Life Fuel Distribution Problem

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### Abstract

The work presented in this paper aims to address a real-life fuel delivery problem. Each customer's order is associated to given quantities for a number of fuels. Each order must be serviced by a single vehicle (split deliveries are not allowed) within a strict time window. A heterogeneous fleet of vehicles with multiple-compartments is available. Safety and legal considerations imply the following loading constraints: i) each compartment can be loaded with a single order element (i.e., requested quantity for a fuel), and ii) unloading of compartments can be performed with a certain order. The objective of this problem is to minimize the number of vehicles used to deliver the orders to the customers and total traveled distance of the vehicles used. We provide a linear integer programming formulation of the proposed problem that incorporates the loading constraints. A Two-Phase Heuristic Algorithm is proposed to solve the proposed routing and scheduling problem. The first phase of the algorithm involves a route construction heuristic that aims to determine feasible solutions of the proposed problem. In the second phase of the algorithm a route improvement routine is applied involving swaps of orders. Two types of swaps are performed. The first type of the swap is implemented exchanging the position between two orders loaded to different vehicles. The second type of swaps involves changing the position of two orders loaded in the same vehicle. Both of the two types of improvement routines of the second phase should respect the loading and time constraints and aim to minimize the total traveled distance of the used vehicles, computed in the first phase of the algorithm. The accuracy of the solutions of the proposed real-life fuel delivery problem is assessed on a set of different problem instances. Additional experiments are performed in order to assess the additional cost of the fuel delivery routes attributed to the loading constraints.

keywords: hazardous materials  
vehicle routing and scheduling  
loading constraints

## Shared logistics opportunities in urban areas: Assessing route sharing practices for 3PL freight distributions in the region of Attica

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### Abstract

Urban areas are currently experiencing a great degree of negative impacts from freight transport activities due to the gradual growth rate of the urban population and the frequent deliveries trend mainly in retail stores. In order to promote sustainability in urban areas, EU has adopted various strategies which directly influence the transport and logistics sector performance and limit the negative impact that arises from their operation. Shared logistics practices turned to be a very promising strategy in the urban freight distribution era. The aim of this paper is initially to review the state-of-the-art in collaborative city logistics strategies and then to investigate shared logistics opportunities among third party logistics (3PL) operators in the area of Attica Region. Currently most of the 3PL companies operate without incorporating any collaborative practices as the logistics sector in Greece is characterized by fragmentation and harsh competition. However, they have currently expressed their interest for deploying collaborative solutions in order to decrease their costs and enhance their customer service. To this end, a smart matching algorithm was developed in order to consolidate the transportation flows of two major Greek 3PL companies. Subsequently, a series of experiments was conducted using both real-life and generated data, provided by the Greek 3PL operators, so as to identify matching opportunities among the interested parties. During the experimentation process, the route sharing practice is examined where specific vehicles perform collaboratively the deliveries of the 3PL companies. More specifically, they collect freight from the 3PLs' depots and deliver it to the final customers. Various business cases were examined and a number of KPIs was used in order to evaluate the proposed route sharing strategy. The results showed that via collaborative freight distribution the number of vehicles used and the operational costs were decreased while the loading factor was increased.

#### keywords:

City logistics  
Urban freight distribution  
Sustainable transportation  
Transport pooling  
Route sharing



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## **session 6: Multicriteria Decision Making II**

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**session chair: Ioannis Giannikos**

## Using a MACBETH based multicriteria approach for virtual weight restriction in a DEA multi-stage ranking process

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### Abstract

This paper enriches existing multi-stage ranking models, by incorporating virtual weight restrictions to the G-DEA model proposed by Hadad et al. (2003). The key idea behind our approach lies on the fact that we use a multicriteria approach, which allows decision makers to estimate and apply a common set of weight bounds at all stages of the DEA super-efficiency multi-stage ranking process. The proposed approach enriches the discrimination power of the underlying multi-stage ranking process, since it allows decision makers to define the importance of inputs and outputs over the final ranking of the assessed DMUs. The weight bounds are obtained using the MACBETH methodology. The proposed approach is applied in a real case study, involving 33 general hospitals of the Greek NHS. The final rankings, as obtained by a weight restricted version of the G-DEA model, indicate that the proposed methodology can indeed increase the discrimination power of the G-DEA model and improve DMUs ranking.

<b>keywords:</b>	Data Envelopment Analysis (DEA) Super-Efficiency DEA model DMUs ranking Virtual Weight Restriction MACBETH
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## Preference Classification based on Multi Criteria Decision Analysis and Preference Aggregation Methods

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### Abstract

Applying methods of aggregation disaggregation approach to behaviour analysis provides information such as: preferences, marginal and global utilities, which can be used to cluster alternatives actions-choices. The aim of this work concerns the development and application of methods for investigating clustering capabilities through the application of methods and techniques from the field of group decision-making, of preferences aggregation and from artificial intelligence. The proposed methodology will be applied to data from market research.

#### keywords:

Multi – criteria analysis  
Group decision-making  
Preference aggregation  
Classification



## Wind Farms Suitability Analysis Using TOPSIS and VIKOR Approaches: A Case Study in Thrace Region

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### Abstract

Wind farms siting can be considered as a Multi Criteria Decision Making problem that consists of set of alternative locations and set of selection criteria. As a result the implementation of multicriteria decision analysis frameworks to the spatial context can significantly support strategic spatial planning. Granted that the rapid increase of fossil fuels consumption resulted to the release of tremendous amounts of greenhouse gases and the rapid depletion of them, many countries as well as the European Union are implementing policy frameworks to support sustainable development. The use of renewable energy sources instead of the conventional ones is in the core of policy actions and consists a field of great priority nowadays. Due to integral role of renewable energy sources in future energy consumption much research emphasis has to put in enabling the implementation of these technologies. However, it is recognized that renewable energy resources are not fully environmentally safe granted and even more they are associated with a variety of environmental impacts. Recent experience highlights that as major disadvantage is the fact that they are not available at every geographic location. Moreover their implementation is more favorable at remote locations that often are of high ecological value. Thus, identification of preferable locations for the establishment of renewable energy system is a decision-making problem that requires evaluation of the available land in relation with economic and environmental limitations.

The paper at hand presents a framework that examines both decision criteria and constraints implementation into the wind farms site suitability problem. Both criteria and constraints form an objectives tree through their classification into three main criteria categories which namely are: environmental, socio-economical and design considerations. At the first step absolute suitability analysis aims to identify candidate siting locations that satisfy all the examined constraints by performing Boolean operators. Then relative suitability analysis is implemented in order to rank efficient locations using suitability measures in GIS environment. The proposed analysis is presented throughout a real case study in Eastern Macedonia and Thrace region, while multicriteria evaluation is implemented using TOPSIS and VIKOR decision models.

**keywords:**

Suitability Analysis  
GIS  
TOPSIS  
VIKOR  
Wind Farms

## Utilising Multicriteria Decision Aid for the measurement of Project Success. The PROMITHEAS methodological frame

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### Abstract

The evaluation of project success is characterized by complexity, diversity and ambiguity concentrating the strong interest of academics and business managers over the last decades. The measurement of project success is a complicated and unstructured process while: a) the results of a project or a group of projects can be obtained after and in many cases long time after the project completion, b) the longer term benefits are often indirectly related with the projects, c) the subjectivist perspective of different stakeholders is creating difficulties for the use of one success verdict, d) the correlation between the evaluation criteria and the organisation strategic goals taking into account the external environment is another challenging issue and e) the relative importance of the criteria varies between different stakeholders and depends on the time when the evaluation taking place.

The proposed PROMITHEAS approach (PROject Multicriteria Interactive Tool for Holistic Effectiveness ASsessment) for the project success evaluation concludes to the estimation of a value system based on the selection criteria combining the disaggregation - aggregation multicriteria decision aid UTA methods and the Multi-Objective Linear Programming Techniques. Through this approach the following main objectives are achieved: 1) the evaluation of the projects' success according to the strategic goals of an organisation, 2) the use of a consistent family of criteria in the analysis taking into account the relative importance of the criteria and 3) the consideration of different stakeholders in all stages starting from the selection process of the projects' portfolio to the final evaluation of project success. The value system estimated by this approach can lead to the analysis of the success or failure of the projects by deducting differences from the initial strategic planning. The PROMITHEAS approach is illustrated through a real world case study concerning the evaluation of Post Graduate Educational Programmes of a higher Educational Greek Business School.

#### keywords:

Multicriteria Decision Aid  
Project Effectiveness  
Project Success  
Project Management

## An application of non weight MCDM for the evaluation of GEM entrepreneurial ecosystems

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### Abstract

For over 15 years the Global Entrepreneurship Monitor (GEM) releases an annual report on Entrepreneurship, including data from more than 100 countries. The data are collected by national experts and cover two basic elements, namely the entrepreneurial behavior and attitudes among the population and the entrepreneurial ecosystem. Moreover, explanatory national reports are written for each country by a panel of experts, but comparative studies are more rare. We apply multi-criteria decision methods in order to assess the entrepreneurial ecosystem of selected countries. We use data from the National Expert Survey (NES), indicating multiple facets of the economic and social environment, as input criteria and we examine each country as a different alternative. The method used was initially proposed by P. H. Huang<sup>1</sup> and T. Moh (2016) and is based on Perron-Frobenius theorem on primitive matrix properties. The method produces a primitive comparison matrix based on pair comparisons of alternative cases on each criterion. Only the win-tie results of each comparison are taken in account and not the magnitude of the difference. Finally a ranking vector is extracted based on the spectral radius and the corresponding eigenvector. The main benefit of the method is that it does not require experts' assigned weights for the criteria used. Finally, the ranking results are compared to those of some popular MADM methods.

keywords:	entrepreneurial ecosystems multiple criteria analysis multiple criteria decision making ranking alternatives global entrepreneurship monitor
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June 8-10, 2017 | Thessaloniki, Greece

**session 7: OR in Finance & Economics**

**session chair: Michalis Doumpos**

## The Robustness of Portfolio Optimization Models: An Empirical Comparative Analysis

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### Abstract

Nowadays, optimal portfolio selection constitutes a serious issue for both investors and financial consultants. Both companies and investors decide to invest their capital in different financial assets to increase their profits. This is carried out by constructing portfolios yielding that optimize return and risk measures. For the construction and the selection of such investment portfolios, several models have been proposed, extending the classical mean-variance portfolio theory with the introduction of new performance attributes.

In the literature, several comparative studies have been presented. Most of them however, adopt a rather restrictive approach focusing solely on a single portfolio (the one that minimizes risk) without considering the whole set of efficient portfolios, which are also relevant for investors.

This paper, tries to move a step forward, focusing on the performance of the whole efficient set, rather a single portfolio. In particular, we examine the out-of-sample robustness of efficient portfolios. This is carried out by considering both return and risk measures and investigating the outcomes of several portfolio scenarios, from popular optimization models. The considered models, include the traditional mean-variance model, conditional value at risk, mean-absolute deviation, and a multi-objective model. Tests are conducted using data for S&P 500 stocks, over 42 time periods during 2005-2016. The results are analyzed through different performance indicators representing the deviations between historical (estimated) efficient frontiers, actual out-of-sample efficient frontiers, and realized out-of-sample portfolio results. The outcomes of the analysis provide insights into the robustness of the models over time, their similarities and differences, and their relative performance under different performance metrics.

**keywords:**

Portfolio optimization  
Efficient portfolios  
Multi-objective optimization  
Robustness

## **Reciprocity in Trade: An Empirical Investigation Using Experimental Economics Methods Under Real Circumstances**

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### **Abstract**

The Theory of Expected Utility is the basic theory that explains how people make decisions in emergency situations (Bernoulli, 1954). Almost all economic theory is built on the assumption that people act selfishly neglecting the well-being of other human beings. During the last decade many researchers have, however, provided evidence which indicates that the behavior of economic agents may well be affected by considerations of fairness and reciprocity (Kahneman et al. 1986; Fehr et al. 1998). Taking into consideration the above mentioned, this particular paper presents the findings of a combined research conducted with undergraduate students at the University of Patras, in the Department of Business Administration of Food & Agricultural Enterprises and Environment & Natural Resources Management, based in Agrinio. The purpose of the research is to examine the model of "Homo Economicus" and "Homo Reciprocans", the two kinds of economic people. That is to say, it attempts to identify whether the individuals are only interested in their own financial well-being or in their neighbor's as well. This research was carried out over a five-month period (March-June 2015). In particular, the survey is divided in two separate sub-researches. The first one consists of a (N =100) sample of students and the second sample is (N=50). Each individual for the first experimental process had 10€ (not real money) available for playing but for the second process had 5€ (real money). In this way and by comparing the results, we pursued to examine if individuals present a different economic behavior and reciprocity when it comes to real money. Two games of the Experimental Economics and Game Theory were used in the experimental part of the survey. These games are the Ultimatum Game and the Dictator Game. All in all, taking into account the results, it is concluded that individuals show a reciprocal behavior both in the first and in the second experimental research.

<b>keywords:</b>	Experimental Economics, Game Theory Homo Economicus, Homo Reciprocans, Reciprocity
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## Income taxation from Real Estate property (physical and legal persons)

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### Abstract

The real estate business environment since 2008 has changed dramatically. Changes has been located at the evaluation price of real estates, at the reduction of demand on real estate market, overtaxation, the lack of bank finance etc. The real estate properties are part of the economic capital and first we will examine how we tariff properties when the holder is a natural person (individual) and second how we tariff properties when the holder is a legal entity. The article 35 of law 4172/2013 among other things, states that the income from capital includes income that an individual acquires from real estate property. These provisions are applied when income has been earned from real estate in the tax years starting from 01/01/2014 onwards. At the same law and specifically at the article 47, the legislator provides that all revenues earned by legal persons and by legal entities are considered income from business activity and the result (profit) is taxed as profit. Taking all the above distinctions into consideration, in this paper we will first be occupied with what the law predict for individuals and especially with 1. The determination of the concept of income from real estate, 2. When the income from rents which are disbursed retroactively by law or court order are considered to be subject of tax income, 3. Indicative cases of the concept of income from real estate property, 4. Valuation of income in kind from own use or allotment, discharge, 5. Scale taxation of income from Real Estate 6. Uncollected rents. Moreover, all the above issues will be approached from the aspect of legal persons and we will identify the tax burden with examples. Finally, for a complete reference to the properties, there will be a brief analysis of the context of enforcing other taxes on real estate rights:

1. Undivided taxes of Real Estate and other clauses (Law 4223/2014). (EN.F.I.A.)
2. Special real estate tax (Law 3091/2002, article 15).
3. Transfer of Real Estate property.

keywords:	Real estate properties taxation income taxation
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## Tax morale in Greece

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### Abstract

Although several papers have been published on the Greek shadow economy, tax morale in Greece has not been adequately explored. This research aims to investigate the effect of the economic downturn on the determining factors of tax morale through primary data from a European Union funded research project on the Greek shadow economy. The findings indicate that worsening economic conditions favor the acceptance of activities in the shadow economy and provide policy orientations towards transferring activities from the shadow to the official economy, a goal which is part of Europe 2020 strategy.

keywords:	Greece tax morale shadow economy economic crisis
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June 8-10, 2017 | Thessaloniki, Greece

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## **session 8: Strategy & Analytics**

**session chair: Fotis Kitsios**

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## Strategic Tool for the Assessment of Company's Business Excellence & Competitiveness Level

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### Abstract

The paper aims in presenting a methodological framework for the development of a Strategic Tool for the Assessment of Company's Business Excellence & Competitiveness Level. This Strategic Tool consists of a Balanced Scorecard based Assessment Tool which can be applied in every company. The Assessment Tool includes two parts, first the "Basic Characteristics" part and second the "Business Competency Issues" part. The first part refers to the basic characteristics for each company and contains five areas namely: annual turnover, number of employees, number of products / services, number of customers and existence of production. Each characteristic takes relevant values for different levels.

The second part contains several business competency issues, which are divided, in the first level, in four categories (Operations/Processes/Systems, Human Resources, Customers, Financial), based on the well-known structure of Balanced Scorecard methodology. The Operations/Processes/Systems, the Human Resources and the Customers categories are in turn divided in sub-categories in order to cover the most critical areas of each category in separate groups. The business competency issues are evaluated with a range of values indicating the low and the high and relatively showing the level of excellence of the company in each business competency issue. The score for each business competency issue is based i) on the value for each business competency issue ii) on the value of the basic characteristic and iii) on the correlation of the business competency issue with the basic characteristic which depicted on a correlation matrix that has been developed for that purpose. With this Strategic Tool, which has been designed in such a way that can be applied in companies of any sector and any size, a Company can have a "Quick Scan" which enables it to identify specific or broader areas for further and thorough business analysis or urgent reorganization actions.

keywords:	Strategy Business Competency Balanced Scorecard Competitiveness Business Excellence Assessment Tool
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## A Roadmap to Social Media Analytics

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### Abstract

Social media can be seen as the most remarkable innovation penetrating everyday life. On January 2017, Facebook counts more than 1.8 billion active users and Google more than 415 million. Every second, users upload 10.000 photos on Instagram and perform over 20.000 times of Skype calls, while Internet produces 31.500 GB of data. If Facebook was a country it would be bigger than China or India, two times bigger than Europe, ten times bigger than Russia and 1.8 million times bigger than Vatican City. Therefore, analyzing social media represents a revolutionary way for companies to increase their performance, transforming their business model and for public authorities to offer new-digital services and innovative information facilities to citizens.

The objective of this study is to provide a roadmap regarding the SMA landscape, by investigating different fields and objectives of research and by classifying relevant models, different tools and techniques through the proposed frameworks. Moreover, we present the main definitions for social media analytics (SMA) examining further different approaches, divided in structural and content-based approach. The article provides with two different frameworks and suggests methodologies and tools for social media analysis on different fields of research, marketing or public administration so as to increase business performance or provide with relative facilities to citizens.

<b>keywords:</b>	social media analytics social media e-government public administration business performance
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## The influence of social media on consumers' behavior

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### Abstract

Online social networking has become one of the most popular online activities that more and more people preferably spend their free time on. Lately, the high rate of data transmission combined with the hectic everyday lifestyle that the actual society imposes, have raised the necessity of time-saving solutions. As a result, consumers search for direct and quick alternatives for their purchases, in order to cover their needs. Also, the most important role of social media is that it has changed the way of how consumers and marketers communicate. Social media is a great communication tool that people use to connect to others or communicate with organizations. Social networking platforms as a part of everyday life are virtual places where people as users, share their opinion, warnings, experiences and information. The consumers' social and commercial experience on the internet has been enriched through the daily use of social media. On the other hand, companies benefit from this state and try to provide their products through a "friendly" environment such as social networks, less direct to the consumers, aiming to maximize the customers' experience. The present study aims at estimating the influence of the use of online advertisements in consumers' behavior. This paper is related to the impact of social media on consumers' behavior, therefore it has been made a quantitative research. The study has been conducted with the use of questionnaires addressed to active users of social media. Furthermore, the results have been analyzed, aiming to underline the effectiveness of advertising via social media as means of sales.

#### keywords:

Social media  
consumer behavior  
brand  
consumer perception  
social networks  
social media marketing

## An Empirical Evaluation of Strategic Information Systems Planning Phases in SMEs: Determinants of Effectiveness

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### Abstract

Strategic Information Systems Planning (SISP) supports business goals and business strategy, through the use of Information Systems (IS). Findings from previous surveys indicate that many managers make too much efforts to SISP process while others too little. When managers invest too much efforts, the process could be confused, delayed or its implementation is prevented. When managers avoid investing too much time to the process, the implemented plans could be inefficient so the objectives could not be achieved. Consequently, the assessment of the process is significant because managers can reduce these unsatisfactory results. Findings conclude that managers concentrate more on Strategy Conception and Strategy Implementation and they do not invest time on Strategic Awareness and Situation Analysis, as a result the implemented plans are not effective, successful and they do not meet the objectives. Many factors which influence SISP process could be taken into consideration in order to explain these results. Almost 80% of businesses have been highly influenced by the financial crisis. So, more attention is needed to be paid in Small-Medium Enterprises (SMEs) and how they use IS and strategic planning in order to deal with the crisis. Despite the fact that family businesses focus on business's long-term sustainability, they do not develop strategic planning. The purpose of this paper is to indicate the phases which contribute to a greater extent of success and to provide conclusions regarding on the implementation of this survey in SMEs. Data was collected using questionnaires to IS executives in SMEs, particularly in North Greece. The questionnaire assessed SISP in terms of Strategic Awareness, Situation Analysis, Strategy Conception, Strategy Formulation and Strategy Implementation Planning. The contribution of this paper is twofold. Firstly, it expands the current knowledge regarding the significance of SISP and second it helps IS executives to improve the process.

keywords:	Strategic Information Systems Planning Planning success Business Strategy Information Technology
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## Measuring Leaders' Strategic Thinking

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### Abstract

Can a visionary person be understood by only taking a glance in the person's written texts? And what about the person's tendency to risks undertaking? And what happens when this person is a leader in any kind of activity? Leaders establish and share the values, develop and communicate the vision, determine the mission and formulate and implement the strategy. Apart from being determined, the leader should be able to present his vision and to stir up his audience and envisage them. Additionally, he should be determined to undertake risks. Previous researches have examined the link between their personal characteristics and planning system, the human capabilities of leaders and the effect of organizational characteristics. The Leadership Excellence Model which has been studied by many researchers contains these elements but they cannot be measured directly. Additionally, as far as it concerns measurement of characteristics found in written texts, the measures of texts' characteristics were initially introduced and constructed. Previously, researchers have proposed three new measures in order to quickly see the degree of entrepreneurial thought of an individual, as this can be sought in the individual's written texts and constructed those measures. The purpose of this paper is to propose measures in order to investigate and measure the degree of a person's strategic thinking, mainly focusing on leaders. These measures concern: (a) the measure of risk taking (which is actually a score) and (b) the measure of (visionary). This might be useful for evaluators of modern enterprises and for researchers of political and social sciences, trying to find out the vision which is found in the written texts of the particular person.

keywords:

Heuristic Measures  
Strategy  
Leadership



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June 8-10, 2017 | Thessaloniki, Greece

## **session 9: Decision Making Applications II**

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**session chair: Yiannis Nikolaidis**

## Multi agent based decision making framework for logistics centers development

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### Abstract

Supply chain transportation and logistics centers are key components of the national asset portfolio. The decision to invest in a new logistic center could take from a few years to some decades. This is mainly because of the need to reserve and spent many capitals, the long payback period, the number of the agents and stakeholders involved in decision process, and –many times- the investment and business risks are high. Agents and stakeholders need to define the framework and the outputs of the decision process taking into account the project characteristics, the different expectations and different interactions between agents. An investment in new transport infrastructure is a complex dynamic system. Each stakeholder (or agent) within the system of system decision making process engages repeatedly interactions and different expectations. Therefore, the decision making framework is an essential challenge linked with the key decision factors meet the stakeholder expectations highlighting project trade-offs, financial risks, business uncertainties and market limitations.

This paper deals with an agent based decision process theory for new transport supply chain systems and logistic centers, where a wide range of agents- stakeholders with different expectation is involved. According to a consequences analysis and systemic approach the relationship of supply chain and logistic center infrastructure development, economic system development and agents' expectation is analyzed. Adopting the system of system methodological approach, the decision making framework, variables, inputs and outputs are defined, highlighting the key agents' role and expectations. The framework is based on agent-based theory and describes interactions among individual agents and their expectations, providing a decision making process-oriented. The application provides the methodology outputs presenting the proposed agent based theory framework for a strategic new supply chain transportation and logistics center in North Greece.

#### keywords:

agent-based decision framework  
logistics center  
transport business analytics



## A case study on optimizing the performance of a production company using a new mathematical model

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### Abstract

It is well-known that, the use of modern analytics by companies in competitive markets, is of vital importance both for their efficiency and for the financial profit. This work presents a novel mathematical model for a real-world production optimization problem of a company which is located in Northern Greece. The company produces non-alcohol soft drinks and needs to allocate its human resources in order to have the optimum profit. Therefore, the objective of the model is the minimization of the company's idle man-hours subject to fulfil the demand of the customers. As algebraic modeling languages are very well suited for prototyping and developing optimization models, this production planning mathematical model was implemented in the AMPL mathematical programming language and solved using IBM ILOG CPLEX optimizer. Furthermore, we also describe the competitive advantages offered by our quantitative approach and the initial allocation plan by the company.

<b>keywords:</b>	Production optimization Mathematical modeling AMPL
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## Taxonomy for effective decision making in medium size tourist resorts

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### Abstract

The business challenges in tourism industry are essential growing over the years. The dimensions of competitiveness are key factors toward resilience and sustainability, while the socially coherence, stability and security are top issues addressing the tourism business uncertainty. Because of the income generated by tourism many destinations try to stimulate business and attract market shares while the international business environment leads to development of high number of multinational firms and agents. The cornerstone towards effective and successful business development is to provide the facilities, the services and the prices that meet the needs of demand. Therefore, for the tourist services providers, the development of flexible organizational scheme, the implementation of DSS supporting substantial decisions making and the efficiency and performance monitoring are the driving forces on tourism industry planning and management. This paper deals with effective decision making and management in tourist resorts-hotels, focused on medium size resort-hotels that are the majority in Mediterranean region. By adopting the System of System concept in hotel operation and management, a multi-agent decision framework is presented, highlighting the key decision objectives, variables and stakeholders. Applying a functional analysis, the taxonomy for an effective capability driven DSS system relevant for medium-size resorts is discussed and the key data driven functions are presented. The research results of a gap-analysis for the hotel-resorts in Alexandroupolis region in Northern Greece are discussed, providing key messages to planners, decision makers and managers towards tourism sector resilience and productivity

<b>keywords:</b>	agent-based decision framework resort-hotel business strategy tourism industry business analytics
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## Monitoring Students' Evaluation of University Courses and Faculty Members using SPC Viewpoint

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### Abstract

Statistical Quality Control (SQC) and, more specifically, Control Charts (CCs) have been widely used as industrial tools for solving various quality problems. Their use has been expanded into the service sector since the late 1980s. Higher education (HE) belongs to the service sector as it presents some of its typical characteristics. Similarly to other services, quality control and improvement of HE processes is absolutely necessary. Particularly the teaching process may be evaluated by several bodies such as the administration of Universities, the academic personnel, the professors themselves and, certainly, students. The latter represent the most prevalent source of evaluation in practice. A common means that is used for this purpose is a survey questionnaire that students fill out at the end of each semester. Analysis of information and data collected through this process can be significantly facilitated and upgraded through the use of CCs. To choose the proper CC for monitoring students' evaluation we take into consideration that a traditional indicator of a CC performance is the Average Run Length (ARL). Due to i) the small number of semesters for which real data is available in practice and ii) the small sample size of student classes that evaluate courses per semester (in most cases  $n < 30$ ), we choose the Monte Carlo simulation method for "creating" data to be used for the evaluation of different types of CCs. We present the first results of our numerical investigation.

keywords:	Quality management SQC Control chart ARL Simulation Monte Carlo
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## Simulation study of an adaptive decentralized approach for the optimization of traffic control systems

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### Abstract

Successful traffic control system design requires availability of large volumes of data and the personal involvement of experienced engineers. In addition, even if they are well-designed at first place, they still require fine-tuning, as well as periodic re-calibration and maintenance due to the changing behavior of the traffic flow. To overcome these problems, centralized and decentralized adaptive optimization techniques have been developed, which, however, cannot always guarantee efficiency due to the involved highly stochastic dynamics, scaling and/or model unavailability problems, and data inner-transmission limitations. To confront such problems, L4GCAO (Local for Global Cognitive Adaptive Optimization), a novel model-free approach, has been developed. L4GCAO aims at maximizing global system performance by calibrating the parameters of a given control strategy through decentralized self-learning elements that periodically share a single piece of information, which is the overall system performance. To investigate the performance and efficiency of L4GCAO under realistic traffic conditions and to compare it against CAO (Cognitive Adaptive Optimization), its centralized counterpart developed and successfully applied in the past, extensive simulation-based experiments have been conducted considering the urban network of the city center of Chania, Greece. The simulation results indicate that L4GCAO performs similarly to CAO. As the tuning algorithm utilizes both demands and information of the overall system state, the centralized approach of CAO leads to the same performance results a few iterations earlier compared to L4GCAO, where only local information is available, along with the overall network performance. On the other hand, the main drawback of the centralized approach is the necessity of a, centrally available, large data set including information concerning the overall-network state, fact that may limit its applicability and operational efficiency to small and medium scale control problems. As the investigations presented herein indicate, this drawback may be overcome with the decentralized approach, without having to really sacrifice system performance.

#### keywords:

Decentralized optimization  
Centralized optimization  
Adaptive optimization  
Large-scale traffic control systems

## Demand Covering Problems with Facilities' Interaction

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### Abstract

The general problem of locating facilities that serve a given set of customers is essentially strategic in nature for almost every company or organization. The process of finding appropriate locations (sites) implies a long term investment, since it typically includes land property costs and high construction expenses, while it also functions as an indicator of the customers' preferences for the particular sites that are chosen. Thus, locating facilities could have a huge impact on the effectiveness, competitiveness and vitality of any firm or organization. Typically, covering models do not take into account the quality of the services provided as a feature of the facility or the interaction between facilities and demand. This paper examines several reformulations of the basic models that incorporate the quality of services provided by each facility and the ability to meet demand after multi-site co-operation. These formulations were tested on a series of instances from the OR Library (Beasley 1990). In particular, the computational times and the quality of the solutions were examined in a variety of problems with different number of customers and different topological features.

keywords:	Location Analysis Cooperative cover Covering Problems
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June 8-10, 2017 | Thessaloniki, Greece

## **session 10: Supply Chain Optimization**

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**session chair: Michael Madas**

## A fairness-informed modelling extension to the single-airport slot scheduling problem

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### Abstract

The high air transport growth witnessed over the past 30 years has not been matched by equivalent airport capacity expansion projects, hence leading to severe airport congestion problems and notable delays. A promising research direction that has gained the increasing attention of the academia, industry and policy makers lies on the deployment of schedule optimization methods and models for allocating scarce airport resources, expressed in slots, among competing airlines. Existing research has pursued modelling formulations of the current IATA-based slot allocation mechanism by mainly opting for the minimization of various expressions of schedule efficiency and/or acceptability. Both schedule efficiency and acceptability are essentially expressed in the form of some schedule displacement metric (i.e., difference between requested and allocated slot times) and optimized with respect to multiple objectives such as the total or maximum schedule displacement and the number of slots displaced above certain thresholds. Lately, some researchers introduced fairness considerations by postulating that the schedule displacement “assigned” to each airline should be proportional to the number of slots requested by that specific airline.

In our paper, we propose a fairness-informed modelling extension to existing single-airport slot scheduling models. In particular, we introduce and model the notion of “marginal schedule displacement”, which can be defined as the incremental schedule displacement caused by each slot request. The computation of the marginal schedule displacement of each slot request is performed in two stages. In the first stage, we solve the single-objective scheduling model minimizing the total schedule displacement without the given slot request. At the second stage, we solve the model once more to obtain the respective total schedule displacement value after including the given slot request. The difference of the values derived from the objective function among the two subsequent computation stages signifies the marginal schedule displacement as a result of accommodating the particular slot request. The intuition is that, in the presence of congestion, each slot request causes an additional schedule displacement that eventually “penalizes” subsequent slot requests. The proposed model aims to ensure that each airline absorbs its “fair share” of the total marginal schedule displacement exerted onto the system (i.e., proportion of airline-specific marginal schedule displacement over total marginal schedule displacement). In doing so, we enrich previous, single-objective modelling formulations aiming to minimize total schedule displacement with a fairness constraint ensuring a fair allotment of marginal schedule displacement to each airline, depending on the actual marginal displacement imposed to other users. The proposed model will be demonstrated with the use of real-world scheduling data at a small, regional airport in Greece.

**Author keywords:** slot allocation, airport scheduling, marginal displacement, fairness

## A Multi-stage Approach for Sustainable Supplier Selection and Order Allocation

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### Abstract

In recent years, the sustainability awareness has become an important issue in supply chain management and companies prefer to work with partners focusing on this subject. The first step in supply chain management is supplier selection. This study presents a multi-stage approach for sustainable supplier selection and order allocation problem. The approach consists of two stages. The first stage focuses on determining the weights of criteria used in sustainable supplier selection and ranking the potential suppliers whereas the second stage is related to finding the optimal order sizes that should be allocated to suppliers. A novel hybrid approach consisting of Fuzzy Decision Making Trial and Evaluation Laboratory (DEMATEL) and Taguchi Loss Functions have been used in order to rank suppliers. In the second stage, information from the first stage is used as inputs to determine the optimal order quantities that should be allocated to each supplier using bi-objective optimization. The illustration of the proposed framework is shown on a real case study which helps decision makers to select the sustainable suppliers and determine order sizes.

keywords:	Sustainable supplier selection fuzzy DEMATEL Taguchi loss function order allocation multi criteria decision making bi-objective optimization
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## The logistics role in community resilience: a case example of a community based social partnership in Greece

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### Abstract

The various organisations included in social partnerships jointly address gaps in their society and community. Some social partnerships are planned from the top, other, grass-root partnerships are deeply rooted in their communities. Such grass-root, community based partnerships are based on the principles of self-organisation, yet logistically, this can bring many challenges. This study therefore focuses on the logistical aspects of a community based social partnership in Greece, and the contribution of this partnership to community resilience. In such a context, logistical activities are performed by the membership base of various non-governmental organisations in a manner of “collective action” rather than the commercial sector. Interestingly, community resilience refers to a capacity for collective action, hence organising logistical activities in this fashion ultimately contributes to community resilience.

This study focuses on self-organisation, and a resultant community based social partnership (CBSP) in Greece, with members from the private, public and civic sectors, in the midst of a financial crisis. In the context of logistics, a conceptual model has been developed linking the partnership with self-organisation, social capital building, and community resilience. The partnership has been analysed both in terms of its process related dynamic properties and measured outcomes. Research method was based on both formal and informal interviews, written communication with various members of the partnership and secondary data analysis. Topics included operational organisation and process description of the actions, information regarding the logistics of the various actions, such as transportation, warehousing and distribution of in kind donations; accountability; relationships between partners; links to social capital attributes. Community impact to social assets, health and well-being has been shown. Measured outcomes include numbers of collected and disseminated food and medicine and provision of health services.

#### keywords:

Community based social partnership, logistics, community resilience, financial crisis, disaster management

## **A Decision-Making Framework for Sustainable Supply Chain Management of Perishable Goods**

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### **Abstract**

Sustainability in supply chain management (SCM) refers to a holistic process that involves multiple synergies and interactions between various supply chain (SC) stakeholders, while suggesting a set of principles that can be employed for economic, environmental, and social optimum decision-making approaches. For perishable products, the impact of SCM on their quality is critical, since ineffective SCM practices may lead to increased storage and transportation times which may in turn affect their quality as well as quantity due to inappropriate maintenance practices that rise the amount of product waste due to their perishable characteristics. Specifically, for food products, issues of "food safety and security" emerge, that can even affect human health. Under this context, the purpose of the paper is to provide a decision-making framework that assigns aspects of business ethics to the sustainable management of the supply chain of perishable products, and involve the provision of fresh, price and environmentally friendly products to the consumers. In order to address this issue, we will develop and employ multi-criteria (cost, time and emissions minimization) mixed integer linear programming (MILP) model, and further apply it in a realistic case study for deriving managerial insights.

#### **keywords:**

Decision-making  
Supply chain  
Sustainable management  
Perishable goods

## The Impact of Additive Manufacturing on Pharmaceutical Supply Chain Network Configuration

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### Abstract

Additive Manufacturing (AM) has raised the increasing interest of researchers, market professionals and media during the last few years. AM comprises a technological platform that enables the “on-demand” fabrication of customized products, using a variety of metallic, polymer or ceramic materials, with significant implications on supply chain configuration (e.g., shorter, more collaborative and decentralized) and performance (e.g., reduced lead times and inventory, increased customization, form postponement, service level improvements). Several industrial applications of AM have been already brought forward in the aerospace, automotive, spare parts and healthcare sectors. AM applications in healthcare pertain mainly to the production of medical tools and hearing aids, and more recently to the pharmaceutical supply chain (i.e., drug production). Pharmaceutical supply chain (PSC) stakeholders are facing serious challenges, such as high product availability, exceptionally high service level standards, and capital-intensive drug manufacturing under high demand uncertainty. AM constitutes a radically new drug production process that has been shown to deliver substantial benefits in the PSC by enabling on-demand and distributed production, reduced lead times, personalized dose drugs, as well as multi-API tablets and tailored release profiles. Despite the previous experience of simultaneous deployment of AM and traditional manufacturing (TM) in various sectors such as aerospace, automotive and spare parts production, there has been limited research on the potential adoption of AM in the pharmaceutical supply chain. The objective of this paper is to assess the impact of AM adoption on the configuration of the pharmaceutical supply chain (PSC). For this purpose, we propose a MILP model formulation which aims to minimize the total cost consisted of the following cost elements: i) AM facility investment cost, ii) production cost for primary manufacturing of the Active Pharmaceutical Ingredient (API), iii) secondary manufacturing for drug production and packaging and iv) transportation cost of primary and secondary manufacturing products. The minimization of the total cost function is subject to network connectivity, production capacity, demand fulfillment, flow conservation and non-negativity constraints. The proposed model is applied at a small problem case involving a 4-echelon PSC network for theophylline API tablets. In particular, there are 5 primary and 4 secondary manufacturing sites of theophylline API and tablets, 3 distribution centers that can also host AM facilities, and 3 customer zones placed in England. Data about manufacturing locations come from literature, while demand data related to the number of tablets consumed and the API content have been collected from the NHS Business Services Authority. Results from the model demonstration at the specific problem suggest that when AM production cost is less than 7 times the corresponding TM production cost, a simultaneous production of AM and TM is feasible. On the other hand, the AM is the only feasible production method when AM production cost falls below TM production cost.

#### keywords:

Additive Manufacturing, Pharmaceutical Supply Chain Facility Location, Network Configuration



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## **session 11: Digital Economy**

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### **session chair: Emmanouil Stiakakis**

## Adoption of Digital Currencies: The Companies' Perspective

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### Abstract

In recent years, technological innovations, economic changes and a host of monetary and political issues conduce to the gradual spread of the adoption and the use of digital currencies. The interest for digital currency as a new means of transaction has increased, as traditional currencies have become fiat and due to the increasingly lack of the public confidence in the credibility of financial institutions, leading to new ways of transactions, without third party mediation. Bitcoin is the first decentralized cryptocurrency system that appeared in 2009 and since then many other cryptocurrencies have been created (altcoins) based mainly on Bitcoin's technological infrastructure. This paper aims to present the results of the first online academic survey about the actual use of digital currency by companies and freelancers globally, with an emphasis in the European Union, where Greece belongs. Considering digital currency as a pioneering technological innovation, a combination of Diffusion of Innovations (DOI) Theory (mainly Innovation Decision Process Model - IDPM) and Technology Acceptance Model (TAM) has been applied. The goal of the survey was to investigate the actual use of digital currency, as a means of transaction by companies and how it is affected by the constructs of Perceived Ease of Use, Perceived Usefulness, and Perceived Security directly and other constructs indirectly, according to the research model. Based on the responses provided by 254 companies and freelancers the results exhibit that the penetration of digital currencies usage is in increasing progress. Will the companies include digital currencies as a new mode of payment in their Marketing Strategies? This survey's results are useful for entrepreneurs, stakeholders of digital currencies in every business sector, banks, financial institutions, users of digital currencies, digital currencies experts, scientists and policy makers.

<b>keywords:</b>	digital currency bitcoin DOI TAM technological innovation
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## Assessing Digital transformation obstacles in multinational firms

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### Abstract

Although organizations are constantly trying to improve their operations by importing new technologically advanced digital tools, the actual usage is often very limited compared to the planning phase, resulting the system to be used only by a small percentage of the employees who display a significant resistance to change. This is even more difficult to be achieved in multinational companies where a system has to be compatible with a large number of users based on different geographic regions and having significantly different patterns of behavior. In order to better identify the problem we conducted a large scale research in the purchasing department of a multinational car-industry company represented across the globe, with over 100 production sites in 30 countries.

By selecting the latest e-procurement tool introduced by the company which provides many automation functions such as online receipt of invoices, order confirmation, order check, order status check, multi scale reporting and other features we developed a questionnaire based research tool based on TAM and distributed it to over 1000 employees of the company's procurement center worldwide. The response was 230 fully completed questionnaires which allowed us to investigate the acceptance / adoption of the specific tool by the company's executives in order to predict the intentions of existing and potential users and the expected benefits of e-procurement in line with the intentions of existing and potential users.

Results revealed that over 48% of respondents intend to use the tool to a small degree, 29% to a medium degree, and only 23% to a significant degree. The results also showed that respondents who do not intend to use the tool attribute their attitude to the lack of relevant training, the difficulty to use it, and the fact that the company does not promote the tool usage as obligatory. This reveals the importance of relevant training activities, the need for an easy to use system and the call for for the top management to develop an implementation strategy for integrating the tool into business processes in a mandatory and efficient way.

**keywords:**

digital transformation  
e-procurement  
technology acceptance  
multinational companies

## Utilization of Internet of Things to improve Digitization of Academic Institutions

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### Abstract

Internet of Things (IoT) is fast becoming a trend in a plethora of industries, and the technologies for transformative business applications are constantly growing. Yet many organizations have been slow to recognize and act on these new opportunities. Predictions for the growth of the IoT vary considerably but in general the usage trend in expanding from Smart Cities, Smart Environment and waste management, smart Retailing and Logistics, Smart Industry and Agriculture and many more. However limited attention has been given to how IoT can improve the operations of Educational Institutes. In this research we developed a framework to measure the potential usage of IoT to a University by focusing on the following functions:

- Authorized entrance without using keys
- Students and Absenteeism Management
- Reduction of energy consumption and maintenance costs
- Improve staff and students safety
- Easily trace academic equipment.

Our research initiated by recording specific needs that are present to an academic institution and can be improved with the application of IoT. The next step was to identify systems that support IoT technology that can cover these needs. To investigate the attitude towards the implementation of these systems we developed, pre-tested in a limited sample and rolled out a questionnaire to students of Academic institutes in Greece, resulting in a sample of 190 completed questionnaires. The results indicate that there is a positive view towards the adoption of the aforementioned systems and especially the usage of IoT (RFID and smart cards) to verify staff members and manage entrance and exit without keys would improve the overall teaching experience by minimizing idle time.

Regarding the students part, the usage of IoT (Smart cards) to attend workshops and labs is expected to improve the quality of the lectures by minimizing the disturbance for both instructors and students through the attendance process. Also devices that track attendance will allow instructors to get a significant feedback on the issues that attract more audience and help them improve their academic performance. The usage of IoT regarding academic equipment will lead to increased security and easier inventory management resulting in reduction of related costs. Additionally the usage of temperature control systems, air-conditioning, ventilation and smart lighting controls can lead to significant energy savings. The usage of building structure health monitoring and intelligent evacuation systems will lead to increased safety for staff and students in case of an emergency situation, however the respondents were not as optimistic as with the immediate implementation in classroom related activities. Although this research has some limitations such as the limited sample and the absence of a cost-benefit analysis research, it can lead to a stream of research that can reveal a significant potential for applications IoT in Academic Institutions.

**keywords:** Internet of Things, Academic Institutions, Digital Transformation

## Cloud Computing Adoption and E-government

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### Abstract

Cloud computing is one of the latest ICT innovations, offering many advantages and leading to the digital transformation of private and public organizations. Despite the advantages, initiatives for cloud computing adoption in public administration are in early stage and relatively slow, comparing to initiatives for adoption in private organizations, due to various influencing factors. At the same time, academics and practitioners indicate that cloud computing not only has the potential to offer significant advantages in the public sector, but is expected to be a fundamental part of e-government strategy in the upcoming years.

The aim of this paper is to investigate the relationship between cloud computing and e-government, to highlight the importance of cloud computing adoption in public administration and to offer insights on the way that cloud computing can contribute to the successful deployment of e-government services. Through the study of relevant theoretical models and frameworks, enabling and inhibiting factors for cloud computing adoption in the public sector are identified, classified and analyzed. Furthermore, initiatives that have taken place so far in Greece in the area of cloud computing and e-government are presented. The paper contributes to the knowledge domain of cloud computing adoption and e-government and indicates fields that can be further researched in this area.

#### keywords:

cloud computing  
cloud computing adoption  
e-government  
public sector  
public administration



## Assessment of the Internet market in Greece; The case of Mushrooms and Truffles

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### Abstract

This paper studies the Internet market of mushrooms and truffles in Greece. Mushrooms and truffles are found in normal diets since antiquity and also as a delicacy, because of their texture and highly desirable taste and aroma. The cultivation of mushrooms in Greece started in the mid-sixties. During the last ten years, the need of the production of cheap nutritious food, led to the fast development of the mushroom and truffle cultivation sector. The Internet provides a stable communication infrastructure to citizens and businesses and has augmented business opportunities. The research focus on registration and assessment of SMEs located in Greece and operating in field of mushrooms and truffles, with emphasis on the classification of their business websites in groups according to their marketing and digital characteristics and functions. Through Electronic Data Interchange organization is digitally and methods are automated. E-services concerning business and commerce and lately mobile services, applications and tools have achieved very fast acceptance and high visibility, combined with many modern digital techniques and devices. An increasing number of agribusinesses are looking to the Internet as a marketing, management, service, and coordination tool gaining momentum in the everyday marketing trying to have win-win deals. With the alternative marketing channel of the Internet, we already find agribusiness trying to promote mushrooms and truffles through the Web.

keywords:	Internet, e-commerce, market, SME cluster analysis, mushrooms, truffles
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## **session 12: Business Analytics**

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### **session chair: Thomas Bournaris**

**Adonis Kontos**  
**Marathon Data Systems**





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**OR in the digital era - ICT challenges**

June 8-10, 2017 | Thessaloniki, Greece

**session 13: Forecasting & Maintenance Optimization**

**session chair: Alexander Chatzigeorgiou**

## Container flow forecasting through neural networks based on metaheuristics

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### Abstract

In order to increase commitment to intermodality through railway there is a need for more efficient planning of operations in ports as main connection points between maritime and railway transportation systems. Reliable forecasts of container flows may substantially contribute to this objective through improved reliability, lead time, costs and flexibility of rail intermodal services. In this paper we developed a neural network prediction approach based on metaheuristics for generating reliable forecasts of container flows. The approach uses fuzzy if-then rules for selecting between two different heuristics for developing neural network architecture, simulated annealing and genetic algorithm. These non parametric models are compared with traditional parametric ARIMA technique. Time series composed from monthly container traffic observations for Port of Barcelona are used for model developing and testing. Models are compared based on most important criteria for performance evaluation and for each of the data sets (total container traffic, loaded, unloaded, transit and empty) the appropriate model is selected.

keywords:	intermodal forecasting metaheuristics arima
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## Neural network based methodology for predicting energy consumption in public and environmental management

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### Abstract

Artificial Intelligence has been applied in various scientific sectors the recent years, with the development of new technologies and methodologies for constructing artificial neural network models. In this research, the application of Artificial Intelligence is studied for developing neural network forecasting models in order to predict the final energy consumption which covers the energy consumption in industry, transport, households, public administration, commerce and other sectors. The energy consumption forecasting can be very valuable in adopting management practices regarding the energy management and also in designing and planning national energy strategies. Several topologies were examined in order to develop the optimal artificial neural network forecasting model. The results showed that the proposed methodology can provide energy consumption predictions with a very good accuracy which can be very valuable in public and environmental management since they can be used in order to help the authorities at adopting proactive measures in energy planning and management.

keywords:	Artificial Intelligence Energy Management Environmental Management Neural Networks Public Management
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## Feedforward Neural Network Model in Unemployment Rates Forecasting in Public Administration

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### Abstract

The application of Artificial Neural Networks in many scientific fields has been increased the last years with the development of new neural network technologies and techniques. In this study, Artificial Neural Networks are applied for building forecasting models in order to predict unemployment rates. A Feedforward Neural Network structure was used since it is considered as the most suitable in times series predictions. In order to develop the best artificial neural network forecasting model, several network topologies were examined regarding the number of the neurons and also the transfer functions in the hidden layers. Several economic factors were taken into consideration in order to construct the neural network based prediction models. The results have shown a very precise forecasting accuracy regarding the unemployment rates. The proposed technique can be very helpful in public administration at adopting proactive measures for preventing further increase of unemployment.

keywords:	Artificial Intelligence Economic Development Neural Networks Public Administration Unemployment
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## Optimization the availability of a system subject maintenance under conditions

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### Abstract

My diploma thesis was in the field of Reliability engineering and system safety with the subject of 'Optimization the availability of a system subject maintenance under conditions' which was based on a published paper of Chen D-Y, Trivedi KS with title "Closed-form analytical results for condition-based maintenance Reliability Engineering and System Safety, Elsevier. My diploma thesis addresses the problem of optimizing the availability and operational cost of a stochastic production system that undergoes random failures, periodic inspections, and maintenance and repair activities. Two distinct models are examined. The difference between the two models is that in the second model the machine also experiences hard failures, where the machine abruptly ceases to operate regardless of the current deterioration state. The two systems are modelled as continuous time Markov chains. For the purpose of this thesis functions that compute the steady-state probabilities, availability and cost of the two systems were implemented in the programming language of the (MatlabR2015a) environment. Moreover, scripts were implemented in the same programming language that call the aforementioned functions and 1) compute the availability and mean time to fail (MTTF) for different values of the mean time between inspections (MTBI), and 2) compute the optimal MTBIs in respect to the availability and operational cost for different values of the failure rate. The behaviour of the system was examined by conducting a series of experiments for alternative values of the input variables which the user can modify any time.

keywords:	Artificial Intelligence Economic Development Neural Networks Public Administration Unemployment
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## **A method for providing joint predictive maintenance and inventory recommendations**

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### **Abstract**

Equipment failures in manufacturing processes concern industries because they can lead to severe issues regarding human safety, environmental impact, reliability and production costs. The stochastic nature of equipment degradation and the uncertainty about future breakdowns affect significantly the decision making process of experts in the context of predictive maintenance strategy. The decision about proactive maintenance actions requires a balance between the cost due to premature action and the cost of unexpected breakdown, while the ordering time of spare parts and their stocking quantities need to be planned so that holding costs are minimized by avoiding, at the same time, stock-outs. These proactive recommendations should be based on real-time prognostic information in an event processing, streaming computational environment, able to process big data in an efficient and scalable way. We propose a real-time, event-driven decision model that is triggered by prediction events and provides proactive recommendations about the optimal action and the optimal time of its implementation regarding maintenance and inventory-related aspects. The proposed method aims to contribute to the Decide phase of the “Detect- Predict- Decide- Act” proactive principle. It takes as input a prediction event from the Predict phase including the probability distribution function of the failure occurrence along with its associated parameters. The proposed decision method takes advantage of the basic model for proactive event-driven computing, which is based on Markov Decision Process (MDP), and extends it in order to address the joint optimization of predictive maintenance and inventory problem. Unlike previous approaches, the proposed method is able to process sensor-generated real-time big data, while it incorporates multiple alternative maintenance actions and associated spare parts orders.

#### **keywords:**

Predictive maintenance  
Logistics  
Proactive event processing  
Markov Decision Process





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## **session 14: Agricultural Management**

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### **session chair: Jason Papathanasiou**

## **Evaluation of agricultural productivity by using multicriteria analysis: A case study in Central Macedonia in Greece**

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### **Abstract**

The agricultural sector in Greece provides a pivotal and opportunistic key success factor in fostering the country's entrepreneurial activity that hopefully will ultimately lead to the much desired sustainable growth and economic development. Thus, it is imperative for all decision-makers and stakeholders to know the efficient ranking and optimization of their operations management in rural areas. In doing so we used the methodology of PROMETHEE II multicriteria decision-making approach for the comparison of agricultural productivity and ranking the seven prefectures of Central Macedonia in Greece, based on productivity indicators of agricultural resources, like the gross return produced in each region. Data was collected for the period of 2013 to 2014. The results revealed that the prefecture of Pella surpasses on productivity the remaining six, while in the second and third place the prefectures of Imathia and Pieria follow. Finally, the validity of the specific ranking results is discussed and recommendations are given to the improvement of region' performance and productivity.

**keywords:**

Mutlicriteria analysis  
PROMETHEE  
productivity of agricultural resources

## Software design and development for spatial tillage allocation using the Revised Simos methodology combined with the Multicriteria Analysis Methods AHP and VIKOR

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### Abstract

The applied socioeconomic policies of the last three decades led to the establishment of a globalized market and business process system. Considering the new financial context, the organizational schema of agricultural enterprises is largely enforced to abandon the traditional development techniques by adopting modern strategies oriented to the integration of Information and Communication Technologies (ICTs), the connection of agricultural production to the global market demands and the utilization of administrative tools that improve the business process performance. This paper presents the development of a decision support system (DSS) for the supports of decision making for spatial tillage allocation, during the design procedure of national and/or local agricultural policies. The suggested DSS integrates the weights estimation methodology Revised Simos with the VIKOR and AHP multicriteria analysis methods and can be used to solve complex decision problems that have more than one alternative solutions, which can be evaluated using conflicting qualitative and quantitative criteria. Motivation for the development of this software is the creation of a tool as a valuable assistance for the optimization of productivity, concurrently with the minimization of the limited resources consumption. The system includes a database, developed with the DBMS MySQL, where the necessary crop related data is stored. The rationale is structured upon three collaborative but functionally independent modules, one for each implemented method. Using the AHP and the Revised Simos modules stakeholders can calculate the relevant weights for the evaluation criteria needed for VIKOR's application on data. The result of VIKOR is a ranking of the alternative solutions and the suggestions of the best compromise solution. The DSS was applied experimentally on a set of 128 crops chosen from the official publication "Indicators 2007" of the department of Development, Innovation & Rural Economy of the Administrative Authority of Central Macedonia.

#### keywords:

Tillage allocation  
Multicriteria analysis  
VIKOR  
AHP  
Revised Simos

## Technical efficiency of organic Emmer wheat in Greece

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### Abstract

This paper estimates the efficiency and performance of triticum dicoccum “ZEA” wheat farms. Triticum dicuccum is an emerging crop due to its claimed health benefits in the absorption of gluten from the human body and its high content in nutrients such as zinc.

Data were obtained from questionnaires collected from twenty farms in the prefecture of Ellassona in Central Greece that had established production of this new wheat varietal. Results obtained using the Data Envelopment analysis methodology show that triticum dicoccum can be an important business opportunity even though triticum dicoccum has lower yields compared to most widely cultivated wheat varietals.

keywords:	Triticum dicoccum technical efficiency Data Envelopment Analysis sustainable agricultural development
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## Meta-learning in Precision Agriculture: Disease detection of plants with biomimetic novelty detectors

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### Abstract

Pathogenic fungi have served as biological control agents against weeds. *Microbotryum sillybum* is a smut fungus which naturally infects *S. marianum* in Greece. The fungus infects the plant systemically resulting in seed replacement with teliospores. The fungus is considered as an important biocontrol agent for thistles in problematic areas. To assess the effectiveness of biological control, the detection of infection is fundamental. Early stage plant disease detection is possible by comparing spectral signatures from diseased plants. The successful combination of several machine learning techniques with relevant sensors has enabled the efficient diseased plant identification. *Silybum marianum* plants have been inoculated with *Microbotryum sillybum* and symptoms have been assessed by a handheld spectroradiometer. The spectra have been preprocessed by second derivative and the first 10 principal components were extracted. Auto-encoders are types of neural networks that learn a data representation. They are trained so that they can reproduce input patterns in a mirroring sense in their output layer. In the auto-encoder architecture only one hidden layer is utilized with a number of hidden units which correspond to input features. The One Class Self-Organising Map (OCSOM) creates a model from healthy data and successively classifies new data conferring to its deviation from the healthy baseline condition. During novelty recognition, novel instances from feature combinations (in the current case spectral features) are used to form the input to the network while the SOM algorithm chooses the best matching unit. As regards the OC-SOM classifier, the producer's and user's accuracies of the 10 principal components of the spectra achieved a score of 65.6% to 93.3% and 71.7% to 91.3 % respectively. As regards the Autoencoder classifier, demonstrated a producer's and user's accuracy of 76.4% to 85.7% and 75% to 86.6 % respectively.

**keywords:** data mining, precision agriculture, crop monitoring, learning algorithms

## Big Data Platforms To Support Operational Intelligence - The Precision Agriculture Paradigm

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### Abstract

Over the last decade, data has increased in a large scale and in various fields. It is now easier to collect it than even before due to several devices and systems that communicate via the Internet. We move forward to the Internet of Everything (IoE), a term that refers to the intelligent connection of people, processes, data and things and builds on top of the Internet of Things (IoT). It enhances the power of the Internet to improve business outcomes and make people's lives better by adding to the progress of IoT. A new world of insight awaits organizations. Speedy decisions based on fresh data can help them gain competitive advantages. Operational Intelligence (OI) is a term that refers to real-time business analytics that provide visibility into business processes and events while they occur. It can complement traditional Business Intelligence (BI) that provides analytics from historical and structured data. OI and BI support different time frames and different types of data, but they complement each other. BI professionals can seek analytic support for big data and extend their software solutions to include technology for OI.

Real time analytics on big data demand scalability, low latency, high throughput and fault tolerant mechanisms. The emergence of frameworks for storing, processing and carrying out big data analytics in the cloud was inevitable. In this paper, we initially present such frameworks along with their strengths and limitations. Real time data analytics generated by these frameworks have various important applications. This paper examines the precision agriculture paradigm, which is based on collecting real-time data via several devices (e.g. sensors) about weather, soil quality, crops, equipment and even labor costs to help the producers make smarter decisions.

keywords:	Big Data Precision Agriculture Data Analytics Real Time
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## A Nexus approach for Agricultural Sustainable Management

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### Abstract

The growing demand and scarcity of the natural resources, as well as the climate change effects may have major implications on national and world security in terms of the water scarcity, drought, energy crisis, famine and land degradation. To address the problem, an intergraded approach (NEXUS) that encompasses the inter-connectedness of the main sectors of water, energy, food and land use is needed, to ensure thereby sustainable development by enhancing resource use efficiency, encouraging greater policy coherence and promoting investment options that co-balance benefits across these sectors.

The achievement of sustainable development calls for significant changes in current patterns of development, production and consumption and advocates, inter alia, the reduction of wasteful consumption of natural resources and the prevention of pollution, as well as socio-economically effective and efficient policies and strategies.

This paper discusses the management options that may have a Nexus approach on the management of water, soil and waste, in order to enhance the sustainable intensification of agriculture, and contribute to the socio-economic development. It also examines various economic assessment methods which are used in the management process and decision making in the framework of sustainable development. Finally, the most appropriate operational research models and applications are proposed that promote the decision making in Nexus systems.

keywords:	Water-energy-food nexus Resources management Sustainable development Operational research methods and applications in agricultural management
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## **session 15: OR & ICT**

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### **session chair: Kostas Psannis**



## Development of a framework for the assessment of technical and non-technical skills in the ICT sector

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### Abstract

In modern times and during the recent global economic crisis, a paradox has emerged: the workforce becomes more and more skilled and trained, while unemployment rates remain very high. The new generation shows a clear tendency towards education by obtaining various diplomas and certifications. This situation has created a highly educated generation and therefore the selection of the appropriate employee is becoming as difficult as ever. Moreover, it becomes more and more difficult for a candidate to stand out among so many other equally qualified individuals. The elements, which can really make a difference, are the skills a candidate possesses. Skills are divided into two broad categories: technical skills and non-technical or soft skills. Technical skills include all the aspects of formal learning, which results in obtaining degrees and certifications. Nevertheless, the skills that can make a candidate really stand out are non-technical or soft skills. These skills include many personal characteristics of the individual, which form a unique combination of assets. Soft skills are not developed exclusively within the context of formal education, but are mainly part of a wider process of lifelong learning. The aim of the present paper is the development of a framework for the assessment of both technical and non-technical skills in the Information Technology and Communications sector. In this context, content analysis of online job ads was conducted, in order to determine the significance of each skill generally in the ICT sector, as well as in each of the 23 professions included in this sector. The results demonstrate that every ICT-related profession requires a different ideal combination of skills. The implications of the present research will lead to a new, automated, and reliable personnel selection process, which assesses both technical and non-technical skills for a specific profession or job offering.

**keywords:**

soft skills  
non-technical skills  
technical skills  
ICT

## Exploring the Development of ICT Solutions for Energy Efficiency & End-Users' Engagement

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### Abstract

Smart Energy Cities and their development hold a key position in the European Union's agenda, with the main objectives of reducing energy consumption, energy cost and environmental footprint in European cities. With the modern revolution of smart devices and the Internet of Things (IoT), a large amount of multiple-sourced and heterogeneous information are made available for analysis and processing. Specifically in the field of energy efficiency and energy management, the roll-out of smart sensors and smart energy meters has created significant opportunities for creating and utilizing innovative technological-based solutions and intelligent systems, on the city level. Under this perspective, the scope of this paper is to present a novel approach for exploiting multidisciplinary data within a smart city context, towards energy efficiency and end-users' engagement, utilizing ICT-based solutions targeted to empower local authorities and end-users. The process of the initiate acquisition and semantic enrichment of the heterogeneous data coming from various sources of a smart city is explored, followed by data analytics techniques and inference rules aiming to produce short-term action recommendations and meaningful insights. Finally, an experimental introduction of energy currency as part of energy management is presented, along with a proposed evaluation of the potential benefits and engagement of the energy end-users.

**keywords:** Smart Cities, ICT tools, Energy Efficiency, End-User Engagement, Energy Currency

## Internet users' perceptions towards price comparison sites in greece

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### Abstract

The global economic crisis, which began in the middle of 2007 and the early 2008 created the need for cheaper products to consumers. This need, in combination with the Internet evolution and the e-commerce growth, brought Greek consumers closer to the use of new technologies to purchase products and use services. Because of the economic crisis, consumption has shifted to online shopping, where products are usually sold at lower prices than at the physical stores. Also, economic crisis raised the awareness of consumers by conducting price research before purchasing. Price comparison among websites, also known as online shopping comparison sites, filled consumers' need for lower prices while shopbots, and Internet shopping agents, have become one of the most successful applications of the Internet in the online shopping environment. Price comparison website is nowadays a significant source for online shoppers by providing access to information regarding the price and details of the product, reducing buyers' search costs and supporting their decision-making by providing price comparison possibilities, which is seldom present in the physical retail shopping context. The present research aims to investigate the factors, which may affect Internet users' intention to use a price comparison website. To achieve the goal of the study, factors regarding the features of price comparison websites and e-commerce websites were used. Data collection was performed by using convenience sampling technique in conjunction with snowball sampling technique, via an electronic questionnaire, which was distributed online, through email and the social network Facebook. Data from 200 students, who had all used at least once a price comparison website, were collected. Results showed that the perceived website image, as well as the users' overall satisfaction with the website, have a positive impact on their intention to use a price comparison website. The findings of the research can contribute both to the literature and can provide valuable insight to price comparison websites and can improve services, increasing both their popularity and their revenues.

#### keywords:

Price comparison websites  
Price comparison  
Price comparison website characteristics  
Intention to use

## Accounting information systems in higher education: Assessment of graduate students' level of knowledge regarding IT technology and its applications.

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### Abstract

The current reality of the business world, commands that economists and especially accountants include in their daily routine contemporary and advanced information systems with which it is considered necessary that economists and accountants be familiar and well trained. In a recent large accounting education study, technology has been defined as one of the decisive factors of change affecting the modern enterprise dramatically and rendering the traditional accounting model anachronistic and obsolete. (Albrecht and Sack, 2000, pp.5 and 13). The lack of education of business schools comprises an obstacle to the normalization of new circumstances as there is no defined standard of necessary knowledge and the appropriate lessons learning technologies, are not included in the curriculum. However, this seems to be a problem plaguing the global educational community. Awayiga, Onumah, & Tsamenyi, 2010, underline that over the last decades, accounting education has come under criticism for failing to meet the increasing demands and constant changes in the business environment. McMahon, Gardner, Gray, & Mulhern, 1999, emphasize the need to embrace students' perspectives by planning to increase their use of computers and ensuring that all graduates are able to discover new technologies when entering the business world.

Accountants are involved in a wide-range of roles in business and it is important for them to possess IT knowledge and skills relevant to their roles to provide competent and professional services. However, the scope of IT is broad and not all IT knowledge and skills relate to an accountant's role. This raises the questions: what kind of IT knowledge and skills do accountants need? What are the entry-level IT skills and knowledge that educators should provide? (Godfrey & Tam, 2012). Educators have to cope with these issues constantly. (Cytron & Tie, 2001) The purpose of this paper is to determine the level of IT knowledge of Financial Accounting students in Greece, identifying gaps and how these deficiencies affect the business career of graduates. The accomplishment of this purpose has been made through the method of a questionnaire which has been distributed to graduate students of educational institutions in order to evaluate their IT knowledges and skills. After processing and analyzing the data, we present the results and we are led to similar conclusions.

#### keywords:

Information technology knowledge  
accounting graduate students  
accounting information systems  
accounting information skills, accounting education

## Performance Evaluation of Routing Protocols for Big Data applications

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### Abstract

In the last years, the rapid growth in network communications necessitates the deep knowledge of the process called routing. To be more specific, routes of information (packets) are held on the device called router, which is responsible for the optimal transmission of pieces of data (packets) from the source to the destination by using the routing protocols and routing algorithms, which cooperate for the search and the selection of the best path. There are two different types of routing process: static routing, which is done manually by the administrator of the network and dynamic routing, which is done automatically through the usage of routing protocols. Static routing protocol is used when network architecture is simple while dynamic routing protocols are used when architecture complexity increased. There are various types of dynamic routing protocols being widely used. The three categories of dynamic routing protocols are the distance-vector protocols like RIP, which uses the Bellman-Ford algorithm, the link-state routing protocols like OSPF, which uses the Dijkstra algorithm, and a hybrid type of routing protocol, like EIGRP, which uses an algorithm called Dual. In this paper, we will not only illustrate a comparative analysis of the characteristics and the metrics of dynamic routing protocols, but we will also compare the performance of different Interior Gateway routing protocols, like EIGRP, OSPF and RIP, in real-time applications Big Data, Video conferencing and VoIP, based on end to end packet delay, network convergence duration, packet delay variation and Jitter of VoIP by using Riverbed Modeller simulator. Our aim is to show how dynamic routing protocols perform in real time applications while some failures are happening on different network links.

keywords:	EIGRP OSPF RIP QoS Big Data
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**session 16: Statistics & Data Mining**

**session chair: Odysseas Moschidis**

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## Subjective well-being in Europe: a multidimensional statistical analysis of ESS data

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### Abstract

Subjective well-being (SWB) refers to people's own evaluations of their lives, evaluations that are both affective and cognitive where the affective part is better known as happiness and the cognitive as life satisfaction. Many studies have been conducted to discover the determinants of well-being and most of them have outlined the importance of household's income to all the dimensions of well-being. Nevertheless, the relationship of income and SWB is not so simple and many other factors can intervene. In this study, the main source of the data analyzed is ESS, a large multi-country survey that contains many questions and aspects, which have as the main scope to evaluate social characteristics of European citizens and is also considered central to the measurement of well-being. With this analysis, we attempted to discover the most important factors that influence happiness(H) and life satisfaction(LS) and whether H and LS have the same impact on other variables. For the analysis of the data a method from the multidimensional field is applied, Correspondence analysis (CA). The final results emerged from this study, seem to prove that LS and H have the similar attitude with most variables of the study. Moreover, it was deduced that income is not the most important determinant of SWB, as many other variables had demonstrated almost the same attitude.

<b>keywords:</b>	European Social Survey Subjective-well Being Correspondence Analysis Life satisfaction Happiness
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## Predicting the quality score of a large dataset of wines using the statistical methods of SVM and NN

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### Abstract

The web market structure nowadays it is facing the issue of “big-data” and “large datasets”. The huge increasing evolution of electronic transactions is creating the corresponding increasing of e-commerce data through e-shop and clients. The business decisions depend more and more in analyzing and predicting the results, having in disposition many of such datasets and variables. The information and computing age of nowadays made available many tools to facilitate this procedure of analyzing and predicting results. Our main tool for analyzing and getting these results is the open source statistic language of R.

In our work having a large dataset of real physicochemical properties of wines of a known northern Greek wine company, we investigate and research some statistical results, trying to predict the quality score depending on these properties. Furthermore we apply various statistical models such as “Support Vector Machines” and “Neural Networks” making various predictions of quality score, using training and testing samples of the datasets and comparing these results. We elaborate some algorithms for our models that we are using, in order to obtain better results and improve the efficiency of the above models.

keywords:	prediction data analysis statistical methods support vector machines neural networks algorithms wines physicochemical properties
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## Redundant constraints identification in linear programming using statistics on constraints

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### Abstract

For very large LP problems, only a relatively small percentage of constraints are binding at the optimal solution. Many researchers have proposed algorithms for identifying the redundant constraints in LP models. Approaches like LP method, deterministic method and heuristic methods identify redundant constraints but need significant computational work and time. Some fast algorithms that were developed identify a small number of redundant constraints. In this work, the proposed method, based on some constraint statistical analysis, like the mean solution of each constraint, seems to identify a significant number of redundant constraints, in comparison with other methods in non-negative LP problems.

In details, when a constraint is binding, the mean solution of the constraint is a feasible solution of the linear problem. For each constraint, a confidence interval corresponding to the mean solution is constructed and a comparative experiment between the constraints is made. A classification rule based on the lower and the upper bound of the estimated confidence interval of each constraint, as well as the cosine between the coefficients of each constraint and the coefficients of the objective function is used to determine whether the constraint is binding or redundant. Then, the constraints are ordered using probabilities from the classification rule. The proposed algorithm suggests that the constraint that has the maximum lower bound of the confidence interval among the lower bounds of the other constraints has the higher probability to be redundant. The classification rule has a significant overall percentage of correct prediction and an almost accurate percentage of correct prediction of redundant constraints. Finally, binding constraints have greater values of the estimated confidence interval than redundant constraints. For this purpose, linear problems with coefficients that were generated independently and randomly from the uniform distribution were used and the trials were performed for different training data sizes.

keywords:	linear programming redundant constraints classification mean solution confidence interval
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## An Optimization Algorithm for K-Means Clustering with Missing data using Simulated Annealing

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### Abstract

The classification in the case of missing data is a widely investigated problem which can influence the effectiveness of clustering systems. There are many techniques for clustering of data based on similarity. K-Means is one of the simplest unsupervised learning methods among all partitioning based clustering methods. It classifies a set of data objects in clusters. We used a new distance function based on logical principles and proposed k-means clustering algorithm using simulated annealing. The algorithm is implemented in the programming language c#. Our computational results show the superiority of the proposed clustering algorithm and the significance of newly introduced distance function.

keywords:	optimization simulated annealing missing data clustering k-means distance
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## An Analysis of Online Social Networks and Process Mining

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### Abstract

This study examines published literature involving online social networks and analyzes their typology, motivation to participate, topology, and metrics in such networks. The paper identifies research gaps in online social networks and explores directions for analyzing organizational process management, which can be applied to developing online social network software system and their structure as well as functionality. Many believe that understanding online social networks will allow businesses to develop more successful sites, evaluate and manage current ones, make predictions about the users' behavior and the fate of products, and assess the impact of online social networks on the Internet in general (Ahn 2007, Dechoudry 2008, Dholakia 2004, Hennig-Thurau 2004, Mislove 2007, 2012). Furthermore, Beyene (2008) suggests that evaluating online social networks can lead to algorithms that could mitigate spam, improve Internet searches, defend against attacks, and detect which users on a site are most influential or trustworthy. Additionally, knowing the typology of sites also allows us to characterize the typical user and identify abnormal ones (Beyene 2008, 2015).

This study examines published literature involving online social networks and analyzes its typology, motivation to participate, topology and metrics in such networking. The study addresses the issues related to the research gap in analyzing online social networks and intends to suggest a framework for analyzing social networking activities, namely processes. In particular, the online social network is used to identify who are involved and conduct what activities with others. Primary research questions addressed are 1) What are the research areas and approaches on online social networks to systematically identify activities/processes? 2) What is the dynamics underlying online social networks? First we provide a review of the online social networks literature. Then we identify the issues and critical factors to address in the future research of developing a framework for analyzing online social network activities.

keywords:	Online Network Social Network Analysis Process Mining Communications Metrics
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## A Multivariate Exploratory Approach of the Attributes of the Visitors of Greek Thermal Springs

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### Abstract

The purpose of this paper is to analyze the different dimensions of the quality of the services that are applied in Greek thermal springs. The definition and the measurement of the quality of the services are important in this sector because it impacts in the general satisfaction. Thermal springs are an upcoming, mixed touristic product, used for healing or/and entertaining reasons. Therefore, we questioned a set of thermal springs' users and recorded their answers into variables that cover their personal, geographical, educational, economical profiles as well as their responses about thermal spring services. Collected data are processed with exploratory statistic analysis methods that find application space in exploratory holistic analysis in order to highlight the strongest trends in a phenomenon structure, especially when this has not been analyzed before.

keywords:	exploratory analysis marketing, management multiple correspondence analysis thermal springs
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**session 17: Business Process Management**

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**session chair: Kostas Vergidis**

## Directing business processes towards Operational Research

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### Abstract

Business processes are a collection of related, structured activities performed to achieve a defined business outcome. Adopting a business process perspective is an essential advantage for organizations to orchestrate and achieve continuous improvements on time and within specified resource constraints. As a result, Business Process Management (BPM) has become an area of high interest among scholars, professionals and practitioners. The increased popularity of the domain, however, has resulted in a variety of interdisciplinary approaches with limited tangible, quantifiable –and thus measurable– benefits. Operational Research (OR) has flourished during the last decades, providing businesses and organizations with problem-solving techniques and methods aiming to enhanced performance and improved efficiency. The benefits of employing an OR perspective in the management of business processes are critical and consequently motivate the market towards adopting and promoting the continuous advancement of this field. One of the most powerful contributions of OR is the ability to deal in a quantitative manner with uncertainty. This can support businesses with better control, decision-making and coordination of efforts. The developed OR techniques can provide solutions on the supposition that all elements of the problem are quantifiable. In this paper, the authors consider and specify business processes and the BPM lifecycle in a way that is in accordance to quantitative OR methods. In more detail, the authors present: (i) a comprehensive definition for business processes through considering the most influential approaches on the field, (ii) the necessary elements forming a business process design, (iii) the ‘building blocks’ concept that describes the business process elements interrelation, and, (iv) an enhanced BPM lifecycle with a quantitative orientation in both methods proposed and techniques selected. The overall approach assists in formally defining and evaluating business processes while utilizing important mathematical and computational aspects of OR in particular in the area of continuous and discrete mathematical optimization. The result is an initial selection of appropriate business process modeling practices that produce measurable improvements and corresponding benefits.

keywords:	business processes business process management operational research business process modelling
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## Towards an adaptable Enterprise Architecture based on re-configurable business processes

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### Abstract

Enterprise Architectures (EAs) were introduced to provide a holistic view towards designing, sustaining and continuously improving a robust operating model for the organisation. Existing EA frameworks aim to align business processes, IT infrastructure, human roles/actors and data flows resulting in complex architectural descriptions that encompass a vast amount of lists, tables and diagrams. Despite these ambitious aims, studies indicate that the potential of EA has not been fully realized. The authors claim one of the reasons is the lack of adequate support for managing flexible, dynamic business processes. Business processes constitute an essential ingredient of all EA frameworks, e.g. TOGAF, DODAF, TEAF etc. However, current EA frameworks mainly support static business processes. The authors suggest EA frameworks should be further elaborated towards fully supporting automated and re-configurable business process designs that are capable of adapting in accordance with the ever-changing requirements and challenges that organisations face in the contemporary and dynamic environment they operate. In this paper, a re-configurable business process framework demonstrates how it can be integrated in one of the most widely used EA frameworks, namely TOGAF and in particular its Business Architecture phase. The suggested approach is demonstrated with examples of business process designs. This new approach in business process modelling and its potential benefits are discussed along with future directions towards the path of dynamic evolution and adaptation of the TOGAF Business Architecture phase. It is suggested that integrating state of the art in re-configurable business processes with EA frameworks is a step forward for Enterprise Architectures to achieve their overarching goal.

#### keywords:

Enterprise Architectures  
business processes  
organisational structure  
TOGAF

## Design and optimisation of business processes: Initial experiments with PCA-II

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### Abstract

This paper introduces a new process composition algorithm for the Business Process Optimization (BPO) problem. BPO is concerned with constructing feasible process designs with participating tasks of optimum attribute values such as duration and cost. To consider a business process design as feasible, the process input resources have to be consumed and the process output resources have to be produced by participating tasks that have to be interconnected via their individual input and output resources. Their paper employs an existing BPO framework that employs a series of Evolutionary Multi-Objective Optimization Algorithms (EMOAs) to generate a series of diverse optimized business process designs for the same process requirements.

The algorithmic composition of each design occurs through the application of a Process Composition Algorithm (PCA). PCA produces the visual representation of a business process design given the quantitative representation and checks whether the generated design corresponds to a feasible business process. However, the current PCA implementation interconnects tasks that require a single input resource and produce a single output resource. Additionally, the main genetic operations –crossover and mutation– impair the feasibility of existing solutions resulting to inconsistent PCA designs from one generation to another. This paper introduces PCA-II in an attempt to overcome effectively the limitations described above and construct business process design interconnecting more tasks resources while maintaining the design feasibility. PCA-II composes the tasks of a potential solution to a business process design that preserves its feasibility through generations and alters only its attribute values. Initial experiments utilizing PCA-II show an increase in the EMOAs efficiency in terms of both time and quality of the generated non-dominated solutions. PCA-II enhances the genetic algorithms inherent capability to promote and preserve better solutions through the evolution of solutions compared to the original PCA.

keywords:	business process optimisation (BPO) process composition, Evolutionary Algorithms Process Composition Algorithms, process design
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## Business Process Model Generation using Natural Language Processing

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### Abstract

Business Process Management (BPM) has become a strategic component of modern organizations. Process modeling is used within organizations as a method to increase awareness and knowledge of business processes and to deconstruct organizational complexity. Most of the time a business process model is created based on extensive documentation that describes the business process in detail thus making the creation of a clear and unambiguous process model a strenuous and complex task. Apart from ensuring clarity and clear understanding of the underlying business process model, extracting it from documentation is also very time-consuming. Information Extraction (IE) is the task of extracting structured information from unstructured or semi-structured text. In general, IE is achieved by applying Natural Language Processing (NLP) tasks and techniques. Financial professionals already use IE and NLP to seek specific pieces of information from news articles to discover mergers and aid their decision making. In the same manner, the various business process documentations can be treated in an automated way using little or no input from an expert business process analyst at least in the initial generation of a business process model solely from text-based resources.

The aim of our research is to explore how NLP can be applied in the domain of BPM in order to automatically generate business process models from existing documentation within the organization. The main idea is that from the syntactic and grammatical structure of a sentence the components of a business process model can be derived (i.e. activities, resources, tasks, patterns). The result is a business process model depicted using BPMN – a dedicated business process modeling technique. The extraction can be achieved by applying well known NLP techniques such as Part of Speech tagging, Named Entity Recognition and Co-reference Resolution. This research proposes a system that aids the extraction of Business Process Models from existing specifications or completely automates it without the intervention of a dedicated business process analyst at least at the early stages of model generation.

#### keywords:

business process modelling  
business process mining  
automated model extraction  
Natural Language Processing (NLP)

## Business Process Management Integrated with Risk Management in Construction Industry

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### Abstract

The main purpose of this paper is to identify and explore business process management issues in the construction industry, using business process modeling methods and tools which integrate the risk management perspective. Business Process Management is the approach of analyzing and improving business processes, in order to create a more efficient and effective organization. Business process management is achieved through business process models. These models can represent the processes from different perspectives: activities, events, decisions, resources, organizational roles, IT infrastructure. Business process management can be applied in different organizations, offering a great variety of benefits like standardization, control, analysis and improvement of business processes.

In construction companies, projects commonly are exceedingly complex. Even similar construction projects may actually have vastly different risk characteristics in different regions and different processes might need to be applied. In most cases, there are inadequate amounts of information and time. Large construction projects most notably need to deal with a plethora of statutory regulations and with the presence of various interest groups. Naturally all of these factors lead to misunderstandings and create problems that can't be easily resolved. When facing such complex projects, identifying and controlling the numerous risk factors is essential. Otherwise poor performance and inconsistent results are likely to occur. Business process management can be applied in construction companies in order to formalize their operations and finally achieve the benefits of business process control and continuous improvement. Moreover, risk management aspects must be implemented in process models in order to integrate activities with risks, their controls and the mitigations actions for efficient risk management. This paper presents an application of business process management in construction industry, integrating the common modeling views like function view, organizational view and information systems view with the risk management view. This perspective is essential for construction companies. After presenting the created business process models, the paper discusses the benefits gained for the case company. The work presented in this paper can clearly demonstrate the positive impact of business process management in the construction company's operations.

#### keywords:

Business process management  
Business process modeling  
Risk management  
Construction industry



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## **session 18: OR in Construction**

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### **session chair: Georgios Aretooulis**

## **A Lever of Development not only for Northern Greece but for the country as a whole**

**Glykeria Kalfakakou**



## Proposal for an effective Decision Support System for the Pre-Selection of the Type of Concrete Highway Bridges

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### Abstract

Bridges are ranked second in terms of investment volumes, but first in terms of difficulty, compared to other types of Construction projects. In the Preliminary Design Phase of a concrete highway bridge project, a question arises concerning the pre-selection of the most suitable type of bridge. The question is considered critical, since the answer is related not only to the Cost-effectiveness of the construction, but also to the satisfaction of a number of compliance criteria, such as Constructability, Safety, Serviceability, Aesthetics, Durability and Environmental harmonization. Therefore, the development of a reliable Decision Support System with respect to the selection of the type of Concrete highway bridges is an important research objective, for which only fragmentary efforts have been made worldwide so far. These efforts were concerned exclusively with the cost of bridges. In the context of this study, all contemporary construction capabilities for bridges, which correspond to the distinct types of concrete highway bridges (ranging from the simple case of one-span bridges to the 'Super Bridges', like Cable-stayed and Suspension bridges), are defined. Furthermore, certain evaluation criteria governing the design of bridges are established, after thorough research. These criteria are then weighted and incorporated within the most appropriate Multicriteria analysis method. Through the application of this method, the respective optimal selection of the bridge type can be achieved, among a number of potentially suitable alternatives. Additionally, for the validation of results obtained by the method, the implementation of the proposed Decision Support System was deemed necessary in some case studies of famous bridges in Greece (e.g. Megalorema, Metsovitiko and Arachthos of Egnatia Odos Motorway, Evripos Cable-stayed Bridge), in order to confirm or deny the correctness of each selected type of bridge, by today's standards. The study aims at covering new ground in decision making in Bridge Design.

keywords:	Decision Support System Concrete Highway Bridges Pre-selection Multicriteria analysis Evaluation criteria Case study
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## Construction activity in Greece during the period 2004-2014: Evaluation of the construction companies listed in Athens Stock Exchange using investment ratios

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### Abstract

The subject of the present study is to evaluate the performance of some of the biggest construction companies, included in the Athens Stock Exchange (ASE) list, using investment ratios. The research aims to study the extent to which, the events occurred during the period 2004-2014 as well as the subsequent modulation of investment behavior, affected the attractiveness of some of the most important developmental branches of the Greek construction industry. Initially, this study refers to the Greek construction activity and specifically to the overall contribution of the Greek economy as well as the factors influencing its course. Afterwards, reference is made regarding the Greek contracting enterprises for public works, their rankings in the respective registers, the capacity of the contractors' qualifications as well as their accounting and financial statements. Moreover, a detailed analysis is performed concerning the fundamental concepts of Athens Stock Exchange (ASE), the products being exchanged and the companies which are listed in the construction sector of ASE. Also, a description is made regarding the concept of financial analysis and particularly the analysis of financial statements using investment ratios. The methodological approach of the present study includes parameters such as the appropriate investment ratios, a specific period of time, the construction companies and the frequency of their financial reporting. The selected investment ratios which are commonly used and referred by authoritative websites and scientific journals are the following: price-earnings ratio, price to book ratio, price to sales ratio, earnings per share and dividend yield equity. The listed construction companies are selected by a specific criterion; having a construction certificate of 7th degree. As far as the period of time is concerned, the present survey concerns a crucial interval between 2004 and 2014, whereas the frequency of financial reporting is carried at annual base due to the aggregated provided information. At this point, it should be mentioned that the present survey deals with the calculation of the unweighted and weighted comparative performance of the construction companies being studied using specific investment ratios through the Promethee software. Moreover, this study demonstrates the results and the relative conclusions regarding the research questions raised during the evaluation of the construction companies being studied. Specifically, it is concluded that during the period 2004 -2014, according to the investor confidence (related to their future development), leading companies are those which their consolidated financial statements outweigh their corporate financial statements whereas as far as the investment attractiveness is concerned leading companies are regarded those which their consolidated financial statements are approximate to their corporate financial statements.

#### keywords:

Evaluation of construction companies  
Investment attractiveness of construction companies  
Investment ratios  
Case study

## The Concept of Entropy in the Management of Construction Projects: A decision-making model of risk uncertainty

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### Abstract

This article presents the calculating algorithm of entropy budgets that attempts to examine the significance of unanticipated cost and time of construction projects. A careful examination of the related literature to the specific domain, pointed to the need to analyze entropy from the distinct perspective of project management. The main problem seems to be that there is a major gap in the understanding of how entropy can be used more effectively in the construction industry, in order to foresee non deterministic situations that influence the budgeting process. More explicitly, the computational algorithm holds upon the budgetary data of the construction problem, and it gives as an output the calculation of the complementary cost and complementary working-hours. The results were estimated with the method of Monte Carlo. More explicitly, the selected methodology helped us to define and to ascertain the exact dimensions of the complementary cost and the number of the working-hours. And as whole, it was estimated that the method of Monte Carlo cannot exceed 15%. However the probability of the computational algorithm was found to produce stable statistical inferences, i.e. 70% in the case of high-risk projects and 99% in the case of a low-risk. The innovation of this work is that we manage to develop an algorithm that successfully uses the concept of entropy in the decision-making phase, by producing a coherent analysis that improves the whole construction planning utilization.

keywords:	Project management risk assessment entropy
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## Scheduling and Risk Analysis in Large Construction Projects using Learning Curves Approach

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### Abstract

Methodical organize and efficient planning is inevitable for organizations that invest in more than one concurrent project, in order to become reliable and efficient. The contemporary construction industry uses special software packages for activities harmonic correlation mapping and the effective project planning. This paper schedules data from two large scale case studies using Primavera P6 Professional v15.2 for planning and scheduling while Monte Carlo method is used from Primavera Risk Analysis for schedule's risk and "what-if" scenarios simulation. These tools provide a variety of methods, taking into account distribution's pattern and learning curve's progress. We study the effectiveness of several distribution patterns, learning curve shapes, skewness and kurtosis in order to monitor a project's plan baseline schedule and the ongoing progress.

Risk Analysis uses "Risk register" and "Weather modeling" based on activities' nature. Both projects that are studied include a variety of typical and non-typical activities, leading to different conclusions after the repeatedly fuzzy analysis of Monte Carlo in distribution patterns. Finally, based on the literature, we evaluate the distribution fitting in activities, using skewness – kurtosis plane.

The results demonstrate the necessity of using sophisticated software in real-time large construction projects as well as the importance of distributions pattern, learning curves and weather modeling.

<b>keywords:</b>	Project Management Risk Analysis Distributions Learning Curves Stochastic Modeling Primavera
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## A Combined Use of GIS, PROMETHEE and Monte Carlo Simulation Methods for Major Transportation Infrastructure Impacts Evaluation

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### Abstract

Renowned for their ability to deal with spatial problems, commercial GIS software packages can play crucial role in spatial decision making processes, given that they are provided with sophisticated tools that allow both private and public organizations to manage and analyze spatial referenced data. However, especially during the last two decades, there is a strong consensus regarding their limited capacity as Decision Support System since they do not facilitate procedures that allow the consideration of Decision Makers' (DMs) preferences in either structured or semi-structured decision problems for selecting and/or ranking alternative scenarios with respect to the satisfaction of conflicting objectives. In order to expand GIS abilities to the consideration of decision criteria, OR/MS researchers strongly pronounce in favor of developing synergies between GIS and multicriteria decision making tools. The rationale of this integration is the GIS ability to store and manage and visualize geographically referenced data and the efficiency of Operational Research tools for modeling decision problems. As a result MultiCriteria Spatial Decision Support Systems (MC-SDSS) provide a consistent framework that allows alternatives ranking combining both spatial data and DMs preferences according to a selected decision rule

Regarding to their applicability in situations that involve classification multiattribute decision models are considered as a very attractive procedures in urban and regional planning regarding the appraisal of transportation infrastructures realization. Egnatia motorway consists one of the most significant innervations that have been realized in Greece during the early pre-Olympic Games period and up to the year 2007. With a length of 670km crosses 12 regions that lays between the Igoumenitsa port at the northern west and the Kipoi customs at the northern east respectively part of Greece. As a motorway it has been designed as a dual carriageway with two traffic lanes per direction resulting to an overall construction cost of about 6b€. Aiming to enrich Northern Greece potential in transport industry and tourism European Union has heavily invested in its construction. In the present an integration among GIS functionalities and multi-attribute decision making models such as PROMETHEE method is discussed in detail. The framework proposed aims to estimate the impacts provoked by the realization of Egnatia motorway in regional level. For that the 12 regions are evaluated with the use of socioeconomic, environmental and transportation indices. Moreover, the analysis facilitates sensitivity analysis performance through Monte Carlo simulation implementation. The proposed framework consists a valuable tool that allows public investments evaluation in regional level and in the same time inter-regional inequalities estimations. Finally, the characteristics of a toolkit under development are presented.

**keywords:** Regional Planning, Multicriteria Evaluation, GIS, PROMETHEE, Monte Carlo Simulation



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**session 19: Environmental Management**

**session chair: Pantazis Georgiou**

## Potentials of biomass production in the region of Central Macedonia

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### Abstract

The aim of this paper is to examine the potentials of biomass production in the Region of Central Macedonia (RCM). For this reason, a model of Multi-Criteria Analysis (MCDA) with ELECTRE III method is developed, with the construction of outranking relations. The final goal is to select the optimal crop plan between the seven regional units as a pilot case for biomass production. Alongside a technical and economic analysis of the study area is conducted for the existent crop plans of each regional unit. The main findings of the paper is the ranking of the seven regional units of the region of Central Macedonia according to their potentials of biomass production and the optimal crop plan for producing biomass from agricultural residues. The results show that cereals and arable crops present higher biomass production levels than fruit trees and other crops.

keywords:	Biomass production Multicriteria model Electre III
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## A taxonomy survey of Life Cycle Assessment used for the evaluation of biomass production

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### Abstract

Exploitation and Sustainable Management of Renewable Energy Sources (RES) is now more than ever an ultimate goal and challenge for modern societies and agricultural districts as well. Biomass is a widely used source of energy, which can be exploited during the whole year, as the variety of the resources used (mainly plant resources), enables a constant and continuous provision of bio-energy. In order to achieve proper coordination and mutual support between the changing guidelines and sustainable objectives of policy makers and farmers, appropriate decision-making tools should be implemented. In the framework of sustainable bio-fuel production, integrated impact assessment tools should be implemented, in order to assess the potential social, economic and environmental impacts. Life cycle assessment (LCA) is applied successfully for more than 15 years in agricultural systems. LCA enables the development of alternative scenarios to come up with at the optimal option of environmental performance, thus being one of the most credible impact assessment tools. In this context, we have classified different researches regarding sustainable biomass production and others, which have successfully implemented LCA. This taxonomy of LCA papers is a step towards the better understanding of this modular process, which can be used to simulate the response of bio-energy production in a wide range of contexts (bio-fuels, agricultural residues, energy crops etc). This piece of work demonstrates and exalts the LCA supportive tool for the evaluation of various exploitation biomass systems and their combinations, as it focuses on the multiple aspects of sustainability and environmental protection of different research papers.

**keywords:**

Life Cycle Assessment  
biomass production  
impact assessment

## A multi-criteria fuzzy AHP approach for assessing forest management sustainability: A Greek case study

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### Abstract

Sustainable forest management implementation and monitoring constitutes a legal requirement for all public forests of the EU countries including Greece. However, the forest management sustainability assessment process is a complex task, mainly because it involves integration of multiple environmental, socioeconomic and institutional impacts at different spatial scales of the alternative forest management policies, which are considered for implementation at any forest location. Much of the on-going research, therefore, is focusing on development of tools that can facilitate the forest management sustainability assessments. This paper presents a multi-criteria fuzzy AHP approach, which was used to assess the forest management sustainability performance of eight alternative forest management policies for the forests of Eastern Macedonia and Thrace Region in Greece. The sustainability assessment process was implemented through the operation of the National Forest Governance Council and it included a 10 year planning horizon. The “business as usual” policy alternative was used as the baseline condition. Impact assessments were performed by using relevant spatially referenced environmental, socioeconomic and institutional impact indicators from the INFORM knowledge base. An Overall Forest Sustainability Performance Index (OFSPI) was calculated for each of the eight alternative forest policies. Based on the OFSPI values, continuation of the business as usual alternative will reduce the Region’s forest sustainability over the planning horizon under consideration. On the other hand the alternative policy that can contribute the most to the Region’s forest sustainability concerns the improvement of wood stock for technical, firewood and pulpwood production.

**keywords:** fuzzy AHP, Forest Sustainability, impact indicators

## **Optimization Model for Irrigation Water Management under Deficit Irrigation**

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### **Abstract**

In this paper an optimization model is developed to determine the optimal allocation of irrigation water to multiple crops in irrigated agriculture under deficit irrigation. The deficit irrigation is the distribution of limited amounts of irrigation water to satisfy essential water needs of plants. Deficit irrigation has been suggested as a way to increase system benefits, at the cost of individual benefits, by decreasing the crop water allocation and increasing the total irrigated land. The model takes into account the water availability for irrigation. The impact on crop yield due to water deficit and the effect of soil moisture dynamics on crop water requirements taken into account by an integrated soil moisture balance model. The soil moisture balance model calculates the consumptive green and blue water used from irrigated crops. The objective function of the model is based on crop-water production functions and economic values. The model constraints include the available water resources, irrigation water requirements, crop yield etc. The optimization problem is non-linear without analytical solution and with multiple local optima. For this reason, global optimization techniques are used to identify the global or near global optimal solution. Namely, the results concern the optimal water allocation to meet irrigation requirements of specific cropping pattern of an irrigated area under deficit irrigation. The model can be used as a decision support tool for irrigation scheduling.

## Integrated Water and Waste Management System in Motorways: The Case of Egnatia Odos S.A

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### Abstract

The Egnatia Motorway is a major project in Greece, completed within the last years and one of the largest in Europe. It constitutes one of the 14 Transportation European Network priority projects, co-funded by the European Union. It is a 670 km modern motorway (approx. 1000 km including vertical axes), serving as communication link spanning northern Greece, from its western to its eastern border, and a key element of the transport system in the European south-eastern region. Sharing the global concern on issues pertaining to environmental degradation, the company "EGNATIA ODOS SA" applies an integrated system of environmental management, that is, a method of organising and implementing environmental protection measures in design, construction, operation and maintenance stages of the project. The company also puts lots of effort in keeping balance between technical and economical activities and their impact on environment, being aware that development cannot be achieved without ensuring protection of natural resources. Aiming at sustainable development, "EGNATIA ODOS SA" introduces a new perception and an innovative environmental management strategy during operation and maintenance of the motorway, protecting both natural and human environment. "EGNATIA ODOS SA", in order to protect surface and ground waters runs programs for the monitoring and assessment of the motorway's run-off waters quality at the points of discharge to the adjacent receivers (i.e. rivers, lakes). Furthermore, facility plants (Pollution Control Units) responsible for preventing pollution of water and other sensitive areas are constructed and used along the motorway axis. "EGNATIA ODOS SA", adopts the national and european policy regarding waste management and takes measures to prevent the generation of waste and to promote reuse, recycling and other forms of recovery in order to reduce the quantity of such waste, whilst also improving its environmental performance, via waste management programs. Finally, the company implements an integrated evaluating, management and reporting system to ensure the environmentally sustainable operation of the motorway on all the environmental parameters mentioned above

#### keywords:

Environmental Management System  
Water Management  
Waste Management  
Pollution Control Units  
Environmental Reporting System  
Sustainable Motorways

## Group decision making and consensus control in climate policy: a multiple-criteria decision support tool

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### Abstract

The process of achieving transitions towards low carbon societies not only is mandated by the effects and concentration trajectories associated with climate change, but also constitutes a complex, interdisciplinary problem. Policy making in this direction is, therefore, a challenging task. Climate-economy models have so far been used in order to support policy makers in this area, but these tools usually ignore the valuable knowledge and experience embedded in various stakeholder groups that must nevertheless be included in the policy making process. To this end, different expert-driven approaches, such as multiple criteria decision analysis, can largely contribute. The aim of this paper, therefore, is to develop a decision support tool that can both support climate policy making by means of an appropriate multi-criteria methodology and emphasise the desired group decision making aspect. In this respect, a Fuzzy TOPSIS-based methodological framework is introduced and a dedicated spreadsheet-based tool that can support this process, while offering consensus control metrics, is developed and presented. The analytical framework is applied in a case study aiming to assess different climate policy instruments against implementation risks in the Greek building, energy and transport sectors towards a low carbon transformation.

**keywords:** Energy policy, Multiple criteria decision analysis, Decision support tool, Group decision making, Climate change, Consensus control





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**session 20: OR in Health**

**session chair: Fotis Kitsios**

## Hospitals productivity measurement in a metafrontier framework

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### Abstract

This study measures the performance of 111 Greek public hospitals from 2009 to 2013. According to their hierarchical structure the 111 hospitals are divided in 17 primary, 71 secondary and 29 tertiary hospitals. Since the overall sample is heterogeneous, both in resources and production characteristics we introduce the metafrontier Malmquist productivity index. The attractive feature of metafrontier model is that it considers the heterogeneity between production units in the comparison of efficiency. Analyzing the gap between a group frontier and the metafrontier indicates the potential improvements that can be made in the efficiencies of the hospitals of that group, when one removes the restrictions/regulations and uses the best practices that are associated with all hospitals in the sample. Hence, in our case the metafrontier analysis ensure that heterogeneous hospitals are compared based a single homogenous technology. More specifically, the group frontier is a representation of the state of knowledge/technology pertaining to the transformation of hospitals inputs into outputs in their operational level, while the metafrontier represents the state of the knowledge/technology in evaluating hospitals of the whole health care system in an organizational level. The proposed Malmquist index satisfies the requirement of circularity, is immune to linear programming infeasibility, overcomes the problem of base period dependency, and considers the heterogeneity among hospitals. To investigate sources of productivity change, this index can be further decomposed into within-group efficiency change, within-group technical change, and technical leadership change.

keywords:	Data envelopment analysis metafrontier Malmquist productivity index Greek hospital performance
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## Prioritizing user requirements: The case of an e-health mobile application

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### Abstract

Requirement prioritization is used for determining which candidate requirements of a software product should be included in a certain release. A big issue when prioritizing requirements is the choice of the most suitable technique, based on its applicability and the obtained results. In the field of requirements prioritizing, several methods are used. Some of the most established are Analytical Hierarchy Process, Binary Search Tree, Planning Game, 100-point method and the combination of Planning Game with AHP (PGcAHP). It would be interesting to combine PG with AHP, so that this combined method would use the strengths in each method and eliminate their weaknesses. The benefit is that the requirement engineer could pay attention to the most important requirements instead of those less important. This could mean that the development team saves time. The target of this research is ranking the user requirements of an e-health application, in order to determine which of them will be implemented in its development process. Questionnaires were developed, distributed in waiting rooms of physicians and also were available online. The outcome of this research will be used in the development process of a mobile application.

keywords:	multi – criteria e-health AHP Planning Game PGcAHP
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## Evaluating occupational stress and job satisfaction in health sector during the austerity: the case of Greek NHS dentists

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### Abstract

The Greek National Health System (Greek NHS) has been strongly affected by austerity policies since 2010: substantial cuts on government health spending as well as a broad restructuring of the public health sector have been imposed in a short period. Therefore, the Greek NHS professionals, including non-hospital dentists, have to overcome wage cuts, health personnel reduction, job and social instability as well as an increased demand of public healthcare services. The aim of this study was to evaluate the occupational stress of non-hospital Greek NHS dentists, during the current economic crisis and public sector reform, by using Effort – Reward Imbalance (ERI) questionnaire, a contemporary research instrument strongly linked to labour market conditions. Methodology: All 192 non hospital NHS dentists were invited to participate; 135 (70.3%) agreed. Of them, 68 (50.4%) were men ( $55.3 \pm 6.6$  years) and 67 (49.6%) were women ( $54.3 \pm 4.5$  years). The Greek version of the ERI, a semi-quantitative 23-item questionnaire using a simplified, uniform 4-point Likert response scale, was delivered between July and October 2012, with permission of the Greek Ministry of Health. Results: Dentists indicated a moderate degree of job satisfaction; ER ratio  $>1$  was found in 58.1% of dentists while specific determinants of occupational stress and job satisfaction were defined. Conclusions: A relative imbalance between efforts given and rewards received was found in non-hospital (primary care) Greek NHS dentists at the time of research. Therefore, well designed interventions should be implemented to address occupational stress, which is expected to increase during the ongoing crisis. Additionally, targeted policies by the Greek government aiming to improve the Public Dental care System in the Greek NHS would also be necessary.

keywords:	dental care Effort – Reward Imbalance (ERI) occupational stress job satisfaction Greek National Health System (Greek NHS)
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## Evaluation of Alternative Maintenance Management Information Systems for a Greek Pharmaceutical Company using the Promethee Method

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### Abstract

Nowadays, continuous modernization and the need for higher productivity in the industry require the use of complex production equipment. The pharmaceutical industry is a typical case where strategic competitive advantage is a constant need, as the consequences of lost production due to a mechanical failure or due to a of major breakdown creates high risks of lost orders and customers. The selection of the most suitable information system for the management of the maintenance process is an important decision in this industry, not only because it leads to the infrastructure modernization, but also because it can help in the improvement of the production processes. This article describes a decision making process in order to select a maintenance management information system for a big pharmaceutical manufacturer, acting mainly as a third party for other companies in Europe. To this end, an appropriate decision making methodology (Promethee) and corresponding software (Visual Promethee) were used. After a detailed discussion with the company's managerial stakeholders, three information systems were recognized as candidate alternatives. In cooperation with the company, the main assessment criteria were defined (divided into categories and sub-categories in two hierarchical levels). The scoring process was decided to be performed by two independent departments (Technical Department and Information Technology Department), each of which defined its own criteria weights. The final assessment resulted utilizing a synthesis of the evaluations of both departments. Based on the results, the most appropriate information system was selected taking full advantage of the sensitivity analyses that were included in the decision making process which was supported by the Visual Promethee software. The paper critically comments on the different perceptions and priorities that may arise in a selection process with the participation of different decision makers (departments) with conflicting stakes, and suggests ways through which related problems can be overcome.

#### keywords:

Maintenance Management  
Decision Making  
Promethee  
Information System  
Pharmaceutical Industry



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