high complexity of the problem, a multi-objective meta-heuristic algorithm, namely NSGAII, is then applied to provide solutions in a reasonable amount of time. In the proposed algorithm, special mechanisms have been used to enhance its efficiency. These mechanisms include a procedure for initial solution generation and another for maintaining feasibility of solutions when they undergo different operators. Finally, the proposed algo-rithm has been applied to solve the problem of trans-portation planning in petroleum products distribution network of Kurdistan province. Results reveal that the proposed algorithm is efficient.

**Key Words:** Transportation planning, multi-objective optimization, distribution network, petroleum products, time-window, NSGAII.

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## Abstract

Supply chain risk management has become an essential issue for supply chain management. Companies must focus not only on the efficiency of supply chain, but also on manageability of its risks. There are two types of supply chain risks: operational and disruptional risks. Operational risk is associated with the uncertainty of a process such as customer demand, amount of supply, and cost fluctuations. Disruptional risk encompasses natural and man-made disasters, such as earthquakes, floods, hurricanes, terrorist attacks, financial crises, or labor strikes. If an unanticipated event occurs, all of the supply chain members will be affected and the result will cause significant loss. Supplier risk is one the of the supply chain risks that could be the source of other supply chain risks and leads to the inability of the supply chain to meet the customers demand.

The Supplier selection process is one of the most important components of production and logistics management for many companies. Selection of a wrong supplier could be enough to weaken the company's financial and operational position. Selecting the right suppliers significantly reduces purchasing costs, improves competitiveness in the market and enhances end user satisfaction. This research proposes a hybrid model of interval valued ANP, interval valued fuzzy FMEA and interval valued fuzzy TOPSIS for the selection of the supplier with the lowest risk in the supply chain. This method applies the interval valued fuzzy ANP to determine the weight of each criterion and sub-criterion, uses interval valued fuzzy FMEA to rank the risk factors related to each supplier and interval valued fuzzy TOPSIS for the final supplier ranking. In addition, we applied linguistic variables to the parameter in which these variables are expressed as triangular interval-valued fuzzy numbers. A steel company is then studied to validate this model. The result shows that this company can categorize its suppliers more effectively and can select a low-risk supply chain partner at the same time.

# TRANSPORTATION PLANNING OF MULTIPLE PETROLEUM PRODUCTS WITH TIME-WINDOW CONSTRAINTS FOR SUPPLY, DEMAND, AND TRANSPORTATION ROUTES (CASE STUDY: KURDISTAN PROVINCE)

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## Abstract

In this research, distribution network of petroleum products in operational level is investigated. This network consists of transportation roads as well as pipelines. Based on the assumptions and limitations of the network, there are time windows for distribution time of products, demands, and transportation routes. The aim of this research is to propose a time plan for transportation of petroleum products which consists of a transportation schedule for each product including the volume of product, type of vehicle, and transportation route. The objective is to maximize demand coverage as well as to minimize total transportation costs. The components of the network under investigation are refineries, major storages, power plants, gas stations, minor storages, and customers. Petroleum products can be transported through all roads by different types of trucks (if the road is available for that type of truck during transportation time). Moreover, petroleum products can be transported to minor storages, power plants, and gas stations directly from refineries or through major storages. According to the fact that different trucks with different capacities are used for transportation, some roads are not available for specific types of trucks. Additionally, some roads may be unavailable for some or all types of trucks in specific time periods. In order to provide a mathematical framework for this problem, the problem is formulated as a mixed integer linear programming model. In the proposed model, a variety of real-world assumptions have been considered. According to the

supply disturbance. In this regard a basic integer linear programming model is developed using GAMS software and based on that, problem solving algorithm according to a reactive approach with considering supply disturbance occurrence is presented. Then using a real example, proposed model and solution method is described. For evaluating the proposed method, sample problems in CSPLib have been used and for simulating the supply disturbance occurrence, in each sample problem one special part has been disturbed. Then proposed algorithm has been compared with continue of first sequence as a conventional method. Computational results indicate that solutions obtained by proposed method based on mathematical programming are optimum and preferable in comparison with alternating method.

# MATHEMATICAL MODELING OF COLLABORATION IN REVERSE SUPPLY CHAINS CONSIDERING THE UNCERTAINTY OF DATA

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## Abstract

By increasing the environmental consciousness, reverse supply chain is getting known in business theory and application. However, the high costs of implementing them is one of the important impediments for managers. In the current paper, a variant of vendor managed inventory is proposed for parallel reverse supply chains and the cost functions are compared with the non-collaborative and simple collaborative cases. In the non-collaborative case, different reverse supply chains are working in isolation and there is no sharing between them. The simple collaboration is possible when the members just share a collection center as a warehouse. The proposed collaboration is designed such that these members share their information with collection center and this center plans for collecting and transferring returns to the recovery centers in a way that less inventory is hold at that center.

To compare our model with the traditional and simple collaboration, the cost functions are defined for two parallel simple three tier reverse supply chains. In order to reflect the reverse supply chain uncertainties, probability distribution of the amount of returned products is considered at the cost functions. Then, the mathematical situation for superiority of the proposed model to non-collaborative and simple collaborative case is studied using these cost functions. Two mathematical non-equalities show these situations as the result of this part. As this collaboration is not used in the reality, to compare the results in actual case, some illustrative examples are created by two different probability distributions for return generation. Finally, a Monte Carlo simulation technique is used for about 100 samples in1000 periods. The average costs for different components of cost function are calculated. Comparing the costs shows 48% decrease in shifting from non-collaborative to simple collaborative, 54% decrease in changing the non-collaborative case to the proposed model, and 11% decrease in changing the simple collaboration to proposed one. However, the results show a high decrease in costs of the model and its superiority to other two cases. The model can be expanded to broader and longer reverse supply chains by future researchers. Some other opportunities for study subjects are also introduced in the last section.

# A HYBRID MODEL OF INTERVAL VALUED ANP, INTERVAL VALUED FUZZY FMEA AND INTERVAL VALUED FUZZY TOPSIS FOR SUPPLIER SELECTION ON RISK ENVIRONMENT

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# PERFORMANCE OF DEFENSE INDUSTRIES ORGANIZATION

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## Abstract

The importance of quality management systems in organizations and defense industries is an undeniable fact that is the foundation for growth and development of the quality movement on the national level. One of the most powerful statistical techniques in the collection of quality engineering techniques and statistical tools is the design of experiment. A very desirable feature in the integrity of the process is shown concerning with the standard ISO9001 where organizations were asked for the characteristics and trends of processes and products to provide the results of monitoring and measurement. In other words, the innovation of this research in the field of application of design of experiments is to measure the effects of various factors on the process of quality management system. In this study, we investigate the history of applications and benefits of design of experiments technique as well as how the results analyzed. The important case study of this research was in the defense industries organization and ten selected industries. The conducted analyses show that the change from decentralized to centralized training planning, or the change of management style from open to closed, is a not significant difference in the performance of the process, such that the main reasons are the same in traditional methods as in the planning and management styles of the organization or due to inactivity of processes. In both cases, the fundamental changes within the above-mentioned concepts in the field of executive demands are asked. To conclude, the necessity for fundamental changes in the concepts of training planning and management style is emphasized as inevitable. Moreover, another innovation of this study is the verification of the application of the proposed technique in a quality management system, including its process.

**Key Words:** Quality management system, design and analysis experiments technique, process performance.

# MATHEMATICAL MODELING AND SOLVING THE CAR SEQUENCING PROBLEM WITH CONSIDERING UNEXPECTED SUPPLY DISTURBANCES

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## Abstract

In the automotive industry, final assembly lines are usually designed for the production of a large variety of cars. Different assembly processes are not only required by different equipment, but also because multiple types or even several different models are built on the same assembly line. These modern assembly lines are called mixed-model assembly lines. Because the distribution of the workload is highly dependent on the production sequence, the planning of the sequence, including how the orders go through the assembly line, is crucial for high utilization. A huge theoretical and practical effort has been undertaken in recent years to plan production optimally. An important decision problem in mass-producing customized product to order is the sequencing problem, which decides on the succession of models launched down an assembly line. The objective of car sequencing problem is to find an optimal permutation for a collection of cars sharing the same basic product model to be built in the same production line of car plants.

Due to disturbances that occur during the supply and production process, the carefully planned production sequence often cannot be performed as intended. This paper treats the car sequencing problem in final assembly line with considering the unexpected occurrence of parts

and release times is discussed. In most of basic scheduling problems, the processing time of the jobs is assumed to be constant. This assumption is true in some cases, but because machines and tools depreciate and their efficiency reduces during time, this assumption cannot be true in all cases. In addition, in some industries like steel industry, job's delay for process results in longer processing time. These kinds of jobs are introduced as deteriorating jobs, so a job is deteriorating whenever its processing time is not constant and is dependent on scheduled jobs. In this thesis, scheduling problems with deteriorating jobs are studied. A general classification of these problems is presented and literature review is studied. Then, flowshop scheduling with deteriorating jobs is discussed, and minimizing the number of tardy jobs is assumed as objective function. It is proven that the complexity of the problem is NP-hard. Therefore, a heuristic algorithm is proposed to achieve near optimum solution in a short time. Besides, an exact branch and bound algorithm, along with utilizing heuristic algorithm as upper bound, was proposed to achieve an optimal solution. Computational results demonstrate that branch and bound method solves problems with 24 jobs in the set High and 22 jobs in the set Low in a reasonable time. Results show that a high percentage of nodes are fathomed by lower bounds and dominance rules that shows the capability of the branch and bound algorithm. Also, it is shown that the average ratio of optimal solution to the heuristic one is at most 1.15 which is smaller in contrast with other studies in the related field in the literature. Finally, according to the efficiency of the presented approach, sample problems with large dimensions are generated and solved and their results are displayed.

**Key Words:** Deteriorating jobs, flow shop, number of tardy jobs, branch and bound, release times.

# MULTI OBJECTIVE PORTFOLIO SELECTION BY COMBINING MARKOWITZ AND DEA CROSS EFFICIENCY MODELS

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## Abstract

Nowadays, the stock market is one of the common ways to invest money. Selection an appropriate portfolio is one of the main problems for investors. This paper proposes an integrated multi objective model for portfolio selection problem. The model is based on Markowitz mean-variance model. Markowitz model considered maximization of portfolio expected rate of return and minimization of portfolio risk. In the proposed model portfolio efficiency is considered in addition to portfolio return and portfolio risk simultaneity. The proposed model is a multiple objective programming model which maximizes return and efficiency and minimizes risk of the portfolio. Due to weaknesses of classic DEA model, the paper applies DEA cross-efficiency model to estimate efficiency. There are two problems of using simple cross-efficiency evaluation in portfolio selection. One of them is the lack of portfolio diversification. Under cross-efficiency evaluation, selecting DMUs which averagely perform well in all factors and excluding DMUs which perform well in only subset of factors is more likely. Due to this issue, a poor diversified portfolio will be selected which include similar DMUs. The other problem is the ganging-together phenomenon of cross-efficiency. Assume two DMUs have similar factor levels; hence they will use similar inputs and outputs weights. It is clear that two DMUs increase each other's cross efficiency score and have more chance to win. On the contrary, a DMU which its factor levels are so different from other DMUs has lower chance of winning. The model is solved in two ways: using exact algorithm and using Non-dominated sorting genetic algorithm (NSGA-II) and the results are compared. To illustrate the performance of the proposed model, the actual data from 52 assets of Iran stock market is gathered and the results are compared with Markowitz model. The results showed that our proposed model increases portfolio efficiency in compared with Markowitz model while reduction of expected return is low.

**Key Words:** Portfolio selection, Markowitz mean- variance model, cross efficiency DEA model, NSGA II.

# APPLICATION OF DESIGN OF EXPERIMENTS TECHNIQUE IN QUALITY MANAGEMENT SYSTEM FOR ASSESSING VARIOUS FACTORS AFFECTING PROCESSES

The optimal actions for each component at the end of each period are derived, such that the availability of the system subject to a constraint on system costs over maintenance planning horizon is maximized. The total maintenance cost of the system includes the cost of performing PM, cost of performing CM, system stopping cost due to performing PM, and system stopping cost due to performing CM. A numerical example is given to illustrate the proposed model.

# EVALUATING THE PERFORMANCE OF FUZZY MISSING DATA ESTIMATION METHODS ON THE FUZZY BIVARIATE PROCESS CAPABILITY INDEX $C_{pm}$

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**Abstract**
The ability of the process in satisfying the customers' expectations is determined by using the process capability indices. In some real applications, it is possible to encounter uncertainty in the observations and specification limits of the quality characteristics. The uncertainty of quality characteristics often occurs due to the constraints in measurement systems and human subjectivity in many manufacturing industries. In these cases, the observations and specification limits are defined by fuzzy numbers. On the other hand, missing observations can be occurred as a result of insufficient sampling, high costs, and errors in measurements or during data acquisition. Moreover, machine breakdown, illegible recording of response, damaged experimental resource are common reasons for missing data. There are some methods, such as mean and regression, for estimating missing data in the literature. These methods are used to estimate data when the observations are crisp and there is no uncertainty in the observations. To the best of authors' knowledge, these methods are not evaluated for estimating the missing data in the context of multivariate process capability indices with fuzzy observations. In this paper, we propose two estimation methods, including fuzzy mean and regression methods, to estimate the missing data under uncertainty. Then, the performance of the proposed estimation methods on the results of the fuzzy process capability index $C_{pm}$ is evaluated when the missing data are estimated by using the proposed estimation methods. In addition, the effects of missing data percentage and correlation coefficient on the fuzzy process capability index are assessed when the missing data are estimated by using mean and regression methods. The results show that the regression method is more efficient than the mean method to estimate the missing data. The performance of the estimation methods also improves when the sample size increases. However, the performance of the proposed estimation methods deteriorates when the fuzziness increases.

# MINIMIZING THE NUMBER OF TARDY JOBS IN A FLOW SHOP SCHEDULING WITH DETERIORATING JOBS AND RELEASE TIMES

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**Abstract**
In this paper, minimizing the number of tardy jobs in two-machine flowshop scheduling with deteriorating jobs

# THE EFFECTIVE PARAMETERS IN IRAN'S E-GOVERNMENT READINESS ASSESSMENT

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**Abstract**
E-government (EG) means extensive use of information technology for optimization of government and governance mechanisms, aimed at increasing transparency of business processes, eliminating the spatial and temporal distance between the people and government, and increasing the participation of people in the political process. E-government essentially refers to the utilization of Information Technology (IT) and other web-based telecommunication technologies to improve and/or enhance the efficiency and effectiveness of service delivery in the public sector. E-government consists of the digital interactions between the government and citizens (G2C), government and businesses (G2B), government and employees (G2E), government and governments /agencies (G2G), as well as citizen interaction with their government (C2G).
In this article, considering the indicators and models of EG readiness, EG implementation and EG maturity, and using comparative studies and Iranian expert opinions provided the appropriate parameters for evaluating e-government readiness in Iran. This model comprises various aspects including management readiness, security readiness, network readiness, roles and regulation readiness, standard readiness, monitoring and evaluation readiness, cultural readiness, content readiness, government employee readiness, equipment readiness, financial readiness, political readiness, computer software readiness and citizens readiness.

# OPTIMIZATION SEQUENCE OF PREVENTIVE MAINTENANCE ACTIVITIES FOR A REPAIRABLE MULTI-COMPONENT SERIES SYSTEM

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**Abstract**
This paper proposes a mathematical model to determine optimal sequence of preventive maintenance (PM) activities for a repairable multi-component series system. The structure of system is series, i.e., if a component of system fails, the system stops. The occurrence of each component's failure is modeled by a non-homogeneous Poisson process (NHPP) with an increasing failure rate. It is assumed that maintenance planning horizon has been divided into equal time periods, and at the end of each period, four possible actions for each component (mechanical service, repair, replacement or do nothing) have been considered. If mechanical service or repair is performed, the age of component is reduced. In this situation, the age of component is returned somewhere between the current age of it and the state of "as-good-as-new". However, repair reduces the age of component more than mechanical service. If the component is replaced, it is returned to a state of "as-good-as-new". If no action is performed, the age of component is not changed.
If the system is suddenly stopped before the end of each period, corrective maintenance (CM) is performed. The objective is to determine optimal preventive maintenance activity for each component of system at the end of each period. In other words, it must be decided about each component of system at the end of each period to perform which kind of PM activities.

## Abstract

In the midst of webpages, two issues raise for users to access the desired resources. These issues are speed and accuracy that are two important factors for users' satisfaction of web services, for which an appropriate information retrieval tool to provide suitable responses is required. Therefore, developing an efficient search engine could be useful in order to attract customers and increase their satisfaction.

However, Web search engines often face with a crucial problem, that is, their results, include highly diverse pages in correspondence with vague queries. This kind of diversity makes choosing the most relevant pages more difficult for search engines. On the other hand, the obtained results may be undesirable from the user's perspective. In such a situation, discovering natural grouping of pages and finding their representatives help the engines to cover all admissible meanings related to user's query. Clustering is the well-known approach for this reduction purpose, i.e., finding a few representatives among highly diverse Web pages.

In this paper, we focus on a pioneering algorithm and aim to improve it in terms of the quality of responses and the execution speed. To do so, we propose to provide initial clusters by means of a well-known algorithm, called K-means. This could be a proper initial point. We also reformulate a time-consuming formula of the main algorithm by taking advantages of the properties of linking network. Furthermore, we formulate a set of significant variables of the main algorithm to increase the quality of the clustering. These variables have been considered constant in the main algorithm. The experimental results on ground-truth datasets indicate that the performance of our algorithm is about 30% superior to the performance of the main algorithm both in terms of quality of clustering and execution speed.

Moreover, as an interesting case study, we execute our algorithm on the dataset of Persian blogs. We provided this dataset by collecting the information about links and texts included in some blogs. Implementing our algorithm on this interesting dataset provides marvelous results in the case of extracted clusters.

**Key Words:** Clustering, e-commerce, content, link, search engine, complex networks.

## CONTRACT DESIGN IN A THREE-ECHELON SUPPLY CHAIN, IN THE CASE OF INFORMATION UNCERTAINTY

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## Abstract

At the time of contract design in multi - echelon supply chains, some important information about cost or demand may not be available. In such a situation, contract design with upstream and downstream, i.e., a supplier and a retailer, members of a supply chain becomes an important issue. In this research, a three- echelon supply chain, consisting of a supplier, a manufacturer, as contract designer, and a retailer, is considered. Due to different reasons, such as time- consuming supply process, it is assumed that the manufacturer has to place supply orders before the start of a selling season. The retailer prepares the final product for the selling season with stochastic demand. At the time of supply contract, the manufacturer has a continuous distribution from the retailer's processing cost. However, uncertainty about the retailer's cost is eliminates eliminated after a while. The manufacturer's optimal supply order, according to an option contract, is investigated. The option contract helps the manufacturer to postpone some decisions until information uncertainty about retailer's cost is eliminated. The manufacturer, firstly, decides about initial and option orders. Later, after realization of the retailer's cost, the manufacturer decides about the exercised orders. Through exercised orders, the manufacturer can adjust initial orders. The optimal exercised orders, are calculated analytically. Also, it is established that the manufacturer's objective function is concave in terms of initial and option orders, and thus, the optimal value of these variables can be found easily.

The manufacturer also offers a coordinating buy-back contract to its downstream member, i.e., the retailer. The optimal values for the buy-back contract, whenever the manufacturer obtains a specific portion of the manufacturer-retailer system profit, are calculated.

In the numerical experiments, it is investigated how each manufacturer's contract with its upstream and downstream members affects each other. The numerical results show that the designed supply chain contract in each supply chain echelon, depends on the information and the contracts of the other echelons, and contracts should not be considered separately from each other.

ported and evaluated to illustrate the strengths of the modelling approach and the solution method used. The models are solved using Varaible Neigborhood Search (VNS) and Simulated Annealing (SA). To demonstrate the strength of these rough methods, the results of accurate model solutions are utilized as well. In this way, the innovations of this research , in terms of both modeling and solution methods, are depicted. Genrally, by using the proposed model, firstly the hub-locations are selected. Then, proper annular routes for each hub can be determined. Prudence of the results is a testament that the proposed model and recommended solution algorithm are capable of effective organizition of Iran's postal network.

# PRESENTING A HYBRID ELECTROMAGNETISM-LIKE MECHANISM AND K-MEANS FOR DATA CLUSTERING

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## Abstract

Clustering is one of the useful methods in many scientific fields. It is a classification process for putting data in specific groups or clusters based on the similarities between them. In literature, many algorithms, such as heuristic and meta-heuristic, have been successfully applied to solve clustering problems. Among them, the K-means is well-known due to its simplicity and computational efficiency, although it suffers from several drawbacks due to its initial state and may be trapped in local optima.

Electromagnetism-like Mechanism (EM) algorithm is a new population-based meta-heuristic to tackle complex optimization problems. It imitates the attraction- repulsion of the electromagnetic theory that is based on Coulomb's law for obtaining the optimal solution. Unlike some meta-heuristic algorithms such as Genetic Algorithm (GA) and Tabu search (TS), in EM, each particle is influenced by all other particles within its population.

In this paper, to skip the local optimum, the K-means method is combined with the Electromagnetism-like Mechanism (EM) algorithm, and a new algorithm, called K-EM, is presented to solve clustering problems. In K-EM, there are two main phases. In the first phase, K-EM executes the K-means algorithm within the population size and tries to produce favorable centroids for desired clusters, which terminates when there is no change in centroid. In the second phase, the fitness value of each particle is computed and the particle that has the best fitness value is stored. Then, the particles are fed into the improved local search procedure. Then, the total force exerted on each particle is computed. In the move procedure, the particle position is moved according to the resultant force exerted on them. The search process of finding the best results continues until the stop criterion is met.

In order to evaluate the performance of the proposed algorithm, five distinguished and standard datasets are chosen from the UCI Machine Learning repository. These datasets are solved and the results are compared with the results of those of K-means, GA, Simulated Annealing (SA), Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), and EM. The results illustrate that the proposed K-EM algorithm has good proficiency in obtaining desired results.

# A NEW ALGORITHM FOR CLUSTERING WEB-PAGES BASED ON LINKS AND CONTENT

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# Abstracts of Papers in English

## A NEW APPROACH FOR MODELING AND SOLVING HUB LOCATION-ROUTING PROBLEM IN IRAN POSTAL NETWORK

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**Abstract**

In distribution networks of goods and services, identifying hub locations and determining annular routes connecting the hubs to satellite centers, ( i.e. Location-Routing problems) is one of the most important issues of strategic and operational decision making problems. In Iran's current postal distibution network, in most cases, dispatching is done directly; with no major hubs for management of packages. Accordingly, given the significance of time and cost in Iran's postal network, this study is dedicated to modeling the problem of locating hubs, routing, and comparing the results with the currently existing methodologies. Location-Routing problems are commonly investigated by researchers through two approaches: either modeling, or solving models. In this paper, however, both approaches will be studied. In this study, a new model is developed and then implement on Iran's postal network. In the new model, in order to estimate reliability measure, the distance between cities nominated as ptential hubs and also the volume of the packages dispatched from origins and destinations are taken into considerations. In the next step, these reliability measures are utilized in determining the exact hub locations as well as in allocating satellite centers, which function as non-hubs, to those hub locations. Moreover, a new solution method is presented by employing an iterative two-step metaheuristics. Results are then re-