

## Turkey/Turquie

(264)

### UNITWIN/UNESCO Chairs Programme

#### Progress report

Period of activity : 2007-2008

#### UNESCO Chair in Computer-Integrated Manufacturing

Report established by: Prof. E. Ertugrul Karsak & Prof. Ethem Tolga, Co-Chairholders

## I. Activities

### 1. Academic activities

*Courses in the Curriculum:*

Code	Course Title	Level
IND 304	Modelling and Simulation	(Undergraduate)
IND 331	Manufacturing Techniques	(Undergraduate)
IND 332	Production Planning and Control	(Undergraduate)
IND 431	Production Management	(Undergraduate)
IND 432	Computer Aided Manufacturing Systems	(Undergraduate)
IND 461	Plant Layout and Materials Handling	(Undergraduate)
IND 491	Senior Year Project	(Undergraduate)
IND 525	Advanced Topics in Simulation	(Graduate)
IND 531	Production Systems Analysis	(Graduate)
IND 532	Sequencing and Scheduling	(Graduate)
IND 533	Modern Manufacturing Systems	(Graduate)
IND 542	Logistics	(Graduate)
IND 599	Master's Thesis	(Graduate)

*Duration:* 1 semester

*Target Group:* Industrial Engineering and Computer Engineering undergraduate students, Industrial Engineering and Computer Engineering graduate students.

*Geographical coverage for partners:* National + Students enrolled in Erasmus-Socrates Exchange Program (i.e. Western Europe, Central Europe, Eastern Europe)

### 2. Conferences/Congresses/Meetings

The 28th National Congress on Operational Research and Industrial Engineering (YA/EM'08), was held at Galatasaray University, Istanbul between June 30th and July 2nd, 2008. Prof. E. Ertugrul Karsak served as the Chair of the Organizing Committee for YA/EM'08. YA/EM Congresses are an annual meeting place of Turkish researchers and practitioners in industrial engineering and operational research. The aim of YA/EM'08 was to share theoretical and applied studies in industrial engineering and operations research on an academic platform and discuss the contribution of these works to both academia, and production and service industries.

Another objective of the Congress was to gather distinguished academic and business environments to present different ideas and viewpoints, and to act as an intermediary for future works.

The theme of YA/EM'08 was set to be "Creativity, Innovation and Technology". 450 participants from various institutions attended the Congress. 402 abstracts were submitted and after a peer-review process, 338 papers were selected for presentation. These papers mainly focused on "heuristic methods", "multiobjective/multicriteria decision making", "Industrial Engineering/Operational Research applications in industry", and "mathematical programming". With the organization of the student project competition, it was aimed to introduce creative works of industrial engineering/operational research students to academia and industry. Moreover, several industrial applications were shared with the attendees through an industrial project competition.

### **3. Interuniversity Exchanges/Partnerships**

- Ahiska, S.S, Member of the Research Group  
Destinations: IIE Annual Conference and Expo: Industrial Engineering Research Conference, Vancouver, BC, 2008  
Purpose: Paper presentation, "Inventory Policy Characterization for a Single Product Recoverable Manufacturing System"  
Duration: 1 week
- Akyüz, M.H., Öncan, T., Members of the Research Group  
Destinations: 22nd European Conference on Operational Research (EURO XXII), Prague, Czeck Republic, 2007  
Purpose: Paper presentation, "A Simulation Approach to the Sequencing and Dispatching Problem in a Flexible Manufacturing System"  
Duration: 1 week
- Büyüközkan, G., Member of the Research Group  
Destinations: 10. Joint Conference on Information Science, Salt Lake City, USA, 2007  
Purpose: Paper presentation, "Modelling New Product Development Activities using Fuzzy Cognitive Maps"  
Duration: 1 week
- Büyüközkan, G., Member of the Research Group  
Destinations: International Event on Concurrent Enterprising, Lisbon, Portugal, 2008  
Purpose: Paper presentation, "A Strategic Evaluation Framework for Collaborative Product Development Practices"  
Duration: 1 week
- Büyüközkan, G., Member of the Research Group  
Destinations: Portland International Center for Management and Engineering Technology Conference, Cape Town, South Africa, 2008  
Purpose: Paper presentation, "Strategic Analysis of Mass Customization Strategies In Product Development"  
Duration: 1 week

- Feyzioğlu, O., Member of the Research Group  
Destinations: 10. Joint Conference on Information Science, Salt Lake City, USA, 2007  
Purpose: Paper presentation, “A Design Approach to Create Mixed Shop Layouts” (coauthored by E. Zengin)  
Duration: 1 week
- Feyzioğlu, O., Büyüközkan, G., Members of the Research Group  
Destinations: 19th International Conference on Multiple Criteria Decision Making, Auckland, New Zealand, 2008  
Purpose: Paper presentation, “Evaluation of Suppliers Considering Decision Criteria Dependencies” (coauthored by B.B.Çalışkur)  
Duration: 1 week
- Genevois, M.E., Member of the Research Group  
Destinations: 11th International Conference on Human Aspects of Advanced Manufacturing Agility and Hybrid Automation, Poznan, Poland, 2007  
Purpose: Paper presentation, “Recycling and Reuse of WEEE, an Application for Reuse Channel” (co-authored by İ. Bereketli)  
Duration: 1 week
- Genevois, M.E., Ulukan, Z., Members of the Research Group  
Destinations: 5th International Conference on Enterprise Systems, Accounting and Logistics, Crete Island, Greece, 2008  
Purpose: Paper presentation, “Recycling and Reuse of WEEE, a Stochastic Model for Reuse Channel of an Enterprise in Turkey” (co-authored by İ. Bereketli)  
Duration: 1 week
- Karsak, E.E., Member of the Research Group  
Destinations: 14th International Conference on Industry, Engineering, and Management Systems, Cocoa Beach, Florida, USA, 2008  
Purpose: Paper presentation, “Valuation of Advanced Manufacturing System Investments Using Real Options Approach” (co-authored by C.O. Özogul and E. Tolga)  
Duration: 1 week
- Sener, Z., Member of the Research Group  
Destinations: IEEE International Conference on Systems, Man and Cybernetics, Montréal, Canada, 2007  
Purpose: Paper presentation, “A Decision Model for Advanced Manufacturing Technology Selection Using Fuzzy Regression and Fuzzy Optimization” (co-authored by E.E. Karsak)  
Duration: 1 week
- Ulukan, Z., Member of the Research Group  
Destinations: 10. Joint Conference on Information Science, Salt Lake City, USA, 2007  
Purpose: Paper presentation, “0-1 Fuzzy Goal Programming Approach to Multiobjective Waste Paper Collection Method Selection” (co-authored by Y. Kop)  
Duration: 1 week

#### 4. Publications

- Title: “Integration of Internet and web-based tools in new product development process”  
Author(s): Buyukozkan G, Baykasoglu A, Dereli T  
Source: Production Planning & Control  
Year: 2007, Volume: 18, Issue: 1, Pages: 44-53  
Abstract: New product development is considered to be vital for a company's long-term survival. In today's rapidly changing production environments customers are asking for highly customised products with affordable prices. A new production era that is known as mass customisation has already started in many sectors. The customer should become an integral part of the product design process in such an environment. The integration of Internet and web-based tools for customer data collection, communication and data processing is inevitable in order to speed up the production process and cut down the costs. This paper deals with management of product development with focus on synthesising new technology based concepts related to product development, and discusses their use in the various stages of product development process. It also provides guidelines for successfully implementing technology oriented new product development practices with a customisation perspective.
- Title: “Evaluation of suppliers' environmental management performances by a fuzzy compromise ranking technique”  
Author(s): Buyukozkan G, Feyzioglu O  
Source: Journal of Multiple Valued Logic and Soft Computing  
Year: 2008, Volume:14, Issue: 3-5, Pages: 309-323  
Language(s): English  
Abstract: Traditionally, companies have considered factors such as price, quality, flexibility, etc. when evaluating supplier performance. Meanwhile, many of them have also begun to consider "green" issues with the increasing environmental pressures. This paper presents an evaluation model based on a specific multi-criteria decision-making method, namely VIKOR, for rating suppliers' environmental performance. The original VIKOR method has been proposed to identify compromise solutions, by providing a maximum group utility for the majority and a minimum of an individual regret for the opponent. In its original setting, the method treats exact values for the assessment of the alternatives, which can be quite restrictive with unquantifiable criteria. This will be true especially if the evaluation is made by means of linguistic terms. For this reason, we extend the original VIKOR method so as to process such data and to provide a more comprehensive evaluation in a fuzzy environment. The enhanced method is demonstrated with an industrial case.
- Title: “Selection of the strategic alliance partner in logistics value chain”  
Author(s): Buyukozkan G, Feyzioglu O, Nebol E  
Source: International Journal of Production Economics  
Year: 2008, Volume: 113, Issue: 1, Pages: 148-158  
Abstract: As the incredible growth of the Internet is changing the way corporations conduct business, logistics service providers must consider changing their traditional logistics system into an electronic (e)-logistics system. The purpose of this study is to provide a decision support to make a careful assessment of e-logistics partner. As a matter of fact, companies are increasingly aware that they need to work together with their logistics partners in order to best serve their customers and achieve business excellence. However, the selection of a suitable partner for strategic alliance in a logistics value chain is not an easy decision and is associated with uncertainty and complexity. For this reason, the aim of this research is to

propose a multi-criteria decision-making (MCDM) approach to effectively evaluate e-logistics-based strategic alliance partners. In addition, because subjective considerations are relevant to the partner evaluation and selection decision, a fuzzy logic approach is adopted. The proposed evaluation procedure consists of several steps. First, we identify the strategic main and sub-criteria of alliance partner selection that companies consider the most important. After constructing the evaluation criteria hierarchy, we calculate the criteria weights by applying the fuzzy Analytic Hierarchy Process (AHP) method. Finally, we conduct the fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to achieve the final partner-ranking results. A case study is also given to demonstrate the potential of the methodology.

- Title: “Optimum component test plans for phased-mission systems”  
Author(s): Feyzioglu O, Altinel IK, Ozekici S  
Source: European Journal of Operational Research  
Year: 2008, Volume: 185, Issue: 1, Pages: 255-265  
Abstract: We consider the component testing problem of a system that has to perform a mission consisting of a sequence of stages. Once a stage is over, all failed components of the system are replaced before the next stage starts in order to improve its reliability. The components have exponential life distributions where the failure rates depend on the stage of the mission. We formulate the optimal component testing problem as a semi-infinite linear program. We present an algorithmic procedure to compute optimal test times based on the column generation technique and illustrate with numerical examples.
- Title: “An integrated group decision-making approach for new product development more options”  
Author(s): Feyzioglu, O; Buyukozkan, G  
Source: International Journal of Computer Integrated Manufacturing  
Year: 2008, Volume: 21, Issue: 4, Pages: 366-375  
Abstract: Quality function deployment (QFD) is a well-known planning methodology for translating customer needs into relevant design and production requirements. The intent of applying QFD is to incorporate the voice of the customer into the various phases of the product development cycle for a new product, or a new version of an existing product. The traditional QFD structure requires individuals to express their preferences in a restricted scale without exceptions. In practice, people contributing to the process tend generally to give information about their personal preferences in many different ways, numerically or linguistically, depending on their background. Moreover, collaborative decision-making is not an emphasized issue in QFD even though it requires the involvement of several people. In this study, the QFD methodology is extended by introducing a new group decision-making approach that takes into account multiple preference formats and fusing different expressions into one uniform group decision by means of fuzzy set theory. Moreover, a benchmarking procedure based on the Choquet integral is proposed to rate competing systems and find which dimensions need improvement.

- Title: “A two phase multi-attribute decision-making approach for new product”  
 Author(s): Kahraman C, Buyukozkan G, Ates NY  
 Source: Information Sciences  
 Year: 2007, Volume: 177, Issue: 7, Pages: 1567-1582  
 Abstract: This study aims at improving the quality and effectiveness of decision-making in new product introduction. New product development has long been recognized as one of the corporate core functions to be competitive on an increasingly competitive global market. However, developing new products is a process involving risk and uncertainty. In order to solve this stochastic problem, companies need to evaluate their new product initiatives carefully and make accurate decisions. For this reason, a systematic decision process for selecting more rational new product ideas is proposed. Basically, two stages of decision-making are described: the identification of nondominated new product candidates and the selection of the best new product idea. These stages are composed of an integrated approach based on a fuzzy heuristic multi-attribute utility method and a hierarchical fuzzy TOPSIS method. Finally, an application is given to demonstrate the potential of the methodology.
- Title: “Robot selection using an integrated approach based on quality function deployment and fuzzy regression”  
 Author(s): Karsak EE  
 Source: International Journal of Production Research  
 Year: 2008, Volume: 46, Issue: 3, Pages: 723-738  
 Abstract: The decision-makers have been experiencing difficulties in determining the most suitable robot alternative due to the increase in number of robots and the diversity in their application areas. A robust decision framework for robot selection should consider multiple and conflicting criteria and the dependencies among them. This paper introduces a decision model for robot selection based on quality function deployment (QFD) and fuzzy linear regression. The proposed approach benefits from the fact that QFD focuses on delivering value by taking into account the customer requirements and then by deploying this information throughout the development process, and applies this perspective to robot selection. Fuzzy linear regression is considered as an alternative decision aid for robot selection problems where imprecise relationships among system parameters exist. An example robot selection problem is presented to illustrate the proposed decision-making approach.
- Title: “Using data envelopment analysis for evaluating flexible manufacturing systems in the presence of imprecise data”  
 Author(s): Karsak EE  
 Source: International Journal of Advanced Manufacturing Technology  
 Year: 2008, Volume: 35, Issue: 9-10, Pages: 867-874  
 Abstract: The aim of this paper is to present a comprehensive methodology for evaluation and selection of advanced manufacturing technologies, incorporating both the economic and strategic aspects and the related imprecise as well as exact data into the decision making process. Initially, a data envelopment analysis (DEA) model that can take into account crisp, ordinal, and fuzzy data is introduced. Then, the developed framework is used for flexible manufacturing system (FMS) selection. The DEA approach is performed by employing capital and operating cost, required floor space and work-in-process (WIP) as the input variables, and using product flexibility, quality improvement and lead time reduction as the output variables. The assessment of FMS alternatives versus product flexibility and quality improvement are represented via ordinal data, while WIP and lead time reduction are stated using triangular fuzzy numbers. The proposed framework is illustrated through an application and comparative results are presented.

- Title: “Exact solution procedures for the balanced unidirectional cyclic layout problem”  
 Author(s): Oncan T, Altinel IK  
 Source: European Journal of Operational Research  
 Year: 2008, Volume: 189, Issue: 3, Pages: 609-623  
 Abstract: In this paper, we consider the balanced unidirectional cyclic layout problem (BUCLP) arising in the determination of workstation locations around a closed loop conveyor system, in the allocation of cutting tools on the sites around a turret, in the positioning of stations around a unidirectional single loop AGV path. BUCLP is known to be NP-Complete. One important property of this problem is the balanced material flow assumption where the material flow is conserved at every workstation. We first develop a branch-and-bound procedure by using the special material flow property of the problem. Then, we propose a dynamic programming algorithm, which provides optimum solutions for instances with up to 20 workstations due to memory limitations. The branch and bound procedure can solve problems with up to 50 workstations.

## **II. Impact**

The manufacturing firms need to focus on increasing the quality and responsiveness to customisation, while lowering costs to compete in today’s global marketplace. The evolution of advanced manufacturing systems offers a great potential for increasing flexibility and changing the basis of competition by ensuring both cost effective and customized manufacturing at the same time. The UNESCO chair in Computer-Integrated Manufacturing at Galatasaray University is established to specifically enhance education and research related to the evolution of computer integrated manufacturing in Turkey. The UNESCO chair has played a key role in enhancing the infrastructure of the Faculty of Engineering and Technology at Galatasaray University through directing the construction of a Computer Integrated Manufacturing (CIM) laboratory. CIM laboratory is used for educational and research purposes. In addition to its use in both the undergraduate and graduate curriculum, the laboratory is used for training programs offered to manufacturing industry professionals.

## **III. Forthcoming activities**

- Cooperation with universities in the European Union for research projects.
- Providing nationwide educational and research assistance to the universities lacking technical materials.
- Strengthening the ties with the manufacturing industry in Istanbul by organizing continuing training programs.
- Providing know-how to SME and conducting research projects for resolving problematic issues in manufacturing processes.
- Supervising master’s and doctoral theses in computer integrated manufacturing.
- Searching for financial support for inviting visiting professors.
- Taking active part in e-learning programs in computer integrated manufacturing.

#### **IV. Development prospects**

The following equipments are planned to be acquired in order to extend the activities of the CIM laboratory:

Rapid Prototyping Machine STRATASYS FDM 360mc:

Base System: 355 x 254 x 254 mm, two auto load canister bays.

Real Material: ABS-M30, PC, PC-ABS .

Achievable Accuracy: +/- .127 mm or +/- .0015 mm per mm.

Network Communication: 10/100 base T connection. Ethernet protocol.

Operator Attendance: Limited attendance for job start and stop.

Operating Environment: Maximum room temperature of 29.4°C.

Power Requirements: 230 VAC, 50/60 Hz, 3 phase, 16A/phase