Department of Industrial Engineering & Management

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RESEARCH AREAS

QFD METHODOLOGY FOR LINKING PROJECT SUCCESS FACTORS TO OUTCOMES IN A SPECIFIC BUSINESS CASE

Shuki Dror and **Oren Eliezer**

Defining Project Success (PS) outcomes and PS factors is not an easy task. A favorable outcome depends on the stakeholders' perspective, the project type, the project life cycle stage, and organizational characteristics. The present study focuses on an individual business case to develop a procedure for quantitative evaluation of the relations between various PS factors and outcomes based on the Quality Function Deployment (QFD) method.

A House of Project Success (HoPS) matrix is created using combined input from various managers and experts. This matrix summarizes the desired improvements in the PS outcomes and connects them to the relevant PS factors. Based on the HoPS matrix, outcomes and factors that maximize the desired results of the PS policy are chosen using the Mean Square Error (MSE) criterion.

The paper describes the implementation of the above methodology in two organizations and two project types, namely weapons development and an ERP implementation, demonstrating different project success causal structures.

Keywords: Project success factors, project performance, Quality Function Deployment (QFD), Mean Square Error (MSE), decision-making

LINKING OPERATIONAL PLANS TO BUSINESS OBJECTIVES USING QFD

Shuki Dror

Selection of appropriate operational plans is an essential yet complex task as it requires an understanding of the implications for the strategic objectives in a given industrial situation. This research utilized the Quality Function Deployment (QFD) method as an instrument for ranking the operational plans of an individual organization in terms of its business objectives.

Two methodological stages are suggested. In the first stage, a "House of Strategy" matrix translates the improvement needs of a company's objectives into a list of competitive priority measures ranked according to their relative importance. A Mean Square Error (MSE) criterion supporting the selection of vital competitive priorities to be improved is employed. In the second stage, each vital competitive priority is broken down into its relevant process scenarios, and an operational matrix is constructed to translate the desired improvement in the process scenarios into a list of operational plans ranked by importance. Again, the MSE criterion supports the selection of vital operational plans. In the construction of the operational matrix, it is assumed that synergy between the operational plans might change for each process scenario; i.e. there might be several roofs, corresponding to the number of rows in the operational matrix.

Keywords: Strategy implementation, business objectives, operational plans, Quality Function Deployment (QFD)

IDENTIFY IMPORTANT FACTORS FOR SERVICE SIMULATION EXPERIMENTS USING QFD

Shuki Dror

Service design is a form of conceptual design that involves the activity of planning and organizing people, infrastructure, communication, and material components of a service to improve its performance. A simulation experiment models the various scenarios of a service system. One of the aims of the designer is selecting appropriate factors for the determination of the simulation scenarios. The complete set of possible scenarios is huge, so it is often useful to get subjective input to help screen some vital factors. Taguchi advocates a three-stage design procedure for off-line quality control: (i) system design; (ii) parameter design; and (iii) tolerance design. In the parameter design stage, which is the key stage in the Taguchi method, factors affecting the performance of Y are categorized as controllable factors and noise factors. In this paper, a Quality Function Deployment (QFD) matrix highlights controllable factors and noise factors to consider when running a simulation experiment for a service system. It is assumed that interactions between the factors might change for each performance measure; i.e. there might be several roofs, corresponding to the number of rows in the QFD matrix. The MSE criterion is utilized here for selecting the vital service factors to be examined in the simulation experiments.

Keywords: Service design, simulation experiments, Quality Function Deployment (QFD)

MATRIX APPROACH TO ANALYSIS OF HUMAN ERROR AND THEIR PREVENTION BY QUALITY ENGINEERING AND MANAGERIAL TOOLS

Emil Bashkansky and **Shuki Dror**

This research applies well-known quality engineering matrix techniques such as quality function deployment, Teoriya Resheniya Izobretatelskikh Zadatch (TRIZ), and failure mode, effects, and criticality analysis for characterizing, mapping, and preventing human error (or, at least, reducing damage caused by errors). Human errors ('WHATs', in the language of quality function deployment) are classified according to ten characteristics, while twenty typical types (or protective layers)—'HOWs'—in quality assurance systems are proposed for preventing/stopping/minimizing, to some extent, damage caused by errors. During the analysis of a specific system, any error is estimated according to its likelihood and severity, and every protective layer receives a score according to its effectiveness in preventing errors. Synergy or antagonism between protective layers may also be taken into account when calculating effectiveness. The approach facilitates evaluation and comparison of the effectiveness of different quality assurance systems dealing with human errors. The authors emphasize the need to create a 'recipe book' based on historical databases, which will enable application of the optimal prevention efforts after characterizing the potential human errors according to the ten criteria mentioned above.

Keywords: Human errors, prevention, quality engineering tools, QFD, TRIZ, FMECA

TAGUCHI METHODS FOR OFF-LINE QUALITY CONTROL

Irad Ben-Gal and **Shuki Dror**

Three decades ago, Taguchi developed a systematic approach to off-line quality control and process design that is now known as the Taguchi method. Although some statistical aspects of the method are debatable, there is no argument that it has been widely applied to various processes and industries and has gained enormous attention. This study summarizes the main concepts of the Taguchi method and covers some of its implementations.

Keywords: Robust design, quality control, process optimization, parameter design, design of experiments, statistical experiments

A CORPORATE SOCIAL RESPONSIBILITY (CSR) MODEL – A QUALITY FUNCTION DEPLOYMENT-BASED METHODOLOGY

Natalia Zaitsev and **Shuki Dror**

Corporate Social Responsibility (CSR) aims to increase long-term profits through positive public relations, to establish high ethical standards to reduce business and legal risks, and to boost shareholder trust by taking responsibility for corporate actions. CSR strategies encourage the company to make a positive impact on the environment and stakeholders, including consumers, employees, investors, and communities.

The goal of an organization is a sustainable context called CSR outcomes. According to discussions in the literature, the main outcomes of CSR are reputation, consumer loyalty and positive firm evaluation, stakeholder relations, customer choice of company/product, financial performance, firm capability, reduced risk, and enhanced organizational identification.
The study seeks to create a framework that investigates the relationship between all types of indicators of an organization's activities and the CSR outcomes at the institutional level of CSR analysis. A structured methodological approach based on a Quality Function Deployment (QFD) is developed.

Keywords: Corporate Social Responsibility (CSR), Quality Function Deployment (QFD), CSR outcomes

A NEW FRAMEWORK FOR ORGANIZATIONAL KNOWLEDGE THAT ENABLES CRITICAL JUSTIFICATION

Doron Faran

Knowledge is defined as "justified true belief", but knowledge management pays very little attention to either justification or truth. This paper reviews the justification methods that organizations employ de facto — positivism, conventionalism and pragmatism and discusses their weaknesses. The method of critical rationalism (CR) is then presented as a remedy for these weaknesses, and the opposition to this method in the organizational field is discussed. A new knowledge framework that realigns the canonical theories of organizational knowledge is constructed. The main argument in this paper is that the framework does facilitate CR. The implementation of CR is demonstrated in a case study.

Keywords: Knowledge, truth, justification, critical rationalism

ADVERTISING EFFECTIVENESS FROM THE HERMENEUTIC STANDPOINT

Doron Faran and **Arie Maharshak**

The core of the research focuses on the dilemma of advertising effectiveness. On the one hand, companies tend to invest substantial amounts of money in promoting their products, while on the other hand, customers quite often fail to understand the message embedded in a marketing campaign. Consequently, highly valued campaigns that receive prestigious awards do not deliver. While the failures of advertising campaigns have been thoroughly investigated in the literature, few explanations for the failures have been proposed. This contribution builds on the criticism of cognitive narrowness and takes the cultural stance a step further through application of the hermeneutic tradition.

Keywords: Advertisement, hermeneutics, interpretation, culture

APPLIED PROBABILITY

Tamar Gadrich, **Haggai Katriel**, and **Rachel Ravid**

Applied probability is concerned with the application of probability theory to other scientific and engineering areas (e.g. physics, biology, medicine, computer science, technology, and social sciences). This research applies generalizations of classical models to solve problems that have emerged in modern industry. Occupancy models are an example of one of the models used to generalize the classical coupon collector problem and applied in the area of statistical quality control.

Discrete-time population models are widely used in the field of population ecology. The population-level consequences of assumptions regarding the behavior of individual organisms is investigated using site-based models (a bottom-up approach). We applied stochastic processes (discrete time Markov chain and Gaussian Markov chain approximation) and agent-based simulation approaches to investigate system dynamics.

Keywords: Probability models, statistical quality control, occupancy problems, enumerative combinatorics, mathematical biology, ecology, population dynamics, site-based models

CROSS CULTURAL HUMAN RESOURCE (HR) MANAGEMENT

Hilla Peretz and **Yitzhak Fried** (Texas Tech University, USA)

Cross-cultural management focuses on content pertaining to HR management with a cross-border dimension. This longitudinal research study examines the effects of national values on a variety of HR practices (among them, performance appraisal, training strategies, and HR information systems) as well as the effect of fit between HR practices and national values on organizational performance indicators. The study comprises a large sample of over twenty countries and is based on data from several years, with the goal of exploring the stability of these relationships before and after the financial crisis.

Keywords: National values, human resource management, organizational performance

ENVIRONMENTAL ECONOMICS

Natalia Zaitsev and **Mira Baron** (Technion—Israel Institute of Technology)

In the mid-1990s, we forecast the number of Israeli visitors to a unique planned recreational site in the north of Israel, currently known as Agmon Hula. The contingent valuation method used to predict this number was based on tourists' willingness to visit the planned site from among all the recreational sites in the region.

The current study examines the assumptions and results of that study and compares the forecast to the actual outcome. We concentrate on the number of visitors forecast, which enables us to examine the economic impact and is crucial in analyzing the ecological carrying capacity.

The planned commodity was a site offering a safari, a bird sanctuary, horseback riding, a

swimming pool, and a picnic area. The project, however, was not carried out as planned, and currently is a bird sanctuary only.
The forecast of 380,000 visitors in the first year of operation did not materialize. The prediction might have been closer to the actual number (220,000) if we had considered the percentage of respondents who ranked visiting bird sanctuaries as one of their two favorite activities.
Updating the predicted number of visitors is straightforward and plays a crucial role in predicting carrying capacity. A new forecast of the number of visitors over the next twenty years is made.

Keywords: Recreational site, forecasting the number of visitors, contingent valuation method

FLEXIBLE MANUFACTURING SYSTEMS (FMS): OPERATIONS AND CONTROL

Boris Shnits

Flexibility in FMS is made possible largely owing to the use of versatile and/or redundant machines, which in turn facilitate alternative system routing. Alternative routing enhances a system's ability to better balance machine workloads and achieve higher system robustness and productivity. To fully exploit these features, an FMS must be able to adapt to different shop conditions, i.e. for a given system status to select the appropriate operational policy in real time. This research focuses on developing methodologies and control schemes that enable an FMS to improve its efficiency and productivity and to cope with the volatile production environment in which the FMS operates. These control schemes deal with solving a multi-criterion, dynamic scheduling problem using optimization-based techniques and simulation.

Keywords: FMS control, dynamic scheduling, multi-criteria decision making, simulation

FLEXIBLE WORK ARRANGEMENTS: A CROSS-CULTURALPRESPECTIVE

Hilla Peretz and **Yitzhak Fried** (Texas Tech University, USA)

Flexible work arrangements (FWAs) have become increasingly prevalent in the global competitive environment. Little is known, however, about how societal cultures affect the implementation of FWAs and their effect on organizational outcomes. This research addresses this issue by focusing on two complementary topics: (a) the influence of five important societal (national) cultural values (power distance, uncertainty avoidance, individualism/collectivism, assertiveness, and future orientation) and key organizational variables; and (b) the contribution of the level of congruence between these societal cultural values and FWAs on the organizational outcomes of absenteeism and turnover.

Keywords: Flexible work arrangements, national culture, organizational outcomes

GENERATION Y: A CROSS-CULTURAL PERSPECTIVE

Hilla Peretz and **Emma Parry** (Cranfield University, UK)

Increased life expectancies and initiatives to retain older workers for longer means that the workforce is becoming more age-diverse. Hence, to effectively attract and manage this new cohort of employees, employers need to develop a clear understanding of the work values, preferences, and attitudes of the new generation entering the workforce (generation Y) and how they might differ from previous generations. To date, research and practical advice has largely ignored the impact of national or cultural context on this diversity. This lacuna may explain the failure of so many studies to find generational differences in work values if the samples used were not from a single nationality. Specifically, the main question of this study is to examine whether generational differences (in work values and work behaviors) are different among different cultures or are global. To empirically examine the study question, a novel strategy is used: data mining of social networks and turnover.

Keywords: Generations, work values, national culture

HUMAN FACTORS IN DESIGNING JOINT COGNITIVE SYSTEMS FOR MANUFACTURING

Nirit Gavish and **Hussein Naseraldin**

Recently, several cognitive systems for manufacturing management have been developed. In these systems, human and artificial intelligent entities work together as a team in a situation termed a "Joint Cognitive System." Humans utilize the computerized system most effectively if they accept the system's analysis of the problem and recommendations for handling it. The assumption is that in joint cognitive systems for manufacturing, human performers begin their interaction and decision-making processes using an explicit, analytic, theory-based style. After gaining experience with the results of their decisions, they shift to an implicit, experience-based, non-analytic style. Hence, to achieve good cognitive coupling, the computerized system should adapt itself to performers' shifts in cognitive style. In other words, the system input should be analytic and theory-based at the beginning (e.g. "According to model X, the recommended production plan is Y"), and later be heuristic and experience-based (e.g. "Last time, in a similar situation, you chose production plan Y"). The research hypothesis regarding the contribution of an adaptive cognitive style to the performance of the joint cognitive system is empirically evaluated in a manufacturing management setting using simulation. The research is conducted in two phases. The first phase examines the hypothesis regarding the changes in the operator's cognitive style. The second phase evaluates the effect of the system's cognitive style using different cognitive styles in various stages and levels of interaction. Participants are freshmen students in the Department of Industrial Engineering and Management at ORT Braude Academic College of Engineering, Israel, who are enrolled in the Introduction to Industrial Engineering course.

Keywords: Joint cognitive systems, manufacturing, decision making, cognitive style

HUMAN RESOURCE AUTONOMY WITHIN MULTINATIONAL CAOMPANIES

Hilla Peretz and **Mila Lazarova** (Simon Fraser University, Vancouver, Canada)

Growing organizational dependence on international operations highlights the role of human resource management and confronts organizations with the dilemma of having to find the right balance between global integration and local responsiveness. This research examines whether and under what circumstances subsidiary human resource autonomy enhances performance indicators. It seeks to answer two major research questions: (1) Whether a higher level of subsidiary human resource autonomy is associated with improved subsidiary performance; and (2) Whether the relationship between level of subsidiary human resource autonomy and subsidiary performance is influenced by cultural and institutional distance between the multinational company's headquarters and the subsidiary.

Keywords: Multinational companies, human resource, performance

HUMAN RESOURCE MANAGEMENT – DIVERSITY STUDY

Hilla Peretz

The realization of the importance of group diversity is growing rapidly among organizations and research theorists. Diversity has been credited with both positive and negative outcomes for team performance. The research explores two major topics: (1) The factors influencing positive implementation of diversity with regard to group performance and its effectiveness; and (2) The acceptance of affirmative action in different contextual settings (both organizational and national) and its influence on performance.

Keywords: Diversity, team performance

INVENTORY MANAGEMENT

Illana Bendavid, **Hussein Naseraldin**, and **Yale T. Herer** (Technion—Israel Institute of Technology)

A major decision in the supply chain context is the inventory level of a product along the supply chain. The inventory level affects the service level the customer receives and thus affects operational performance. Even though decisions regarding inventory levels are typically made after several other strategic and tactical decisions, integrating inventory decisions with strategic decisions at an early stage has a crucial effect on overall performance. Inventory management encompasses inventory policies and practices. For example, lateral transshipment is a practice in which excess inventory is moved along the supply chain to locations with a shortage of inventory, thus eliminating excess and shortage costs.

Keywords: Inventory policy, inventory-location model, lateral transshipments, unit-price discount

LINE BALANCING

Boris Shnits

Production or assembly line balancing refers to assigning work elements and resources to workstations on the line so that the workload at all workstations is equal. One specific research direction involves the balancing of a robotic assembly line. In robotic assembly line balancing (RALB), the problem is that different robots may be assigned to assembly tasks; and each robot, because of its capabilities and specialization, needs different assembly times to perform a given task. The solution to the RALB problem includes finding the optimal assignment of robots to line stations and achieving a balanced distribution of work among the different stations. A genetic algorithm is used to find a solution to this problem.

Keywords: Line balancing, robotic assembly lines, genetic algorithms

MULTINATIONAL CORPORATIONS' (MNCs) PERFORMANCE IN THE POST-GLOBALIZATION ERA

Hilla Peretz and **Michael Morely** (Limerick University, Ireland)

Multinational Companies (MNCs)— defined as large corporations incorporated in one country and producing or selling goods or services in various countries — stand at the center of globalization and serve as the engine of international business. The shift to a deglobalization phase —specifically, the reality that the world is becoming more uncertain and unpredictable due to the emergence of international conflicts, protectionism, and nationalism — represents a challenge to MNCs, their strategies, and their performance. Although the effects of deglobalization on societies are starting to be studied in the economics and sociology literature (for example, Hillebrand, 2010, who studies the effects of deglobalization on income equality; or Casery, 2017, who examines the phenomenon from an historical point of view), the mainstream literature of international management and organizational studies has yet to explore how this new phenomenon affects organizations in general and MNCs in particular. This study explores how and under which circumstances deglobalization affects performance of MNCs.

Keywords: Multinational corporation, organizational performance, deglobalization

ORGANIZATIONAL AFFIRMATIVE ACTION PROGRAMS

Hilla Peretz, **Ariel Levi** (Wayne State University, USA), and **Yitzhak Fried** (Texas Tech University, USA)

Organizational affirmative action programs (AAPs) have been widely adopted in the US, and have been extensively investigated as a major human resource activity. Over the past four decades, organizations have implemented AAPs to remedy discrimination against ethnic and racial minorities, women, and disabled people, and to diversify their workforces. Interestingly, AAPs have been implemented not only in the US, but also in organizations in other countries and

cultures. Despite the increased globalization in the business environment, however, there is a paucity of research on the prevalence of AAPs across nations, and on whether societal values affect the type of AAPs that organizations implement.

Keywords: Affirmative action programs, national culture, absenteeism, turnover

PROJECT MANAGEMENT AND SCHEDULING

Illana Bendavid and **Boaz Golany** (Technion—Israel Institute of Technology)

Project scheduling is one of the nine knowledge areas in the body of knowledge comprising project management. This area is the keystone of project planning and control since it requires and integrates information about several project characteristics such as estimated duration of activities, precedence constraints deriving from the technological precedence relations among the activities, resource constraints, and due-date constraints. After this information has been processed, the scheduling activity generates a feasible schedule that optimizes one of the multiple existing objective functions such as minimization of project duration, maximization of a project's net present value (NPV), and many others. This feasible schedule is generally used as a baseline schedule according to which commitments with external entities are made for planning activities such as material procurement and delivery of orders. In other words, this schedule determines when suppliers have to deliver materials needed for the project's activities, and also sets due dates for subcontractors who execute some project tasks.

Keywords: Stochastic project scheduling problem, activity gate, flexible commitment, resource management, project control

QUALITY, DEPENDABILITY, HEALTHCARE, AND SAFETY ENGINEERING

Emil Bashkansky, **Tamar Gadrich**, **Shuki Dror**, **Rachel Ravid**, and **Yariv Marmor**, in cooperation with the Department of Applied Mathematics

This research focuses on effective methods for evaluation, analysis, statistical control, prediction, and improvement of quality measured using categorical scales. Such scales are widely used in other fields of quality and safety engineering: customer satisfaction surveys, FMECA and risk analysis, defects and quality classification, inter- and intra-laboratory comparisons, homogeneity/heterogeneity tests, statistical process control, human error classification and prevention, testing, diagnostics, healthcare analysis, QFD, and others. In turn, design and analysis of optimal control schemes for such scales facilitates effective quality data mining and determination of dominant distinguishing parameters. Some of the developed methods are ready for immediate industrial application and are applied in decision making for patient-involved health care, product quality classification and control, security arrangements, and metrology.

Keywords: Quality control, categorical data analysis, prediction, improvement, human errors prevention, metrology, testing, diagnostics, QFD, categorical data

QUEUEING SYSTEMS

Rachel Ravid and **David Perry** (University of Haifa)

This research focuses on performance analysis of priority queuing systems. It assumes that the systems are in a steady state, and the aim is to find the steady state probabilities and the customer sojourn time distribution.

Keywords: Queuing systems, renewal processes, priority queues

RISK MANAGEMENT

Meir Tahan, **Tsvi Kuflik** (University of Haifa), and **Efrat Yuval** (University of Haifa)

Development and deployment programs continue to suffer from budget overruns, schedule delays and poor technical performance, in most cases as a result of failure in handling uncertainty in complex software system development. Development communities lack a systematic method for identifying, communicating and resolving technical uncertainty. This research focuses on the risk identification stage and tries to understand the reasons for unidentified risk appearing during project development by interviewing project managers working in industry. The findings suggest that the unidentified risk factors can be divided into three main types: managerial, behavioral and external. Each category consists of factors which, through the awareness and openness of project teams and managers, can help avert many problems and achieve project success.

Keywords: Risk identification, unidentified risks, uncertainty

ROBUST FACILITY LOCATION AND CAPACITY PLANNING

Hussein Naseraldin and **Opher Baron** (University of Toronto)

A facility refers to a retail outlet, service depot, or production plant. In all cases, facility planning involves determining how many facilities to open so as to cover a demand created in a specific area. It also involves determining the location of each facility. By determining these two decisions, we fix most of the supply chain network structure. Several approaches to making these decisions are possible. Among others, a robust optimization approach guarantees solutions that are robust to changes in the parameters due to uncertainty, in particular, uncertainty in demand.

Keywords: Number of facilities, network design, distance metric, robust optimization

ROBUST SCHEDULING

Hussein Naseraldin and **Boris Shnits**

Scheduling in service is an important operation. If uncertainty exists, robust optimization is a valid approach to adopt. While uncertainty can stem from various sources, the processing time is

a major factor. This paper focuses on modeling and solving a scheduling problem in a hardware department that receives several requirements for board development. Two types of resources are at hand: designer and layout. Several tasks are performed by each resource. The problem is to minimize the total tardiness of all boards. A major challenge in such an environment is the fact that the due date of the jobs, i.e. the boards, are on the critical path of the larger system development. Thus, improvement in the performance of board development will have an impact on the system's performance.

DUE DATE ASSIGNMENT (DDA) PROBLEM

Hussein Naseraldin, **Liron Yedidsion** (Technion—Israel Institute of Technology), and **Chen Bukay** (Technion—Israel Institute of Technology)

Scheduling is a crucial aspect of operations control, whether in manufacturing or in service. The decision-maker faces various types of scheduling problems. Among others, there is the Due Date Assignment (DDA) problem, where the objective is to minimize costs by examining the resulting delivery time of each scheduled job. Additional reasons for delay in delivery time include a broken machine, a machine being configured, and a newly hired operator exploring his learning curve. The problem is exacerbated if the uncertainty is related to other types of data for which there is no previous experience or historical data set. To cope with this limitation, robust optimization (RO) is emerging as a promising methodology to incorporate uncertainty in the decision-making process, when not relying on full probabilistic information. This research proposal utilizes robust optimization of model scheduling problems to derive efficient solutions for these scheduling problems.

Keywords: Robust optimization, scheduling, due-date assignment

STAFFING EFFECTIVENESS AND THE ROLE OF NATIONAL INSTITUTIONS

Hilla Peretz, **Lena Knappert** (Tilburg University, The Netherlands), **Zeynep Aycan** (Koc University, Turkey), and **Pawan Budhwar** (Aston University, UK)

In today's global rivalry for talent, multinational and domestic organizations compete for the best candidates and are concerned with how to design and implement staffing activities that fit the global and the local contexts. However, most studies on this topic show a tendency to occur in a vacuum with a disproportionate emphasis on individual-level validity, seemingly oblivious to the surrounding world and context. This study, built on neo-institutional theory, develops a multi-level conceptual model that captures the impact of national institutions on staffing practices, the effect of these institutionally-embedded staffing practices on organizational outcomes, and the influence of institutional pressure (i.e. tight vs. loose social norms) on these relationships.

SERVICE DESIGN WITH APPLICATION TO EMERGENCY DEPARTMENT SYSTEMS

Tamar Gadrich, **Shuki Dror**, and **Yariv Marmor**

To handle problems and trends in emergency department (ED) operations, designers and decision makers simulate and evaluate various scenarios before testing them in a real-life environment. Conceptualizing broad possible scenarios for ED operations prior to simulation, however, is usually neglected. This paper suggests a framework for the schematic conceptual development of these scenarios.

The application of the methodology is illustrated in a specific ED. It contributes to the area of ED computer simulation by suggesting a methodology that offers the following advantages: (1) Simulation scenarios that can be schematically formulated rather than based on trial-and-error experiments; and (2) Scenario development that can be integrated in the different stages of simulation model development to support designers and management in understanding ED problems, improvement goals, the data that should be collected, and the operational changes that should be applied.

Keywords: Simulation, design of experiments, conceptual modeling, scenarios, emergency department

SMART GRID OPERATIONS MANAGEMENT

Hussein Naseraldin and **Liron Yedidsion** (Technion—Israel Institute of Technology)

Technology development has led to a new electricity network type, called the Smart Grid. The basic notion behind the Smart Grid concept is to improve the overall efficiency of electricity production, delivery, and consumption, while increasing the reliability and security of the electrical grid. Deviations in electricity consumption rates throughout the day lead to different electricity pricing schemes. Assuming that consumers (individuals and businesses alike) adapt to the pricing schemes by postponing usage of some electrical devices until off-peak periods, costs will be reduced. Furthermore, the electricity provider will benefit, as the demand at peak periods will be leveled and capacity requirements will balance out over time. Smart Grid operation management involves the determination of related decisions using operation management and operation research tools and methodologies.

Keywords: Smart grid, lot-sizing, algorithm complexity

ADDITIVE MANUFACTURING FOR RESILIENT SUPPLY CHAIN

Hussein Naseraldin and **Atanu Chaudhuri** (Alborg University, Copenhagen, Denmark)

The adoption of Additive Manufacturing (AM) across industries has increased significantly in recent years due to the faster pace of development of underlying technologies and companies recognizing its potential. As the barriers for adopting additive manufacturing are overcome, the technology has the potential to fundamentally change how products are designed and

developed, produced, delivered and serviced. AM thus requires a significant redesign of the external supply chain structure around a company and the internal processes within new product development, manufacturing, order fulfillment, spare parts delivery, and logistics within a company. In the near future, products will be manufactured using a combination of both traditional manufacturing technologies and AM. But small and medium suppliers who currently use traditional manufacturing technologies find it difficult to overcome the design, manufacturing, and supply chain related challenges associated with adoption of AM. This research explores various aspects of integrating AM in the regular manufacturing arena.

Keywords: Industry 4.0, Additive Manufacturing, 3D printing

SUPPLY CHAIN AND INDUSTRY 4.0

Hussein Naseraldin, **Atanu Chaudhuri** (Alborg University, Copenhagen, Denmark), **Yuval Cohen** (Tel Aviv Afeka College of Engineering, Israel), **Francesco Pilati** (University of Bologna, Bologna, Italy), and **Xavier Brusset** (Skema Business School, France)

Industry 4.0 is about the adoption of new technologies in the industrial arena. The major technology, called Industrial Internet of Things (IIoT), includes massive transformation in digitization and communication between the industrial shop floor and the digital world. Assembly lines and assembly systems are a major echelon in the value chain of many products, and are related to the coupling of various parts. However, in the era of Industry 4.0, the parts can communicate with each other while data is constantly being gathered. In a broader view, the supply chain will be affected as well. Things will be connected along the supply chain, and decision-making and reasoning abilities will be enabled. Also, a disrupting technology like blockchain is more likely than ever to alter the way we view the value chain, structure-wise and operation-wise. This research explores the impact of the IIoT on three levels: strategic, tactical, and operational.

Keywords: Smart manufacturing, Industry 4.0, Assembly 4.0

SUPPLY CHAIN DESIGN AND MANAGEMENT

Hussein Naseraldin

The main objective of supply chain management is to achieve operational excellence across all aspects of a firm. This can be achieved by maximizing the value created by each and every decision and operation. This optimization results in superior performance, which leads to an increasing market share with satisfied customers. To achieve this, all decisions must be aligned and integrated. That is, operational decisions must be taken into consideration when making strategic decisions. Among the most important strategic decisions in a supply chain context are the number and location of facilities.

Keywords: Supply chain design, network configuration, multi-echelon, supply chain performance

SYSTEM INTEGRATION

Meir Tahan

Engineering system integration presents a multiplicity of challenges. Among other things, different disciplines must be balanced, the work of several teams must be coordinated, and the issue of units that are necessary but not available on time must be handled. Special test equipment must be designed, hubs and stubs must be prepared, and risks that are liable to occur during integration must be assessed and prevented. All these problems and difficulties result in schedule delays and unplanned expenses.

This paper presents a structured methodology for building an integration preparation plan and thereafter guiding the actual integration. The methodology is based on the "V" model for systems engineering. The left side of the "V" represents the design stage and the right side represents the integration stage. The "looking forward" methodology follows the development steps, and at each step looks forward to the relevant integration step, anticipating what may be required for successful integration. This action creates versatile integration tools that are sufficiently flexible to absorb unexpected variations in the project.

Keywords: System integration, testing, verification, validation

INTEGRATION PLAN

Meir Tahan and **Roy Benish** (HTS – High-Tech Solutions)

An integration plan is usually prepared intuitively by experienced engineers based on their previous experience and on project constraints. Since this plan is intuitive, it may not be optimal. The integration process involves severe uncertainties such as units not being available on time, integration increment duration, and testing costs. Many times, such uncertainties cause changes in the project plan. The integration team members may find themselves unprepared for these changes,again because the integration plan is not optimal. This research offers a model-based software tool for finding an optimal path for system integration. The tool finds the optimum path, assuming deterministic integration parameters or parameters with inherent uncertainties. The tool is designed for project managers, integration teams, and academic integration research. It has built-in flexibility to serve a variety of organizations and users.

Keywords: System integration, integration plan, integration tool

EFFECT OF FEEDBACK ON IMPROVING VISUAL ATTENTION SKILLS

Nirit Gavish and **Hagit Krisher** (ORT Braude College – Students' Support Center)

A common cause of reading disorders is visual attention deficit. Research has demonstrated that training using a dedicated training program and protocol can improve visual attention skills and reading abilities. The common method is based on exposing trainees to slow, smooth pursuit tracking of fragmented stimuli. This gradual exposure enables the trainees to acquire

visual attention skills. Until now, however, training was based solely on bottom-up processes and higher-level cognitive inferences; top-down processes were not considered. The current research examines whether adding controlled feedback to the training protocol can support top-down processes, which, in combination with bottom-up processes, will facilitate learning and skill transfer.

Keywords: Training, visual attention, reading, bottom-up, top-down

USE OF SERIOUS GAMING TO IMPROVE INTELLIGENCE ANALYSIS

Doron Faran and **Nirit Gavish**

The quality of intelligence analyses depends on the analysts' skills. Even though training programs supported by e-learning have shown progress, the creative reasoning skills and reflexes of law enforcement agents are not completely optimized. This research focuses on understanding how analysts use both deduction and induction in their thinking, seeking ways to help them fully exploit their skills, knowledge, experience, and creativity. A computerized training program that addresses the major training needs of analysts will be developed, and the serious gaming approach will be used for this training program.

Keywords: Intelligence, serious gaming, training, analysis

WATER QUALITY FUNCTION DEPLOYMENT

Natalia Zaitsev and **Shuki Dror**

Access to a reliable source of potable water is essential for the survival of human life and almost all living organisms. Technological advancements in recent decades have generated a variety of interchangeable methods for improving water quality. This study seeks to create a framework to facilitate the selection of the right technology by a water supplier aiming to improve the quality of tap water being supplied. A structured methodological approach based on Quality Function Deployment (QFD) is presented. This process extracts the desired improvements in water quality (as identified by its users through a questionnaire) and translates them into the required technical improvements, and ultimately, into core technologies ranked by importance. In constructing the water QFD, two matrices representing questionnaire results were analyzed. Normalized improvement scores were calculated at each of three hierarchical levels: customer requirements, technical parameters, and technologies. The components to improve at each level were selected using analysis-of-variance (ANOVA). The methodology for selecting relevant technologies for improving tap water quality was implemented in the Galilee region in Israel.

Keywords: Quality function deployment, tap water quality, importance of technology

OPTIMAL CONTROL OF A TWO-SERVER FLOW-SHOP NETWORK

Yossef Luzon (Tel Aviv University), **Yariv Marmor**, and **Eugene Khmelnitsky** (Tel Aviv University)

This paper suggests a new, intuitive, and simple method for scheduling jobs in a two-server flow-shop network (FSN) with a minimum makespan objective. Multiple types of jobs with corresponding constant service times arrive at the network at various times over a finite time interval. An analog fluid network is proposed, and its optimal fluid control policy determined. This paper makes use of this optimal control policy to suggest a new method for scheduling jobs in the original discrete FSN and prove its asymptotic optimality. The method is particularly attractive because it falls into the class of easy-to-implement and computationally inexpensive online algorithms. Numerical simulations are used to evaluate the performance of the suggested method and show that it performs optimally in almost all simulated instances. Some additional properties of the network are discussed and illustrated.

Keywords: Flow-shop network, scheduling policy, tandem fluid network, optimal control, fluid-based queueing discipline

OPTIMIZATION AND SIMULATION OF ORTHOPEDIC SPINE SURGERY CASES AT MAYO CLINIC

Asli Ozen (University of Massachusetts Amherst), **Yariv Marmor**, **Thomas Rohleder** (Mayo Clinic), **Hari Balasubramanian** (University of Massachusetts Amherst), **Jeanne Huddleston** (Mayo Clinic), and **Paul Huddleston** (Mayo Clinic)

Spine surgeries tend to be lengthy (with a mean time of four hours) and highly variable (with some surgeries lasting 18 hours or more). This variability, along with patient preferences motivating scheduling decisions, has resulted in both low operating room (OR) utilization and significant overtime for surgical teams at the Mayo Clinic. This paper discusses the development of an improved scheduling approach for spine surgeries over a rolling planning horizon. First, data mining and statistical analysis were performed using a large data set to identify categories of surgeries that could be grouped together based on surgical time distributions and could be categorized at the time of case scheduling. These surgical categories are then used in a hierarchical optimization approach with the objective of maximizing a weighted combination of OR utilization and net profit. The optimization model is explored to consider trade-offs and relationships among utilization levels, financial performance, overtime allowance, and case mix. The new scheduling approach was implemented via a custom web-based application that allowed the surgeons and schedulers to identify the best surgical days interactively with patients. A pilot implementation resulted in a utilization increase of 19% and a reduction in overtime of 10%.

Keywords: Operating room scheduling, surgery scheduling, mixed-integer program

INPATIENT FLOW IN HOSPITALS: A DATA-BASED QUEUEING-SCIENCE PERSPECTIVE

Mor Armony (New York University), **Shlomo Israelit** (Rambam Healthcare Campus), **Avishai Mandelbaum** (Technion—Israel Institute of Technology), **Yariv N. Marmor**, **Yulia Tseytlin** (IBM Research), and **Galit B. Yom-Tov** (Technion—Israel Institute of Technology)

Hospitals are complex systems with essential societal benefits and huge mounting costs. These costs are exacerbated by inefficiencies in hospital processes, which are often manifested by congestion and long delays in patient care. Thus, a queueing-network view of patient flow in hospitals is natural for studying and improving performance. The goal of the research is to explore patient flow data through the lens of a queueing scientist. The means is exploratory data analysis (EDA) in a large Israeli hospital, which reveals important features that are not readily explainable by existing models. Questions raised by the EDA include these: Can a simple (parsimonious) queueing model usefully capture the complex operational reality of the Emergency Department (ED)? What time scales and operational regimes are relevant for modeling patient length of stay in the Internal Wards (IWs)? How do protocols of patient transfer between the ED and the IWs influence patient delay, workload division, and fairness? EDA also underscores the importance of an integrative view of hospital units, by, for example, relating ED bottlenecks to IW physician protocols. The significance of such questions and the related findings raise the need for novel queueing models and theory, which are presented here as research opportunities. Hospital data, and specifically patient flow data at the level of the individual patient, is increasingly collected but is typically confidential and/or proprietary. We have been fortunate to partner with a hospital that gives all the research partners access to its data. This enables reproducibility of the findings through a user-friendly platform that is accessible via the Technion's SEELab.

Keywords: Hospitals operation, queueing network, exploratory data analysis (EDA), emergency department, internal ward

AN APPOINTMENT SCHEDULING POLICY FOR HEALTHCARE SYSTEMS WITH PARALLEL SERVERS AND PRE-DETERMINED SERVICE LEVELS

Boris Shnits, **Illana Bendavid**, and **Yariv N. Marmor**

The appointment scheduling problem is well-known in the literature. The use of appointment systems has been adopted widely in many different fields, including service industries and especially healthcare. This research focuses on healthcare systems where patients arrive according to pre-assigned appointments. We consider healthcare systems with several parallel servers, where a given sequence of patients, with randomly distributed service durations and a possibility of no-shows, is to be scheduled. The aim is to minimize the end of day and increase resource utilization while requiring a minimal probability of each appointment starting on time (quality of service). We formulated the problem using mathematical programing and developed a multi-server numerical-based (MSN) algorithm to solve it. We conducted experiments and checked the impact of the problem parameters on the end of day, customers' average waiting time, and the percentage of customers that waited for service, showing how server pooling improves the above system measures. Once the appointments are set, a methodology determines the shift

length to balance overtime costs (costs of overtime hours) against under-time costs (costs of regular, unused hours).

Keywords: Optimization, appointment scheduling, healthcare systems, service levels, simulation

ABRUPT CHANGE OF PROCESS BEHAVIOR: THE ANDERSON-DARLING DETECTION TOOL

Yariv N. Marmor and **Emil Bashkansky**

A manufacturing process must be stable to produce a quality product. When a process-stabilizing factor fails, the behavior of process data, which should indicate a change has occurred, also changes. This change may be discovered by different methods, among which the Anderson-Darling (AD) method has certain advantages—when the change relates to the nature/shape of the data distribution and while location and scale parameters remain unchanged. The authors propose a method of change point detection, based on tracking the maximal contrast between AD statistics before and after the sliding time point inside a moving data window. For the purpose of easy and effective use of the proposed method, a free access auxiliary Excel™ program tool was developed. Performance of the proposed method is studied, and two illustrative examples of its application are presented. The proposed tool can be used both for online and offline data processing.

Keywords: Change point estimation, fault detection, goodness-of-fit methods, process monitoring, simulation modeling

PATIENT DIAGNOSTIC STATE EVOLUTION DURING HOSPITALIZATION: DEVELOPING A MODEL FOR MEASURING CLINICAL DIAGNOSTIC DYNAMICS

Yariv N. Marmor and **Emil Bashkansky**

Patient health is represented by a set of diagnoses, which determines personal health status. Each set corresponds to a certain health state and can be treated as an individual performance in this state, so individual health can be considered as a corresponding multi-state system. Appropriate metrics for measuring patient's state diagnosis changes during hospitalization are proposed. The first metric determines the dissimilarity between two single diagnoses, each of which is based on an internationally recognized classification scheme. The second metric aims to compare two sets of diagnoses with respect to the same patient and is based on the first metric, but uses additional, recently proposed ideas of measuring heterogeneity/segregation between sets of categorical data. A numerical example and a real-world illustration of the above measures are provided. The ultimate goal is the analysis of multi-state health status data to improve the accuracy and quality of medical diagnostics.

Keywords: Medical diagnosis, accuracy, misclassification, dissimilarity, healthcare quality

MINIMUM FLOW TIME IN A TANDEM TWO-SERVER FLUID NETWORK

Yossef Luzon (Tel Aviv University), **Yariv Marmor**, and **Eugene Khmelnitsky** (Tel Aviv University)

This research considers a tandem, two-server fluid network with two fluid types. Each server in the network has two buffers, one for each fluid, and the capacity of each server can be shared among the fluids. An initial amount of fluids is to be processed by both servers and drained through the system. We determine the processing rates for which the servers' capacity is optimally shared, with the objective of minimizing the total flow time. Three cases of the optimal strategy are discussed.

Keywords: Fluids, servers, optimal control, stochastic processes, closed-form solutions, complexity theory, approximation algorithms

DEVELOPING AN OPTIMAL APPOINTMENT SCHEDULING FOR SYSTEMS WITH RIGID STANDBY TIME UNDER PRE-DETERMINED QUALITY OF SERVICE

Illana Bendavid, **Yariv N. Marmor**, and **Boris Shnits**

A critical step in patient care path is diagnosis. The demand for advanced imaging tests such as computerized axial tomography (CAT) scans, magnetic resonance imaging (MRI), and positron emission tomography (PET) has increased dramatically in the past 15 years. Since imaging equipment remains relatively expensive, to fit the demand, the imaging resources must be managed effectively while ensuring required quality of service. In PET, a radiopharmaceutical (radioactive substance) is injected into patients prior to their scans. The time between substance injection and scan (standby or uptake time) is rigid. This constraint makes the patient appointment scheduling more challenging, because if at the end of the expected uptake time the scanner is not available, the quality of the scan is jeopardized (due to the short half-life duration of the substance). The availability of the scanner is a consequence of prior scan appointments and durations. The aim of this work is to develop an approach for appointment scheduling in a system with one scanner, given a sequence of patients and rigid uptake time, to minimize the length of day while satisfying a minimal predetermined quality of service. To solve this stochastic problem, we formulate its equivalent deterministic problem, based on simulated data, as mixed-integer linear programming. To overcome the dimensionality limitations, a simulation-based sequential algorithm solves the problem in a reasonable time. A fixed slot per scan policy, as a benchmark, is inferior to this method, especially in achieving stable and fair quality of service for patients.

Keywords: Optimization, appointment scheduling, healthcare systems, quality of service, simulation

SOME METROLOGICAL ASPECTS OF PREFERENCES EXPRESSED BY PRIORITIZATION OF ALTERNATIVES

Amalia Vanacorea (University of Naples Federico II), **Yariv N. Marmor**, and **Emil Bashkansky**

With the growth of industrial process sophistication, new horizons have opened up for modern metrology. This research focuses on metrological aspects of multi-agent assessment, expressed by

prioritization. Specifically, it examines the case of a group of agents expressing their preferences over a fixed set of alternatives by means of weak orders. Preference chains are compared via simple distance metrics based on cosine similarity. Following a metrological approach, the agents' precision in performing prioritization tasks is evaluated in terms of repeatability and reproducibility. This is done by analyzing the preference variations in different trials of the same prioritization task and among different agents involved in the prioritization process. The paper introduces a median concept for aggregating multi-agent preference orderings to obtain a collective solution. The proposed strategy is illustrated through a case study of consumers expressing their preferences regarding a set of alternatives. Further research opportunities are also discussed.

Keywords: Assessment; preference chain; distance metric; repeatability; reproducibility; decisions fusion

THE RELATIONSHIP BETWEEN INDUSTRIAL ENGINEERING AND MAIN PHYSICAL CONCEPTS

Boris Shnits and **Emil Bashkansky**

The teaching of physics, a basic discipline studied by undergraduate industrial engineers, usually focuses on content, and unfortunately, to a much lesser extent, on general concepts and ideas that are important for a modern industrial engineer. The authors present twelve key physical concepts, which in their view and experience are crucial to the education of intelligent and proficient industrial engineers. The authors provide arguments supporting the direct and indirect relationship between these concepts and the practice of industrial engineering. They emphasize the expediency in adjusting the existing approach to teaching physics to include these concepts, thereby aligning it with modern industrial engineering needs on the eve of the fourth industrial revolution.

BINARY TEST OF LATENT ABILITY: EVALUATION & DESIGN PROBLEMS

Emil Bashkansky and **Vladimir Turetsky**

In recent years, substantial progress in the analysis and interpretation of binary test results has been achieved. This is the simplest issue of unidimensional ability, when the test item performance of the object under test (OUT) can be explained by a single latent ability. The test consists of a set of K test items, where every test item response is estimated on the binary scale basis (pass/fail) and we need to evaluate the intrinsic ability of this OUT. Usually, it is assumed that the results of different test items, applied to the same OUT, are conditionally independent (i.e. the response to one test item does not affect the response to another). Given a specific item response function (IRF) model, assessment of the tested ability usually is produced according to the principle of maximum likelihood estimation (MLE) or on the basis of a Bayesian approach (if some preliminary information about the tested ability exists). When levels of test item difficulties

are known beforehand, the problem solution is relatively easy, but when the number of OUTs is bounded and levels of difficulties are unknown beforehand, analysis of the results faces significant computational difficulties. Nevertheless, in principle, the problem is solvable. However, when we consider how to optimally allocate test resources — that is, how to choose the level of test item difficulties, how many repetitions to perform for every level, what is the criterion of optimality, etc.— we come to terra incognita. The research is an attempt to describe possible approaches to and criteria for the test planning problem, rather than its complete solution. We also treat some real applications of the proposed approach in education and antagonistic games.

CONFERENCES, WORKSHOPS, & SEMINARS

THE ANNUAL GALILEE QUALITY CONFERENCE
Karmiel, Israel; June 2016, May 2018
http://www.braude.ac.il/conferences/quality16/
http://www.braude.ac.il/conferences/quality18/

The IE&M Department conducted 25 research-oriented seminars during 2016-2018.

REFEREED PAPERS

E. Bashkansky, S. Dror and **O. Eliezer,** QFD methodology for linking project success factors to outcomes in a specific business case. *Journal of Modern Project Management*, 5, 3, 2018.

I. Bendavid, Y. N. Marmor, and **B. Shnits**, Developing an optimal appointment scheduling for systems with rigid standby time under pre-determined quality of service. *Flexible Services and Manufacturing Journal*, *30*(1), 54-77, 2018.

H. Peretz, Y. Fried, and **A. Levy**, Flexible work arrangements, national culture, organizational characteristics, and organizational outcomes: A study across 21 countries. *Human Resource Management Journal*, 28, 182-200, 2018.

Y. N. Marmor and **E. Bashkansky**, Abrupt change of process behavior: The Anderson-Darling detection tool. *Quality Engineering*, *30*(2), 283-292, 2018.

N. Yuviler-Gavish, G. Madar, and **H. Krisher,** Effects on performance of adding simple complementary auditory feedback to a visual-spatial task. *Cognition, Technology & Work, 20(2),* 289-297, 2018.

S. Dror, Linking operational plans to business objectives using QFD, *Total Quality Management and Business Excellence*. Online 09 Mar 2017. http://dx.doi.org/10.1080/14783363.2017.1300053

M. Lazarova, H. Peretz, and **Y. Fried,** Locals know best? Subsidiary HR autonomy and subsidiary performance. *Journal of International Business*, 52, 83-96, 2017.

Y. Luzon, **E. Khmelnitsky,** and **Y. Marmor**, Minimum flow time in a tandem two-server fluid network. *IEEE Transactions on Automatic Control*, *62*(7), 3540-3545, 2017.

N. Zaitsev and **S. Dror**, A. Corporate Social Responsibility (CSR) model - A QFD based methodology. *Total Quality Management and Business Excellence*, published online: 17 Dec 2017, 1-12.

S. Dror, Identify Important factors for service simulation experiments using QFD. *Quality and Reliability Engineering International*, 32, 6: 2107–2114, 2016.

E. Bashkansky and **S. Dror**, Matrix approach to analysis of human errors and their prevention by quality engineering and managerial tools. *Quality and Reliability Engineering International*, 32, 2:535–545, 2016.

E. Bashkansky and **V. Turetsky,** Proficiency testing: Binary data analysis. *Accreditation and Quality Assurance,* 21 (4), 265-270, 2016.

I. E. Ben-Gal and **S. Dror**, Taguchi Method for off-line quality control. *Wiley StatsRef: Statistics Reference*. Online. 1–7, 2016.

T. Gadrich and **E. Bashkansky**, A Bayesian approach to estimating uncertainty of inaccurate categorical measurements. *Measurement, 91,* 186-193, 2016.

T. Gadrich and **H. Katriel,** A mechanistic stochastic Ricker model: Analytical and numerical investigations. *International Journal of Bifurcation and Chaos, 26*(4), 2016.

V. Turetsky and **E. Bashkansky** Testing and evaluating one-dimensional latent ability. *Measurement,* 78, 348–357, 2016.

N. Yuviler-Gavish and **H. Krisher,** The effect of feedback during computerised system training for visual temporal integration. *International Journal of Learning Technology, 11,* 3-21, 2016.

N. Yuviler-Gavish and **N. & H. Krisher**, The effect of computerized system feedback availability during executive function training. *Journal of Educational Computing Research, 54,* 701-716, 2016.

N. Yuviler-Gavish and **H. Naseraldin,** The effect of previous experience when introducing a decision aid in a decision support system for supply chain management. *Cognition, Technology & Work, 18,* 439-447, 2016.

ACCEPTED FOR PUBLICATION

A. Vanacore, Y. N. Marmor, and **E. Bashkansky,** Some metrological aspects of preferences expressed by prioritization of alternatives. *Measurement*.

Y. Mikhaylidi, H. Naseraldin, and **L. Yedidsion**, Operations scheduling under electricity time-varying prices. *International Journal of Production Research*.

V. Turetsky and **E. Bashkansky**, Testing and evaluating one-dimensional latent ability. *Measurement*.

BOOKS AND CHAPTERS IN BOOKS

Y.N. Marmor and **E. Bashkansky**, Patient diagnostic state evolution during hospitalization: Developing a model for measuring clinical diagnostic dynamics. In *Recent Advances in Multi-state Systems Reliability* (pp. 343-354). Springer, Cham. 2018.

E. Shamilov, **N. Gavish**, **H. Krisher,** and **E. Horesh**, Tangible user interface. In International Conference on Engineering Psychology and Cognitive Ergonomics, pp. 471-479. Springer, Cham, 2018.

N. Gavish, **H. Krisher,** & **G. Madar**, The effect of feedback in a computerized system of puzzle completion tasks. In International Conference on Universal Access in Human-Computer Interaction. Springer International Publishing, pp. 449-459, 2016.

H. Peretz and **L. Knappert**, The cultural lens. In E. Parry, C. Brewster, & M. Morely. (Eds). *Handbook on Contextual Approaches to Human Resource Management*. Oxford University Press, in press.

REFEREED CONFERENCE PROCEEDINGS

S. Dror and **O. Eliezer**, QFD Methodology for linking project success factors to outcomes in a specific business case. In Proceedings of the *ENBIS 2018* conference, Nancy, France, 20**1**8.

S. Dror, Design of effective performance measurement system using QFD. In Proceedings of the *PMA 2018* Conference, Warsaw, Poland, 2018.

N. Gavish, **D. Faran,** and **M. Berman**, Computerized training to avoid under-exploration tendency in theory of mind. HCI International 2018. Las Vegas, Nevada, USA, 2018.

N. Zaitsev and **S. Dror**, A Corporate Social Responsibility (CSR) based strategies concerning firm's/region's effective development. In Proceedings of the 58th edition of ERSA's landmark event: *58th ERSA Congress*, August 28th-31st 2018, Cork, Ireland, 2018.

S. Dror, Design of service simulation experiments using QFD. In Proceedings of the *RESER 2017* conference, Bilbao, Spain, 20**1**7.

N. Gavish, **D. Faran,** and **M. Berman**, Training exploration in theory of mind. HCI International 2017. Vancouver, Canada, 2017.

S. Dror, QFD for design simulation experiments of service processes. In Proceedings of the *ENBIS 2016* conference, Sheffield, England, 20**1**6.

S. Dror, The house of quality for product service design. In Proceedings of the *RESER16* conference, Naples, Italy, 2016.

N. Gavish, **H. Krisher,** and **G. Madar**, The effect of feedback in a computerized system of puzzle completion tasks. HCI International 2016. Toronto, Canada, p. 449-459, 2016.

ORAL PRESENTATIONS AT INTERNATIONAL CONFERENCES

E. Bashkansky and Y. Marmor, How to overcome problems associated with new types of data, *18th Annual European Network for Business and Industrial Statistics (ENBIS) Conference*, Nancy, France, 2–6 September, 2018.

E. Bashkansky and V. Turetsky, Binary test of latent ability: Evaluation and design problems, *18th Annual European Network for Business and Industrial Statistics (ENBIS) Conference*, Nancy, France, 2–6 September, 2018.

S. Dror, *18th Annual European Network for Business and Industrial Statistics (ENBIS) Conference*, Nancy, France, 2-6 September 2018.

S. Dror, *Performance Measurement and Management (PMA*) *Conference*, Warsaw, Poland**,** 23-26 September 2018.

H. Peretz, Employee reactions to HPWS in multinational companies: Effects of Subsidiary and Parent Cultures. Presented at the Academy of Management, August, Chicago, IL, USA, 2018.

E. Bashkansky and V. Turetsky, Binary test design problem, *International Conference Advanced Mathematical and Computational Tools in Metrology and Testing*, Glasgow, UK, August 2017.

E. Bashkansky and V. Turetsky, Assessing assessors, *17th Annual European Network for Business and Industrial Statistics (ENBIS) Conference*, Naples, Italy, 9–14 September, 2017.

S. Dror, *27th European Association for Research on Services (*RESER*) Conference*, Bilbao, Spain, 7-9 September 2017.

T. Gadrich and **E. Bashkansky**, How to evaluate uncertainty of categorical measurements?, *17th Annual European Network for Business and Industrial Statistics (ENBIS) Conference*, Naples, Italy, 9–14 September, 2017.

T. Gadrich and **H. Katriel**, Estimating a Poisson parameter based on incomplete information: Precision vs. simplicity. *31st European Meeting of Statisticians (EMS)*, Helsinki, Finland, 24-28 July, 2017.

Y. Marmor, *17th Annual European Network for Business and Industrial Statistics (ENBIS) Conference*, Naples, Italy, 9–14 September, 2017

H. Peretz, Addressing the challenges of large scale, cross-national survey data collection. Presented at the Academy of Management, Atlanta, GA, USA, August 2017.

H. Peretz, Generation Y and work values: Are they really that different? A cross-cultural examination using data mining of social networks. Presented at the Global Conference of International HRM, New York City, USA, May 2017.

S. Dror, *16th Annual European Network for Business and Industrial Statistics (ENBIS) Conference*, Sheffield, England, 11-15 September 2016.

S. Dror, *26h European Association for Research on Services (RESER) Conference*, Naples, Italy, 8-10 September 2016.

T. Gadrich and **H. Katriel**, Asymptotic and numerical analysis of stochastic population dynamics using a finite Markov chain. *World Congress in Probability and Statistics, Toronto, Canada,* 11-15 July, 2016.

T. Gadrich and **H. Katriel**, Application of discrete time Markov Chain to ecological models with small population. *2nd International Symposium on Stochastic Models in Reliability Engineering, Life Science and Operations Management (SMRLO'16)*, Beer Sheva, Israel, 15-18 February, 2016.

H. Peretz, The impact of national culture on the use and outcomes of E-HRM. Presented at the Academy of Business, Anaheim, CA., USA, August 2016.

H. Peretz Dual effects of subsidiary and parent organizations' human resource practices on employee responses. Presented at the Academy of Management, Anaheim, CA., USA, August 2016.

NON-REFEREED CONFERENCE PROCEEDINGS AND ABSTRACTS

E. Bashkansky and **Y. Marmor**, Some aspects of multi-agent decisions expressed by prioritization of alternatives. *14th ORT Braude College Interdisciplinary Research Conference*, Pastoral Hotel, Kfar Blum, Israel, 2018.

E. Bashkansky and **Y. Marmor**, New insights from consumer preferences expressed by prioritization chains. *14th ORT Braude College Interdisciplinary Research Conference*, Pastoral Hotel, Kfar Blum, Israel, 2018.

E. Bashkansky and **V. Turetsky**, Binary test of latent ability: Evaluation and design problems, *18th Annual European Network for Business and Industrial Statistics (ENBIS) Conference*, Nancy, France, 2–6 September 2018.

E. Bashkansky and **Y. Marmor**, How to overcome problems associated with new types of data, *18th Annual European Network for Business and Industrial Statistics (ENBIS) Conference*, Nancy, France, 2–6 September 2018.

B. Shnits, I. Bendavid, and **Y. Marmor,** An appointment scheduling policy for service systems with parallel servers and pre-determined service levels. *13th ORT Braude College Interdisciplinary Research Conference*, Nahsholim Seaside Resort, Israel, 2017.

I. Bendavid, Y. Marmor, and **B. Shnits,** Appointment scheduling: an empirical based solution and tool. *20th Industrial Engineering and Management Conference (IE&M 2017)*, Tel Aviv, Israel, 2017.

E. Bashkansky, and **V. Turetsky**, Binary test design problem, *International Conference on Advanced Mathematical and Computational Tools in Metrology and Testing*, Glasgow, UK, August 2017.

T. Gadrich and **E. Bashkansky**, How to evaluate uncertainty of categorical measurements?, *17th Annual European Network for Business and Industrial Statistics (ENBIS) Conference*, Naples, Italy, 9–14 September 2017.

E. Bashkansky and **V. Turetsky**, Assessing assessors, *17th Annual European Network for Business and Industrial Statistics (ENBIS) Conference*, Naples, Italy, 9–14 September 2017.

N. Gavish, **D. Faran,** and **M. Berman**, Computerized training for enhancing exploration in theory of mind learning. *Chais Conference for Innovation in Learning Technologies*. Open University, Ra'anana, Israel, p. 40E-48E, 2017.

N. Gavish, **D. Faran,** and **M. Berman**, Computerized training as a tool for training of enhancing exploration. *Initiatives for Promoting Learning in Higher Education*. ORT Braude College, Karmiel, Israel, 2017.

N. Gavish, **Y. Ungar**, **M. Ovadia**, **H. Alper,** and **G. Einy**, Reducing risk when handling hazardous materials by integrating automatic robotic system. *Israel Ergonomics Association Annual Conference*. Herzliya, Israel, 2017.

N. Gavish, **Y. Ungar**, **M. Ovadia**, **H. Alper,** and **G. Einy**, Reducing risk when handling hazardous materials by integrating automatic robotic system. *The 13th ORT Braude College Interdisciplinary Research Conference*. Nahsholim, Israel, 2017.

N. Gavish, **Y. Ungar**, **M. Ovadia**, **H. Alper,** and **G. Einy**, Reducing risk when handling hazardous materials by integrating automatic robotic system. *Quality - South Conference*. Beer Sheva, Israel, 2017.

Y. Marmor and **E. Bashkansky**, Emergency department diagnostic quality and its impact on hospital load. *13th ORT Braude College Interdisciplinary Research Conference*, Nahsholim Hotel, Israel, 2017.

Y. Marmor and **M. Sudry**, Development of an appointment scheduling methodology for several types of patients in a stochastic system with rigid waiting times. *13th ORT Braude College Interdisciplinary Research Conference*, Nahsholim Hotel, Israel, 2017.

I. Bendavid, Y. Marmor, and **B. Shnits,** PET appointment scheduling: An empirical based solution and tool. *12th ORT Braude College Interdisciplinary Research Conference*, Hagoshrim, Israel, 2016.

I. Bendavid, Y. Marmor, and **B. Shnits,** An appointment scheduling policy for healthcare systems with multiple servers, non-flexible uptake time, and pre-determined services levels. *7th Israeli Industrial Engineering and Management Meeting (IIERM)*, Tel Aviv, Israel, 2016.

B. Shnits and **E. Bashkansky**, The relationship between industrial engineering and main physical concepts. *12th ORT Braude College Interdisciplinary Research Conference*, Kibbutz Hagoshrim, Israel, 2016.

Y. Marmor, E. Bashkansky, and **S. Mazin**, Abrupt loss of stability: Anderson Darling detection tool. *12th ORT Braude College Interdisciplinary Research Conference*, p. 39, Kibbutz Hagoshrim, Israel, 2016.

L. Dov, N. Gavish, H. Krisher, E. Horesh, and **E. Shamilov**, Augmented reality training system for teaching cognitive skills in kindergartens. *The 12th ORT Braude College Interdisciplinary Research Conference*. Hagoshrim, Israel, 2016.

L. Dov, N. Gavish, H. Krisher, E. Horesh, and **E. Shamilov**, Augmented reality training system for teaching cognitive skills in kindergartens. *Israel Ergonomics Association Annual Conference*. Tel Aviv, Israel, 2016.

O. Shapiro, N. Gavish, Y. Ungar, and **G. Einy**, Robotics in handling hazardous materials. *12th ORT Braude College Interdisciplinary Research Conference*. Hagoshrim, Israel, 2016.

O. Shapiro, N. Gavish, Y. Ungar, and **G. Einy**, Robotics in handling hazardous materials. Israel Ergonomics Association Annual Conference. Tel Aviv, Israel, 2016.

D. Faran, N. Gavish, and **M. Berman**, Training exploration in theory of mind perception. *12th ORT Braude College Interdisciplinary Research Conference*. Hagoshrim, Israel, 2016.

N. Gavish and **H. Naseraldin**, The effect of timing and complexity of the decision aid in a decision support system for supply chain management. *12th ORT Braude College Interdisciplinary Research Conference*. Hagoshrim, Israel, 2016.

N. Gavish, D. Faran, and **M. Berman**, Training for exploration disposition in Theory of Mind. The 3rd Conference on Cognition Research of the Israeli Society for Cognitive Psychology. Acre, Israel, 2016.

N. Gavish and **H. Krisher**, Computerized training for executive functions: the effect of feedback availability. *Chais Conference for Innovation in Learning Technologies*. Open University, Ra'anana, Israel, p. 34E-40E, 2016.

OTHER PUBLICATIONS

GRANTS

N. Gavish, *Ministry of Economy and Industry. Grant for preventive activities research*, Principal Investigator, 2015-2017.

H. Peretz, *Generation Y and work values: A cross-cultural examination using data mining of social networks*, (*SHRM Foundation*), Principal Investigator. Joint grant with Y. Fried and E. Parry, 2015-2017.

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Journal of Statistical Theory and Practice
Journal of Applied Statistics
International Journal of Advanced Manufacturing Technology

I. Bendavid
Mathematics of Operations Research
Naval Research Logistics
OMEGA
MSO&M Conference

D. Faran
Management Learning

T. Gadrich
Probability and Statistics Letters
Quality Technology and Quantitative Management
Journal of Applied Statistics

N. Gavish
International Journal of Human-Computer Interaction
Interactive Learning Environment
International Journal of Advanced Robotic Systems
Journal of Computer Assisted Learning
Journal of Educational Computing Research
Cognition Technology & Work
PLOS ONE
Cognition
Multimodal Technologies and Interact

H. Naseraldin
Manufacturing & Service Operations Management
Management Science
IIE Transactions
Naval Research Logistics
Production and Operations Management
Journal of Operations Management

European Journal of Operational Research
Applied Mathematical Modeling
International Journal of Production Research
Computers and Industrial Engineering
Central European Journal of Operations Research

H. Peretz
European Journal of Work and Organizational Psychology
International Organizational Performance
Leadership Quarterly
Human Resource Management Journal

B. Shnits
International Journal of Production Research

Y. Marmor
Omega: The International Journal of Management Science
EJOR (European Journal of Operational Research)
IISE (Institute of Industrial and Systems Engineers) Transactions
Applied Mathematics and Computation Journal
Journal of the Operational Research Society
MSOM (Manufacturing and Service Operations Management Society) Conference
Israeli Industrial Engineering & Management Conference
WSC (Winter Simulation Conference)

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