SCIENTIFIC CURRICULUM

BIOGRAPHICAL DATA

Name	Giovanni
Surname	Mazzuto
Nationality	Italian
Date of Birth	March 29, 1983
Residence	Cda Camicipietro snc, 86170 Isernia (IS)
Domicile	Via Adriatica 52, 60027 Osimo (AN)
Telephone	3336140093
Email	g.mazzuto@staff.univpm.it

QUALIFICATIONS

- **PhD XII cycle curriculum "ENERGETICS"** - Awarded on March 15, 2014 at Università Politecnica delle Marche (Ancona, Italy) with thesis entitled: "Fuzzy Cognitive Maps tool for Industrial Engineering." Supervisor: Prof. Maurizio Bevilacqua (Università Politecnica delle Marche Ancona, Italy).
- **Master degree 29/S in Ingegneria dell'Automazione Industriale** - Awarded on July 21, 2010 at Università Politecnica delle Marche (Ancona, Italy) with the thesis entitled: "Tecniche di simulazione per l'analisi della Supply Chain." Thesis advisor: Prof. Maurizio Bevilacqua (Università Politecnica delle Marche Ancona, Italy).
- **Bachelor's degree in Computer and Automation Engineering** - Received on July 21, 2006 at Università Politecnica delle Marche (Ancona, Italy) with a thesis entitled: "Development of a Java interface for simulation and control of a mobile robot". Thesis advisor: Prof. Giuseppe Orlando (Università Politecnica delle Marche Ancona, Italy).

CERTIFICATIONS HELD

- **National Scientific Qualification for Associate Professor**, call D.D. 1532/2016, concursive sector 09/B2, Industrial Mechanical Plants (achieved on 24/07/2018).
- **Facilitator and Workshop Designer** with the LEGO® SERIOUS PLAY® method certified by Association of Master Trainers in the LEGO® SERIOUS PLAY® method (no expiration date).

WORKING EXPERIENCES

- **Period: 01/12/2020 - Present**. collaboration contract prot. n. 1503 of 25/11/2020 at Dipartimento Ingegneria Industriale e Scienze Matematiche, at Università Politecnica delle Marche (Ancona, Italy), titled "Analisi e valutazione della diffusione dell'imprenditorialità nel settore Biohealth" Research responsible: Prof. Maurizio Bevilacqua (Università Politecnica delle Marche Ancona, Italy).
- **Period: 01/02/2020 - 30/11/2020**. collaboration contract prot. n. 119 of 27.01.2020 at Dipartimento Ingegneria Industriale e Scienze Matematiche, at Università Politecnica delle Marche (Ancona, Italy), entitled "Support to the management activities of a Cyber Physical System for the simulation of

advanced manufacturing systems." Research Head: Prof. Maurizio Bevilacqua (Università Politecnica delle Marche Ancona, Italy).

- **Period: 01/02/2019 - 31/01/2020**. Research fellow at Department of Industrial Engineering and Mathematical Sciences, at Università Politecnica delle Marche (Ancona, Italy). Research entitled "Simulation and efficiency tools in Indutry 4.0 perspective for companies operating in the hybrid-additive manufacturing sector." Research leader: Prof. Maurizio Bevilacqua (Università Politecnica delle Marche Ancona, Italy).
- **Period: 01/02/2017 - 31/01/2019**. Research fellow at Department of Industrial Engineering and Mathematical Sciences, at Università Politecnica delle Marche (Ancona, Italy). Research entitled: "Innovative tools for the evaluation of reliability and availability of production systems for the definition of best practices in order to optimize the management of business operations." Research leader: Prof. Maurizio Bevilacqua (Polytechnic University of Marche Ancona, Italy).
- **Period: 01/02/2015 - 31/01/2017**. Research fellow at Department of Industrial Engineering and Mathematical Sciences, at Università Politecnica delle Marche (Ancona, Italy). Research titled: "Development of simulation models for assisted application." Research leader: Prof. Maurizio Bevilacqua (Università Politecnica delle Marche Ancona, Italy).
- **Period: 01/01/2014 - 31/12/2015**. Research fellow at Department of Industrial Engineering and Mathematical Sciences, at Università Politecnica delle Marche (Ancona, Italy). Research titled: Development of simulation models for application in assisted environment." Research responsible: Prof. Maurizio Bevilacqua (Università Politecnica delle Marche Ancona, Italy).

TEACHING ACTIVITY

- **Academic year 2020 - 2021**. Contract professor at Marche Polytechnic University, Faculty of Engineering, course "INDUSTRIAL PLANTS", Master Degree LM33, 9 CFU
- **Academic year 2020 - 2021**. Contract professor at Università Politecnica delle Marche, Faculty of Medicine, course "PREVENTION AND PROTECTION OF RISKS MODULE C", 2 CFU.
- **Academic year 2019 - 2020**. Contract professor at Università Politecnica delle Marche, advanced course "INDUSTRY 4.0 ARCHITECTURES, PROCESSES AND TECHNOLOGIES", 8-hour module on "SIMULATION AND DESIGN OF INDUSTRIAL PROCESSES".
- **Academic year 2019 - 2020**. Contract professor at Università Politecnica delle Marche, Faculty of Medicine, course "PREVENTION AND PROTECTION OF RISKS MODULE C", 2 CFU.
- **Academic year 2019 - 2020**. Contract professor at Università Politecnica delle Marche, Faculty of Engineering, course "DESIGN OF THERMOMECHANICAL INDUSTRIAL PLANTS", Master's degree LM33, 6 CFUs.
- **Academic year 2018 - 2019**. Contract professor at eCampus Telematic University, course of "PLANT DESIGN", Master Degree LM33, 9 CFUs.
- **Academic year 2018 - 2019**. Contract professor at Università Politecnica delle Marche, advanced course "INDUSTRY 4.0 ARCHITECTURES, PROCESSES AND TECHNOLOGIES", 8 hours module on "SIMULATION AND DESIGN OF INDUSTRIAL PROCESSES".
- **Academic Year 2018 - 2019**. Teaching co-advisor for the course "INDUSTRIAL LOGISTICS" (Bachelor Degree, 60 hours) at Università Politecnica delle Marche (Ancona, Italy).
- **Academic year 2017 - 2018**. Teaching co-advisor for the course "INDUSTRIAL LOGISTICS" (Bachelor degree, 60 hours) at Università Politecnica delle Marche (Ancona, Italy).
- **Academic year 2016 - 2017**. Teaching co-advisor for the course "INDUSTRIAL PROJECT AND PLANT MANAGEMENT" (Master degree, 60 hours) at Università Politecnica delle Marche (Ancona, Italy).

- **Academic year 2015 - 2016**. Teaching co-advisor for the course "INDUSTRIAL LOGISTICS" (Bachelor degree, 20 hours) at Università Politecnica delle Marche (Ancona, Italy).
- **Academic year 2015 - 2016**. Teaching co-advisor for the course of "INDUSTRIAL PROJECT AND PLANT MANAGEMENT" (Master degree, 60 hours) at Università Politecnica delle Marche (Ancona, Italy).
- **Academic year 2014 - 2015**. Teaching co-advisor for the course "Industrial Logistics" (Bachelor Degree, 60 hours) at Università Politecnica delle Marche (Ancona, Italy).

INTERNAL/EXTERNAL COLLABORATIONS AND JOURNAL

- Responsible for the group of Industrial Plants ING-IND/17 Università Politecnica delle Marche of the Cyber Physical System at Laboratorio I-Labs.
- External collaborator at LABORATORY OF KNOWLEDGE AND INTELLIGENT COMPUTING (KIC), Department of Computer Engineering Educational Institute of Epirus Arta, Greece, as certified by http://kic.teiep.gr/laboratory-members/?lang=en.
- Member of the advisory board for "INTERNATIONAL JOURNAL OF OPERATIONS AND QUANTITATIVE MANAGEMENT" as attested by http://www.ijoqm.org/advisoryboard.asp.
- Member of the editorial board of the international journal "INTERNATIONAL JOURNAL ON INFORMATION TECHNOLOGIES AND SECURITY" as ADDITIONAL REVIEWER as attested by http://ijits-bg.com/international-editorial-board.
- Guest Editor for INTERNATIONAL JOURNAL OF QUALITY & RELIABILITY MANAGEMENT. Special Issue titled "A BIG DATA ANALYTICS APPROACH TO QUALITY, RELIABILITY AND RISK MANAGEMENT," January 2019, Volume 36, number 1.
- Guest Editor for INTERNATIONAL JOURNAL OF OPERATIONS AND QUANTITATIVE MANAGEMENT. Special Issue entitled "SUSTAINABILITY ASSESSMENT OF INNOVATIVE PRODUCTS, PROCESSES AND SERVICES VS TRADITIONAL ONES," September 2014, Volume 20, number 3.
- Organizing committee member Summer School "Francesco Turco", SSD Impianti Industriali Meccanici entitled "A CHALLENGE FOR THE FUTURE: the role of industrial engineering in a global sustainable economy". Biennium 2013/2014.
- October/November 2017 - Visiting researcher PRESSING LABORATORY OF KNOWLEDGE AND INTELLIGENT COMPUTING (KIC), Department of Computer Engineering at Educational Institute of Epirus of Arta (Greece) under the supervision of Professor Chrysostomos Stylios.

CONFERENCE PARTICIPATION

- IEEE on Systems, Man and Cybernetics 2019- International Conference on "INDUSTRY 4.0", 06-09 October 2019, Bari, Italy.
- POMS 2018 - International Conference on "PRODUCTION AND OPERATIONS MANAGEMENT", October 22-24, 2018, Granada, Spain.
- XXIII Summer School Francesco Turco on "CHALLENGES AND OPPORTUNITIES FOR INDUSTRIAL ENGINEERING", 12-14 September 2018, Palermo (PA), Italy.
- INCOM 2018 - 16th IFAC Symposium on "INFORMATION CONTROL PROBLEMS IN MANUFACTURING", June 11-13, 2018, Bergamo (BG), Italy.
- XXII Summer School Francesco Turco on "INNOVATION AND DEVELOPMENT IN ENGINEERING APPLICATION", 13-15 September 2017, Palermo (PA), Italy.

- CIRP ICME 2017 - 11th CIRP International Conference on "INTELLIGENT COMPUTATION IN MANUFACTURING ENGINEERING", July 19-21, 2017, Ischia (NA), Italy.

SCIENTIFIC ACTIVITY

The scientific activity reported below and focused on the Industrial Mechanical Systems field's topics highlights how the knowledge acquired during the research activity finds fulfillment in the paradigm represented by Industry 4.0. The development of new digital technologies such as augmented reality (memory [2]) and the improvement of those already existing introduces at the plant level significant advantages in the most diverse areas: from energy management to that of operations, from process optimization to total plant integration. As explained in memory [3], optimizing a plant's performance can, and must, be connected to the guarantee of safety conditions for both the operator and the single machine. In this regard, what follows is intended to express precisely this concept. Thus, integrating multiple aspects allows, from the analysis of a specific problem, to identify essential factors, hitherto hidden, to resolve other issues.

FUZZY COGNITIVE MAPS IN INDUSTRIAL MECHANICAL PLANTS

Fuzzy cognitive maps (FCM) can be considered a useful and advantageous tool for analyzing problems of different nature. The possibility to model the perception of a problem according to the knowledge and experience of those who have continuously approached the same allows building models without exploiting mathematical equations sometimes difficult or absent. Moreover, exploiting the fuzzy logic, the FCMs take into account a fundamental aspect such as uncertainty. Every aspect comes modeled and simulated, considering its intrinsic uncertainty.

The use of experts (and not) of the sector allows to evidence hidden aspects, essentially due to the typology of the relationships that everyone has with the problem in analysis. On the other hand, it puts in light a weakness of the method. Memoir [7] highlights how several experts must be involved in constructing the FCM but the domain of knowledge available to each of them is limited to the nature of the relationship with the object under analysis. Considering an expert as reliable because of his proven experience does not imply that his knowledge covers all the problem's aspects. For this reason, again memory [7] defines an approach to expert evaluation and map modeling concerning the areas of interest involved. For example, a doctor may have high credibility for his or her judgments when directed at the medical practice, but perhaps low when referring to drug management practices.

Memory [8] refines the modeling of an FCM, based on the involvement of experts, allowing the use of additional information present, for example, within documents and records or in databases (increasingly used thanks to the development of technologies) to define the weights and relationships constituting the map itself.

As highlighted in the literature, the absence of standardized methodologies for realizing a cognitive map opens to research a vast field of development of the procedure itself. The evolution of information technology and the possibility of accessing large amounts of data imply the development of methodologies that keep pace. Memory [13] improves on the traditional approach by incorporating within it aspects of the DEMATEL methodology, which is very similar to that of FCMs; two specific approaches in decision-making. It highlights their similarity and differences to propose a hybrid modeling decision support system. It can be considered the first example of such hybridization. The results obtained highlight how they can be considered and used jointly, demonstrating their ability to model dynamic behaviors and create an advanced decision support system.

Reasoning in modeling terms, it is important to underline how much data are not always advantageous to obtain the prefixed objectives. They must be reworked, and their abundance requires the development of computationally efficient and effective algorithms.

The need to disseminate the principles behind an effective and efficient data processing methodology was the lever for a special issue in the International Journal of Quality and Reliability Management [5].

The hybrid algorithm proposed in the paper [4] aims, in this regard, to define an approach to model FCMs thanks to the information contained in high complexity datasets, exploiting Swarm Intelligences algorithms such as Bee Colony Optimisation and Flower Pollination Optimisation. The link between them is represented by applying the DB-Scan clustering technique that allows identifying the right number of clusters without a priori knowledge. The hybridization highlights the algorithm's effectiveness in estimating the correlations between the factors involved for a specific problem, with low RMSE and computation time.

The different approaches, defined over the years, have been applied to numerous areas of study in industrial mechanical systems.

Memoirs [1] and [9] demonstrate the tool's effectiveness regarding the analysis of the domino effect in the Supply Chain, specifically in the fashion industry, and the preponderant aspects related to its resilience. The proposed method allows evaluating the most important factors that, from a single triggering event, can damage the entire Supply Chain. By analyzing causal relationships that this methodology highlights, decision-makers can examine the domino effect among concepts that affect Supply Chain resilience in a stepwise fashion.

Memoirs [46] and [11] apply and then review, respectively, cognitive map analysis in the area of Risk Assessment, specifically in the context of clinical risk from drug administration. Memoirs [46] and [11] aim to develop a procedure for analyzing the drug administration process to understand and highlight the critical issues and risks associated with the process and the cognitive mechanisms that govern human decisions during the process itself. The whole drug administration process, from the patients' entrance to the health unit to the drug itself, can hide the potential causes of errors or the lack of compliance procedures—the more complex the system to manage, the greater the liability for incorrect operations. Improved clinical outcomes can result from a more controlled drug administration process, reducing the likelihood of errors by the operators involved. Therefore, it is critical to fully understand the cognitive mechanisms that influence errors and decision making in medication management. Identifying the critical factors that influence drug therapy management process allows the definition of corrective actions for a better and continuous quality of life for the patient.

In memory [49], issues related to accidents in an Italian refinery were studied. Although the company in question has a system for monitoring and controlling machinery, it is involved in a large number of small accidents at work, mainly due to human behavior. For this analysis, it was necessary to investigate which factors, at the individual level, were involved in the perception of risk, constructing the relative FCM. The resulting analysis made it possible to define a method that generically makes it possible to determine the causes of each type of accident. It was possible to decide on that factors such as lack of attention and concentration or fatigue are the main causes of accidents at work. In this way, and in light of the results obtained, managers can establish appropriate control procedures to reduce the likelihood and consequence of a work-related injury.

Safety conditions within an industrial plant and any other reality are closely related to the conditions in which the machines involved operate and where they are located. Memory [21], for this reason, allows defining the essential aspects related to the use of service machines and, consequently, a good maintenance plan directly related to the definition of critical indices to ensure a high level of safety and high quality of service for all plant equipment. The traditional approach, based on inspection and maintenance risk (RBI&M), requires that each parameter considered in the definition of critical indices be divided into intervals to assign a score. By processing these scores, the critical indices are calculated. However, what rules allow the company to define the interval and set the corresponding score? Are these rules subjective or objective? Industry literature points

out that maintenance managers often make these decisions. FCMs have been used to structure and support decision-making processes. The criticality of equipment is described in terms of concepts that affect its operation. No ranges or scores are defined. Only structural and functional characteristics are used to determine an overall criticality index. The resulting fuzzy model can analyze, simulate, test the influence of concepts, and predict system behavior.

VALUATION OF THE ENVIRONMENTAL IMPACT OF PROCESSES AND PRODUCTS

Research in this area has focused on assessing many different products' environmental impacts, especially those in everyday use. In particular, memory [25] was focused on the realization of dishes for domestic use with less impactful materials. Three different materials were analyzed: plastic (polypropylene), ceramic, and mater-bi (biodegradable plastic, "modified starch"). To obtain a detailed analysis, the whole process has been divided into the three macro phases of production, use and disposal. Moreover, to standardize the analysis, it has been analyzed considering the same type of product for each material. The results analyzed in terms of environmental impact, through the LCA software SimaPro 7.3.3, and identifying critical points within the complete life cycle have shown how the use of biodegradable material is not so obvious. The life cycle of the biodegradable mater-bi plate is the most polluting. The use of an alternative biodegradable material or the modification of "modified starch" production processes are the first suggestions that should be considered for process improvement.

The paper [35] compares the environmental impacts associated with cotton yarn production from cultivation to washing and drying when the cotton is supplied by four companies located in four different countries (Egypt, China, India, and the United States). Impressive results were obtained from cultivation scenarios where productivity influences the value of each country's environmental impact. The highest greenhouse effect is produced by the Indian company, with 0.89 kg of CO2 equivalent (per 1 kg of cotton). Fuel consumption and ammonium nitrate are the first elements of the greenhouse effect in all companies due to their extensive use and lack of rotation with other unprofitable crops. In Chinese and Egyptian farms, irrigation sources are severely threatened, and it is necessary to switch from irrigation to drip irrigation system. The cotton yarn production stage provides an impact of 2.81 kg of CO2 equivalent. The most critical impacts of cotton yarn production are the Dyeing (1.24 CO2 kg-eq.) and Spinning (0.64 CO2 kg-eq.) phases and are nearly related to reactive reagents pigments, electricity, and thermal energy. As far as thermal energy consumption is concerned, some improvements in the dyeing plants (recovery of cooling water, the return of condensed steam to the boilers, or reuse of different process waters) can allow the company to reduce CO2 emissions by 41.7%. Besides, a 34.6% reduction in CO2 emissions can be achieved at the spinning stage by using an optimized suction pipe in combination with adjustable inverter control.

However, considering new production processes is not always advisable or necessary. The memoir [10] points out that the simple reuse policy is very often beneficial and economical. Specifically, this study aims to improve an existing honey production supply chain's environmental sustainability by pursuing sustainable supply chain management philosophy and life cycle assessment principles by focusing on the most widely used packaging solution: the glass jar. Once the "AS-IS" honey packaging situation of an Italian province was analyzed, parallel packaging reuse scenarios and redistribution supply chains were modeled, involving different collaboration levels between honey producers and the beekeeping consortium. These scenarios were then compared to the AS-IS situation, taking into account five environmental factors important for bee survival: equivalent carbon dioxide emission, equivalent emissions of triethylene glycol to water and soil, equivalent emission of sulfur dioxide to air, and m2 equivalent reduction of organic crops per year.

The results show that the adoption of a packaging reuse policy together with a policy of collaboration of producers could lead, in five years, to reduce these factors by an average of 16% (with a packaging reuse rate of 10%), to over 70% (with a packaging reuse rate of 85%).

The interesting results obtained from LCA analysis of common objects were the starting point for a learning game designed to help ordinary people understand the importance of our choices in everyday activities such as shopping and cooking. Today, several industries are using life cycle assessment methods to manage risk, create well-considered regulations and policy announcements to protect brands, and redesign processes, products and services. Despite their prevalence, Life Cycle Assessment concepts are still unknown in many academic and industry contexts. In the past, the inability to see our actions' full life cycle has led to unexpected consequences in many fields such as increased cancer rates, destruction of species and habitats, and high levels of waste (both financial and material). This study aims to develop a new educational approach for learning Life Cycle Assessment concepts by applying them to meal preparation daily. The work was carried out through several learning games, called "Cook & Teach" [27], in an engineering course at the Università Politecnica delle Marche (Ancona, Italy). This study aims to investigate three main aspects. The first aspect is the change in the student's knowledge of sustainable development. The second one is the change in the student's perception of his professional skills' growth after completing the project. The last aspect is related to how the student's perception of his motivation and involvement in the project is related to professional skill development change. The game sessions analyzed and discussed in this paper show the educational power and training value of the "Cook & Teach" for LCA topics and how the new game facilitates product selection, as confirmed by all the actors involved. The results highlighted that this new educational approach to teaching LCA principles had stimulated student attention and participation.

The need to disseminate the principles behind a proper selection of activities for greater environmental responsibility was the lever for a special issue in the International Journal of Operations and Quantitative Management [36].

PRODUCTION AND SUPPLY CHAIN MANAGEMENT

The environment in which companies operate has changed profoundly, and with it the company organization has undergone a profound evolution. Over time, there has been a progressive shift of market control from the product to the customer and the end consumer. Today, the need to monitor, anticipate and control sales phenomena, foreseeing the evolution of consumption and market trends is now consolidated. The company and all the individual areas are involved: marketing to management, but the logistics chain still covers a decisive role. This has always been attributed secondary importance, but currently, it has been re-evaluated, thanks also to the Internet's affirmation and the new modalities of exchange of goods and services. The logistics for whichever type of enterprise, is it of small, medium or significant dimensions, has assumed in these last years one determining valence with contours even strategic, contributing to increase the entire "process of business" business.

The memory [26] has the scope to supply information to optimize, as an example, the sanitary logistics of the management of the medicines to face the cut of the sanitary expense. The effects of the different configurations of the pharmaceutical supply chain are quantitatively evaluated on the resulting average stock, service level, and Bullwhip effect of the supply chain studied for a case study of an Italian district, taking three levels: suppliers, central body, and hospitals. A model of the various supply chain configurations was created using simulation. Specifically, 24 supply chain configurations were examined, resulting from the combination of supply chain design parameters, namely: transshipment policies (Emergency Lateral Transshipment or Total Inventory Equalization); reordering and inventory management policies (economic order quantity or economic order range); required service levels (90% or 95%); the number of vans available (one or two). For each

configuration, the average hospital stock, service level, and a "Bullwhip Effect" analysis is calculated. To know which input variables are statistically significant, a DoE (Design of Experiments) analysis was performed. The results obtained provide useful insights and suggestions for optimizing healthcare logistics and the drug supply chain. According to the DoE analysis developed, it can be stated that the introduction of transshipment policies provides important improvements in terms of service levels and inventory. To reduce the "whiplash" effect, which results in decreased service levels and increased management inventory costs, an EOQ reorder policy should be adopted. Results were subsequently tested in simulation and analyzed in memory [17].

In the context of healthcare organizations, memory [30] develops a systemic approach that can detect waste and errors and suggest organizational and/or technological solutions for continuous improvement. The proposed framework involves the integration of IDEF0 and FMEA methods. The developed methodology is applied to the pharmacy department of an average Italian hospital. Using IDEF0, it is possible to identify all activities occurring within the pharmacy warehouse. Also, process mapping allows exploring how the pharmacy communicates with the departments and vice versa. Next, the FMEA technique is applied to perform a risk analysis in the various activities identified. Such an in-depth analysis of the management of activities allows corrective actions to improve the logistics aspect and, consequently, minimize error events. To fully demonstrate the benefits and limitations of the developed approach, extensive validation in various healthcare facilities is required.

An effective way to accelerate and guide the best way a process of change-oriented to innovation and improvement of the Supply Chain is to anchor it to a successful management and operational model. The "lean" model, with its well-established principles and tools, represents an excellent reference model for companies, particularly those where speed, flexibility and operational efficiency are considered essential factors. This paper [33] aims to analyze the effects of fast changes in the packaging line of a pharmaceutical company. Using an integration of several lean practices, the study aims to reduce batch changeover and changeover time by up to 50%, increasing overall equipment effectiveness by 25%. The SMED approach helps the pharmaceutical company eliminate unwanted activities and outsource and reduce internal activities through simplification or standardization. Good manufacturing practice (GMP) procedures in the pharmaceutical industry limit internal configuration items' conversion to external configuration items. It has been shown how the practical application of SMED can bring productivity improvements. In particular, standardization of configuration activities and increased reliability in the material supply chain and reducing the average replacement time, can also reduce the standard deviation of installation process time.

Achieving major improvements in process performance measures such as quality, speed, service, and cost requires a fundamental rethinking and redesign of the underlying process or Business Process Reengineering (BPR). Many companies have been forced to change their processes to survive in a highly competitive market. In the paper [44], a framework based on IDEF3 methodology and dynamic simulation for process analysis and re-engineering is presented. This approach is used to analyze, diagnose, and manage process changes represented with an IDEF3 model. To assess the impact of the considered changes, support the process analysis and model the proposed process's performance, a dynamic simulation is used, specifically an Italian airport. This work aims to demonstrate a BPR technique's performance innovation to achieve significant improvements in critical contemporary performance measures concerning quality service and speed in the airline cargo handling process. Again, the purpose of memory [24] is to automate a manual assembly line following a structured structure in the motorcycle industry. Process re-engineering is implemented to improve and automate the assembly process of a manufacturing company. The manual process transition to the new semi-automated assembly line consists of 4 main phases: as-is analysis, Process Re-engineering and Layout Design, training, and finally, mass production. The study showed that automation of the line produces significant improvements: a consistent increase in workstation saturation, better cohesion with Just in Time principles, reduction in the workforce employed, and increased rigor of the quality control process. The scope of the study was limited to one of the fixed assembly lines. In the future, the company plans to perform similar studies on

the other lines. This investigation shows a significant benefit associated with structured automation of implementation in the assembly process field. The results will be especially relevant to process and logistics managers involved in planning a new assembly line or redesigning an existing one.

The application of new technologies, such as RFID, promises great advantages in the field of BPR: from the cost reduction achieved already at a "non-integrated" level within individual companies, to the total visibility achievable at an "integrated" level of use among all members of the supply chain.

Memory [34] discusses the implementation of an RFID system for the office and furniture division of a leading Italian furniture company. This system allowed for a type of "electronic ID card" to ensure product authenticity and traceability. Through Business Process Re-Engineering (BPR) methods, the "AS IS" and "TO BE" scenarios obtained as a result of the proposed changes are analyzed. In particular, two production steps are explored in this work: sewing and inventory. The differences between the "AS IS" and "TO BE" systems are analyzed to highlight the improvement obtained by using the RFID system and to perform a cost analysis of the management and implementation of new scenarios. In this regard, memory [23] aims to develop a new procedure, based on RFID technology, to reduce clinical risk and simplify surgical instruments' sterilization processes. Automatic identification and data storage will allow the hospital to minimize bacterial infection problems, loss of surgical instruments, and wasted time due to instrument counting and monitoring. This procedure was developed in a medium-sized Italian hospital, focusing on processes performed in sterile operating units, the operating room, and corporate units. The sterilization process of surgical instruments was analyzed as it was always implemented until 2013, identifying any related problems. The process was then redesigned to evaluate the changes involved and identify additional opportunities for improvement. The procedures were modeled using AIO WIN software, which supports the IDEF0 method. Activities related to different management options were analyzed and compared in terms of costs and savings. Successful implementation of any innovation requires an understanding of its benefits and costs. Memoir [42] examines the changes in costs and benefits associated with adopting technology process innovation as the innovation spreads throughout the healthcare industry. Using RFID as an exemplary technology, the study shows the importance of the benefits and costs associated with technological process innovation. The case study analyzed provides the order of magnitude of the problems that can be solved with the introduction of the new system and shows the information provided as an output from the associated computer system. The study identified the profile of costs and benefits related to technology adoption for technology managers in general. It offered some insight into how this profile changes based on the stage of technology evolution. This study proposed the implementation of a medication management system based on RFID technology. The study also revealed that the adoption of RFID technology allows for seamless drug tracking throughout the system. In addition, this technology greatly reduces operators' actions in management and administration operations and, thus, errors.

Such evaluations can be validated through simulative methodologies that are less economically impactful and more straightforward to analyze the results. Memoir [32] aims to develop a Business Process Re-Engineering (BPR) method to analyze and overcome business growth in operational activities. A framework based on the Delphi method, IDEF3 methodology, discrete event simulation, and experiment design is presented to predict future scenarios and analyze their consequences. An Italian airport was surveyed to explain the proposed approach. In particular, the company managing the airport aims to increase air traffic and it is necessary to evaluate the impact of this choice on ground handling operations. The BPR procedure proposed in this paper allowed the company to analyze the internal As-Is handling processes and to design a To-Be scenario to improve the efficiency and quality of service. The paper [51] aims to show an approach to model and solve the airport congestion problem through discrete event simulation software. After analyzing an airport's operation, we modeled it in a discrete event system to realize, through the simulation software Simul 8, a prediction of this system's behavior, varying conditions, and parameters. In particular, we wanted to study economic benefits, the option of airport expansion. Therefore, we examined the hypothesis of 2- and 3-track

expansion of a single-runway airport to evaluate any new situation's economic benefit, based on the relative change in the total cost of the flight queue. Memory [41] is based on a discrete event simulation model and reproduces the sewing department of a clothing company engaged in the fashion industry. It aims to quantitatively evaluate the effects of different production configurations on flow time and throughput. In particular, the production steps of men's jackets are examined. Eight configurations are considered, derived from the combination of two parameters: batch size and the number of machines. For each configuration, the flow time, production capacity, and waiting time are calculated. A subsequent analysis of DoE type was performed on these configurations to identify significant single and combined effects of the above parameters on the observed results. The goal is to achieve improvements in the production process. The data provided by the simulation are used to perform a critical analysis of the system production and lead to the formation of proposals for layout improvements. Consequently, memos [48] and [50] aim to develop a new methodology for designing and managing a supply chain (SC) and, at the same time, for evaluating the performance of each stakeholder involved in a production chain. The proposed methodology was applied to a footwear supply chain based on colored Petri nets (CPNs). The supply chain analyzed in this paper is a complex production system consisting of a network of manufacturers and service providers related to logistics systems that provide transportation and storage. The developed model uses colored and timed Petri nets to represent a supply chain. Resources are Petri Net (PN) locations, tokens are jobs, orders, and/or products, while colors represent job attributes. These colors are used to encode different types of data and values associated with the tokens. A "colored token" represents a specific production order or a certain quantity of one particular material supplied. Therefore, it can be processed in various ways and can be easily located within the CPN model. The use of colored Petri nets allows companies to create a compact representation of states, actions, and events of the modeled system. This network's particular structure allows designers the easy implementation of a simulator using dedicated "object-oriented" programming, which is a useful tool for developing what-if analyses.

OPERATIONS AND PROJECT MANAGEMENT

In recent years, there has been an increased emphasis on operations management (OM) models and theories due to the close ties between competitive and supply chain strategies. Thus, companies must choose appropriate and specific responses to address market challenges. In memoir [20], an optimization process for footwear manufacturing is discussed through the IDEF0 approach, redesign of production planning activity, and introduction of RFID (Radio Frequency Identification) tools to better map the manufacturing process. The AS-IS map of a famous footwear brand was analyzed to identify its strengths and weaknesses through a WHAT-IF analysis. Then, the TO-BE map was identified by introducing a new production scheduler and RFID technologies. The study showed that the new management approach could help the company achieve better production management, thus increasing the opportunity to expand into the global market. Specifically, RFID technology offers a solution to the difficult logistical tracking of inventory or equipment, particularly in applications where optical systems do not work and when read/write capabilities are required. Also, an economic investment feasibility analysis is described that shows the benefits of the redesigned management system.

Project activity planning is one of the most important steps in many industrial processes, from construction to production. Memory [19] aims to define a multi-criteria priority indicator that integrates the principles of critical chain project management (CCPM), which considers the human factor for the delay in task completion, and fuzzy logic (FL), which models human reasoning. The defined priority indicator provides a different distribution of activity weights based on their project schedule position. In particular, the fuzzy scheduling approach was performed to overcome the lack of literature on the subject. The results demonstrated the method's effectiveness and efficiency by improving the makespan project with a 40% reduction compared to traditional approaches. In this regard, product development projects, like many other types of projects, can often exceed their planned schedule by 50% to 100%. This is often attributed to uncertainty or unexpected. To

compensate for this age-old dilemma, project managers and staff have learned to pay by adding additional time to their schedule estimates. Yet, even when they do, projects still exceed their schedules. In this case study, the Theory of Constraints (TOC) and Critical Chain (CC) method is applied to yacht shipbuilding. TOC is an approach that can be used to develop specific management techniques. The TOC technique for project time management is often referred to as the CC technique. By utilizing the synergies provided by the simultaneous adoption of project management policies and critical chain planning methods, considerable changes can be made to produce plans that provide a shorter duration at the lowest possible cost. The purpose of the memoir [29] was to analyze the process as it had always been implemented until 2008, identify any related problems and inconsistencies, and then describe the re-engineering of this process, evaluating and emphasizing the changes involved and identifying additional opportunities for improvement.

In the construction context, memoir [31] considers the problem in planning the activities of a project subject to precedence and resource constraints in a way that optimizes several conflicting objectives. Activity durations cannot be precisely specified in advance. Instead, we assume that based on previous projects' experience, the means, standard deviations, and specific percentiles of the respective probability distributions can be reliably estimated.

The algorithm applied to solve this problem is based on goal programming techniques in conjunction with Goldratt's critical chain management method (CCPM). The algorithm was used in a case study related to constructing an accommodation module for an oil platform. Goal programming is a multi-objective programming technique that attempts to minimize deviations to a set of goal values for the given goals in a way that satisfies all operational constraints of the problem. Several solutions can be obtained and the best solution will depend on the priority associated with each goal. This work has considered project makepan minimization and project resource leveling as goals to be pursued. The results obtained using the proposed algorithm were compared with classical project management techniques (PERT / CPM) that the company involved in the case study used in many projects and the basis for making a real application to help managers in project management, as explained by the memory [12].

Traditional Resource-Constrained Scheduling Project (RCSP) is one of the most complex tasks in the project management industry. Many researchers have devoted efforts in recent years to solve this critical issue. Moreover, interesting studies analyze the problem regarding the mathematical formulation. Thus, tools of exact solutions and/or heuristics allow extending the analysis to a wide range of operational management problems. Memory [15] describes a novel approach for project/process modeling based on timed colored Petri nets (TCPNs) to simplify resource allocation in a resource-constrained problem. In particular, its use provides a robust formalism for representing and analyzing parallel systems. The use of TCPN enables the analysis of interdependencies, criticality, substitution, conflicting resource priorities, and resource availability variations. A new model is proposed and emphasizes the usefulness of real-time task planning in a resource-constrained project environment. Memory [18] continues to develop an approach for project modeling using colored timed Petri nets (TCPNs) to facilitate resource allocation in projects under constraints, commonly encountered in practice since TCPNs provide a powerful formalism for representing and analyzing parallel systems. However, very little has been done to integrate this graphical and mathematical tool with the project management area so far. The case study analyzed concerns the construction of an Italian highway.

Interesting is the contribution of memory [39] that investigates the influence of project managers' personality on a multinational company's success. The methodology proposed to analyze the personality of project managers is based on the Myers-Briggs type indicator. 40 projects carried out in 2012 by multinational companies, concerning new product development (NPD), have been analyzed, comparing the profile of project managers with the results obtained in terms of traditional performance indices (time delay and project over-budget) and performance indices usually used in the "Lean Production" sector (waste time and type of "waste").

A detailed analysis of the most important "waste" during project development is carried out using the VSM (Value Stream Mapping) technique. Based on the Myers-Briggs personality tool, results show that extroverted managers (as opposed to introverted managers) do projects that show less delay and less waste of time. Reticent managers often make "Over-processing" and "Defect" types of waste. In addition, managers perceive lower delays and over-budgeting. Regarding the limitations of this work, it should be noted that we collected data from project managers retrospectively. Although we believe that several aspects of the data collection effort helped improve the results' accuracy, future research could conduct case study research in real-time to obtain more detailed information about the proposed reports and avoid retrospective bias. We also focused on a single respondent, the project manager. This helped us to ensure that their interpretations played an important role in the development of the product. However, we cannot examine team members' opinions that may be different from the views of project managers regarding some questions. This research provides useful information for developing proactive approaches to prevent project failures, including creating more effective messages and methods to help companies make the best choices when hiring managers. In addition, this research would enable organizations better to match short-term organizational needs with appropriate personality types.

MAINTENANCE, SAFETY AND RELIABILITY

Occupational health and safety issues, such as occupational injuries, are among the most important areas of action for global social policy. Memory [49] presents fuzzy cognitive maps (FCM) to explore the importance of relevant factors in industrial plants. For this purpose, industrial plants are described in terms of the factors influencing injury risk and the causal relationships involved. In this work, injuries in an Italian refinery were studied. The company in this setting has a system to monitor and control machinery but has many minor injuries at work. The causes of these injuries were found in human behaviors. To analyze the injuries, it is necessary to investigate the individual-level causes of risk perception. For this investigation, an FCM allows us to construct a risk perception schema. The resulting analysis of all these schemas allowed us to define a method that generically allows determining causes for each type of injury. Indeed, it was possible to determine that poor attention and concentration or fatigue are the main causes of work-related injuries. In light of the findings, managers can establish appropriate control procedures to reduce injury events. In addition, the fourth European Working Conditions Survey revealed that 20% of workers from the EU-15 and 30% from the 10 new member states believe their health is at risk due to work-related stress. Too often, the drive for continuous improvement focuses on efficiency and effectiveness and downplays the importance of process workers' overall consequences.

The memoir [45] aims to provide a comprehensive approach, including all the aspects mentioned above. The case study of an Italian automotive group is proposed. At first, the implementation of a visual workplace is presented, and all related improvements are highlighted. Then we verified the effects of the new operational approach on the workload of mental operators.

In the analysis of possible situations critical to an individual's safety, memoirs [46] and [11] focused on the management of drug therapy, which, like many medical processes, has a high level of complexity. Many errors occur by performing drug management activities since operators must make many decisions and many people are involved. These errors can occur at any stage of drug management, from entry into the healthcare unit, to the drug itself. Fuzzy cognitive maps allowed the authors to highlight the cognitive mechanisms that influence human decisions in drug management. The main factors that predominantly affect drug therapy, up to the final event: the drug itself, were highlighted. The construction of the cognitive map was used to initiate a process of awareness that improved patient safety.

But it is necessary not only to consider what is risky for an operator as much as for a product within the SC and the manufacturing process. The purpose of memoirs [28] and [6] is to define the most suitable blancher-

freezer combination for the preservation treatment of a specific food. The proposed approach in decision making is based on data envelope analysis (DEA). Through efficiency evaluation, each decision-making unit (DMU) is both self-assessed and evaluated across the other DMUs. Cross-valued efficiency provides an order of efficiency among all DMUs, with high discriminatory power, avoiding potentially unrealistic weighting schemes. Efficiency, used to rank and select systems, is a function of the resources used (input values) and the results of each DMU's activity (output values). An interdisciplinary working group defined the correct set of inputs and outputs.

Regarding the blanching process, the selected input parameters are electricity consumption, steam consumption, water consumption, wastewater, biochemical oxygen demand, and peroxidase; the selected output parameters are residual vitamin C and plant performance. For the freezing process, the selected input parameters are power consumption, freezing capacity, dehydration, and freezing time; the output parameter chosen is plant throughput. The proposed approach can be implemented to establish the ideal blancher/freezer selection, also in case it is necessary to include other parameters or other food processing systems. Memoir [37] proposes an inexpensive, rapid, and user-friendly failure and effects analysis (FMEA) system applied to quality control of supplied products. The traditional FMEA has been modified and adapted to the characteristics and requirements of quality control. The paper introduces a new revised FMEA approach, in which the "failure concept" has been changed to "defect concept". Typical FMEA parameters have been modified and a nonlinear scale has been introduced for their evaluation. In addition, two weight functions have been introduced in the calculation of the risk priority number (RPN) to consider several critical situations previously ignored. The RPN is assigned to several similar products to reduce the complexity problem. A comprehensive procedure is provided to help managers decide on critical suppliers, creating homogeneous families to overcome the single product code approach's complexity. The relative importance of factors is evaluated in the RPN definition. This different approach facilitates QA managers by acting as a structured and "friendly" decision support system: the QA manager can easily assess critical situations and simulate different corrective action scenarios to choose the best one. This FMEA technique is a dynamic tool and the process performed is iterative. The method was applied in a small, medium-sized company that manufactures whirlpool tub, shower, spa, and sells bathroom furniture. The business application was performed by involving an inter-functional and multidisciplinary team.

Similarly, memory [40] investigates a different methodology with which to analyze the concept of total quality control (TQC) through the use of a value stream map (VSM). This study investigates the conditions for performing input quality control activities on a supplied product to create values and competitive advantages in the procurement process. The results show that the use of VSM to obtain TQC allows a complete view of the process and provides important technical and economic information. The proposed methodology facilitates and supports decision-making actions in the control process and the type of control needed to execute the process to ensure product compliance. VSM was also investigated in memory [22] to investigate the influence of technology and management practices of new product development (NPD) project on the project's success in terms of observed time to value. Specific hypotheses are posed based on literature searches and semi-structured interviews with project managers used for the pilot study. A total of 40 projects carried out by the multinational company involving NPD, are analyzed, comparing the product and project characteristics with the results obtained in terms of performance indices usually used in the "Lean Production" sector: "waste time" and "waste type". This research showed that "overuse" is the most important waste realized in projects when the product concept is entirely new. Great support was found for the hypothesis that clear product concept definition can reduce waste time. Unexpected result was obtained by analyzing the category "Aspects of the information process". The most frequent use of support systems (i.e., implementation of the quality function, computer-integrated manufacturing, computer-aided design, etc.) tended to increase the waste time. Essential links were also found between aspects of the project team and low wasting time. In conclusion, identifying waste sources can help managers assess their current innovation practices, identify gaps between their current practice and best practices, and define action plans to close these gaps.

The concept has since been revisited by memoir [14] which draws attention to human behavioral factors. The goal is to evaluate a possible solution to improve the NPD process by focusing on the group combination. Time-colored Petri nets (TCPNs) were used to model the NPD process because using colors makes it possible to investigate profoundly different situations and compare different solutions. Two categories of colors were defined to manage the TCPN model: "Operational" (OPg), referred to as traditional activity information, and "Behavioral" (BHg), related to operators' skills. The results show that, if human behavioral factors are considered during the evolution of the process, in conjunction with engineering approaches, it is possible to improve the system and, concerning the personality of the Team Leaders, they must manifest a high performance and perceived personality in combination with the mastery of the project management discipline.

Once again, the paper [43] investigates the comparison between standard and revised techniques. In particular, its purpose is to show the comparison between the results of a standard FMECA, and FMECA with grey relation analysis, in a particular case study of an Italian boiler factory. The standard FMECA application is based on the Priority Number Risk (RPN) method, where the event and severity factors are calculated based on a fault tree analysis of the whole system. Then the theory of gray relations is introduced to determine the risk priority of potential failure causes. The study takes into account particular means used by the factory to collect data about the failures and malfunctions of its boilers, which is the Call Center.

An adequate maintenance plan is directly related to critical indices' definition to ensure a high level of safety and a high level of service quality for all equipment in the plants. According to risk-based inspection and maintenance (RBI & M), the traditional approach requires that each parameter considered in the definition of critical indices is divided into ranges to assign a score to it. With the processing of these scores, the critical indices are calculated. However, what rules allow the company to define the range and assign the relative score? Are these rules subjective or objective? The field literature points out that maintenance managers often perform these decisions. To overcome this approach, a method based on Fuzzy Cognitive Maps (FCMs) is presented in memory [49].

FCMs were used to structure and support decision-making processes. Criticality of equipment is described in terms of concepts that affect its operation. No ranges or scores are defined; only structural and functional characteristics are considered in order to define a criticality index. The resulting fuzzy model can be used to analyze, simulate, test the influence of concepts and predict system behavior. The RBI & M model, proposed in this paper, has been analyzed through an Italian refinery case study. The purpose of the paper [47] is to show a technique for maintenance scheduling and control, used by the oil refinery plant "API" (located in Falconara, Italy) to maintain its resources. Referring to the modern need for a careful maintenance policy and its management techniques and methodologies provided in the relevant literature, we will discuss the critical index, as a synthetic and representative method, widely used by the API plant (although still supported by other methods), on which to base a correct and efficient maintenance policy. In this paper, the data refer to the fifteen elements that will then define the Critical Index, and will be explained in detail later; the years considered are 2009 and 2010. The paper [38] shows the activity of parameterization of maintenance costs, in an Italian combined cycle power generation plant, defining a tool for selecting maintenance packages for the plant. Based on the use of a software program, this tool provides indices and values that identify those maintenance packages and activities that could represent economic risks for the plant. This parameterization work is not intended to determine which maintenance packages should be applied and should not, but is intended to provide guidance to plant maintenance management on which activities are preferable to perform. At the same time, memoir [16] highlights critical issues in the extraction and management of oil, a key energy production element. In particular, oil spills are a critical issue from both an environmental and economic perspective. Association rules mining can describe the frequent patterns that characterize the dataset and explain relationships that can be extracted. Since this technique also provides probability measures of the extracted rules, it can be considered valuable support in defining maintenance procedures and identifying possible failures. The analysis results revealed the characteristics of plants that experienced an oil spill during

the period from 1971 to 2014, as well as the most likely consequences resulting from such losses. For these reasons, they should be considered in the development of both maintenance policies to limit the number of future oil spills, or possibly to be able to address them and limit their impact.

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