Preface

Nowadays, every industrial setting needs a well thought-out, long-term strategy in investing ICT tools, and systems. The industrial systems are becoming more widespread and computer-network enabled. Selecting best solution and defining the scope of each manufacturing process from a plethora of rapidly changing options is incredibly difficult. The ICT solution has proven to be instrumental in the advancement of modern product design and manufacturing processes. In the recent years, there has been a corpus of technologies being used in CAD/CAM/CNC and many more. Among them are the knowledge-based system, artificial neural network, genetic algorithm, agent-based technology, fuzzy logic, Petri Nets, and ant colony optimization.

There is a need of understanding the system from engineering perspectives and methods for the problems to tackle in the industrial environment. The industrial informatics focuses on different methodologies of information technologies to enhance industrial fabrication, intelligence and manufacturing processes. The industrial informatics uses the infrastructure of Information Technology for analysis, effectiveness, reliability, higher efficiency and security enhancement in the industrial environment.

The book presents practical as well as conceptual knowledge of the latest tools, techniques and methodologies of industrial informatics. Each chapter presents the reader with an in-depth investigation regarding the actual or potential role of ICT in the context of the industrial setting. The book presents state-of-the art and future perspectives of industrial information technologies, where industry experts, researchers, and academicians shared ideas and experiences surrounding frontier technologies, breakthrough and innovative solutions and applications.

ORGANIZATION OF THE BOOK


Chapter 1, “Fundamentals of Industrial Informatics and Communication Technologies,” reviews fundamental concepts of industrial informatics and communication technologies. The capabilities of Information and Communication Technologies (ICT) and industrial practices are explained. The chapter also explores opportunities for research problems in the fields of wireless fieldbus systems and wireless industrial communications.

Chapter 2, “Industrial Information Security, Safety and Trust,” discusses fundamentals issues in information security, safety and trust in industrial settings. The chapter explains basics of information security
that includes Confidentially, Integrity, and Availability (CIA) that are one of the essential ingredients of information security. The chapter also discusses various reasons for security loop-holes prevalent in industrial setting. The chapter also presents discussion on security and safety infrastructure, various recommendations and useful tips gathered from state-of-art literature. The chapter has also presented analysis on the security consultants and experts available for providing services to industrial settings.

Chapter 3, “Fuzzy Logic: Concepts, System Design, and Applications to Industrial Informatics,” presents the basic concepts of fuzzy logic and industrial intelligence. The limitations of the conventional crisp logic in describing uncertainties encountered in real life situations are discussed with recourse to some specific examples. Furthermore, the manifestation of human intelligence in handling uncertainties is discussed by taking recourse to fuzzy rule based systems based upon the foundations of fuzzy logic.

Chapter 4, “ANNs for Identifying Shock Loads in Continuously Operated Biofilters: Application to Biological Waste Gas Treatment,” presents different waste gas treatment techniques developed to eliminate odorous and toxic pollutants from air. Authors have also discussed biological waste gas treatment systems such as biofilters that are commonly used in industrial settings to handle emissions at high gas flow rates and low pollutant concentration.

Chapter 5, “Novel Meta-Heuristic Optimization Techniques for Solving Fuzzy Programming Problems,” discusses some of the basic issues and methodologies concerning fuzzy programming problems. The chapter presents three meta-heuristic optimization techniques to solve the fuzzy programming problems in industrial production systems. The chapter also outlines an introduction to real-world industrial problem for product-mix selection involving eight variables and twenty one constraints with fuzzy technological coefficients and thereafter, a formulation for an optimization approach to solve the problem.

Chapter 6, “Functional Safety of Distributed Embedded Control Systems,” presents a new concept of components called “Control Component” (CC) to cover all of the used technologies in the industrial settings. To guarantee the functional safety of distributed control software components, authors have defined an agent-based architecture.

Chapter 7, “Integration of Fuzzy Logic Techniques into DSS for Profitability Quantification in a Manufacturing Environment,” provides insight into the issues relating to integration of fuzzy logic techniques into decision suppport systems for profitability quantification in a manufacturing environment. The chapter presents fuzzy logic algorithms using logistic membership functions and resource variables for decision making aiming at quality improvement.

Chapter 8, “Rough Set Based Aggregation for Effective Evaluation of Web Search Systems,” presents a different set of problem for knowledge base industrial settings. Authors have presented basic concepts and application of Rank Aggregation in commercial search engines. In industrial environment, there are many applications where we need to apply Rank Aggregation.

Chapter 9, “Technology Support for Knowledge Management in Industrial Settings: Issues and Implications,” provides a role of knowledge management techniques for efficient production. Author has argued to develop specific framework for knowledge management (KM) support in industrial environments. The chapter also presents KM in customer based organizations and highlight and discuss, in some detail, the factors which make Information Technology (IT) support particularly specific for KM in industrial settings. In order to design IT tools for effective knowledge sharing, there is a need for researchers to go beyond the theoretical frameworks and concepts.

Chapter 10, “Industrial Informatics: Assertion of Knowledge from Raw Industrial Data,” emphasize on the significance of semantic knowledge management systems in industry, to handle the available resources more efficiently. Authors have provided a review of existing tools and technologies in this domain and highlighted the need and importance of semantic applications for industrial data processing.
Chapter 11, “Adaptive Network Based Fuzzy Interference System (ANFIS) Modeling of an Anaerobic Wastewater Treatment Process,” has presented wastewater characteristics and composition, the hydrodynamics of the process, and microbial activity are critical for achieving long term, optimal reactor performance in industrial settings. This chapter provides sufficient background information on the different biochemical stages of anaerobic treatment, viz., hydrolysis of biodegradable solids, acetogenesis and methanogenesis, the working of a UASB reactor, and some insight into mechanistic modelling of UASBs.

Chapter 12, “Evolutionary Computing: Principles and Applications to Portfolio Optimization,” presents soft computing paradigm to find out possible global optimal solutions to search problems. Author has discussed important of soft computing in the field of industrial informatics to look the challenges of data redundancies and inconsistencies. Different evolutionary algorithms have been put to use to evolve intelligence out of redundancies immanent in industrial databases.

Chapter 13, “Widespread Adoption of RFID Technology,” discusses RFID technology in various application scenarios. Authors has presented a close look at the various applications, the technology driving the RFID systems and presented a comprehensive picture of requirements and considerations of particular RFID technology behind a class of applications like supply chain management.

Chapter 14, “Application of Wireless Sensor Networks in Industrial Settings,” presents background of Sensing, communications and Computing. This chapter discusses about WSN, industrial WSN, and technical challenges. Author has also presented power related issues in WSN. The chapter also discusses some of the major industrial applications and two case-studies of fire-fighting and home healthcare.

Chapter 15, “Linux Based Real-Time Control over Industrial Networks,” presents background of industrial networked control systems. The chapter also presents variable transport delay problem. Authors have shown practical solution of delay problem using GNU/Linux that solves timing correctness by taking project of the plasma cutting machine.

Chapter 16, “Traffic Control of Two Parallel Stations Using the Optimal Dynamic Assignment Policy,” presents investigation of some optimal dynamic policies of assignment to control the entrance of a system. Authors have presented the role of the policy in various application settings.

Chapter 17, “Feasible Automatic Reconfigurations of Real-Time OS Tasks,” discusses some key enabling technologies for reconfigurable uniprocessor embedded real-time systems. Authors have defined Intelligent Agent to automatically check the system’s feasibility after any reconfiguration scenario to verify if all tasks meet the required deadlines. Authors have developed a tool RT-Reconfiguration to support the model.

Chapter 18, “Improving Industrial Product Lifecycle Management by Semantic Data Federations,” authors has pointed the complexity of searching the right information, at the right time, in the right place, and to the right people from large amount of data generated from Internet of Things(IoT). Authors have presented a tool called Aletheia – a distributed Information System that enables the federation and semantic integration of very heterogeneous information sources. The chapter discusses the goals, functionality, and architecture of Aletheia, guided by a real-world case study in the industrial service sector and conducted in cooperation with ABB, a major company providing power and automation technologies, products, and services for utility and industry customers.

Chapter 19, “SoftPLC-Based Control: A Comparison between Commercial and Open-Source EtherCAT Technologies,” presents discussion on Programmable Logic Controllers (PLCs), EtherCAT industrial Ethernet protocol. Authors have also implemented two different EtherCAT commercial and open-source software, respectively.
Chapter 20, “Performance Evaluation of a Dynamic Model of a Photovoltaic Module for Real-Time Maximum Power Tracking,” emphasizes the availability of plentiful renewable resources as an excellent potential to enhance the ability to handle the further development of technology in the generation, storage and distribution of power and energy, and to realize large-scale application of these systems. Authors have also discussed photovoltaic module and presented a dynamic model in MATLAB®/Simulink® MAT/LabVIEW® for such applications.

Chapter 21, “III-V Nitride Based Novel Solid-State Terahertz Power-Source: Application in Defense and Industry,” presents discussion on static and dynamic characteristics of Wide Bandgap. Authors have shown possible applications of such devices in defence and industrial sectors.

Chapter 22, “Secure RFID-Enablement in Modern Companies: A Case Study of the Pharmaceutical Industry,” raises the issues of security threats and privacy issues in RFID technology. Authors have presented case study focusing on the development of detection of counterfeits in the pharmaceutical industries in Europe and in the United States of America that motivates the rising importance for RFID security in industrial settings.

Chapter 23, “An Intelligent Hybrid Model for Bus Load Forecasting in Electrical Short-Term Operation Tasks,” presents a hybrid model for bus load forecasting. The chapter also presents a case study to the real Brazilian electrical system. The reported performance of the models for bus load forecasting is about 14 times faster than the conventional model.

Chapter 24, “Intelligent Techniques for the Analysis of Power Quality Data in Electrical Power Distribution System,” presents intelligent techniques for the analysis of power quality problems in electrical power distribution system. Authors have proposed Artificial Intelligence as a tool to monitor the behaviour of electrical power distribution. Authors have used real Power Quality (PQ) data from a power utility in Victoria Australia to show the effectiveness of the model.

WHO AND HOW TO READ THIS BOOK

This book has three groups of people as its potential audience, (i) undergraduate students and postgraduate students conducting research in the areas of industrial informatics and manufacturing intelligence; (ii) researchers at universities and other institutions working in these fields; and (iii) practitioners in the R&D departments of industrial settings. This book differs from other books that have comprehensive case study and real data from industrial settings. The book has focus on manufacturing intelligence along with industrial informatics.

The book can be used as an advanced reference for a course taught at the postgraduate level in industrial engineering, manufacturing intelligence, and industrial informatics. It can also be used as a source of modern manufacturing techniques and contemporary applications in the areas of industrial communication technologies, PLC, RFID, EtherCAT, FieldBUS, WSN, IEEE 802.11, and beyond, since some 1000+ publications have been cited and listed in the reference lists of all chapters.

Mohammad Ayoub Khan
Ministry of Communications and Information Technology, India

Abdul Quaiyum Ansari
Jamia Millia Islamia, India