Automation Production Systems Computer Integrated Manufacturing

Automation Production Systems Computer Integrated Manufacturing Automation Production Systems A Comprehensive Guide to Computer Integrated Manufacturing CIM Computer Integrated Manufacturing CIM represents the pinnacle of automation in production seamlessly integrating various aspects of manufacturing using computer systems This guide provides a comprehensive overview of CIM its implementation best practices and potential pitfalls I Understanding Computer Integrated Manufacturing CIM CIM utilizes computer systems to control and integrate all aspects of manufacturing from design and planning to production quality control and distribution It aims to optimize efficiency reduce waste improve quality and enhance flexibility Key components include ComputerAided Design CAD Creating and modifying product designs using software Example Using SolidWorks to design a car engine ComputerAided Manufacturing CAM Translating CAD designs into instructions for manufacturing equipment Example Generating CNC machining code from a CAD model ComputerAided Engineering CAE Simulating and analyzing product performance before manufacturing Example Performing finite element analysis on a bridge design Manufacturing Execution Systems MES Monitoring and controlling realtime production processes Example Tracking the progress of parts on a factory floor in realtime Enterprise Resource Planning ERP Integrating all business functions including manufacturing finance and human resources Example Using SAP to manage inventory sales orders and production schedules Robotics and Automated Guided Vehicles AGVs Automating repetitive tasks and material handling Example Robots welding car bodies or AGVs transporting materials within a warehouse Supervisory Control and Data Acquisition SCADA Monitoring and controlling complex industrial processes Example Managing a power plant or water treatment facility II Implementing a CIM System A StepbyStep Guide Implementing a CIM system is a complex undertaking requiring careful planning and 2 execution Follow these steps 1 Needs Assessment Identify your manufacturing challenges and objectives What areas need improvement What are your goals for automation 2 System Design Define the scope of your CIM system selecting appropriate software and hardware components Consider scalability and future needs 3 Data Integration Establish a robust data infrastructure to connect various systems and ensure seamless data flow 4 Software Selection and Customization Choose appropriate software packages and customize them to meet your specific requirements 5 Hardware Installation Install and configure the necessary hardware including computers robots sensors and network infrastructure 6 System Testing Thoroughly test the entire system to ensure proper functionality and identify potential issues 7 Training and Implementation Train your workforce on how to use the new system and implement it gradually to minimize disruption 8 Monitoring and Optimization Continuously monitor system performance and make adjustments to optimize efficiency and productivity III Best Practices for Successful CIM Implementation Start Small Begin with a pilot project to test the feasibility and effectiveness of CIM before implementing it on a larger scale Invest in Training Proper training is crucial for ensuring successful adoption and maximizing the benefits of CIM Choose the Right Technology Select technology that aligns with your business needs and budget Consider scalability and future upgrades Embrace Data Analytics Utilize data analytics to monitor performance identify bottlenecks and make informed decisions Foster Collaboration Encourage collaboration between different departments and stakeholders to ensure seamless integration Prioritize Cybersecurity Implement robust cybersecurity measures to protect your CIM system from cyber threats IV Common Pitfalls to Avoid Lack of Planning Inadequate planning can lead to costly delays and inefficiencies Insufficient Training Insufficient training can result in low adoption rates and ineffective use

of the system 3 Ignoring Legacy Systems Failing to integrate legacy systems can create data silos and hinder overall efficiency Overlooking Cybersecurity Neglecting cybersecurity can expose your system to vulnerabilities and data breaches Lack of Flexibility A rigid system may struggle to adapt to changing market demands and production requirements Underestimating Integration Complexity The integration of various systems is often more complex than anticipated V Examples of CIM in Action Automotive Industry Robots welding car bodies automated painting systems and AGVs transporting parts Electronics Manufacturing Automated assembly lines for smartphones computers and other electronic devices Pharmaceutical Industry Automated pillcounting and packaging systems robotic arms for precise handling of materials Aerospace Industry CNC machining of complex aircraft parts automated inspection systems for quality control VI Summary Computer Integrated Manufacturing offers significant advantages in terms of efficiency productivity and quality Successful implementation requires careful planning investment in training and a commitment to continuous improvement By avoiding common pitfalls and embracing best practices manufacturers can reap the full benefits of CIM and gain a competitive edge in todays rapidly evolving market VII FAQs 1 What is the cost of implementing a CIM system The cost varies significantly depending on the size and complexity of the system the number of integrated components and the level of customization required Smaller implementations might cost tens of thousands of dollars while largescale systems can cost millions A thorough costbenefit analysis is crucial 2 How long does it take to implement a CIM system The implementation timeframe depends on the size and complexity of the system Smaller projects might take a few months while larger projects could take several years Proper planning and project management are key to timely completion 4 3 What are the key performance indicators KPIs for evaluating CIM effectiveness KPIs include production efficiency throughput defect rates inventory turnover lead times and overall equipment effectiveness OEE Tracking these metrics provides valuable insights into system performance and areas for improvement 4 How can I ensure the security of my CIM system Implement robust cybersecurity measures including firewalls intrusion detection systems access controls and regular software updates Conduct regular security audits and train your workforce on best security practices 5 What are the future trends in CIM Future trends include the increasing adoption of artificial intelligence AI machine learning ML and the Industrial Internet of Things IIoT to further enhance automation efficiency and predictive maintenance capabilities The rise of cloudbased CIM solutions is also anticipated

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the purpose of this book is to discuss the state of the art and future trends in the field of computerized production management systems it is composed of a number of independent papers each presented in a chapter some of the widely recognized experts in the field around the world have been asked to contribute lowe each of them my sincere gratitude for their kind cooperation i am also grateful to peter falster and jim browne for their kind support in helping me to review topics to be covered and to select the authors this book is a result of the professional work done in the international federation of information processing technical committee ifip tc5 com puter applications in technology and especially in the working group wg5 7 computer aided production management this group was established in 1978 with the aim of promoting and encouraging the advancement of the field of computer systems for the production management of manufacturing off shore construction electronic and similar and related industries the scope of the work includes but is not limited to the following topics 1 design and implementation of new production planning and control systems taking into account new technology and management philosophy 2 capm in a cim environment including interfaces to cad and cam 3 project management and cost engineering 4 knowledge engineering in capm 5 capm for flexible manufacturing systems fms and flexible assembly systems f as 6 methods and concepts in capm 7 economic and social implications of capm

automation is the technology that is designed to function without human assistance various control systems are used for the operation of equipment used in factories boilers ships aircraft etc automation is achieved by integrating hydraulic electrical mechanical pneumatic and electronic devices and computers it results in labor electricity cost and material cost saving it also ensures improvement of quality precision and accuracy computer integrated manufacturing is the approach to the use of computers for controlling the production process it allows the exchange of information between processes it is used in multiple domains such as in mechanical engineering electronic design automation industrial and production engineering etc this book unfolds the innovative aspects of automation production systems and computer integrated manufacturing which will be crucial for the holistic understanding of modern manufacturing most of the topics introduced herein cover new techniques and the applications of these processes as this field is emerging at a rapid pace the contents of this book will help the readers understand the modern concepts and applications of the subjects

with the approach of the 21st century and the current trends in manufacturing the role of computer controlled flexible manufacturing an integral part in the success of manufacturing enterprises will take manufacturing environments are changing to small batch with batch sizes diminishing to a quantity of one larger product variety produc tion on demand with low lead times with the ability to be agile this is in stark contrast to conventional manufacturing which has relied on economies of scale and where change is viewed as a disruption and is therefore detrimental to production computer integrated manufac turing

CIM AND FLEXIBLE MANUFACTURING PRACTICES ARE A KEY COMPONENT IN THE TRANSITION FROM CONVENTIONAL MANUFACTURING TO THE NEW MANU FACTURING ENVIRONMENT WHILE THE USE OF COMPUTERS IN MANUFACTURING FROM CONTROLLING INDI VIDUAL MACHINES NC ROBOTS AGVS ETC TO CONTROLLING FLEXIBLE MANU FACTURING SYSTEMS FMS HAS ADVANCED THE FLEXIBILITY OF MANUFACTURING ENVIRONMENTS IT IS STILL FAR FROM REACHING ITS FULL POTENTIAL IN THE ENVIRONMENT OF THE FUTURE GREAT STRIDES HAVE BEEN MADE IN INDIVIDUAL TECHNOLOGIES AND CONTROL OF FMS HAS BEEN THE SUBJECT OF CONSIDERABLE RESEARCH BUT COMPUTERIZED SHOP FLOOR CONTROL IS NOT NEARLY AS FLEXIBLE OR INTEGRATED AS HYPED IN INDUSTRIAL AND ACADEMIC LITERATURE IN FACT THE INTEGRATED SYSTEMS HAVE LAGGED FAR BEHIND WHAT COULD BE ACHIEVED WITH EXISTING TECHNOLOGY

THIS IS AN INVALUABLE FIVE VOLUME REFERENCE ON THE VERY BROAD AND HIGHLY SIGNIFICANT SUBJECT OF COMPUTER AIDED AND INTEGRATED MANUFACTURING SYSTEMS IT IS A SET OF DISTINCTLY TITLED AND WELL HARMONIZED VOLUMES BY LEADING EXPERTS ON THE INTERNATIONAL SCENE THE TECHNIQUES AND TECHNOLOGIES USED IN COMPUTER AIDED AND INTEGRATED MANUFACTURING SYSTEMS HAVE PRODUCED AND WILL NO DOUBT CONTINUE TO PRODUCE MAJOR ANNUAL IMPROVEMENTS IN PRODUCTIVITY WHICH IS DEFINED AS THE GOODS AND SERVICES PRODUCED FROM EACH HOUR OF WORK THIS PUBLICATION DEALS PARTICULARLY WITH MORE EFFECTIVE UTILIZATION OF LABOR AND CAPITAL ESPECIALLY INFORMATION TECHNOLOGY SYSTEMS TOGETHER THE FIVE VOLUMES TREAT COMPREHENSIVELY THE MAJOR TECHNIQUES AND TECHNOLOGIES THAT ARE INVOLVED

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DESIGN OF WORK IN AUTOMATED MANUFACTURING SYSTEMS FOCUSES ON THE NEED TO IMPROVE THE WORKING CONDITIONS IN THE WORKPLACE WHILE AT SAME TIME PUTTING EMPHASIS ON THE USE OF TECHNOLOGIES IN VARIOUS INDUSTRIES THE BOOK TAKES INTO ACCOUNT HOW AUTOMATION HAS ALTERED THE OPERATIONS OF SMALL AND MEDIUM SIZED FIRMS THE TEXT THEN PRESENTS A COMPARISON OF THE USE OF COMPUTER CONTROLLED APPLICATIONS IN DIFFERENT COUNTRIES AND INDUSTRIES AS WELL AS HOW THESE APPLICATIONS HAVE INFLUENCED THE WORKING CONDITIONS OF WORKERS AS WELL AS THE DIVISION OF WORK IN THE WORKPLACE THE CHANGES THAT MANUFACTURING INDUSTRIES HAVE UNDERGONE AND THE ADJUSTMENTS THAT WERE MADE IN ADOPTING THE USE OF AUTOMATED MANUFACTURING SYSTEMS ARE ALSO HIGHLIGHTED ALSO NOTED ARE THE CHANGES THAT COMPUTER AIDED PRODUCTION SYSTEMS HAVE DONE ON ENGINEERING INCLUDING THE OBSERVATION THAT WORKERS CAN EFFECTIVELY WORK IN AN ENVIRONMENT THAT IS PARTIALLY CONTROLLED BY COMPUTER CONTROLLED APPLICATIONS HOWEVER THE TEXT ALSO NOTES THAT ORGANIZATIONAL PROBLEMS HAVE EVOLVED IN FIRMS THAT HAVE ADOPTED COMPUTER CONTROLLED APPLICATIONS THE BOOK CAN BE A SOURCE OF INFORMATION FOR SOCIAL SCIENTISTS AND THOSE INVOLVED IN DEVELOPING COMPUTER CONTROLLED APPLICATIONS IN ORGANIZATIONS

IN THE COMPETITIVE BUSINESS ARENA COMPANIES MUST CONTINUALLY STRIVE TO CREATE NEW AND BETTER PRODUCTS FASTER MORE EFFICIENTLY AND MORE COST EFFECTIVELY THAN THEIR COMPETITORS TO GAIN AND KEEP THE COMPETITIVE ADVANTAGE COMPUTER AIDED DESIGN CAD COMPUTER AIDED ENGINEERING CAE AND COMPUTER AIDED MANUFACTURING CAM ARE NOW THE INDUSTRY STANDA

THE INCREASING COMPLEXITY OF MANUFACTURING SYSTEMS AS WELL AS THE OVERALL DEMANDS FOR FLEXIBLE AND FAULT TOLERANT CONTROL OF PRODUCTION PROCESSES STIMULATES AMONG MANY OTHERS TWO KEY EMERGING TECHNOLOGIES

that are already making an important breakthrough in the field of intelligent manufacturing control and diagnostics these two paradigms are the holonic approach based on the event driven control strategy usually aimed at modular control systems that are directly physically linked with the manufacturing hardware equipment and the multi agent approach developed in the area of distributed information processing the research communities working in both these fields are approaching the problem of intelligent manufacturing from different viewpoints and until recently to a certain extent in an independent way we can however observe quite a clear convergence of these fields in the last few years the communities have started to cooperate joining efforts to solve the painful problems involved in achieving effective industrial practice we can see convergence in the terminology standards and methods being applied

master production scheduling ii 60 on line scheduling 65 specific data requirements 69 mailbox approaches 70 conclusion 72 chapter 7 cell level control 75 introduction 75 ccs classification 77 what is a cell 78 ccs operational modes 80 conclusion 86 chapter 8 equipment level control 89 introduction 89 what is meant by equipment 90 equipment level control structure 92 conclusion 94 chapter 9 conclusion and future trends 95 overall production planning and control functions 98 future trends 100 conclusion 102 appendix i master production scheduling ii 103 references 107 index 109
preface this book is intended as an introduction to production planning and control of automated manufacturing systems as such it links together two diverse fields of interest in the area of production planning and control there is a large body of work completed in analytical models computer structures and overall systems equally for the hardware and detailed control aspects of the equipment used for example nc machines robots etc comprehensive studies have also been completed to cover each area fully would result in a work of several volumes instead this book stresses the important elements of both areas that are vital to effective production planning and control of the whole automated manufacturing system

with the approach of the 21st century and the current trends in manufacturing the role of computer controlled flexible manufacturing an integral part in the success of manufacturing enterprises will take manufacturing environments are changing to small batch with batch sizes diminishing to a quantity of one larger product variety produc tion on demand with low lead times with the ability to be agile this is in stark contrast to conventional manufacturing which has relied on economies of scale and where change is viewed as a disruption and is therefore detrimental to production computer integrated manufac turing cim and flexible manufacturing practices are a key component in the transition from conventional manufacturing to the new manu facturing environment while the use of computers in manufacturing from controlling indi vidual machines nc robots agvs etc to controlling flexible manu facturing systems fms has advanced the flexibility of manufacturing environments it is still far from reaching its full potential in the environment of the future great strides have been made in individual technologies and control of fms has been the subject of considerable research but computerized shop floor control is not nearly as flexible or integrated as hyped in industrial and academic literature in fact the integrated systems have lagged far behind what could be achieved with existing technology

modem manufacturing systems involve many processes and operations that can be monitored and controlled at several levels of intelligence at the highest level there is a computer that supervises the various manufacturing functions whereas at the lowest level there are stand alone computer controlled systems of manufacturing processes and robotic cells until recenty computer aided manufacturing systems constituted isolated islands of automation each oriented to a particular application but present day systems offer integrated approaches to manufacturing and enterprise operations these modem systems known as computer integrated manufacturing cim systems can easily meet the current performance and manufacturing competitiveness requirements under strong environmental

changes cim systems are much of a challenge and imply a systemic approach to the design and operation of a manufacturing enterprise actualy a cim system must take into account in a unified way the following three views the user view the technology view and the enterprise view this means that cim includes both the engineering and enterprise planning and control activities as well as the information flow activities across all the stages of the system

the background to the institute the nato advanced study institute asi people and computers applying an anthropocentric approach to integrated production systems and organisations came about after the distribution of a nato fact sheet to brunei university which described the funding of asls the embryonic director of the asi brought this opportunity to the attention of the group of people some at brunei and some from outside who were together responsible for the teaching and management of the course in computer integrated manufacturing cim in brunei s department of manufacturing and engineering systems this course had been conceived in 1986 and was envisaged as a vehicle for teaching manufacturing engineering students the technology of information integration through project work while the original idea of the course had also included the organisational aspects of cim the human factors questions were not considered this shortcoming was recognised and the trial run of the course in 1988 contained some lectures on people issues the course team were therefore well prepared and keen to explore the people organisation and technology pot aspects of computer integration as applied to industrial production a context was proposed which would allow the inclusion of people from many different backgrounds and which would open up time and space for reflection the proposal to organise a nato asi was therefore welcomed by all concerned

national borders are becoming increasingly open for goods and ideas and this is creating challenges both for the industrialized countries and for the developing world most countries wish to keep and to grow their industries and this requires the design and operation of very complex systems in such a way as to maximize jobs profits and the quality of life in general under quite different conditions an improved understanding of the distinct operations variable trade offs indeed quite individual conceptual models of manufacturing systems in different regions is therefore necessitated this publication addresses various aspects involved in the achievement of the aim it presents new developments in production management methods tools for the evaluation of them and assessments of the adequacy of different production management methods applied to various classes of production systems test cases and application statistics are analysed thereby affording a comprehensive picture of the present situation and a vision for enhanced future development

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