A Study on Integrating Optimization Productivity Improvement through Computer Integrated Manufacturing

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Abstract - This study aims to investigate the potential benefits and challenges of integrating optimization techniques for productivity improvement in Computer Integrated Manufacturing (CIM) systems. CIM is a comprehensive approach that integrates various aspects of manufacturing, including design, planning, production, and control, using computer-based technologies. Productivity improvement is a critical goal for manufacturing organizations, as it directly impacts their competitiveness and profitability. Optimization techniques have shown great promise in enhancing productivity by streamlining processes, reducing waste, and maximizing resource utilization. However, the effective integration of these techniques into CIM systems requires careful consideration and analysis.

Keyword - CIM, Computer

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INTRODUCTION

All stages of product creation and production are included in Computer Integrated Manufacturing (CIM), with the aid of specialized software applications. Application data is seamlessly transferred from one program to another to carry out a variety of tasks. For instance, the product data is developed during the design process. Information cannot be lost in transit from modeling to production software. CIM combines the automated parts of a factory or manufacturing facility by sharing data and facilitating communication between the design, production, and related business operations. Computer-aided manufacturing (CIM) removes the need for humans, who are notoriously sluggish, costly, and prone to making mistakes in the production process. By taking a methodical and all-encompassing view of the manufacturing business, CIM aims to significantly boost output.[1]

According to Bedworth et al. (1991), "Computer Integrated Manufacturing (CIM) is an administration theory in which the elements of plan and manufacturing are supported and composed using computer, correspondence, and data advancements." Work cells, robots, planned capacity and recovery offices, and material handling frameworks are just some of the ways in which CIM may partially or completely robotize flexible production.Another type of academic theory, CIM is used to plan, manage, and run the production of a business. It makes use of computers and other technological devices, makes artificial use of cutting-edge management, production, data, programming, and framework building techniques, and naturally balances the needs of humans, machines, and managers alike. It is common knowledge that modern manufacturing companies will use integrated (for example, enterprise- and value-chain-wide) computer systems that include computers and computer applications. [2-3]

Benefit from CIM

The following advantages are made possible by combining the technologies::

- The development of an interactive system that streamlines manufacturing departments' communications with other relevant departments.
- Access to up-to-date information from any manufacturing or subcontracting facility, whether it be on-site or outside.
- Increased data-change responsiveness for production adaptability.
- More leeway for launching brand-new items.
- The production process is now more precise and high-quality.
- The product quality has been upgraded.
- Management of the information flow between departments and upkeep of a user data library.
- shortening of production times to gain an edge over rivals.

- The whole process of manufacturing and shipping has been streamlined.
- Better resources for training and retraining.[4]

LITERATURE REVIEW

Margherita Peruzzini(2018) When used to the design of industrial jobs, ergonomic principles and human factors analysis attempt to improve employees' health and safety while also ensuring the required performance of the production process. Traditionally, designers have relied on observation of employees in activity to identify awkward positions (such as bending, twisting, overextending, or spinning) and define late remedial procedures in accordance with ergonomic standards. Manufacturing ergonomics may now be evaluated on digital manikins using computer-integrated simulations based on virtual prototypes and digital human models (DHMs). Such simulations open the way for a fresh method of designing production systems by assessing alternative designs and improving the workstation's layout before it's even built. In order to better assist in the design of human-centered manufacturing workstations, this article will compare several computer-integrated setups. Defines a protocol analysis to aid in workstation design, taking into account both physical and cognitive factors, and applies it across a variety of digital environments. In specifically, the research compares and contrasts the conventional method with a 2D desktop setup based on standardized DHMs and a 3D immersive mixed reality setup based on motion capture of actual employees functioning in a mixed environment. To compare the performance of the two digital setups for the definition of re-design activities, an industrial case study is utilized to examine the optimization of a production workstation in the energy business.[5]

Virtanen, T. et al., (2010) Computer-integrated manufacturing (CIM) has several chances for enhancing the manufacturing company's system performance. However, it has been reported that there is always difficulty while implementing CIM due to lack of integration between different functional areas of manufacturing such as sales, R&D, design and engineering, production planning and control, distribution in terms of material and information flows. This might be because to flaws in CIM's layout. This study makes an effort to explore and apply concerns of CIM, realizing its significance from the investment and operational efficiency perspectives. This paper aims to (i) review the design and implementation approaches from a strategic perspective, (ii) identify the gap between theory and practibe in the design and implementation approaches of CIM, (iii) suggest a suitable framework for the design and implementation of CIM with the goal of improving productivity and quality, and (iv) propose future research directions in the development of CIM.[6]

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Andrew Y.C. Nee,(1998) Direct tooling for creating a product, such as molds and dies for injection molded parts and metal stampings, and auxiliary tooling, such as jigs and fixtures, are examples of tooling design for manufacturing processes. This article provides a brief overview of the research conducted in those fields during the last two decades at the National University of Singapore's Department of Mechanical Engineering. It is remarkable that the growing prevalence of computational methods has transformed what was formerly considered a "black art" into a field that incorporates both heuristic and scientific approaches.[8]

X.M. Ding, (2000). provides various advantages over subtractive manufacturing processes, but one of its fundamental limits is that it cannot compromise on surface integrity. Data-driven predictive modeling is described for predicting surface roughness in AM, with the goal of improving the surface integrity of additively manufactured components. Several types of sensors, including as thermocouples, infrared temperature sensors, and accelerometers, are used to gather data on temperature and vibration. An ensemble learning method is introduced for training the surface roughness prediction model. The time and frequency domains are used to assess sensor-based condition monitoring data for features. Only a subset of these features is employed to improve computational efficiency and prediction accuracy. Accuracy of the prediction model is validated by using condition monitoring data from a battery of AM experiments run on a fused fi lament fabrication (FFF) machine. Experiments have shown that the proposed predictive modeling approach can reliably estimate the surface roughness of 3D printed components.[9]

Ashfaque Ahmed Chowdhury (2009) An offshoot of the Organization of the Islamic Conference (OIC), the Islamic University of Technology (IUT) in Bangladesh is the focus of this study, which describes their work in the field of Computer Integrated Design and Manufacturing. Undergraduate and graduate degrees in Engineering and Technology are offered at IUT, which serves primarily as a teaching and research institution. Training the next generation of engineers to design, build, maintain, select, and procure manufacturing engineering systems using cutting-edge technology is one of the primary goals of Computer Integrated Manufacturing (CIM) programs. The article discusses the research conducted on CIM systems, the topics covered in class, and the available lab space. Four-year Bachelor of Science in Mechanical Engineering with a production engineering concentration, Master of Science, and Doctor of Philosophy degrees are all on offer. The undergraduate mechanical engineering program includes a research project lasting thirty-two weeks. Computer-aided design and manufacturing (CAM), computer-aided process planning (CAPP), flexible manufacturing systems (FMS), automated storage and retrieval systems (ASRS), robotics and automated conveyance, computerized scheduling and production control, and a business system integrated by a common database are all areas of research in the Department of Mechanical Engineering.[10]

METHODOLOGY

Organizational structure must be adaptable to accommodate CIM. Consensus is developing that outdated production methods and stringent corporate regulations are a major barrier to CIM. Most American factories are structured to encourage specialized rather than integrated production.

- Unreliable and inaccurate scales.
- Facilities that is somewhat out of date.
- The database is inadequate.
- User animosity.
- A glaring lack of specialized talent.
- Problems with system compatibility.
- The generational divide in management.
- A shift in organizational ideology.
- Mixed-processing facilities.
- Adaptive volume and balance.
- A stale structure.
- Different processes available.
- Disappointment of superiors and/or subordinates.

Architecture of the CIM System

The design of the CIM system should take into account the following commercial and production goals.:

- To ensure that the quality of our goods remains stable at all times.
- To get items sent out promptly.
- Thirdly, to broaden the selection available to buyers.
- To develop items that function more effectively.
- to create plans for mass production of electrical products.

that the industrial sector adapts to new circumstances more quickly than in the past. Agile, lean, and virtual businesses are just a few examples of manufacturing techniques that might benefit from using CIM. As a result, research on CIM's potential for growth, its potential uses, and its potential implications in the factories of the future is essential. ERP (Enterprise Resources Planning; not limited to planning) and MES (Manufacturing Execution Systems) seem to be the conceptual pillars of the present day, rather than CIM.

Rising Needs

CAD/CAM integration and control of all Manufacturing processes characterizes the CIM vision of a fully automated plant. Product designers and engineers may now share the same database with production planners and schedulers, shop floor foremen, and accountants. It's one of the cutting-edge methods for boosting the economy's productivity. In addition, it is becoming the backbone upon which the next generation of manufacturing systems, now known as Intelligent Manufacturing Systems (IMS), will be built and designed. It has several prospects that might be of help in enhancing manufacturing's competitiveness. The demand for CIM has been the driving force behind its development.

COMPUTER-INTEGRATED MANUFACTURING SYSTEM IMPLEMENTATION

Proposed Research Environment

The establishment of the specialized research labs is urgently required to properly investigate the possibilities of CIM technology in India. During ISCON-2002 in Lahore, Mr. Tariq Masood initially proposed the subscript concept

Proposed Laboratory	Main Tasks	Proposed Location	Proposed Commencement	Tentative Completion
Product Design Automation	R & D of technology and products for CAD/CAM/CAE in CIMS	NWFP Univ. of Engg. & Tech., Peshawar	2002	2005
Process Planning Design Automation	R & D of technology and products for CAPP in CIMS	NUST, Rawalpindi	2002	2005
Integrated Management Decision Information	R & D of technology and products for Computer Aided Management and Decision in CIMS	LUMS, Lahore	2002	2005
Flexible Manufacturing Engineering	R & D of technology and products for FMC/FMS/FME in CIMS	Univ. of Engg. & Tech., Lahore	2002	2005
Quality Control Technology	R & D of technology and products for CAQ in CIMS	NED Univ. of Engg. & Tech., Karachi	2002	2005
Database and Network	R & D of technology and products for Network and Database in CIMS	GIK Institute of Engg. Sciences & Tech., Topi	2002	2005
System Theory and Technology	R & D of technology and products fortheory, simulation, and AI in CIMS	Univ. of Engg. & Tech., Taxila	2002	2005

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Application Basic Research

Project Research in Application When applied to a specific context, fundamental technology may be seen of as a kind of technology-driven research. The goal of this project is to advance CIM research and development throughout the globe by generating the essential concept and principle verifications and novel ideas. The following categories may be used to break down this project::

- Management Information System (MIS)

- Design Automation and CAD/CAM Integration
- Shop floor Automation
- Quality, and others

Applied Engineering

Implementing the idea of labs should take Applied Engineering into account. Following is a list of justifications for establishing the field of applied engineering:

- Since CIMS is a system that optimizes interactions between people, processes, systems, and policies, it is essential for modern businesses to fully grasp CIM technology.
- The examples set by well-established businesses may help other companies in India implement CIMS.
- Applied businesses and academic institutions will serve as a check and balance for each other, leading to more effective outcomes.
- There need to be more than seven companies singled out as exemplars.

DATA ANALYSIS

1. INTERNATIONAL ASPECTS OF CIM IN POST WTO SCENARIO

The International Role Models

Japan is now one of the world's leading economies in terms of CIM implementation. However, there are notable distinctions between the Western approach to CIM and Japan's application. Hitachi Ltd., Mitsubishi Electric Corp., Toyota Motor Corp., Toshiba, Toyo Engineering Corp., Omron Corp., Tokyo Electric Co., Fanuc Ltd., Shimizu Corp., and Nippondenso Corp. are just some of the names on that list. An improved comprehension of Japan's technological competitiveness is made possible by the CIM research into Intelligent Manufacturing Systems (IMS) and the foundation for preparation of the so-called Future Generation of Manufacturing Systems (FGMS). When economies like Japan's enter the global market, it marks a transition to "Open-CIM," a new generation of CIM that combines the benefits of traditional CIM with those of modern advances in information technology and communication.

C4 (computer-aided design, computer-aided manufacturing, computer-integrated manufacturing, and computer-aided engineering) is an integrated system that replaced GM's previously disparate hardware and software. Through its C4 initiative, General Motors was able to connect its traditionally siloed design, production, and assembly departments. To assure interoperability and interconnectedness among all the actors on the new network, including suppliers, GM decided it was necessary to rebuild the whole production process, despite the fact that its old systems constituted a large financial commitment.

- **International Cooperation Required**

CIM should be a regular subject of debate at national and international conferences in India. Lectures on this topic should be given in India by experts from the United States, Europe, Australia, Japan, China, Taiwan, and other nations with relevant expertise. If we want international academic exchanges to become one of the primary ways of boosting the growth of our CIM technology, we need to work hard to achieve big accomplishments in the main cooperating themes and to open up actively the new possibilities. The establishment of consistent communication channels with relevant international societies is an urgent need. Society for Computer Simulation International (Belgium), International Fuzzy System Association (Canada), Society for Mechanical Engineers (USA), and many more make the list.

2. COMPUTER INTEGRATED MANUFACTURING PATH IN THE FUTURE

Any business hoping to thrive in today's hypercompetitive global market must master the art of communicating relevant information to the right people at the right time. Production can't get away from this need right now. production companies will benefit most from the ability to transport for optional administration and production activities beyond the geographical restrictions among the completely authorized assets. Multiple aspects of modern industry are now being molded by a broad range of global combinations. In this study, we define a virtual enterprise as an ecosystem of interdependent global permutations. Consistently expanding and increasing creative advancement time requires accurate predictions of future research directions in CIM and associated areas. However, on the basis of the ebb and flow of developments in CIM research, an attempt is made to forecast the future direction that will dominate the minds of scientists over the next decade. Virtual businesses are the only ones capable of meeting the sharpness and agility requirements of the current global market. Research into virtual CIM and its use throughout the manufacturing sector is on the upswing, promising a brighter future in light of current market needs. Using virtual CIM has been recommended as a game-changing development for the future of manufacturing to overcome formidable challenges. However, several advancement activities must be done to meet the obstacles of digital endeavors. Therefore, in order to satisfy the competitive and nimble needs of modern economies, research should be further reinforced towards developing a virtual CIM to accommodate the globalized and distributed manufacturing endeavors of today. Coordination of data is praised in a virtual effort, since it is only via data that a virtual association may become substantial, and only by selecting a different era of data innovation would this be possible to be envisioned.American, European, Australian, Japanese, Chinese, and Taiwanese experts in this field are among those working in India. If we want international academic exchanges to become one of the primary ways of boosting the growth of our CIM technology, we need to work hard to achieve big accomplishments in the main cooperating themes and to open up actively the new possibilities. The establishment of consistent communication channels with relevant international societies is an urgent need. Society for Computer Simulation International (Belgium), International Fuzzy System Association (Canada), Society for Mechanical Engineers (USA), and many more make the list.

CONCLUSION

CIM, or computer-integrated manufacturing, is an approach of managing a manufacturing operation using computer systems. Product configuration, process outlining, item booking and control, and state-of-the-art integrated capabilities within a production office all fall under the purview of CIM. All parts of a company must be integrated into the CIM framework. Include capabilities such as business planning, key planning, and client training. Since CIM is meant to be tailored to the needs and applications of a given situation, there is no universally accepted definition of the term. In this way, CIM will be implemented somewhat differently at each company. The purpose of this article is to provide clarity on the rapidly developing prerequisites for launching CIM-focused startups in 21st-century India. To improve production in the post-WTO era, these structures are essential.

REFERENCES

1. K. H. Chen, S, J. Chen, L. Lin, and S. W. Chang, 1998. An Integrated Graphical User Interface (GUI) for Concurrent Engineering Design of Mechanical Parts: Computer Integrated Manufacturing Systems. 11(1-2): 91-112
2. Victor Sandoval, 1994. Computer Integrated Manufacturing in Japan. Amsterdam: Lab. PL-at Ecole Centrale Paris ELSEVIER Sc. Pu. (Manufacturing Engineering)
3. Ambrose, and C. Amon - Systmatic Design of a First Year Mechancial Engineering Course at Carnegie Mellon University, Journal of Mechanical Engineering Education , vol 25, pp. 173 – 181, 1997
4. L. Foston, C. L. Smith, and T. Au - Fundamentals of Computer Integrated Manufacturing. Englewood Cliffs, NJ: Prentice-Hall, 1991.
5. Peruzzini, M., Robotics and Computer Integrated Manufacturing (2018), https://doi.org/10.1016/j.rcim.2018.03.009
6. Virtanen, T. et al., (2010) The design of computer-integrated manufacturing systems "Int. J. Production Economics 34 (1994) 313.-327 0925.5273/94/$07.00 SC) 1994 Elsevier Science B.V. All rights reserved. SSDI 0925-5273(93)E00015-3
7. Gunasekaran (1997) Implementation of computer-integrated manufacturing: A survey of integration and adaptability issues, International Journal of Computer Integrated Manufacturing, 10:1-4, 266-280, DOI: 10.1080/095119297131363
8. A.Y.C. Nee, M.W. Fu, J.Y.H. Fuh, K.S. Lee and Y.F. Zhang, "Automatic determination of 3-D parting lines and surfaces in plastic injection mold design", Annals of the CIRP, 47(1), pp.96-98, 1998.
9. X.M. Ding, J.Y.H. Fuh, K.S. Lee, Y.F. Zhang and A.Y.C. Nee, "A computer-aided EDM electrode design system for mold manufacturing", Int. Journal of Production Research, 38(13), pp.3079-3092, 2000.
10. Ashfaque Ahmed Chowdhury(2009) Computer Integrated Manufacturing Education to Mechanical Engineering Students: Teaching, Research and Practice ,,,vol. 28 (4), pp. 321-333, 2000.

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