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Review of Trends and development in flexible and reconfigurable manufacturing systems

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Abstract- To understand future requirement in manufacturing technologies, on the basis of the expert survey, flexible manufacturing systems are not working up to their full potential. There are various problems associated with FMS like training, reconfigurability, maintenance, software and communication, initial cost. To solve these problems, a manufacturing technology is used known as Reconfigurable manufacturing system desirable next step in the evolution of production systems.

This paper presents the review of new trends and development in a flexible manufacturing system, which leads to introduce Reconfigurable manufacturing system that aims to achieve cost-effective and rapid system changes needed in a short time. Reconfigurable manufacturing system configuration is flexible and used to reduce lead time for launching a new system, rapid manufacturing modification, and new techniques into the existing systems. The technologies related to RMS were identified as modular machines, high-speed machines, and methods, training and awareness for the operation of manufacturing systems.

Keywords- Flexible manufacturing system, new trends in FMS, development in FMS, Virtual manufacturing system, Reconfigurable manufacturing system, high-speed machines, system design, reduce lead time.

1. INTRODUCTION

Unexpected changes in market demandslead to new conditions that manufacturers of consumer goods needed to operate within. Nowadays manufacturing environment is facing various challenges and changes. Traditional manufacturing systems do not solve present market completion problems and a shift is needed. Rapid changes in process technology need to generate production systems which are easily upgradable and into which new technologies and new functions can be easily integrated.

FMS address changes in work orders, production schedules, route sheet, part-programming, and tooling for production of a family of parts. Due to limited capabilities like upgrading, add-ons, customization, and changes in production capacity in flexible manufacturing system lead to the development of new technology like VMS, RMS. The importance of virtual manufacturing system is increasing in the area of developing new manufacturing processes, implementing automated work cells, designing plant facility layouts and workplace ergonomics. VMS reduces cycle times, manufacturing and production costs, improving communication across global facilities to launch new product faster, improve productivity and reduce operating costs for existing product shop.

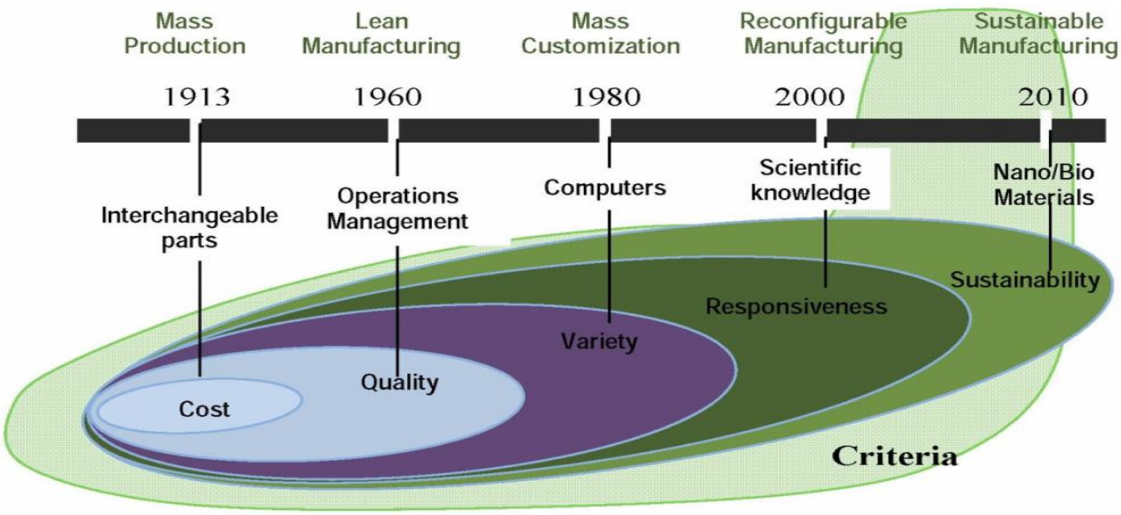

Figure 1: Development of manufacturing technology

VMS is a computer model that represents the overall structure of manufacturing systems and simulates their logical and physical behavior in manufacturing operation. Virtual manufacturing system will provide visualization technology. One of the important components of virtual product lifecycle is virtual prototype. VMS deals with a number of models of various kinds and needs a large amount of computation for simulating the behavior of equipment on a shop floor.

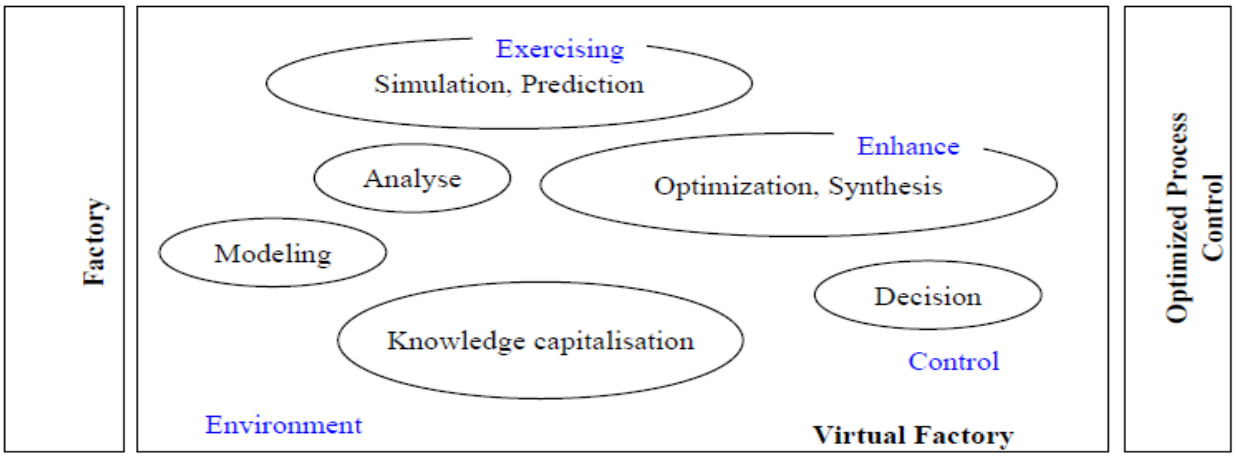

Figure 2: Virtual Manufacturing

The RMS concept was introduced (Koren and Ulsoy,1997; Mehrabi and Ulsoy, 1997; Koren et al.,1999) to respond new market-oriented manufacturing environment. On the basis of design, reconfigurable manufacturing system has a modular structure like software and hardware that allows reconfiguration in strategy to achieve market demands. The key to enabling technology for reconfigurable manufacturing system is modular machines and open-architecture controllers and have the ability to remove/integrate new software/hardware modules without affecting the rest of the system. Due to this RMS have the ability to respond quickly to the production as the market grows and product changes and to be able to integrate new technology (Bollinger and Rusnak, 1998; National Research Council Report, 1998).

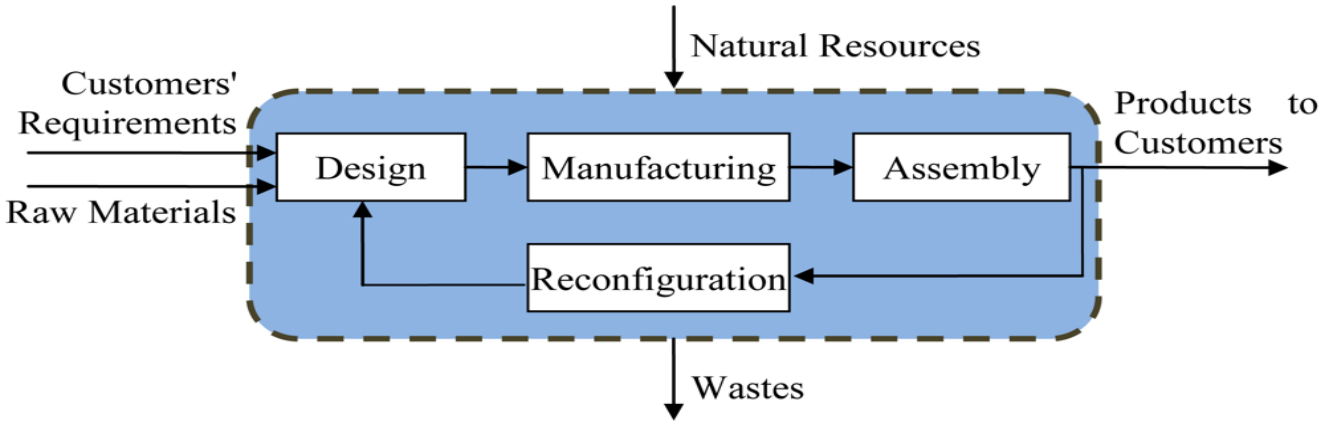

Figure 3: Reconfigurable Manufacturing System

2. LITERATURE REVIEW

The literature of trends and development in flexible and configurable manufacturing system are divided into various categories depending on Virtual manufacturing system, the survey has done like the current assessment of flexible machining systems and key enabling technologies needed for reconfigurable manufacturing systems, the component of the reconfigurable manufacturing system.

A. Flexible Manufacturing System

The Flexible manufacturing system is the combination of manufacturing machine module and material handling equipment controlled by computer systems for the automatic processing to achieve minimum changeover cost.

Table 1 Flexible Manufacturing System

S.No.	Title	Author Name	Year	Result observed
1	Development of Flexible Manufacturing System using Virtual Manufacturing Paradigm	Sung-Chung Kim, Kyung-Hyun Choi	2000	In this study, they developed three models such as the product, the facility and the process model for virtual flexible manufacturing cells which is object oriented paradigm. The VM is to support manufacturability assessments and provide accurate cost, lead time etc.
2	Trends and prespectives in flexible and reconfigurable manufacturing systems	M.G. MEHRABI, A.G. ULSOY, Y. KOREN and P. HEYTLER	2002	FMS has some problems like lack of reconfigurability so an industry developing new technologies like RMS and it is viewed as promising technology with its advanced features.
3	Flexible Manufacturing System A Modern Approach to Manufacturing Technology	ArvindKaushal, Ajay Vardhan, R.S. Rajput	2016	This article discussed about FMS. In order to achieve high productivity and high quality product at low cost as per market demand, FMS is an effective tool.
4	FLEXIBLE MANUFACTURING SYSTEM MODELLING AND PERFORMANCE EVALUATION USING AUTOMOD	Reddy, B.S.P and Rao, C.S.P.	2011	In this author used automad – simulation software used to model and simulate variety of issues. They discussed design and operational issues of automated material handling system.
5	Flexible Manufacturing Systems Scheduling: A Systematic Review	Vivekanand S. Gogi and Dr.K.S. Badarinarayana	2016	This article discussed about major components of FMS namely automatic guided vehicles, Scheduling, artificial neural network and simulation modeling. They suggested there is need for researching on control systems.

B. Virtual Manufacturing System

VMS is the system for flexible manufacturing cells and is used for buildup Computer Integrated Manufacturing. Virtual manufacturing system has been developed using object-oriented paradigm and it is implementing with software.

Table 2: Virtual Manufacturing System

S.No.	Title	Author Name	Year	Result observed
1	CONTROLLING ACTIVITIES IN A VIRTUAL MANUFACTURING CELL	Michael Iuliano Albert Jones	1996	It discusses about virtual manufacturing cell, The virtual manufacturing cell will provide a unique opportunity for testing the capabilities of the existing software applications and adding new ones.
2	VIRTUAL MANUFACTURING Tools for improving Design and Production	Philippe Dépincé, Damien Chablat, Peer-Oliver Woelk	2007	This article explains about virtual manufacturing and its advantages.
3	VIRTUAL REALITY TECHNOLOGIES IN VIRTUAL MANUFACTURING – NOTES ON CURRENT TRENDS AND APPLICATIONS	OgnjanLužanin, MiroslavPlančak	2008	This paper discussed about introducing VR technology in VMS and it also mentioned the types of VR technologies. They explained example of how to build low cost VR technology.
4	Virtual Manufacturing : A Review	Bharath V G, Dr. RajashekarPatil	2015	This review paper presents the origin, concepts, types,systems, applications and drawbacks of Virtual Manufacturing.
5	Virtual Manufacturing and Their Application	ShailendraKumar Bohidar, Prakash Kumar Sen,VivekModi	2015	This paper gives the information about VMS and also suggested that one can gain the benefits of VR system by linking the VMS with parametric CAD/CAM system.

C. Reconfigurable Manufacturing System

RMS is a machining system which can be created by basic modules that can be arranged quickly. Reconfiguration is used to allow adding, removing or modification in specific process capabilities, control to adjust production.

Table 3: Reconfigurable Manufacturing System

S.No.	Title	Author Name	Year	Result observed
1	Reconfigurable Manufacturing Systems	Y. Koren, U. Heisel, F. Jovane, T. Moriwaki, G. Pritschow, G. Ulsoy, H. Van Brussel	1999	To respond to the challenges like global economic completion, rapid social and technological changes have forced manufacturers to introduce new technologies like RMS which replaces the traditional methods.
2	Reconfigurable manufacturing systems: Key to future manufacturing	M.G. MEHRABI, A.G. ULSOY and Y. KOREN	2002	The authors of this article introduced about RMS- the future technology; A new paradigm in manufacturing which is design for rapid adjustment of production capacity and functionality, in response to market conditions.
3	Vision, Principles and Impact of Reconfigurable Manufacturing Systems	YoramKoren and GalipUlsoy	2002	It broadly discussed about the goals and principles of RMS.
4	Reconfigurable manufacturing system: an overview	Malhotra V., Raj T. and Arora A.	2009	In this paper, they introduce the concept, components, capabilities, challenges and characteristics of RMS
5	Research Outline on Reconfigurable Manufacturing System Production Scheduling Employing Fuzzy Logic	TaravatsadatNehzati, Napsiah Ismail, Faieza Abdul Aziz, and Seyed Ali Hosseini	2012	In this they introduced artificial intelligence (Fuzzy logic) based scheduling model to assign job to best alternative machine in RMS.
6	Design of Reconfigurable Manufacturing System: A Review	DeepikaKar ,Dhananjay Kr Singh	2015	It discusses how RMS is configured and they introduced mathematical model for designing RMS.
7	Reconfigurable manufacturing systems: The state of the art	Z. M. BI, S. Y. T. LANG, W. SHEN and L. WANG	2006	This article gives information about requirements of RMS and plans to meet these requirements and he also discussed about issues to design RMS.

Table 4: Comparison of different manufacturing systems

S. No.	Factor	Traditional manufacturing system	Conventional Manufacturing System (FMS)	Advanced manufacturing system (RMS)
1	Process Technology	Fixed	Needs to the adaptable	Responsive
2	Market	Stable	Predictable	Uncertain
3	Manufacturing policy	Pushing	Pulling	Customizing
4	The gap level between manufacturing system and demand variation	Very high	Medium	Low
5	Machine structure	Fixed	Fixed	Adjustable
6	Flexibility	No	General	Customized
7	Scalability	No	Yes	yes

8	System focus	Part	Machine	Part family
9	System structure	Fixed	Adjustable	Adjustable
10	Operation of simultaneous tools	Yes	Yes	yes

Appendix A. Table of abbreviations

S. No.	Description	Abbreviations
1	Flexible Manufacturing System	FMS
2	Virtual Manufacturing System	VMS
3	Reconfigurable Manufacturing System	RMS
4	Virtual Manufacturing	VM
5	Virtual Reality	VR

3. CONCLUSION

The traditional way of production techniques are not suitable to respond to the challenges like global economic completion, rapid social and technological changes, so it leads to development of new technologies like flexible manufacturing system in industries. FMS has some limitations like upgrading, add-ons, customization and changes in production capacity which leads to development of more advanced technology like VMS, RMS. The development in computers, computational techniques and artificial intelligence helped industries to make more sophisticated CAD, CAM and CAE software which play key role in FMS, VMS and RMS. By combining VMS with parametrical CAD/CAM, industries can implement the VR technology. There are three types of VR systems and they are immersive, semi-immersive and non-immersive. The implementation of VMS or RMS is costly so it is not possible for small industries to introduce these technologies.

REFERENCES

[1] Sung-Chung Kim and Kyung-Hyun Choi, "Development of Flexible Manufacturing System using Virtual Manufacturing Paradigm,"International journal of the Korean Society of Precision Engineering, Vol. 1, No. 1, June 2000.

[2] M.G. MEHRABI, A.G. ULSOY, Y. KOREN and P. HEYTLER, "Trends and prespectives in flexible and reconfigurable manufacturing systems,"Journal of Intelligent Manufacturing, 13, 135-146, 2002.

[3] ArvindKaushal, Ajay Vardhan, R.S. Rajput, "Flexible Manufacturing System A Modern Approach to Manufacturing Technology," International Reffered Journal of Engineering and Science (IRJES), Volume 5, Issue 4 (April 2016), PP.16-23.

[4] Reddy, B.S.P and Rao, C.S.P., "FLEXIBLE MANUFACTURING SYSTEM MODELLING AND PERFORMANCE EVALUATION USING AUTOMOD," Int j Simul model 10 (2011)2, 78-90.

[5] Vivekanand S. Gogi and Dr.K.S. Badarinarayana, "Flexible Manufacturing Systems Scheduling: A Systematic Review," Bonfring International Journal of Industrial Engineering and Management Science, Vol. 6, No. 3, June 2016.

[6] Michael Iuliano and Albert Jones, "CONTROLLING ACTIVITIES IN A VIRTUAL MANUFACTURING CELL," Proceedings of the 1996 Winter Simulat1:on Conferenced. J. Iv1.ClJarncs, D. J. A1orrice, D. T. Brunner, and J. J. S\vain.

[7] OgnjanLužanin and MiroslavPlančak, "VIRTUAL REALITY TECHNOLOGIES IN VIRTUALMANUFACTURING – NOTES ON CURRENT TRENDSAND APPLICATIONS," Journal for Technology of Plasticity, Vol. 33 (2008), Number 1-2.

[8] Bharath V G and Dr. RajashekarPatil, "Virtual Manufacturing: A Review," International Journal of Engineering Research & Technology (IJERT)NCERAME-2015 Conference Proceedings.

[9]Shailendra Kumar Bohidar, Prakash Kumar Sen,VivekModi, "Virtual Manufacturing and Their Application," International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 3 Issue V, May 2015.

[10] Philippe Dépincé, Damien Chablat, Peer-Oliver Woelk, "VIRTUAL MANUFACTURINGTools for improving Design and Production,"

[11]Iwata K., Onosato M., Teramoto K., Osaki S. A., Modeling and Simulation Architecture for Virtual Manufacturing System, Annals CIRP, 44, 1995, pp. 399-402.

[12] Lee D.E., Hahn H.T., Generic Modular Operations for Virtual Manufacturing Process, Proceedings of DETC'97, ASME Design Engineering Technical Conferences, 1997.

[13] Y. Koren, U. Heisel, F. Jovane, T. Moriwaki, G. Pritschow, G. Ulsoy, H. Van Brussel, "Reconfigurable Manufacturing Systems," Annals of the CIRP Vol. 48/2/1999.

[14]M.G. MEHRABI, A.G. ULSOY and Y. KOREN, "Reconfigurable manufacturing systems: Key to future manufacturing, "Journal of Intelligent Manufacturing (2000) 11, 403-419.

[15] YoramKoren and GalipUlsoy, "Vision, Principles and Impact of Reconfigurable Manufacturing Systems," Powertrain International, Volume 5, Number 3, 2002, pp. 14-21.

[16] Malhotra V., Raj T. and Arora A., "Reconfigurable manufacturing system: an overview," International Journal of Machine Intelligence, ISSN: 0975–2927, Volume 1, Issue 2, 2009, PP- 38-46.

[17] TaravatsadatNehzati, Napsiah Ismail, Faieza Abdul Aziz, and Seyed Ali Hosseini, "Research Outline on Reconfigurable Manufacturing System Production Scheduling Employing Fuzzy Logic," International Journal of Information and Electronics Engineering, Vol. 2, No. 5, September 2012.

[18] DeepikaKar and Dhananjay Kr Singh, "Design of Reconfigurable Manufacturing System: A Review," International Journal of Scientific Engineering and Applied Science (IJSEAS) - Volume-1, Issue-3, June 2015.

[19] Z. M. BI, S. Y. T. LANG, W. SHEN and L. WANG, "Reconfigurable manufacturing systems: The state of the art," International Journal of Production Research, 2006, 1–26, preview article.

[20] Bollinger, T. (1996) The relationship movement in perspective and some ergonomics implications. Applied Ertgonomics, 27 (2), 111-117.

[21] Jaikumar, R. (1986) Post industrial manufacturing. Harvard Business Review.

[22] Koren, Y. and Ulsoy, A.G. (1997) Reconfigurable Manufacturing System, Engineering Research Center for Reconfigurablr Machining Systems (ERC/RMS) Report # 1, The University of Michigan, Ann Arbor, MI.

[23] Mehrabi, M.G. and Ulsoy, A.G. (1997) State-of-Art in Reconfigurable Manufacturing Systems. Report # 2, Vol. I, Engineering Research Center for Reconfigurable Machining Systems (ERC/RMS), The University of Michigan, Ann Arbor, MI.