Advanced Manufacturing Technology (AMT): A Literature Review

Arif Selim EREN

Kahramanmaraş Sutcu Imam University, Social Sciences Institute, Department of Business Administration, Kahramanmaraş/Turkey

ABSTRACT

This paper presents a literature review of Advanced Manufacturing Technology (AMT) based on a source bank of about 730 AMT publications, software and institutions. After introducing AMT briefly, the study focuses on AMT resources, and history of AMT. Since AMT is a universe of technologies, production methods and methodology about computerized production the three legs of the trivet which construct the basis of AMT are introduced. 10 AMT books are recommended for the use of the researchers. This research is done by using the framework of Chan&Wu(2002). I hope this study will help the practitioners and especially the researchers of AMT.

Key Words: Product Development, Technology Acquisition, Advanced Manufacturing Technology (AMT)

1. INTRODUCTION

AMT is a combination of methodology, production method and technology which aims to ease the way that people produce. With the recent developments and changes both in the market and the claim enterprises are obliged to keep up with these two concepts. Even though it is not uttered beforehand the rationale of AMT starts with the use of first machine. Later on with the use of computers in DNCs the concept is being used till then. In order to provide a reference page for every researcher of the topics included in the text the authors scanned more than 3000 sources of AMT. The ones which seemed to be most relevant to the title are included in the study. Lastly 10 usefull publications of AMT are suggested.

Although they are only mentioned with citations in the study, most of these sources are available from the authors. The articles, books and online resources are classified by sub-titles of AMT trivet.

2. HISTORICAL ORIGINS OF AMT

The history of AMT goes back to 6000 years. The process begins with the use of potter’s wheel and bow drill. This is the beginning of use of technology in manufacturing. The roots of BPA which is an element which constructs BPM originated from this use. Later on, in 1808 Mauldson’s block machine flashed on the development of CMS. Then with the establishment of a discrete department in NCR Corp. HRMS was introduced. Inspired by the views of Frederick Taylor’s management theories and Carl Bath’s machinery applications BPM was being used in manufacture. With the changes in the market and the demand after The Second World War(1945) IRS and NC was used in the production process. During 1950s a lot of improvement was observed such as AS/RS, ONC, CNC, Toyota’s JIT, CAD in arroandance with PDM and PIM, TQM and AGVs. MRP was put forward in 1960 and in 1961 the first robot was used and this led the improvement of Robotics. In 1970s GT, DCS, PLC and also CAM was enounced. 1980s witnessed many development in AMT with the use of g-codes in DNCs CNC and MDE, as an output of CAD/CAM CAPE, CAPP and CAQ as a result of use of TQM and also Lean manufacturing were advanced in this period. In 1990s the use of computer integrated manufacturng systems became more common and this flashed up the development of ERP, SCADA, BPI, RAD, MOM, CONWIP as an alternative to Kanban and lastly IBP. In the 21st Century BPM(modeling), COTS, DSM, HMI, MPM, OBASHI, SOA, S&OP, OEE and lastly HIM were put forward for the use of manufacturers and researchers of AMT.

3. AMT RESOURCES

3.1 Books


3.2. Articles


3.3. Software


3.4. Institutions

There are schools, organizations and companies which aim to train and inform people who are intrested in the area. For example;

Ivy Tech, http://www.ivytech.edu/
Sandia National Labs., http://www.sandia.gov/Main.html,
Innovation Technology Centre, http://www.itcyorkshire.com/default.asp,
University of Nottingham, http://www.nottingham.ac.uk/,
CIT, http://www.citindia.com/index.htm,
LAVC Job Training, http://www.lavc.edu/jobtraining/amti/index.htm,
ECC, http://www.everettcc.edu/,
AMT Online, http://www.amtonline.org/,
MGCCC, http://www.mgcc.edu/,
State University, http://www.stateuniversity.com/,
UMASSD, http://www.atmc.umassd.edu/welcome.cfm,

4. THE AMT TRIVET
In this part of the research the researchers divided the AMT TLAs into three groups, i.e.: Methodology, Production method and technology in order to provide the reader clues for covering the topic. Figure 1 illustrates the distinctions and the legs of AMT trivet

![Figure 1. AMT TLA universe](image)

4.1. Methodology

4.1.1. Business Activity Monitoring (BAM)

Business Activity Monitoring (BAM) is a kind of software that aids in monitoring of business activities, as those activities are implemented in computer systems. Put forward by Gartner, Inc. analysts it represents the aggregation, analysis, and presentation of real-time information about activities inside organizations and involving customers and partners. Its main purpose is to obtain real-time data and analysis of the organization. Thus it utilizes its main benefit that is; coping with the problems immediately by making necessary regulations. A dashboard is used to show the key performance indicators. Also event correlation is done by the use of the data which is displayed in the dashboard. Greenwald et al. (2008), Wayne (2006) and Jeston & Nelis (2006) provide methodological information. Adams (2002) mentions the benefits of usage of BAM, Wei et al. (2007) mentions the role of BAM in SPC. Havey (2005) expresses the relationship between BAM and Process Mining.

4.1.2. Business Driven Development (BDD)

Business Driven Development (BDD) is a methodology which satisfies the need of IT solutions in business requirements. This is achieved by adopting a model-driven approach that starts with the business strategy, requirements and goals and then transforms them into an IT solution. Mitra (2005) provides general information about BDD. Kroll & Royce (2005) presents key principles in BDD and Koehler (2008) emphasized...
the role of visual modeling and transformation in BDD. Kuster et al. (2008) demonstrated BDD as a tool for merging processes. Walhi et al. (2008) pointed BDD for rational compliance.

4.1.3. Business Process Management (BPM)


4.1.4. Business Process Modeling (BPM-2)

Business Process Modeling (BPM) plays an important role on Business Process Management (BPM) and it is the study of by representing the existing processes of an enterprise in order to execute the present state and do betterment for future. It is done by digging out the whole dynamics of the process such as vendors, suppliers, inputs, outputs… etc. The term BPM first conied by S. Williams in 60s but it acquired reputation in 90s. Havey (2005) provides wide information about BPM. Scheer (2000) mentioned the relationship between BPM and ARIS. Lin et al. (2000) constructed a generic framework for BPM. Dennis et al. (1994) compares BPM with old technology with BPM in new technology. They (Dennis et al., 1999) also investigate BPM with group support systems. Moreover Gruhn (1995) explains BPM with workflow management. Nüttgens et al. (1998) discusses BPM with EPC and UML transformation and integration. Luo & Tung (1999) establishes a framework for selecting BPM methods.

4.1.5. Business Process Improvement (BPI)


4.1.6. Constant Work in Process (CONWIP)


4.1.7. Domain Specific Modeling (DSM)

Domain Specific Modeling (DSM) is a method which is used by IT users to design and develop the current process and consists of orders which are written in a special language i.e: Domain Specific Language (DSL). Kelly & Tolvanen (2008), Baumaster et al. (2005), Fishwick (2007), Rossi (2008), Ralyte et al. (2007) provide information about DSM and also Choi et al. (2003) studied rapid energy estimation.

4.1.8. Enterprise Content Management (ECM)

Enterprise Content Management (ECM) is a system which is used to ensure effective information flow via compound technologies. McNay (2002), Glazer & Jenkins (2005), Forquer et al. (2005), Noack (2007), Hilier (2007), Huff (2006), White (2005) and Allen (2008) maintains extensive information about ECM.

4.1.9. Human Interaction Management (HIM)
As far as human is used in manufacturing processes the need to deal with human will be stucked in mind. So the sum of the studies to integrate human factor effectively in manufacturing processes is called Human Interaction Management (HIM). This method is being used as a collateral activity in BMP. Harrison-Broninski (2005) and Fischer (2007), http://www.rolemodellers.com and http://www.human-interaction-management.info/ provide information about HIM.

4.1.10. Human Machine Interface (HMI)


4.1.11. Human Resource Management System (HRMS)


4.1.12. Integrated Business Planning (IBP)

Integrated Business Planning (IBP) is a process in which every function of the enterprise is included in order to obtain better results from the whole process more commonly by establishing estimations on the nest year. That’s why it is done in November and December generally.


4.1.13. Model Driven Engineering (MDE)


4.1.14. Manufacturing Operations Management (MOM)

Manufacturing Operations Management (MOM) is a method of processing the aim of which is to optimize the process itself. Gifford (2007), Galloway (1996), Schröder (1989) and Thierauf & Hoctor (2006) provide information about MOM and Westbrook (1994) studied priority management.

4.1.15. OBASHI

OBASHI is an acronym which is used for explaining a methodology which helps the manager of the plant to visualize the workflow in the manufacturing process and consists of six layers i.e: Ownership, Business, Application, System, Hardware and Infrastructure. http://www.stroma.eu /SOBASHI.asp, http://en.wikipedia.org/wiki/OBASHI, provide information about OBASHI methodology.

4.1.16. Overall Equipment Effectiveness (OEE)


4.1.17. Project Management (PM)

4.1.18. Rapid Application Development (RAD)


4.1.19. Sales and Operations Plan (S&OP)


4.1.19. SOA


4.1.20. TQM


4.2. Production Method

4.2.1. Lean Manufacturing


4.2.2. Group Technology (GT)


4.2.3. Material Requirements Planning (MRP)


4.2.4. Manufacturing Resource Planning (MRP II)


4.2.5. Enterprise Resource Planning (ERP)


4.2.6. Manufacturing Process Management (MPM)


4.2.7. Just In Time (JIT)


4.2.8. Flexible Manufacturing System (FMS)


4.3. Technology

4.3.1. Numerical control (NC)

Numerical control is a kind of machinery which is being operated by commands which are encoded beforehand via numeric cards. Later on this system is developed by putting Open Numeric Controls (ONC).Reintjes

4.3.2. Direct Numerical Control (DNC)

Direct Numerical Control (DNC) is the improved type of ONC by computing the machinery with computer commands. Talavage & Hannam (1988), Liu et al. (2005), Piercy (1984), Jawitz (1997), Preece (1995), Groover (2007) provide information about DNC.

4.3.3. Computer Numerical Control (CNC)


4.3.4. Computer-Integrated Manufacturing (CIM)


4.3.5. Distributed Control System (DCS)


4.3.6. Programmable Logic Controller (PLC)


4.3.7. COTS


4.3.8. Cellular Manufacturing System (CMS)

Cellular Manufacturing System (CMS) is a way of plant lay-out which aims to achieve peak efficiency rates with minimum residual. A well designed cellular plant can keep up with the change in the market than the

4.3.9. Computer Aided Design (CAD)

After the use of first graphic system in mid 1950 by the US Army, Dr. Patrick J. Hanratty who is also known as "the father of CAD/CAM" developed PRONTO, the first commercial numerical-control programming system in this category in 1957. In 1960, Ivan Sutherland used TX-2 computer and this is considered the first step to CAD industry. During the phase of development in 1970s General Motors used the first DAC (Design Automated by Computer) and today CAD is being used in every field of the area which covers design varying from aerospace to diapers.


4.3.10. Computer Aided Manufacturing (CAM)


4.3.11. Computer Aided Quality Assurance (CAQ)

Computer-Aided Quality Assurance (CAQ) is the use of computer integrated systems for quality check. It enables the enterprise to act concurrently in quality assurence. When compared with non-computer aided quality assurance systems CAQ systems are economic because it is free from error, tirement and illnesses. CAQ process includes; attribute charts, vendor rates, inspection of goods, equipment management and documentation. Wigand et al. (2003), Mittag & Rinne (1993) and Werner (2008) provide wide information about CAQ. Wagner & Schneider (1992) studied CAQ in oral heath care. Innala & Torvinen (2000) discusses the most common types of CAQ systems. Mbang & Hasis (2004) studies CAQ in car body engineering. Kollar et al. (1999) studied CAQ in horticulture and food industries.

4.3.12. Computer Aided Production Engineering (CAPE)

Computer Aided Production Engineering (CAPE) is accepted as a novel type of computer aided systems which is stipulated to enrich the productivity of manufacturing systems. The implications of CAPE starts in 1990s.
With a glance in literature one can see that research and theoretical thinking is still being done by conferences and symposiums. McGeough et al. (2001), Puigjaner & Heyen (2006) and Robson & McLaren (1991) provide information about CAPE.

4.3.13. Computer Aided Process Planning (CAPP)


Automated Storage and Retrieval Systems (AS/RS) is a term which arose in 1950s in USA. This is basically as can be derived from its name has automated parts which can easily do classification, sorting, put-away, storage, order-picking, staging and loading of goods. Especially in libraries and warehouses this system is being used effectively for many years. With a glance in literature one can see that Gervasi (2005), Tompkins & Smith (1998) and MacConeill (2007) provide wide information about the system. Eynan & Rosenblatt (1994) studied establishing zones in single-command class-based rectangular AS/RS. Halsam et. al. (2002) investigated the usage of AS/RS in lied library.

4.3.15. Information Retrieval System (IRS)


4.3.16. Automatic Guided Vehicle (AGV)


4.3.17. Supervisory Control And Data Acquisition (SCADA)


4.3.18. Robotics


4.4 Suggested AMT Publications

Researchers and also appliers of AMT can make use of these 10 books in their studies.

✓ Allegri, T.H., 1989, Advanced Manufacturing Technology, Tab Professional and Reference Books

5. CONCLUSION

The need to produce in a better way is becoming more and more important in our day. The more an enterprise manufactures, more with less expense with less errors and less effort the more it gets close to the advantage of competing not only in the domestic but also in the international arena. This study aimed to provide a literature review about AMT for the researchers and practitioners of AMT. Therefore we began with the resouces of AMT. Then we proceeded with the history of AMT. Later on we included information about the sub-titles of AMT and also their sub-titles. Lastly we suggested 10 AMT publications those of which we used more frequently from the others while doing the reseach. It is hoped that anybody who is about to study any of the titles included in this study can make use of this paper.

Acknowledgements

The researcher thanks to his wife for her neverending support and patience to the work which is being done for months.

REFERENCES

Alanen, M., 2003, Realizing a Model Driven Engineering Process, Turku Centre for Computer Science
Aldridge, D.J. & Betts, J., 1995, “Flexibility and responsiveness in relation to the use of MRPII”, Logistics Information Management, 8(6), pp13-19
Allegri, T.H., 1989, Advanced Manufacturing Technology, Tab Professional and Reference Books


Anderson, J.C., 1981, Material Requirements Planning: A Study of Implementation and Practice, American Production and Inventory Control Society


Baasel, W.D., 1976, Preliminary Chemical Engineering Plant Design, Elsevier Pub. USA, p167


Baeza-Yates, R., 1999, Modern Information Retrieval, Addison-Wesley


Bell, M., 2008, Service-Oriented Modeling: Service Analysis, Design, and Architecture, John Wiley and Sons
Bernhardt, R. et al., 1992, Integration of Robots Into CIM, Springer
Bolton, W., 2006, Programmable Logic Controllers: an introduction, Newnes
Boney, J., 2001, Opportunities in Computer Aided Design and Computer Aided Manufacturing, VGM Career Horizons, USA
Boyer, S.A., 1999, SCADA: Supervisory Control and Data Acquisition, ISA
Burmester, S., 2006, Model Driven Engineering of Reconfigurable Mechatronic Systems, Logos-Verl


Butler, R., 1991, Designing Organizations: A Decision-making Perspective, Taylor & Francis, p131


Chang, T.C. et al., 1997, Computer-Aided Manufacturing, Prentice Hall, USA


Chmiel, N., 1998, Jobs, Technology and People, p16


Chong, C., 1997, Best Practice Cases: Manufacturing Process Management, Productivity and Standards Board


Clarke, G.R. et al., 2004, Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes, p15


Conner, G., 2001, Lean Manufacturing for the Small Shop, SME


Crnkovic, I. et al., 2003, Implementing and Integrating Product Data Management and Software Configuration Management, Artech House


Daneels, A.& Salter, W., 1999, “What is SCADA?”, International Conference on Accelerator and Large Experimental Physics Control Systems, 1999, Trieste, Italy
Dean, J.W., 1987, Deciding to Innovate: How Firms Justify Advanced Technology, Ballinger
Dennis A.R. et al., 1994, “Re-engineering business process modeling”, System Sciences, 4, pp 244-253
Domaine, H., 2005, Robotics, Lerner Publications
Duncan, W.R., 1996, A Guide to the project management body of knowledge, Project Management Institute
Elbertsen, L. et al., 2006, “ERP use: exclusive or complemented?”, Industrial Management & Data Systems, 106(6), pp811-824


Evans, K.W. et al., 1992, Programming of Computer Numerically Controlled Machines, Industrial Press


Forquer, B. et al., 2005, Enterprise Content Management Solutions: What You Need to Know, Open Text Corporation


Fraser, K. et al., 2007, “Team-based cellular manufacturing: A review and survey to identify important social factors”, Journal of Manufacturing Technology Management, 18(6), pp714-730

Friday, S., 2003, Organization Development for Facility Managers: Leading Your Team to Success, AMACOM Div American Mgmt Assn, p 256


Gibson, D.V. & Smilor, R.W., 1992, Technology Transfer in Consortia and Strategic Alliances, Rowman & Littlefield, p162


Glazer, D. & Jenkins, D., 2005, Enterprise Content Management Technology Open Text Corp., Canada


Graenebring, A. & Révay, P., 2007, “Service-oriented architecture is a driver for daily decision support”, Kybernetes, 36(5/6), pp622-635


Greenwald R. et. al., 2008, Oracle Essentials, O’Reilly Media Inc., USA, p16


Grieves, M., 2006, Product Lifecycle Management: Driving the Next Generation of Lean Thinking, McGraw-Hill


Hajarnavis, V. & Young, K., 2008, “An investigation into programmable logic controller software design techniques in the automotive industry”, Assembly Automation, 28(1), pp43-54


Hammond, G, 1986, AGVs at work, California Uni, USA, p21


Harborne, R., 1999, “Power Planning”, Strategic Finance


Harrison, M., 1990, Advanced Manufacturing Technology Management, Pitman


Havey M., 2005, Essential Business Process Modeling, O’Reilly Media Inc., USA, p39


Hirano, H., 1988, JIT factory revolution, Productivity Press


Huntington, J., 2000, Control Systems for Live Entertainment, Focal Press, p170

Hurwitz, J. et al., 2007, Service Oriented Architecture for Dummies, John Wiley & Sons


Ingham P, 1990, CAD Systems in Mechanical and Production Engineering, Industrial Press Inc., USA


Johnson, G.I.& Wilson, J.R., 1988, Ergonomics Matters in Advanced Manufacturing Technology, Butterworths


Kalakota, R.& Robinson, M., 2000, E-business 2.0: Roadmap for Success, Addison-Wesley, p244


Koehler J. et al., 2008, “The role of visual modeling and transformations in Business Driven Development”, Electronic notes on theoretical computer Science, 5(15), Switzerland, p6-7

Koenig, D. T., 1990, Computer Integrated manufacturing, Hemisphere pub., USA, p67


Kollar, G. et al., 1999, Problems and results of computer aided quality assurance systems in food industry and horticulture, Computers & Chemical Engineering, 23(5), pp687-690


Kumar, V. et al., 2008, “Performance measurement by TQM adopters”, The TQM Journal, 20(3), pp209-222
Kusiak, A., 2000, Computational Intelligence in Design and Manufacturing, John Wiley and Sons Inc., Canada, page 258
Langenwalter, G.A., 2000, Enterprise Resources Planning and Beyond: Integrating Your Entire Organization, CRC Press, p31
Lewis, K., 1991, “TQM leaders: Born or made?”, The TQM Magazine, 3(2)
Libutti, P. O. et al., 1995, Teaching Information Retrieval and Evaluation Skills to Education Students and Practitioners: A Casebook of Applications, Assoc of College & Resrch Libraries


Loukianov, A.A. et al., 2004, “Implementing distributed control system for intelligent mobile robot”, Artificial Life and Robotics, 8(2), pp159-162


Lownther, D. A.&Silvester, P.P., 1986, Computer-aided Design in Magnetics, Springer-Verlag, Germany


Lynch, M., 1992, Computer Numerical Control for Machining,McGraw-Hill, USA


Lysons, K. et al., 2005, Purchasing and Supply Chain Management, : Financial Times/Prentice Hall, p347


Massey, D.B., 2003, Numerical Control Over Complex Analytic Singularities, AMS Bookstore
McDonald, J.D., 2003, Electric Power Substations Engineering, CRC Press
McFarlane, N., 2003, Rapid Application Development with Mozilla, Prentice Hall PTR
Melby, S. J., 2007, Traceability in Model Driven Engineering, S.J. Melby
Miltonburg, J., 2005, Manufacturing Strategy, Productivity Press, USA,

Nagalingam, S.V., 2000, CIM Justification and Optimisation, CRC Press, p5
Noack,S., 2007, ECM- Enterprise Content Management, GRIN Verlag
Oakland, J.S., 2003, Total Quality Management: Text with Cases, Butterworth-Heinemann
Onstott, S., 2006, Enhancing CAD Drawings with Photoshop, Sybex, USA


Pandey P. C., et al., 2000, “A finite capacity material requirements planning system”, Production Planning and Control, 11(2), pp113-121


Poole, M., 1999, Human Resource Management: Critical Perspectives on Business and Management, Routledge


Pressman, R.S. & Williams, J.E., 1977, Numerical Control and Computer-aided Manufacturing, Wiley, USA


Ptak, C.A.& Schragenheim, E., 2000, ERP, CRC pub., Florida p 43, introduces sales and operations planning as an integrated business planning which provides ability to strategically direct its business to achieve competitive advantage of the plan.


Quesada, R., 2005, Computer Numerical Control: Machining and Turning Centers, Prentice Hall


Raouf, A., & Ahmad, S.I., 1985, Flexible Manufacturing: Recent Developments in FMS, Robotics, CAD/CAM, CIM, Elsevier

Rehg, J.A. et al., 2004, Computer-integrated Manufacturing, Pearson Prentice Hall, USA


Rembold, U. et al., 1993, Computer Integrated Manufacturing and Engineering, Addison-Wesley

Rexford, K.B.& Giuliani, P.R., 2003, Electrical Control for Machines, Cengage Learning, p312


Rooks, B., 2001, “AGVs find their way to greater flexibility”, Assembly Automation, 21(1). p38-43

Ross, T.& Burnett, G., 2001, “Evaluating the human machine interface to vehicle navigation systems as an example of ubiquitous computing”, Int. J. Human-Computer Studies, 55, pp661-647


Rufe, P. D., 2001, Fundamentals of Manufacturing, SME, p262

Rufe, P.D., 2001, Fundamentals of Manufacturing, SME, p257

Rufe, P.D., 2001, Fundamentals of Manufacturing, SME, p266

Ryan, S. M., 2000, “Determining inventory levels in a CONWIP controlled job shop”, IIE Transactions, 32(2), pp105-114


Seames, W.S., 2002, Computer Numerical Control, Delmar, Thomson Learning, USA


Shaw, W.T., 2006, Cybersecurity for Scada Systems, PennWell Books
Shields, M.S., 2001, E-business and ERP: Rapid Implementation and Project Planning, John Wiley and Sons
Sommerville, I., 2007, Software Engineering, Addison-Wesley, p 405
Spanyi A., 2003, Business Process Management is a Team Sport: Play it to Win!, Anclote Press,


Stahl, T. et al., 2006, Model-driven Software Development, John Wiley & Sons


Stark, J., 1986, What Every Engineer Should Know about Practical CAD/CAM Applications, CRC Press, USA


Sukhatme, G.S. et al., 2007, Robotics: Science and Systems II, MIT Press


Summer, M. et al., 2007, Enterprise Resource Planning, Pearson Education


Tempelmeier, H. & Kuhn, H., 1993, Flexible Manufacturing Systems, John Wiley & Sons Inc., USA


Timings, R. L., 2000, Manufacturing Technology, Longman


Turniansky, B. & Hare, A. P., 1998, Individuals in Groups and Organizations: a social psychology approach, SAGE, p74


Viale, J. D., 1996, JIT Forecasting and Master Scheduling, Thomson Crisp Series, USA


Werner, H., 2008, Supply Chain Management: Grundlagen, Strategien, Instrumente und Controlling, Gabler Verlag, p257


Wigand,R.T. et al., 2003, Introduction to Business Information Systems: with 79 figures, Springer,p113

Wight, O.W., 1984, Manufacturing Resource Planning: MRP II : Unlocking America's Productivity Potential, Oliver Wight


Williams, R.L., 1994, Essentials of Total Quality Management, Amacom


Wilson, F.W., 1963, Numerical Control in Manufacturing, McGraw-Hill


Zandi, M., 1985, Computer-aided Design and Drafting, Delmar Publishers, USA.


