

A Comprehensive Review of Integrated Manufacturing Practice in Global Context-Manufacturing Management Perspective

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Abstract: Manufacturing excellence is an outcome of optimum utilization of available resources and continual improvement in manufacturing facilities which fulfill the needs of the stakeholders in the business environment. In developing countries like India, there is a lack of quality manufacturing environment which is the root cause for the failure to meet the dynamic demand in industry. To overcome this hurdle a comprehensive model, namely Integrated Manufacturing Business Excellence System (IMBES) is developed based upon examination of literatures. This consists of 10 successful criteria, namely; Visionary Leadership and Management Commitment (VLMC), Systematic Approach to Management (SAM), Customer Focus and Satisfaction (CFS), Continuous Improvement and Innovation (CII), Organization Culture (OC), Workforce Management (WM), Manufacturing Strategy (MS), Resource Planning and System Audit (RPSA), Supplier Quality Management (SQM), Technology Management and Information System (TMIS) which helps for attaining business excellence in manufacturing industry. IMBES is nothing but a bundle of global manufacturing management concepts, namely; Total Quality Management (TQM), Total Productive Maintenance (TPM), Six Sigma (DMAIC Methodology), Lean Manufacturing (LM), Agile Manufacturing (AM) and Sustainable Manufacturing (SM).

Key words: Manufacturing excellence, IMBES, manufacturing management, criteria, India

INTRODUCTION

The global market has led many companies in the direction of implementing new paradigms in manufacturing to enhance their competitive position. Total quality management, total productive maintenance, Just in Time (JIT), lean, agile and sustainable manufacturing practices are considered, as integral components of outstanding manufacturing practices. Many researchers have studied manufacturing concepts independently for continuous improvement and sustain in a competitive environment. However, there is a gap in achieving business excellence due to lack of complete implementation of manufacturing concepts in an integrated manner. Hence, it is inevitable to formulate a comprehensive, integrated manufacturing model. Therefore, the researchers have developed an integrated manufacturing business excellence model to meet the needs of the stakeholders in all aspects in a minimum duration in a manufacturing environment. In world market, global awards, such as Malcolm Baldrige, National Quality Award (MBNQA), Japan Quality Award (JPA), Australian Business Excellence Award (ABEA), Singapore Business Excellence Award (SBEA), the German Quality Award (GQA), South African Excellence Award (SAEA) are given for manufacturing excellence. Likewise in India awards,

such as Rajiv Gandhi National Quality Award (RGNQA), Golden Peacock Business Excellence Award (GPBEA), IMC Ramakrishna Bajaj National Quality Award (IMCRBNQA), Indian Manufacturing Excellence Award (IMBEA) and Tata Business Excellence Award (TBEA) awarded for those who attained a meritorious position in the business sectors. Every award has successful criteria, as judgmental parameters of the business excellence framework. The business enterprises which meet out the manufacturing excellence requirements, would fetch the above-mentioned awards. Many of the parameters considered in framework of IMBEM.

Therefore, the researchers advocate the IMBEM to attain the business excellence standards and enhance the chance to receive the manufacturing excellence awards. Indian industries, despite having ISO 9002 and 14001 Quality Management System (QMS) and few business excellence models implemented in place, fail to offer quality product with timely delivery to the customers. Unfortunately, the dynamic demand has not met due to lack of adopting structured integrated manufacturing practice in the manufacturing industry, this resulted in producing sub-standard products. Since, industries are in need to adopt a well-structured integrated manufacturing model for producing high quality products with low cost of quick delivery. The main purpose of this study is to

review the various integrated manufacturing management practices in national and international industrial arena. Further, the researchers have proposed the Integrated Manufacturing Business Excellence System (IMBES) model for achieving global quality in manufacturing industry.

LITERATURE REVIEW

While there is a full-fledged independent application of total quality management, total productive maintenance, Six Sigma, lean, agile and sustainable manufacturing concepts are more in manufacturing and service sector, despite the suitability for integrated manufacturing practice still it is lagging in the manufacturing sector. Some researchers have studied and

recognized the familiarity of integrated manufacturing practices with some important critical success factors/critical dimensions/enablers/attributes in international and national industrial scenario, they are shown in Table 1 and 2. In this regard, the researchers have gone through an extent of literature in respect of global management practices in the manufacturing industry and proposed a structured model-IMBES for market sustainability.

There are many research papers which give the outline of various integrated manufacturing management concepts, such as lean and TQM, lean and Six Sigma (DMAIC), TQM and TPM, lean and agile, lean and sustainable, LEAGILE and sustainable, etc. in manufacturing and service industries. Till date, no one developed comprehensive integrated model like integrated manufacturing business excellence model (Fig. 1) to meet

Table 1: Critical success factors/implementation factors of quality management practices in international scenarios

Researchers	Integration/approach	No. of CSF	Critical success factors of TQM/TPM/lean/agile/sustainable/integrated manufacturing practices	Countries
Achanga <i>et al.</i> (2006)	LM	4	Finance, organization culture, infrastructure, team/work force	United Kingdom
Aghajani <i>et al.</i> (2013)	WCM	5	Leadership and empowerment, system integration, manufacturing strategy, organization culture, customer satisfaction	Iran
Alaskari <i>et al.</i> (2012)	Lean tools and ERP System	9	Top management commitment, change in organization culture, effective leadership, effective communication, comprehensive training and education, determination of goals and objective, visible management and commitment, view lean as a long term journey, view lean as long term journey, view and understand lean as philosophy rather than another strategy	United Kingdom
Anvari and Moghimi (2011)	TQM+LP	5	Management by fact, customer focus, supplier partnership, improvement team, continuous improvement and learning	Iran
Asif <i>et al.</i> (2010)	IMS	4	Continuous improvement, standardization, motivation, training and team work	Pakistan
Bamber <i>et al.</i> (1999)	TPM	9	Management commitment, measure of performance, align to mission, Involvement of people, implementation of people, knowledge and belief, time allocation for implementation, the motivation of management and workforce, the existing organization	United Kingdom
Bozdogan (2010)	Lean Enterprise System+TQM+SS+TOC+AM+BPR	5	Continuous improvement, systematic planned enterprise, change disciplined culture, Technology Management and Information System, customer satisfaction	United States of America
Byard <i>et al.</i> (2010)	LSS+AM+TPM+ERP+Supply chain reengineering	2	Sequential approach, integrated strategy management involvement and commitment, cultural change, organization infrastructure, communication, training, linking Six Sigma to business strategy, linking Six Sigma to customer, linking Six Sigma to supplier, project management skills, project prioritization and selections	United Kingdom
Coronado and Antony (2002)	SS	10	Committed leadership, strategic planning, cross functional training, employee involvement, information and feedback, process management, cross functional productdesign, supplier quality management,	United Kingdom
Cua and McKone-Sweet (2006)	TQM+JIT+TPM+Common practice	16		United State of America

Table 1: Continue

Researchers	Integration/approach	No. of CSF	Critical success factors of TQM/TPM/ lean/agile/sustainable/integrated manufacturing practices	Countries
Doolen and Hacker (2005)	LM	6	customer involvement, Pull System, JIT delivery System, set up time reduction, schedule adherence, autonomous and planned maintenance, technology emphasis, proprietary equipment and development	United States of America
Dora <i>et al.</i> (2013)	LM	3	Manufacturing equipment and process, shop floor management, new product development, supplier relationship, customer relationship, workforce management	Belgium
Eid (2009)	WCM	7	Skill workforce, organization culture, in-house expertise	Egypt
Elmoselhy (2013)	LM+AM	5	Management commitment, quality department, continuous improvement, customer involvement, supply chain management, technical capability management, production facility management	Netherland
Garetti and Taisch (2012)	SM	8	Strategy, workforce management, Technology Management and Information System, resource, customer satisfaction	Europe
Gilgeous and Gilgeous (1999)	Business excellence	8	Sustainable business, asset and product life cycle management, resource and energy management, enabling technologies, the role of standards, the role of education, competence development and social science, corporate social responsibility	United Kingdom
Greenberg and Quillian (2012)	SM	7	Empowerment, first-rate management team, learning, quality, technology, innovation, customer focus, supplier relationship	Africa
Gunasekaran <i>et al.</i> (2002)	AM	10	Senior management support, traction, cross-functional collaborative team, social responsibility, monitoring supplier, innovative partnership, management of resources	United Kingdom
Hamid (2011)	LM based on internal and external factor	9	Co-ordination, technology, Knowledge based System, cross functional team, motivation, standardization, organization culture, training, education and information, competence	Malaysia
Ho (2010)	LM+TQM	4	Top management commitment, training and education, thinking development, employee involvement, working culture, communication, resource and business planning, customer focus, government intervention	Malaysia
Jeyaraman and Teo (2010)	LSS implementation	10	Employee involvement, resource and process management, objectives and targets	Malaysia
Kim <i>et al.</i> (2009)	EFQM+Business excellence model	9	Management engagement and commitment, organizational belief and culture, Reward and Recognition System, competency of master black belt/black belt, company financial capability, frequent communication and assessment on lean Six Sigma results, project prioritization, selection, reviews and tracking, project success stories, best practices sharing and benchmarking, effective lean Six Sigma training program, established lean six sigma dash board	Canada
Kovach <i>et al.</i> (2005)	LM+AM+DFSS	5	Leadership, people, policy and strategy, partnership and resources, process, people results, customer results, society results, key performance results	United States of America
Kovacova (2013)	Lean management+SM	12	Top management support, benchmarking, supplier partnership, worker involvement, cultural change	Hungary-Slovak Republic
			Flatten management structure, commitment, capability, learning, multi-skilled people, invest in long term financials, team work, technology, policies, standard stakeholder	

Table 1: Continue

Researchers	Integration/approach	No. of CSF	Critical success factors of TQM/TPM/ lean/agile/sustainable/integrated manufacturing practices	Countries
Leoni (2012)	TQM+Toyotism and LP	3	expectation, integrated preventive environmental strategy, decision making High involvement work practice, information communication technology, industrial relation	Italy
Martinez-Jurado and Moyano-Fuentes (2014)	Adoption of LP based on trigger factor, success factor and control factors	10	Bargaining power of customer, motivation level, corporation motivation, deep rooted culture of total quality, top management role, lean organisation structure, lean leader role, institutional support. Unionization, people's initial scepticism and resistance	Spanish
Naslund (2008)	TQM+BPR+ERP+JIT+LM+SS	11	Business plan and vision, top management support (including funding), project management (including project), champion and team work, change management, organization culture, effective communication, education and training, knowledge transfer, knowledge management (including skill and expertise), organization structure	United States of America
Nordin <i>et al.</i> (2014)	Factors influencing the adoption of SM based on management, internal and external factors	9	Strategy/policy, mindset, system, measure, needs to advance, performance enhancement, law regulations, social pressure, market trends, competition	Malaysia
Pham <i>et al.</i> (2008)	LM+AM+SM	7	Integration, manufacturing strategy, finance, technology and product innovation. Knowledge and skill, marketing strategy, operational strategy	United Kingdom
Pham and Thomas (2011)	LM+AM+SM	8	Finance, strategy, technology, customer focus, leadership, culture, continuous learning, team work	United Kingdom
Power <i>et al.</i> (2001)	AM	7	Participative management style, computer based technology, resource management, continuous improvement, supplier relation, JIT methodology, technology utilization	Australia
Rose	LM	8	Clear strategic vision, top management commitment, project management, organizational change, communication, performance evaluation, skill/expertise, supplier involvement	Malaysia
Salleh <i>et al.</i> (2012)	LM+TQM+ISO9000+ ISO14001+OHSAS 18001+SS	6	Top management commitment, human resource, process and product management, information technology, supplier management	Malaysia
Shaaban and Awni (2014)	CSF for Implementation of TPM	9	Leadership style and influence, management commitment, clear vision and integrated strategy, existence of strong motive (burning platform), availability of financial resources, level of knowledge and experience, organization culture, the role of consultant, benchmarking and sharing best practices	Egypt
Skrudupaite and Jucevicius (2011)	LM+TPS	6	Management involvement and commitment, long term philosophy, change of thinking, lean behavior and work culture, discipline, employee training	Lithuania
Trkman (2010)	Framework of Business Process Management (BPM) based on contingency, dynamic capabilities and task technology fit theories	12	Strategic alignment, level of IT investment, performance measurement, level of employee's specialization, organizational change, appointment of process owner, implementation of proposed change, use of Continuous Improvement System, standardization of process, information, automation, training and empowerment of employees	Slovenia(Europe)
Ustyugova and Noskievicova (2013)	LM+AM	6	Top management commitment, responsible team, employee involvement, communication and information technology, partnership, rewards to motivate employee	Czech Republic
Vazquez-Bustelo <i>et al.</i> (2007)	AM	5	Human resources, technologies, value chain integration, concurrent engineering, knowledge management	Spanish

Table 1: Continue

Researchers	Integration/approach	No. of CSF	Critical success factors of TQM/TPM/lean/agile/sustainable/integrated manufacturing practices	Countries
Yusuf <i>et al.</i> (1999)	AM	10	Integration, competence, team building, technology, quality, change, partnership, market, education, welfare	United Kingdom
Zatzick <i>et al.</i> (2012)	TQM	4	Cost leadership, management support, collaboration expertise, communication	Canada

Table 2: Critical success factors/implementation factors of quality management practices in national manufacturing scenarios

Researchers	Integration/approach	No. of CSF	Critical success factors of TQM/TPM/lean/agile/sustainable/integrated manufacturing practices	Countries
Ahuja and Khamba (2008)	TPM	6	Top management contribution, cultural transformation, employee involvement, traditional and proactive maintenance policies, training and education, maintenance prevention and focused production system improvement	India
Antony and Desai (2009)	SS	10	Management involvement and participation, organization infrastructure, cultural change, training, linking Six Sigma to customers, linking Six Sigma to business strategy, linking Six Sigma to employees linking Six Sigma to supplier, understanding of Six Sigma methodology, project management skills, project prioritization and selection.	India
Desai <i>et al.</i> (2012)	SS	5	Management involvement and participation, organizational infrastructure, linking Six Sigma to customers, understanding of Six Sigma methodologies, leadership for Six Sigma	India
Ghosh (2013)	LM	4	Supply performance, focus on customer needs, implementing Pull System, cross-departmental problem solving	India
Haleem <i>et al.</i> (2012)	LM+TPM + TQM+SS+CRM	9	Top management commitment, customer satisfaction, employee health management, continuous improvement, work force management (rewards and incentives), Technology Management and Information System, Flexible Computer Integrated Management System, responsiveness of supply chain, Poka Yoke Quality System	India
Kumar <i>et al.</i> (2006)	LM+SS	12	Management involvement and commitment, communication, link quality improvement to employee, Cultural change, education and training, link quality improvement to customer, project selection, link quality improvement to business, link quality improvement to supplier, vision and business plan, information technology and innovation, organization infrastructure	India
Paranitharan	Integrated Lean Manufacturing System	9	Top management commitment, systematic approach to management, customer satisfaction, continuous improvement and innovation, organization culture, employee involvement and empowerment, team work, supplier relation management, technology management and audit	India
Paranitharan	IMBEM	10	Visionary leadership and management commitment, systematic approach to management, customer focus and satisfaction, continuous improvement and innovation, organization culture, workforce management, supplier quality management, manufacturing strategy, resource planning and system audit, Technology Management and Information System	India
Ramesh and Devadasan (2007)	AM	5	Management commitment, manufacturing management, manufacturing strategies, technology, employee	India
Seth and Tripathi (2005)	Twelve extracted factors from eleven dimensions in TPM and TQM	12	Focus on customer satisfaction, leadership for improvement, strategic planning for improvement, employee involvement and empowerment, organization systems and human development, education and training, information architecture, Performance Measurement System, materials management, equipment management, process management, management of financial resources	India
Sharma and Kodali (2008)	TQM implementation elements for ME	9	Supplier focus/management, leadership, people/change management, process management,	India

Table 2: Continue

Researchers	Integration/approach	No. of CSF	Critical success factors of TQM/TPM/ lean/agile/sustainable/integrated manufacturing practices	Countries
Sharma and Kodali (2012)	Pillars of ME	12	knowledge management, societal impact/responsibility, continuous improvement, performance measures, customer satisfaction/focus Manufacturing strategy, leadership, knowledge management, green manufacturing, change and human resource management, flexible process, supply chain management, customer relationship management, innovative product planning, total quality management, World Class Manufacturing System and lean manufacturing	India
Sharma and Chetiya (2012)	SS	8	Right tools, measurement, innovation and supplier collaboration, cross functional organization, process engineering, education to external/internal customer metric and measurement, Work Flow Management System	India
Soni and Kodali (2012)	LM+AM	19	Agile: Strategic and manufacturing management, information technology, collaboration management, information technology, demand, logistic, marketing and supplier management Lean: Strategic, marketing, collaboration, logistic, manufacturing and supplier management Leagile: Strategic, marketing, logistic and collaboration management	India
Vinodh and Joy (2012)	SM	3	Economic sustainability, environmental sustainability, social sustainability	India
Vinodh and Rajanayagam (2010)	Enablers of sustainable product design	6	Top management commitment, systematic manner, workforce, cross-functional team, advanced technologies, maximisation of resource efficiency	India
Vinodh <i>et al.</i> (2010)	AM	5	Manufacturing strategy, management responsibility, manufacturing management, employee, technology	India
Vinodh and Vimal (2012)	Lean enablers	3	Management responsibility, manufacturing management leanness, workforce leanness, technology leanness, manufacturing strategy	India

AM = Agile Manufacturing; SM = Sustainable Manufacturing; SS = Six Sigma; LM = Lean Manufacturing; WCM = World Class Manufacturing; LP = Lean Production; LSS = Lean Six Sigma; BPE = Business Process Engineering; JIT = Just In Time; TOC = Theory of Constraints; IMS = Integration Management System; TPM = Total Productive Maintenance; TQM = Total Quality Management; ME = Manufacturing Excellence; IMBEM = Integrated Manufacturing Business Excellence Model; CRM = Customer Relationship Management; OHSAS 18001 = Occupational Health and Safety Management Systems; ERP = Enterprise Resource Planning; ISO9000 = Quality Management Systems; ISO14000 = Environmental Management

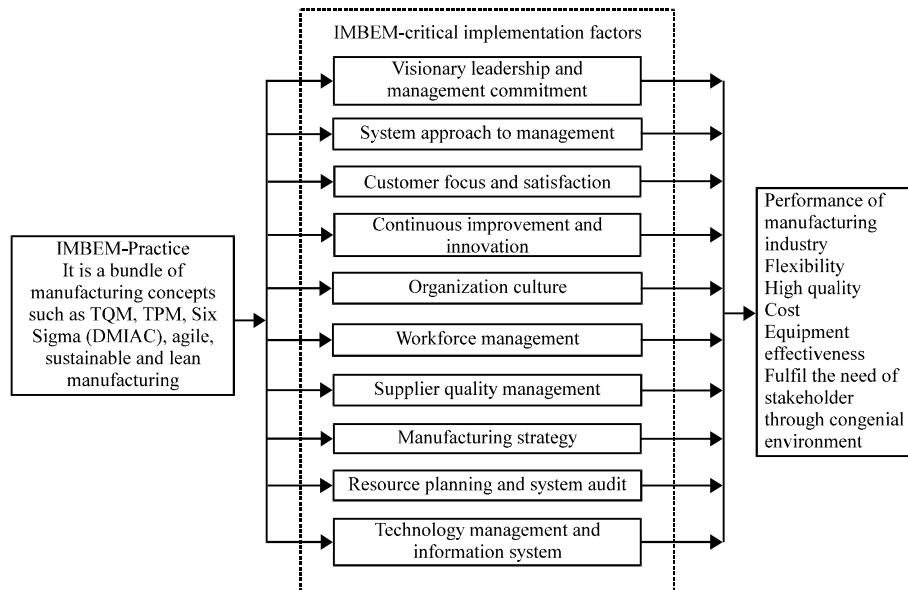


Fig. 1: Integrated manufacturing business excellence model

out the needs of the stakeholders in manufacturing environments. Integrated Manufacturing Business Excellence Model (IMBEM) is nothing but a bundle of global manufacturing management concepts, such as TQM, TPM, Six Sigma (DMAIC), AM, SM and lean manufacturing.

CONCLUSION

India is likely to emerge, as the 2nd most competitive economy in the world after China in terms of manufacturing in the next 5 years. Therefore, it is inevitable to adopt innovative manufacturing concepts to achieve global quality and maintain World Class Competitiveness (WCC) in industry arena. Global quality is nothing but the implementation of integrated manufacturing management practice to ensure a congenial environment for each range of products and related services through all steps of product's lifecycle. The IMBES is a comprehensive one to measure the performance of excellence and to implement it effectively in the manufacturing business environment to satisfy the needs of stakeholders. Hence, the authors suggest that the top management of the business units should establish IMBEM in their organization for long-term sustainability.

LIMITATIONS

The identified critical success factors which are limited from certain research papers in the field of manufacturing. The IMBEM Model has fitted to be universalized, since it has been developed mostly from the studies conducted inland and abroad. The model will be easy and without any complexity due to its compliance to any global manufacturing environment. This proposed model is only theoretical one and can be justified through empirical means by collecting primary data from stakeholders.

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