Assessing the awareness of the agile manufacturing for organizational change in Indian small manufacturing firms

An empirical investigation

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Abstract

Purpose – Agile manufacturing (AM) has the new scenario in the business system and it is widely seen as a "New Revolution" in the manufacturing firms. AM, which continuously focusses on the adoption of new methodologies and quickly respond to the customer expectation. For this reason, many of the research studies are focussed on the AM environment and this system is mainly followed in large sector only and most of the small- and medium-sized enterprises (SMEs) are not aware of it. Especially in the developing countries which are still lagging behind in the implementation of AM. Considering the above reason, the purpose of this paper is to assess the awareness of AM in Indian SMEs.

Design/methodology/approach – By means of researching many literature reviews and empirical data collected by using a self-administrated instrument distributed to the selected Indian SMEs and the awareness about the AM was investigated. The authors have selected 100 SMEs in Indian service sectors and sent the data sheets through by e-mail and also by directly visiting the company and collected the information. A total of 68 useable survey data's were identified from the final analysis. The study data sample consists of a group of selected Indian SMEs, from different industries including the pump and foundry industries. The collected data were analyzed using the graphical representation method and by the statistical analysis.

Findings – The analysis revealed the significance and usage of AM in the Indian SMEs. The results also suggested that the Indian SMEs are well aware of the AM system, through more efforts need to be focussed on implementing this system properly and effectively to improve these standards. By the use of agile models and frameworks in small and medium sized enterprises (SMEs), would result in cost-effectiveness in their quality and services and can be continuously improving the ongoing agile practices.

Research limitations/implications – Indian SMEs managers seem to be stronger familiar with the agile concepts and practices and they believe that agile environment would guaranteeing in their services and high-quality products. Therefore, SMEs should concentrate and invest in agile practices that would help them to improve their competitiveness in the global market. Further, Indian SMEs managers and practitioners would concentrate more about this maintenance of standards and with this dynamic approach it takes toward the agile environment to meet the future challenges.

Practical implications – The data collected and the results provided in this paper will help in understanding, the awareness about the AM environment in Indian SMEs. Also, suggest some additional improvements in the knowledge of agile to the managers and practitioners in the Indian SMEs, which could enhance the level of agile implementation.

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Originality/value – The assessment of agile awareness in Indian SMEs, along with the concepts of understanding the AM environment, has been explained in the literature on AM in the Indian SMEs.
Keywords Organizational change, Small and medium enterprises, Awareness, Agile manufacturing, Agility index
Paper type Research paper

1. Introduction

In the global competitive environment, many small- and medium-sized enterprises (SMEs) are focussing on ensuring their sustainability in their market. SMEs are "the life blood" of the modern economy and many of them now focus on their continuous improvement by adapting their technology advancement (Abor and Quartey, 2010). Due to the rapidly changing tastes and higher expectations of their customers, SMEs are starting to consider their situation and come up with strategies of how to face the new challenges caused by the introduction of new products with increased competition in order to sustain their business and position within the marketplace. Nowadays, many SMEs have started to adopt quality improvement programs such as Six-Sigma, Agile Methodologies, Continuous Quality Improvement, adoption of ISO 9000 series and Quality Assurance.

Agile manufacturing (AM) is popular in large enterprises, but has very limited penetration in SMEs due to limited resources including capital investment, skilled labor, knowledge of the employee, emerging new technologies and the erratic behavior of the global market (Halabi *et al.*, 2010). According to Kotey and Sheridan (2004), managers from the organization should practice the basic principles that would help the growth of the industry. Awareness of agile processes in SMEs should become known to managers by consciously updating their knowledge, behavioral changes, developing skills and improving the ability of the person to perform his/her task efficiently and effectively (Fabi *et al.*, 2009). It is the basic responsibility of the manufacturing firm to educate and train their managers, so that agile processes can be implemented and create a successful growth for the manufacturing firm (Barrett and Mayson, 2007). Whether AM processes is a new approach or a well-known approach for a company, it is essential that all participants in a manufacturing firm must have knowledge and awareness of its principles, tools and techniques and concepts for its implementation (Coronado, 2003). Therefore, the need for AM awareness among managers has been emphasized by different quality experts and practitioners (Ingmar *et al.*, 2014).

Cooper (1983) devised the concept of AM, and predicted that future generations of manufacturing firms would be adaptable, conditional and flexible. Most AM enterprises are capable of responding dynamically to the changes in customer demand and are able to sustain in the competitive market from time to time. Hence AM firms are capable of operating profitability continually in a competitive environment and with changing customer opportunities. Within the literature about agile practices much less has been written about the manager's awareness of AM, and this gap could affect the industry. Most researchers have assumed AM is a new management philosophy and requires special skills and work environment. Hence, in most situations AM either failed or was abandoned. Agile awareness is an essential condition for gradual progression toward developing an agile-based culture in the manufacturing industry. To ensure sustainability, manufacturing firms in a competitive environment should be flexible and quick to respond to market changes, as well as the ability to innovate both product and process (Jenny *et al.*, 2006). While organizing agile awareness, careful consideration should be given to major issues such as quality problems, knowledge and skill levels needed to understand agile processes, challenges

that face the industry, the organizational climate change toward the quality perception, availability and suitability of training facilities and strengthening what is to be different from the present practice (Youssef, 1992).

In view of the lack of awareness about AM and the absence of research on assessing the agile awareness and understanding of the concept of being agile in the service industries, our study therefore aims to address the awareness of agile production programs in Indian SMEs (Ednilson and Mark, 2009). This research is particularly important as previous researchers provide very little evidences concerning the awareness of AM in service industries, particularly within Indian SMEs. Thus, an assessment of AM awareness in Indian SMEs would have to be conducted in order to bridge this gap. This research study also provides useful information to SME managers and quality practitioners regarding AM environment issues and its usage in Indian SMEs. Zhang and Sharifi (2000) asserted that the implementation of AM practices benefits managers and practitioners of the industry and assessed the awareness of AM of the service managers as well as other issues related to AM. The purpose of the research assessment is to know the extent of the practitioners and managers about the understanding of the concepts and issues of AM in Indian SMEs. It was expected that service managers, who had a greater perception of AM concepts, would have the most positive reaction in favor of the practitioners and manager attitude toward customer satisfaction and the quality improvement (Van Assen, 2000).

2. Literature review

There is a limited amount of research about the agile concepts and methodologies. Surprisingly, rigorous studies have not been performed on assessing the awareness of AM and understanding the concept of agile in Indian SMEs. This research study will play a major part in implementing the agile concepts on the manufacturing firms and act as a baseline for work in the future to assess the agility level of the service company.

2.1 AM

The AM concept was first published by the Iacocca Institute at Lehigh University (USA) in 1991. AM is a production model that has altered the environmental results (Vokurka and Fliedner, 1998). Gunasekaran (1998) proposed that AM helps to create new innovations in manufacturing and technologies through radical changes in organizational structure and new marketing strategies. However, these changes in the production model would help to combat future competition (Goldman *et al.*, 1995), it also could help encourage flexibility when adopting changes in a business environment and fulfill the needs of customer demand, which alternatively could take firms into the "world class manufacturing" environment.

The adoption of AM involves manufacturing capabilities responding simultaneously to a wide range of competing objectives, including the quality, cost, technology, morale and delivery of the products (Adeleye and Yusuf, 2006). Burgess (1994) discussed that most of the studies about AM were either review papers or conceptual articles and there were no single studies that focussed on all the constructs. However, most of the articles on AM frameworks were developed using pragmatic philosophy. From the literature studies, we have identified that many Indian manufacturing sectors are still unaware about the use of AM (Goldman *et al.*, 1995). Due to focussing on competition for their survival, every industry is focussing the AM environment, which shares the information from the top level down to the bottom level and functions effectively and efficiently.

2.2 Awareness about AM

The awareness about the AM environment is one of the most important factors in the Indian service sectors. Sharifi *et al.* (2001) asserted that, in order to sustain and achieve success in the global manufacturing environment, the collaboration and cooperation among directors, managers and practitioners plays a key role in the enterprise. Nowadays, most of the Indian SMEs are willing to improve and develop their business in the competitive environment (Cho *et al.*, 1996; Yusuf *et al.*, 1999). To sustain success in their field of business, AM plays a vital role. However, not all the SMEs are willing to use or adopt the AM principles due to the lack of clear understanding about the agility and their influence in practices which can cause failure. Due to specific reasons, the awareness about the AM environment plays a vital role to the first step to success in manufacturing firms. A 20 criteria agile measurement model has been prepared and was sent to selected Indian SMEs and the data collected from the empirical results will show the agility index level of the individual company and the awareness level of AM is identified.

2.3 SMEs growth in India

SMEs are the salient drivers of nation's economy (Varun Kumar *et al.*, 2014). Due to increased competition in the global market, many SMEs are focussing on quality improvement to sustain their business by providing low costs with timely delivery and customer satisfaction. Nowadays, most large-manufacturing firms are highly dependent on SMEs for their good quality of products and services (Khan and Pillania, 2008).

SMEs greatly contribute in terms of job creation, poverty reduction and serving to boost the economic development in both developed and developing countries. In India the business environment in the last decade has seen a radical change due to the growth of SMEs and have become the backbone of the Indian economy. Due to competition in the global market, SMEs have also focussed on quality improvement and customer satisfaction as a way of sustaining their business and the Indian economy has been growing at a healthy rate in the last 15 years. Due to the healthy growth of SMEs, most of the large-scale manufacturing firms also depend on them for good quality of products and services.

The fastest growth rate of SMEs and the increased manufacturing demand from the large-scale production sectors are forcing large-scale manufacturing firms to depend on SMEs, which could potentially lead to increase job opportunities and economic growth. To increase the profitability and save costs, many of the large-scale original equipment manufacturers are also focussed on outsourcing secondary jobs from SMEs. Due to the increased outsourcing activity from large-scale manufacturing firms, a profitable business strategy for the Indian SMEs has been created.

2.4 Why agility in SMEs?

Due to outsourcing activity from large-scale manufacturing firms and an increase in growth rate, SMEs are also looking ahead to the next step for them to take toward success in their business environment. From the increase in demand in the competitive global market, SMEs are focussing on sustaining their Tier I suppliers and are moving to the next level of the AM environment (Meredith and Francis, 2000; Hormozi, 2001). The AM environment in SMEs will play a dynamic role in sustaining their business as adopting new ideas and innovations for the customer ultimately requires agility. The new concept of AM, which is mainly employed in the large-manufacturing firms does not have a universally accepted definition (Cho *et al.*, 1996; Gunasekaran, 1998)

but it is predicted that the manufacturing agility of a firm will enable it to have the ability to survive and make a profit in a competitive environment.

To survive in their business, manufacturing companies must continually strive to innovate new concepts and speed up operational output. If SMEs focus on and develop the next levels, they will experience success in their market as well as others. The main role of assessing the AM environment in SMEs is to provide a good quality of product at a low cost with quick, timely delivery and response to the customer. If the customers and suppliers are satisfied, it would be possible to be sustained in the market business. Most of the Indian SMEs are owned by unskilled workers that have a lack of knowledge, training and others financial facets. To overcome this, the awareness of the AM environment in Indian SMEs plays a major role and framed the 20 criteria in the agile measurement model. This questionnaire is easy to complete by any manufacturing firms employees or practitioners and the level of awareness about the AM environment are identified according to the results.

3. Research methodology

We will discuss our research methodology in this section, which we have developed and adopted in our present study. It is a very important study as it can guide the researchers to accomplish their objectives.

3.1 Research design

The design of the research instrument is modeled on the 20 criteria questionnaire (see the Appendix) and agility level is measured by gathering the information from the manager or practitioners of the chosen company. In this study, questionnaires are sent by e-mail and by directly visiting the company and gathering the information and responses from the managers and practitioners (Kureshi *et al.*, 2010). After collecting the responses from the respondent, the AM experts/managers have to calculate the marks against the questionnaire by referring the agility assessment marks from the scheme.

From the marks scheme the agility index is assessed through each driver. Finally by awarding marks to each driver's and calculating the marks, the agility index level of the company is identified. The agility index is computed using the formula:

$$\text{Agility index} = \text{Total marks secured}/1,000$$

According to Ramesh and Devadasan (2007), the agility index from Figure 1 will fairly indicate the level of which agility is practiced in the company and framed a criteria that agility index with above 0.8 = smart company, 0.6 = agile is practiced, 0.5 = eligible to adopt agile, 0.4 = weaker and 0.3 = cannot be practiced.

3.2 Research data collection

For our research study, we have selected a list of Indian SMEs which are located in and around Coimbatore in Tamil Naidu. The minimum sample size of 100 SMEs are selected for our survey and the research instrument prepared (20 criteria agile measurement model) is sent to each companies by e-mail or by directly visiting the company and gathered the responses from the managers, practitioners, directors, CEO and others including customer relation officer and assistant manager. The collection of the data profile from the respondents has two sections, and the general information gathered from the company's managers or practitioners is shown in Table II.

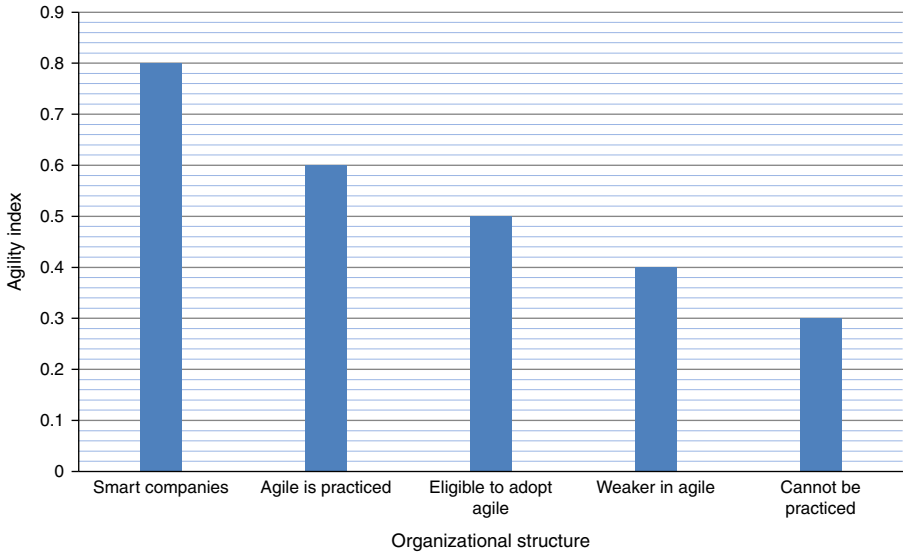

Figure 1.
Organizational structure versus agile index in manufacturing firm

The other section of the main part of our study, were top and middle-level managers/administrators and CEOs who have the sufficient level of experience and qualification and are aware of the AM principle followed in their respective service companies. We sent the cover letter and research instrument (20 criteria agile measurement model) and asked them to respond within three to four weeks, and we also directly visited the company and gathered responses.

After several follow-ups and personal contact from the 100 Indian SMEs, a total of 68 companies responded, approximately 68 percent of the sample size. However, only 52 were useable survey instruments for our study with 16 instruments being unusable, yielding a response of 52 percent, which is well within the range for our research study. The main reasons for the unusable instrument are: 12 respondents (75 percent) did not complete their research instruments properly or having the missing data and four research instruments (25 percent) were undelivered.

3.3 Research instrument

The 20 criteria agile measurement model (Ramesh and Devadasan, 2007; Yang and Li, 2002) has been utilized as a model of our research instrument. In order to implement the AM environment in the SMEs or any other manufacturing firms, it is required to measure the agility level practiced by them. The marks pattern is designed for the 20 criteria agile measurement model which has a range of 0-1,000 marks (Zhang and Sharifi, 2000). The research instrument developed was divided into two sections, one comprising of the general information of their respondents, including their genders, a profession they carried out and years of experience. While the other section, which collects the information on the awareness about AM, and the agile measurement model has been grouped into four categories (Sarkis, 2001): first, agility through management driver (500); second, agility through technology driver (150); third, agility through manufacturing driver (150); and finally, agility through competitive driver (200). The range of 0-1,000 marks are allocated against each drivers and they are grouped as shown in Table I.

Category of agile manufacturing driver	Agile manufacturing criteria	Maximum marks allotted
Agility through management driver	1. Organizational structure (50) 2. Devolution of authority (150) 3. Nature of management (300)	500
Agility through technology driver	1. Design improvement (20) 2. Production methodology (10) 3. Manufacturing networks (10) 4. IT integration (25) 5. Product life cycle (20) 6. Automation type (20) 7. Change in business and technical process (25) 8. Time management (20)	150
Agility through manufacturing driver	1. Manufacturing setups (10) 2. Customer response adoption (100) 3. Employee status (30) 4. Product service (10)	150
Agility through competitive driver	1. Status of quality (50) 2. Status of productivity (10) 3. Cost management (20) 4. Outsourcing (20) 5. Employee involvement (100)	200
Total		1,000

Table I.
Twenty criteria agile manufacturing measurement model marks allotment

3.4 Research questionnaire design

Assessing the awareness of AM is addressed by studying the various literature reviews in view of the importance of the awareness of AM in different aspects as well as the absence of research in the Indian SMEs. Proposed objectives were constructed during the course of our research and to fully carry out this process, a research question was articulated as follows:

RQ1. Are the Indian SMEs aware of the AM principles?

The corresponding hypothesis formulation of this research is:

H1. Indian SMEs are well aware of AM principles?

4. Results and analysis

A scale range from the 20 criteria agile measurement model marks were obtained from the range of 1, could not practice AM to 5, smart companies were used for obtaining the opinion regarding the awareness of AM in Indian SMEs. Five statements were used for measuring the awareness of the AM environment in Indian SMEs and the graphical representation of data and statistical analysis were used to assess the awareness of AM.

4.1 Respondents profile from Indian SMEs

The 20 criteria agile measurement model was created and sent to the selected SMEs in and around Coimbatore. The data collected from the respondent's profile in Indian SMEs is shown in Table II and consists of position/role of the respondents, years of experience, department/section and gender. The position/role of respondents consist

	Frequency	Percentage
Position/role of respondent		
Director/managing director/executive director/CEO/general manager	4	3.846
Project manager/senior manager/senior engineering manager	16	15.384
Manager/technical manager/operation manager	20	19.230
Quality manager/HR manager/executive manager/sales manager	40	38.461
Others	24	23.079
Total	104	100
Years of experience		
< 5	40	38.4615
> 5	64	61.5385
Total	104	100
Gender		
Male	70	67.3076
Female	34	32.6924
Total	104	100
Department/section		
Quality manager	16	15.3846
Product and services	24	23.0769
Customer relation	20	19.2307
Marketing	22	21.1538
Information management service	12	11.5384
Others	10	9.61538
Total	104	100

Table II.
Respondent's profile from Indian SMEs

of the director/managing director/executive director/CEO/general manager (3.84 percent); project manager/senior manager/senior engineering manager (15.38 percent); manager/technical manager/operations manager (19.23 percent); quality manager/HR manager/executive manager/sales manager (38.46 percent); and others including workers and practitioners (23.07 percent). Comparing the length of experience, a total of 61.54 percent have experience of more than five years in their respective fields and the remaining 38.46 percent have less than five years of experience. With regard to the respondent's profile gender, 67.30 percent are male and 32.70 percent are female. The results from the respondents suggest that the majority of the Indian SMEs are male-dominated companies.

The statistics test the differences between earliest and latest responses is used to assess non-response bias from the mail surveys (Krause and Scannel, 2002). Using this method, the first 10 respondents and the last 10 respondents answers' were compared with the test results. This issue will be validated by using *t*-tests with 95 percent confidence level of ($p \geq 0.05$) among the two groups with respect to the AM awareness of the manufacturing firm. Kureshi *et al.* (2010) stated that the resulting analysis indicated that there were no significant differences between the early and late respondents in term of agile awareness ($t = 0.6895$, $p = 0.2496$) thus it is concluded that there was no evidence of non-response bias from the data and it might not be a problem with this study.

4.2 Perceived level of agile awareness through graphical representation

According to Ramesh and Devadasan (2007), the agility index will fairly indicate the level at which agility is practiced in the company and the awareness about 20 criteria is

framed by the five-point scale. If the agility index is above 0.8 = smart company, 0.6 = agile is practiced, 0.5 = eligible to adopt agile, 0.4 = weaker and 0.3 = cannot be practiced.

Figure 2 shows the mean awareness of the AM of 20 criteria agile measurement model and the respondent's results of all the statements loaded is above the moderate mean value of the agility index, that is 3. From the result, it suggests that the many SMEs are eligible to adopt the AM concept and they are aware of it. Hence it is concluded that the level of agile awareness in Indian SMEs is moderately high and they have reasonable knowledge about the principles and concepts of agility.

4.3 Descriptive statistics for the AM awareness

The statistics analysis are mainly used to explore the data collected through the 20 criteria agile measurement model questionnaire from the survey results. This data are summarized and describes the means, standard deviation, variance, skewness and kurtosis of all 20 statements related to the AM awareness and were computed and analyzed for estimating the agility level of the Indian SMEs and are displayed in Table III.

From the empirical survey results, the statement of the 20 criteria agile measurement model has the mean score of statement and is above average with a range from 3.15 to 4.33. The standard deviation range from 0.2290 to 0.6289 and variances range from 0.0415 to 0.3956. On the five-point scale (Ramesh and Devadasan, 2007) it was clear that the eligible agility index of the manufacturing firms is to adopt the AM to be above 0.5. Table III indicates that the respondents of the Indian SMEs fairly received all the awareness statement with a mean more than three (eligible to adopt the AM). This statement with the range of awareness of above 0.5 on the overall range, which they were aware of the AM principles and were eligible to adopt the methodologies. The values of standard deviation and variance indicate the dispersion of higher values in a widely spread distribution which states that the AM awareness and its measuring statement are approximately the same as the normal distribution. From Table III, the skewness and kurtosis are generally close to values, indicating that the assumption for normality appears not to be violated and it can be seen that the mean score of the statements ranges from the 3.15 to 4.33, with the scores corresponding to the above agility level and that they were aware of the statements. Hence it may be concluded that the AM viewed a strategic approach in the Indian SMEs.

5. Discussion and conclusions

Our research paper presents the survey results of some selected Indian SMEs regarding the awareness of the AM environment and various other factors concerning it. As a result, this paper successfully accomplishes the desired objective by assessing the opinions of the practitioners and service managers concerning the awareness of AM in Indian SMEs. From the empirical results, it is concluded that Indian SMEs are well aware of AM systems. Thus, *H1* is supported.

From the empirical results, this paper also further suggests that the AM environment has started to enter the consciousness of practitioners and managers in Indian SMEs. They understand that AM enhances the quality of products and services, with quick customer response and should be practiced throughout the organization to get the desired results. Managers and practitioners also believe that it is a guiding philosophy for the success of manufacturing firms. Many SME managers and practitioners are practicing the agile concepts, areas in which they were previously unaware of due to a lack of training

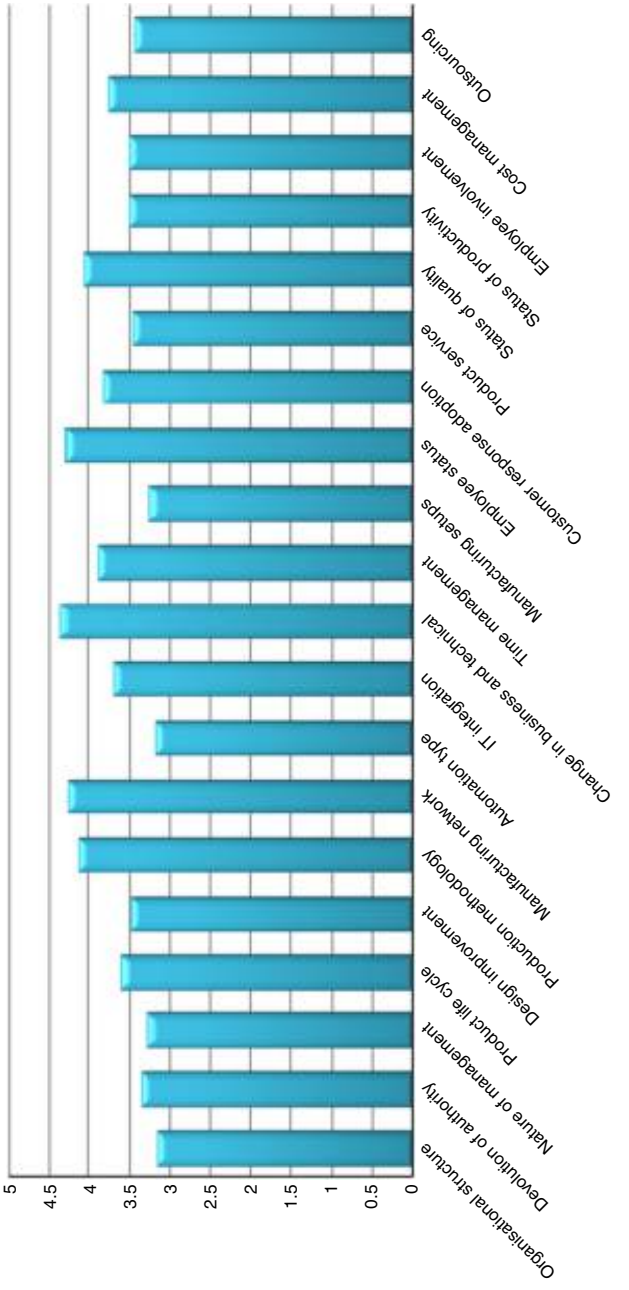

Figure 2.
Perceived levels of agile awareness in Indian SMEs

Statement	Mean	SD	Variance	Skewness	Kurtosis
Organizational structure	3.15	0.5435	0.2954	−0.4528	1.8213
Devolution of authority	3.33	0.5526	0.3053	−0.547	−0.7713
Nature of management	3.25	0.5373	0.2887	−0.5844	1.9532
Product life cycle	3.58	0.6136	0.3765	0.3269	0.9894
Design improvement	3.47	0.6289	0.3956	0.0685	−0.137
Production methodology	4.12	0.4297	0.1846	−0.2367	1.5386
Manufacturing network	4.25	0.5396	0.2912	−0.8286	0.1068
Automation type	3.16	0.5422	0.294	−0.7556	0.955
IT integration	3.67	0.2038	0.0415	−0.8055	1.2238
Change in business and technical	4.33	0.4531	0.2053	−0.2048	−0.4805
Time management	3.87	0.4737	0.2244	−0.1362	−1.6899
Manufacturing setups	3.23	0.4799	0.2303	−0.2466	0.9953
Employee status	4.28	0.229	0.0525	−0.1624	1.937
Customer response adoption	3.82	0.621	0.3856	0.1067	−0.1528
Product service	3.45	0.4706	0.2214	0.928	−0.6771
Status of quality	4.05	0.4169	0.1738	0.1984	1.3711
Status of productivity	3.5	0.2528	0.0639	0.1227	−0.8475
Employee involvement	3.48	0.2381	0.0567	0.2687	−1.2572
Cost management	3.75	0.2723	0.0741	−0.2652	−0.6176
Outsourcing	3.43	0.2821	0.0796	0.6459	−0.1561

Table III.
Descriptive statistics for the agile manufacturing awareness in Indian SMEs

offered by employers. This research also pointed out some improvement that could be made in few areas including training employees about its concepts and practices, and the adoption of AM principle or framework in the company. If this could be implemented, it will improve the company's performance by providing effective results in their quality as well as their services.

It is apparent that the AM environment has become a significant issue for Indian SMEs. Every manufacturing organization is now focussing on it in order for their survival and to stabilize their standards in the global market, and therefore there is no opposition to the implementation of agile concepts. Most of the SMEs, managers and practitioners accept agile principles and tend to see them as a part of a set of policies in their company. Nevertheless, this paper suggests there is strong evidence of practitioners and a managers awareness of various facets of AM principles and practices, but the adoption of these aspects of AM is in response to the "need of the hour." However, from the empirical results, this effect is generated mainly from familiarity with AM concepts and practices and the awareness of AM in Indian SMEs as shown in Figure 3. From the

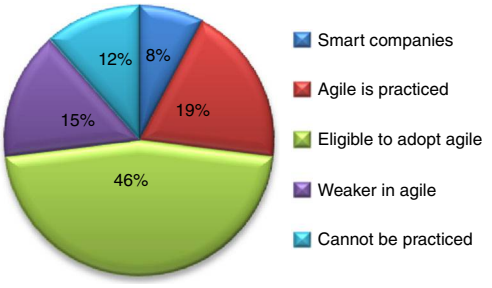

Figure 3.
Awareness about AM in Indian SMEs

empirical results, the majority of the SMEs (46 percent) are eligible to adopt the AM concept from our survey and are unaware about the practices and are lack in their concepts; 19 percent are practicing the agile concepts; 8 percent are smart companies; 15 percent are weaker in practicing agile concepts and 12 percent of the SMEs were AM cannot be practiced.

5.1 Managerial implications and future research

The results and findings of this paper could play a major role in implementing the AM concepts and practices in Indian SMEs. It also suggests that Indian SME managers and practitioners should be more concerned with their standards and in preparing their company to be more effective in the global market for future challenges. This dynamic approach toward the AM environment takes a company to the next level by improving their quality of products and services. SME managers and practitioners should bring a wide functional experience to their current roles and by partaking in continuous training and education that helps them to update their knowledge and skills regularly. This could bring improvements in their quality techniques, and their capabilities to evaluate the range of alternative approaches and practices which could produce the effective results for their company. If more concentration was given by SMEs about adopting AM practices, it could lead them to sustain drastic growth in their respective areas. Finally, the findings from the survey results could contribute a better understanding for both the managers and practitioners in how best to implement the AM environment in SMEs.

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Appendix. Questionnaires to assess agility index

Questionnaires to Assess Agility Index

1. ORGANISATIONAL STRUCTURE

Preamble

An agile manufacturing company requires building teams to serve customers' demands dynamically. The quick building of teams and fulfilling of customers' dynamic demands will be facilitated through organisational structures with minimum layers and the incorporation of modern leadership style, motivational programmes and employee empowerment.

1. What is the type of organisational structure existing in your company?
   (a) Flattened [ ]
   (b) Combination of (a) and (c) [ ]
   (c) Vertical (traditional) [ ]
   1.A. If it is vertical, how many layers are there?
   (a) ≤ 3 [ ] (b) 4 to 6 [ ]
   (c) 7 to 9 [ ] (d) > 9 [ ]
   1.B. If the organisational structure is vertical, how is it distributed?
   (a) Individual departments [ ]
   (b) Cluster of departments [ ]
   1.C. Is the company prepared to change its organisational structure to a flattened one?
   (a) Yes [ ] (b) Partially [ ]
   (c) No [ ]
2. How much time will it take to make a decision if any problem arises while fulfilling customers' dynamic demands? .....
3. Is the flow of information smooth and without hurdles?
   (a) Yes [ ]
   (b) Not fully [ ]
   (c) No [ ]
4. Is the organisational structure
   (a) Departmentalized? [ ] (b) Holistic? [ ]
5. Are there teams available to make decisions at each stage of fulfilling customers' dynamic demands?
   (a) Yes [ ]
   (b) Not at each stage [ ]
   (c) No [ ]
6. How is the final decision made by the President of the company?
   (a) By himself [ ]
   (b) By consulting with the personnel concerned [ ]
7. Is interchangeability of personnel possible from one section to the other?
   (a) Yes [ ]
   (b) No [ ]
   (c) Not fully [ ]

2. DEVOLUTION OF AUTHORITY

Preamble

In order to react quickly in response to the dynamic demands of the customers, the concerned employees need to be provided with necessary authorities. These necessary authorities will allow employees to make decisions on their own to react to the customers' dynamic demands. The difficulty is of course to ensure consistency between collective and individual decision making. In order to overcome this difficulty, a system containing necessary guidelines for appropriately using authorities becomes a need in agile manufacturing company.

1. Is every personnel's responsibility clearly defined?
   (a) Yes, clearly defined [ ] (b) No [ ]
2. Is every personnel's authority clearly defined?
   (a) Yes, clearly defined [ ] (b) No [ ]
3. Can the personnel make decisions without consulting their superiors?
   (a) Yes [ ] (b) No [ ]
4. Does any circumstance exist such that the responsibility is assigned to the personnel but without authority?
   (a) No [ ] (b) Yes [ ]
5. Do you think that offering authority to the personnel would affect the working of the company?
   (a) No [ ] (b) Yes [ ]
6. Has any training been imparted to the personnel on appropriate usage of authority?
   (a) Yes [ ] (b) No [ ]

3. MANUFACTURING SET–UPS

Preamble

In agile manufacturing environment, a company must be able to simultaneously produce multiple and diverse products, and to quickly upgrade and redesign its products and execute efficient production changeovers. This implies that the company's manufacturing facilities should be capable of efficiently responding to the customers' dynamic demands. One of the ways of achieving this goal is to develop system and facilities that would facilitate easy manufacturing set–ups.

1. Is your manufacturing set–up
   (a) Rigid? [ ] (b) Flexible? [ ]
2. Can the machines be moved from one position to the other quickly?
   (a) Yes, within least possible time [ ]
   (b) No [ ]
3. What is the time taken for changing the machine set–up to set a new job?
   .....
4. Are the machines upgradable to a higher level? (Example: PC's operating system is upgraded from Windows '98 to Windows 2000?)
   (a) Yes [ ] (b) No [ ]
5. Are the machines suitable for future modifications (retrofitting), without any difficulty?
   (a) Yes, possible without any difficulty [ ]
   (b) Possible with some difficulty [ ]
   (c) No [ ]
6. Are jigs and fixtures used for processing jobs?
   (a) Yes [ ] (b) No [ ]
   (a) if yes, can they be used for processing other jobs by effecting slight modifications?
   (a) Yes [ ] (b) No [ ]
7. Are automated tools used to enhance the production?
   (a) Yes, used fully [ ]
   (b) Yes, used partially [ ]
   (c) No [ ]
8. Do you have an active policy to help keep work areas clean, tidy and uncluttered?
   (a) Yes [ ] (b) No [ ]

4. STATUS OF QUALITY

Preamble

Agile manufacturing companies need to be quality conscious. Quality is exceeding the expectations of customers. It means that all the processes in the company should be customer centric. Each activity should assist in providing additional value to the customer. There must be a culture of total-quality throughout the business. The role of managers and engineers would be to audit quality and gather feedback. Every fault found must be seen as an opportunity to improve the quality of the products and services.

1. Do you believe that your company's products exceed the expectations of your customers?
   (a) Yes [ ] (b) No [ ]
2. Do you keep looking for new ideas that can be incorporated in your company's products?
   (a) Yes [ ] (b) No [ ]
3. Are you conducting surveys/studies to improve the status of quality practised in your company?
   (a) Yes [ ] (b) No [ ]
4. Are the quality characteristics ensured at every stage?
   (a) Yes [ ] (b) No [ ]
5. Do the operators have the authority to ***"stop the line"*** in case of detecting quality problems?
   (a) Yes [ ] (b) No [ ]
6. What is the minimum quantity to be produced with the highest quality level if the customer wants a new product?
   (a) Below 10 [ ] (b) Between 10 and 100 [ ]
   (c) Above 100 [ ]
7. Are TQM (total quality management) tools such as bar charts, *Kaizen*, etc. used in your company?
   (a) Yes [ ] (b) No [ ]
8. Is quality improvement achieved at the expense of productivity?
   (a) Yes [ ] (b) In some cases [ ]
   (c) No [ ]

5. STATUS OF PRODUCTIVITY

Preamble

Wastes are found in companies in the form of overproduction, waiting, conveyance, poor quality, inventory and motion. Waste elimination is the key for increasing productivity. It is vital to detect defects and errors immediately and provide high quality feedback immediately. Agility enhances through the elimination of wastes.

1. Are efforts exerted in your company to improve productivity in all functions?
   (a) Yes [ ]
   (b) Only in some functions [ ]
   (c) No [ ]
2. Is productivity improvement achieved in your company at the expense of quality?
   (a) Yes [ ]
   (b) In some cases [ ]
   (c) No [ ]
3. Has productivity been linked to the prosperity of the personnel?
   (a) Yes [ ] (b) No [ ]
4. Have any productivity improvement programmes been conducted?
   (a) Yes [ ] (b) No [ ]
5. Is there an organized programme/dedicated team in place to progressively eliminate wastes occurring in the company?
   (a) Yes [ ] (b) No [ ]

6. EMPLOYEE STATUS

Preamble

Multi-skilled employees are needed to develop agile manufacturing companies. Agile manufacturing companies are less dependent on systems, but more dependent on intelligence and expertise of the personnel. The capability, involvement, commitment and empowerment of people within the company are critical to implement agile manufacturing paradigm. Agile manufacturing paradigm requires the employees to be creative and freewheeling. It will require that they continually educate themselves on new technologies and processes which will enable them to better carry out their duties.

1. Are your personnel resilient to changes?
   (a) Yes [ ]
   (b) Not fully resilient to changes [ ]
   (c) No [ ]
2. Are the personnel prepared to accept adoption of new technologies?
   (a) Yes [ ] (b) No [ ]
3. Are the personnel of your company
   (a) Multi-skilled? [ ]
   (b) Specialists in one area? [ ]
4. Is the system of rotation of jobs implemented in your company?
   (a) Yes [ ] (b) No [ ]
5. Are education and cross-training imparted continually to all the existing and new employees?
   (a) Yes [ ] (b) No [ ]
8. Is the company incorporated with training and education facilities that would facilitate employee involvement?
   (a) Yes [ ]
   (b) Not all training and education facilities [ ]
   (c) No [ ]

8. NATURE OF MANAGEMENT

Preamble

A company's culture is unique and highly influenced by the management's vision. In an agile manufacturing company, the management must be able to articulate the vision and culture. The management must encourage the employees' autonomy, so that they express their opinions and share the knowledge they possess in a totally encouraging environment.

1. Are participative type management principles followed?
   (a) Yes [ ] (b) No [ ]
2. Is the feeling of the employees given due respect by the management?
   (a) Yes [ ] (b) No [ ]
3. Is the goal of the management clearly known to all the personnel?
   (a) Yes [ ]
   (b) Not clearly known [ ]
   (c) Not known at all [ ]
4. Is the involvement of management felt in each and every stage of functioning of the company?
   (a) Yes [ ] (b) No [ ]
5. In addition to profit motivation, is due respect given for humanitarian approach?
   (a) Yes [ ] (b) No [ ]
6. Does transparency exist in information sharing?
   (a) Yes [ ] (b) No [ ]
7. Are employer–employees meetings conducted regularly?
   (a) Yes [ ]
   (b) Not regularly [ ]
   (c) Not conducted at all [ ]
8. Are employee suggestions rapidly evaluated and implemented?
   (a) Yes [ ] (b) No [ ]

9. CUSTOMER RESPONSE ADOPTION

Preamble

In 1995, Goldman et al. identified four dimensions of agile competition. The very first dimension is enriching the customer. This entails a quick understanding of the unique requirements of each individual customer and rapidly reacting to them.

5. A. If so, what type of training and education is imparted?
   (a) ON the job [ ] (b) OFF the job [ ]
6. Do all the personnel know who the company's customers are and the company's competitive strengths and weaknesses?
   (a) Yes [ ] (b) No [ ]

7. EMPLOYEE INVOLVEMENT

Preamble

Employees are expected to involve in decision making in agile manufacturing companies. The employee involvement is required to react quickly in response to the customers' dynamic demands. The driving force required to exercise employee involvement is good communication.

1. Does a strong spirit of cooperation prevail among employees for achieving the company's objectives?
   (a) Yes [ ]
   (b) Not strong [ ]
   (c) No [ ]
2. Do employees know what is expected from them?
   (a) Yes [ ] (b) No [ ]
3. Are employees asked for their suggestions?
   (a) Yes [ ]
   (b) Sometimes [ ]
   (c) No [ ]
4. Do your employees have all the tools they need to accomplish their jobs?
   (a) Yes [ ]
   (b) Not all the tools [ ]
   (c) No [ ]
5. Are employees provided with all the necessary information required to accomplish their jobs?
   (a) Yes [ ]
   (b) Not fully [ ]
   (c) No [ ]
6. Are the employees properly recognised for their contributions?
   (a) Yes [ ]
   (b) Sometimes [ ]
   (c) No [ ]
7. Do your employees thoroughly enjoy their jobs?
   (a) Yes [ ]
   (b) Not fully [ ]
   (c) No [ ]

1. Does a culture of continuous improvement in customer service prevail?
   (a) Yes [ ] (b) No [ ]
2. Does any system exist to receive the customer complaints from all the sources through all the possible communication media?
   (a) Yes, fully [ ] (b) Yes, partially [ ]
   (c) No [ ]
3. Does the company encourage the customer to submit feedback?
   (a) Yes [ ] (b) No [ ]
4. At what speed, is the customers' feedback incorporated into the company's products?
   (a) Within a day [ ] (b) Within a week [ ]
   (c) Within a month [ ] (d) Not incorporated [ ]
5. How much percentage of the feedback is taken into consideration?
   (a) 100 % [ ] (b) 50% [ ]
   (c) As per your own schedule [ ] (d) Nil [ ]
6. Is the customer response documented properly?
   (a) Yes [ ] (b) No [ ]
7. Do all personnel who are in contact with the customers have the authority and empowerment to resolve customer problems?
   (a) Yes [ ] (b) No [ ]

10. PRODUCT LIFE CYCLE

Preamble

One of the characteristics of agile manufacturing companies is that the products manufactured by them have very short life cycles. Hence, new products are to be developed and produced before the expiry of the life of the existing products. This implies that fast new product development is an important aspect of agility. In an agile manufacturing company, emphasis is not placed on internal new product development alone but also on recognising that products can be developed through external collaboration too.

1. Are you stating the life of your product to the customer? For example, *Microsoft states* that *Windows* 2000's support will be phased out in 2005–2006.
   (a) Yes [ ] (b) No [ ]
   1.A. If yes, what is the specified life in years?
   .....
2. Does your company encourage customers to switch over to new model/product?
   (a) Yes [ ] (b) No [ ]
3. How do your company's products perform in the field, for a stipulated period?
   (a) By consuming least maintenance cost [ ]
   (b) By consuming excessive maintenance cost [ ]

11. PRODUCT SERVICE

Preamble

Modular design is a requirement of achieving agility as modules of subassembly can be replaced within no time to restore the performance. In this case, customer response is improved as the time required to carry out product service is minimised. Costs go down as activities required to support product service are minimised. Also inventory requirements fall.

1. Are your company's products designed for easy serviceability?
   (a) Yes [ ] (b) No [ ]
2. Are your company's products incorporated with modular design?
   (a) Yes [ ] (b) No [ ]
3. Are your company's service centres well equipped with spares?
   (a) Yes [ ] (b) No [ ]
4. What is the minimum time required to carry out service of a defective product to restore to its original performance?
   .....

12. DESIGN IMPROVEMENT

Preamble

An agile manufacturing company is required to develop new models of existing products and services as well as new products and services themselves. In order to carry out this task, the design of existing products and services is to be improved by making use of modern technologies and manufacturing management models. Besides, new technologies manufacturing management models need to be adopted for designing new products and services.

1. Is your management keen on bringing out new models of products and services frequently?
   (a) Yes [ ] (b) No [ ]
2. What is the average development time of a new model of products or services?
   .....
3. Are all your design personnel trained in all aspects of design?
   (a) Yes [ ] (b) No [ ]
4. Are development projects executed with the participation of representatives from several functions?
   (a) Yes [ ] (b) No [ ]
5. Is the management prepared to invest on latest design technologies like Rapid Prototyping/CAD/CAM, etc.?
   (a) Yes [ ] (b) No [ ]
6. Are DFMA (design for manufacture and assembly) concepts, axioms and guidelines used?
   (a) Yes [ ] (b) No [ ]

   (a) Long term [ ] (b) Short term [ ]
   (c) JIT technique [ ]
2. What is your company's procurement policy?
   (a) Entire lot purchase [ ]
   (b) Based on time schedule [ ]
   (c) Whenever required [ ]
3. Does the company take care to avoid idle investment?
   (a) Yes [ ] (b) No [ ]

15. COST MANAGEMENT

Preamble

Traditional cost management systems are suitable for implementation in mass production environments. It is found that activity–based costing is suitable for implementation in agile manufacturing environment. Activity–based costing essentially adopts a two–stage cost allocation procedure with resources from the general ledger being attributed to adopt activities within the enterprise and subsequently allocated to cost objects (products, services or customers) using cost drivers.

1. What is the costing method followed while pricing the product?
   (a) Activity based [ ] (b) Traditional [ ]
2. Does the present costing system focus on the identification of value–adding and non–value–adding activities?
   (a) Yes [ ] (b) No [ ]
3. Does the present costing system enable the evaluation of future resource consumption?
   (a) Yes [ ] (b) No [ ]
4. Your company's product–cost is fixed
   (a) Based on the competitor's product's price [ ]
   (b) Based on customer's willingness to pay the price [ ]
   (c) By own decision [ ]

16. AUTOMATION TYPE

Preamble

In order to achieve agility, automation should be flexible enough to accommodate changing product configurations. In order to meet agile manufacturing requirements, automation should be simple and cheap. The manufacturing systems should be configured with modular components. This enables reuse and rapid redeployment of existing design and infrastructure to achieve agility.

1. Is your company incorporated with automated systems?
   (a) Yes [ ] (b) No [ ]
   1.A. If yes, what percentage of automation is practised in your company?
   .....
7. Is there any system adopted in your company to carry out regular experiments on designed products and services?
   (a) Yes [ ] (b) No [ ]

13. PRODUCTION METHODOLOGY

Preamble

The production of all components in–house is not economically feasible when product life cycles are shortening and customers want customised solutions. Hence, manufacturing of most components is required to be outsourced. In–house production is also required to be carried out in Flexible Manufacturing Systems. Hence, in an agile manufacturing company, the focus will be on main assembly, flexible manufacturing, external manufacturing and procurement of components.

1. Are all the components of any one of your company's products processed fully in the company itself?
   (a) Yes [ ] (b) No [ ]
2. What is the type of automation adopted while inspecting the components and products?
   (a) Fully automatic [ ] (b) Semi–automatic [ ]
   (c) Manual [ ]
3. What is the type of inspection followed?
   (a) 100 % [ ] (b) Sampling plan [ ]
4. Is the management interested in investing to develop Flexible Manufacturing Systems?
   (a) Yes [ ] (b) No [ ]
5. Are lean manufacturing principles like ***kanban*** and waste elimination being applied?
   (a) Yes [ ] (b) No [ ]
6. Is the management interested in the concept of developing the products whose components are all outsourced but assembled in–house?
   (a) Yes [ ] (b) No [ ]
7. Are the production quantities equalised with customer required quantities?
   (a) Yes [ ] (b) No [ ]

14. MANUFACTURING PLANNING

Preamble

In an agile manufacturing company, the products/services and models are varied frequently. Hence, manufacturing planning to span long duration is to be avoided in agile manufacturing companies. Moreover, manufacturing planning is to be carried for avoiding idle investment and bulk procurement.

1. What is the type of system followed to carry out manufacturing planning?

2. What is the type of automation existing in your company?
   (a) Fixed [ ] (b) Flexible [ ]
3. If it is flexible, what is the percentage of flexibility incorporated in the automated system?
   .....
4. Is the management interested in investing to adopt full automation?
   (a) Yes [ ] (b) No [ ]

17. INFORMATION TECHNOLOGY (IT) INTEGRATION

Preamble

Available, complete, pertinent and easy–to–access information is a key requirement of achieving agility. This could ensure that all customer contacts are thorough and satisfactory. Given the volume of data and information to be processed to achieve this goal, the need of deploying IT infrastructure and e–commerce in achieving agility is highly realised.

1. Is your company nourishing the utilities of e–commerce?
   (a) Yes [ ] (b) No [ ]
2. Is your company making use of IT devices/utilities such as internet, intranet, videoconferencing, etc.?
   (a) Yes [ ] (b) No [ ]
   2.A. If yes, are these utilities paying dividends to the company in the form of reduced manufacturing lead time, quicker information accessing, lesser cost, etc.?
   (a) Yes [ ] (b) No [ ]
3. IT utilities are incorporated with
   (a) Manual style of working [ ]
   (b) Reengineered pattern of working [ ]

18. CHANGE IN BUSINESS AND TECHNICAL PROCESSES

Preamble

An agile manufacturing company must be capable of adapting to changing business and technical scenarios that emerge in the world. Particularly, the agile manufacturing company should be capable of recovering quickly and effectively from the disruption caused by the changes.

1. Is your company's business system flexible enough to accommodate changes in the way of working?
   (a) Yes [ ] (b) Not fully flexible [ ]
   (c) No [ ]
2. Is your company constantly reinventing and reengineering to adopt to changing business and technical scenarios that emerge in the world?
   (a) Yes [ ] (b) No [ ]
3. Is your employee's attitude tuned to accept the changes?
   (a) Yes [ ] (b) No [ ]

4. Does your company's environment permit to conduct pilot study on new production/business processes?
   (a) Yes [ ] (b) No [ ]

19. TIME MANAGEMENT

Preamble

As the agile manufacturing company is required to react quickly in response to the customers' dynamic demands, managing the time is very important. Particularly in the agile manufacturing company, no time should be spent on non–value adding activities.

1. Is every activity scheduled?
   (a) Yes [ ] (b) No [ ]
   1.A. If scheduled, what type of communication system is followed?
   (a) Written documents [ ] (b) Oral [ ]
   (c) IT based [ ]
2. Is there any training programme imparted to personnel regarding the time management concepts?
   (a) Yes [ ] (b) No [ ]
3. Are time compression technologies adopted in your company?
   (a) Yes [ ] (b) No [ ]

20. OUTSOURCING

Preamble

In an agile manufacturing company, often the products/services produced are incorporated with new technologies. As acquiring new technologies and imparting training to the employees to produce this type of product and service are time- and money-consuming processes, an agile manufacturing company is required to outsource its operations and activities which are not its core tasks.

1. What is the percentage of parts/components which are outsourced?
   .....
2. Are supply chain management concepts adopted for enhancing the efficiency of outsourcing?
   (a) Yes [ ] (b) No [ ]
   2. (a) If yes, are IT utilities exploited in managing the supply chains?
   (a) Yes [ ] (b) No [ ]
3. Are suppliers involved in product development?
   (a) Yes [ ] (b) No [ ]
4. Are you working towards a smaller number of qualified suppliers?
   (a) Yes [ ] (b) No [ ]

MARKS SCHEME TO ASSESS AGILITY INDEX

Category of agile manufacturing driver: Agility through management driver

The marks allotted against each option are given under each response.

Category of agile manufacturing driver: Agility through management driver

Criterion number	Criteria	Question number	Responses a	b	c	d	e	f
1.	Organisational structure *Maximum marks = 50*	1.	20	15	0	–	–	–
		1.A.	5	4	3	0	–	–
		1.B.	0	5	–	–	–	–
		1.C.	5	3	0	–	–	–
		2.	<1 Hr 5	<1 Day 4	<2 Days 3	<3 Days 2	<4 Days 1	<25 Days 0
		3.	5	3	0	–	–	–
		4.	0	5	–	–	–	–
		5.	5	3	0	–	–	–
		6.	0	5	–	–	–	–
		7.	5	0	3	–	–	–
2.	Devolution of authority *Maximum marks = 150*	1. 2.	25	0	–	–	–	–
			25	0	–	–	–	–
		3. 4.	25	0	–	–	–	–
			25	0	–	–	–	–
		5. 6.	25	0	–	–	–	–
			25	0	–	–	–	–
3.	Nature of management *Maximum marks = 300*	1.	50	0	–	–	–	–
		2.	30	0	–	–	–	–
		3.	50	25	0	–	–	–
		4.	50	0	–	–	–	–
		5.	30	0	–	–	–	–
		6.	30	0	–	–	–	–
		7.	30	15	0	–	–	–
		8.	30	0	–	–	–	–

MARKS SCHEME TO ASSESS AGILITY INDEX

Category of agile manufacturing driver: Agility through technology driver

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Category of agile manufacturing driver: Agility through technology driver

Criterion number	Criteria	Question number	Responses a	b	c	d	e	f
1.	Product life cycle *Maximum marks = 20*	1.	5	0	–	–	–	–
		1.A.	<5 Yr. 5	5–10 Yr. 4	11 Yr. 3	12 Yr. 2	13 Yr. 1	14 Yr. 0
		2.	5	0	–	–	–	–
		3.	5	0	–	–	–	–
2.	Design improvement *Maximum marks = 20*	1.	5	0	–	–	–	–
		2.	< 1 Month 1;		> 1 Month 0		–	–
		3.	1	0	–	–	–	–
		4.	1	0	–	–	–	–
		5.	5	0	–	–	–	–
		6.	2	0	–	–	–	–
		7.	5	0	–	–	–	–
3.	Production methodology *Maximum marks = 10*	1.	1	0	–	–	–	–
		2.	2	1	0	–	–	–
		3.	2	0	–	–	–	–
		4.	1	0	–	–	–	–
		5.	1	0	–	–	–	–
		6.	1	0	–	–	–	–
		7.	2	0	–	–	–	–
4.	Manufacturing networks *Maximum marks = 10*	1.	0	2	4	–	–	–
		2.	0	2	4	–	–	–
		3.	2	0	–	–	–	–
5.	Automation type *Maximum marks = 20*	1.	3	0	–	–	–	–
		1.A.	>80% 5		50%–80% 3		<50% 0	
		2.	0	3	–	–	–	–
		3.	>80% 5		50%–80% 3		<50% 0	
		4.	4	0	–	–	–	–
6.	IT integration *Maximum marks = 25*	1.	5	0	–	–	–	–
		2.	5	0	–	–	–	–
		2.A.	10	0	–	–	–	–
		2.B.	0	5	–	–	–	–
7.	Change in business & technical processes *Maximum marks = 25*	1.	5	3	0	–	–	–
		2.	10	0	–	–	–	–
		3.	5	0	–	–	–	–
		4.	5	0	–	–	–	–
8.	Time management *Maximum marks = 20*	1.	5	0	–	–	–	–
		1.A.	1	0	2	–	–	–
		2.	3	0	–	–	–	–
		3.	10	0	–	–	–	–

MARKS SCHEME TO ASSESS AGILITY INDEX

Category of agile manufacturing driver: Agility through manufacturing strategy driver

The marks allotted against each option are given under each response.

Category of agile manufacturing driver: Agility through manufacturing strategy driver

Criterion number	Criteria	Question number	Responses a	b	c	d	e	f
1.	Manufacturing set-ups *Maximum Score = 10*	1.	0	2	–	–	–	–
		2.	1	0	–	–	–	–
		3.	1 (< 10 min) (< 10 min)					
		4.	1	0	–	–	–	–
		5.	2	1	0	–	–	–
		6.	0.5	0	–	–	–	–
		6.A.	0.5	0	–	–	–	–
		7.	1	0.5	0	–	–	–
		8.	1	0	–	–	–	–
2.	Employee status *Maximum Score = 30*	1.	10	4	0	–	–	–
		2.	5	0	–	–	–	–
		3.	10	0	–	–	–	–
		4.	1	0	–	–	–	–
		5.	1	0	–	–	–	–
		5.A.	2	0	–	–	–	–
		6.	1	0	–	–	–	–
3.	Customer response adoption *Maximum Score = 100*	1.	10	0	–	–	–	–
		2.	10	5	0	–	–	–
		3.	10	0	–	–	–	–
		4.	25	15	5	0	–	–
		5.	25	15	10	0	–	–
		6.	10	0	–	–	–	–
		7.	10	0	–	–	–	–
4.	Product service *Maximum Score = 10*	1.	3	0	–	–	–	–
		2.	3	0	–	–	–	–
		3.	2	0	–	–	–	–
		4.	<1 Hr. 2	<1 Day 1	>1 Day 0	–	–	–

MARKS SCHEME TO ASSESS AGILITY INDEX

Category of agile manufacturing driver: Agility through competitive driver

The marks allotted against each option are given under each response.

Category of agile manufacturing driver: Agility through competitive driver

Criterion number	Criteria	Question number	Responses a	b	c	d	e	f
1.	Status of quality *Maximum marks = 50*	1.	5	0	–	–	–	–
		2.	5	0	–	–	–	–
		3.	5	0	–	–	–	–
		4.	5	0	–	–	–	–
		5.	10	0	–	–	–	–
		6.	10	5	0	–	–	–
		7.	5	0	–	–	–	–
		8.	0	3	5	–	–	–
2.	Status of productivity *Maximum marks = 10*	1.	2	1	0	–	–	–
		2.	2	1	0	–	–	–
		3.	2	0	–	–	–	–
		4.	2	0	–	–	–	–
		5.	2	0	–	–	–	–
3.	Employee involvement *Maximum marks = 100*	1.	15	10	0	–	–	–
		2.	15	0	–	–	–	–
		3.	10	5	0	–	–	–
		4.	10	5	0	–	–	–
		5.	10	5	0	–	–	–
		6.	10	5	0	–	–	–
		7.	20	10	0	–	–	–
		8.	10	5	0	–	–	–
4.	Cost management *Maximum marks = 20*	1.	5	0	–	–	–	–
		2.	5	0	–	–	–	–
		3.	5	0	–	–	–	–
		4.	3	5	0	–	–	–
5.	Out sourcing *Maximum marks = 20*	1.	>90% 5	80%–90% 4	70%–80% 3	60%–50% 2	50%–60% 1	<50% 0
		2.	2	0	–	–	–	–
		2.A.	3	0	–	–	–	–
		3.	5	0	–	–	–	–
		4.	5	0	–	–	–	–

Total Score (TS) = [ ]; Agility index TS/1000 = _____
Evaluated by: Date:

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