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SUSTAINABLE MANUFACTURING CONCEPTS: A LITERATURE REVIEW

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Abstract:

Purpose – The purpose of this article is to review of literature on Sustainable Manufacturing Concepts.

Method – Several frameworks are explored and discussed. Articles on the subject were searched and retrieved, and a content analysis was carried out. Their relationships include correlation, overlapping area, difference, integration and classification based on Sustainable Manufacturing Concepts dimensions. Total 78 research papers have been reviewed for the research contribution, methodologies, country of research, year of publication and different concepts of relevance.

Results – This paper identifies major research gaps for sustainable manufacturing concepts through various aspects, thus allowing researchers to identify research opportunities. This paper provides a quantitative descriptive analysis and qualitative thematic analysis to provide an analysis on Sustainable Manufacturing Concepts.

Conclusion – Many literature reviews that aim at discussions regarding sustainable manufacturing concepts but none of them focused exclusively on analysis of SM concepts through identification of various factors. Another unique feature of this paper is that total 78 key research papers have been reviewed. The time span taken for this review is about 24 years (1993-2016).

Keywords:

Literature Review, Sustainable Manufacturing Concepts, Correlation, Descriptive Analysis, Thematic Analysis.

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1. INTRODUCTION

Sustainable manufacturing is a term used to describe manufacturing practices that do not harm the environment during any part of the manufacturing process. It emphasizes the use of processes that do not pollute the environment or harm consumers, employees, or other members of the

community. Sustainable manufacturing includes recycling, conservation, waste management, water supply, environmental protection, regulatory compliance, pollution control and a variety of other related issue. Sustainable Manufacturing is also known by different names like environmentally conscious manufacturing, environmentally benign manufacturing, environmentally responsible manufacturing, and green manufacturing. Sustainable manufacturing emphasis on designing and delivering products that minimize negative effects on the environment through their production, use, and disposal. In the current scenario it is better to make product for environmental as well as economic feasibility for the organizations. Also the globalization has forced companies to improve their environmental performance [9].

As sustainable manufacturing is the major requirement of today, so there is a pressing requirement of advancing in this field too. Thus purpose of this review is to find out present status of literature on Sustainable Manufacturing Concepts and implications for future research. This review is accomplished by answering the following six research questions:

RQ1. What is the status of research publication in Sustainable Manufacturing or Related Issues over the years?

RQ2. What is the status of research in Sustainable Manufacturing or Related Issues across countries?

RQ3. What concepts are being researched in Sustainable Manufacturing?

The answers to these three questions are useful in finding out the growth of research in Sustainable Manufacturing across the world. Another important aspect is the set of research tools being used by researchers, hence the following question arises:

RQ4. What research tools are being used by researchers in this field?

The answer to this question will help in knowing about various types of tools which were used by academicians, practitioners in Sustainable Manufacturing according to their problem. This question is also useful to know about problem-specific tools and computational aspects. The most important aspect of the research in Sustainable Manufacturing is the existing studies of the same. In order to extract those basics following questions needs to be answered:

RQ5. Which are the industries in that research already taken?

These questions are very useful for Sustainable Manufacturing because these are directly related to formation of a framework to manage Sustainable Manufacturing Concepts. After answering all the above questions, an attempt will be made to address the basic underlying questions of research gaps and future scope in the field of Sustainable Manufacturing, which can be formulated as follows:

RQ6. What are the research gaps and future scope of research in this field?

In order to find answers to these questions and consequently highlight the inconsistencies in the existing literature of Sustainable Manufacturing, this paper critically reviews the existing Concepts in Sustainable Manufacturing literature, which is discussed in subsequent sections.

The structure of the paper is as follows: Section 1 proposes the set of research questions that this paper aims to answer. Section 2 discusses the existing literature reviews in the area of Sustainability and Sustainable Manufacturing. In Section 3, the methodology which includes article selection, article classification and analysis of classified articles, is presented. In Section 4,a conceptual framework for managing Sustainable Manufacturing Concepts is presented. Section 5, discusses research implications for future research. Finally the paper is concluded in Section 6.

2. LITERATURE REVIEWS

A literature review draws the summary of the existing literature. Rowley and Slack (2004) and Soni and Kodali (2011) enumerated that the literature reviews are important in:

- Supporting the identification of a research topic, question or hypothesis;
- Identifying the literature to which the research will make a contribution;
- Contextualizing the research within that literature;
- Building and understanding of theoretical concepts and terminology;
- Facilitating the building of a bibliography or list of the sources that have been consulted; and
- Suggesting research methods that might be useful; in, analyzing and interpreting results.

But it is also not necessary that each literature review needs to address all these above points. The current study looks to build upon previous literature reviews focussed on various Concepts of Sustainable Manufacturing in order to provide suggestions for future research. Ghandehariun et al., 2016 has conducted a review on Sustainable manufacturing and its application in machining processes. The author examined papers from 1993 to 2013 in a variety of peer-reviewed journals. Sri Hartini et al., 2015 reviewed the relationship between lean and sustainable manufacturing on performance using 58 research articles. Lujie Chen et al., 2014 has provided A literature review and research agenda regarding Manufacturing facility location and sustainability. They used literature from 1990 to 2011. Neeraj Bhanot et al., 2015 gave emphasis on enablers and barriers of sustainable manufacturing by results of a survey of researchers and industry professionals, specially to automotive industry. K Sangwaan et al., 2015 has done a bibliometric analysis of green manufacturing and similar frameworks. Sumit Gupta et al., 2015 emphasised the key determinants of sustainable product design and manufacturing. V K Mittal et al., 2014 wrote about modeling drivers for successful adoption of environmentally conscious manufacturing. Shaikha Al Zaabi et al., 2013 worked for analysis of interaction between the barriers for the implementation of sustainable supply chain management. Jorge A. Arevalo et al., 2011 searched for corporate social responsibility practices in India: approach, drivers, and barriers. Arun N. Nambiar et al., 2010 gave review on challenges in sustainable manufacturing. Dr Rainer Seidel et al., 2008 gave a thought for establishing sustainable manufacturing practices in SMEs. Jamesr. Mihelcic et al., 2003 give discussions for sustainability science and engineering: the emergence of a new meta discipline. Glenn Johansson et al., 2000 gave idea of success factors for integration of ecodesign in product development ð a review of state-of-the-art.

It is evident that there has been no review of work performed in the area of Sustainable Manufacturing concepts, which has quiet large body of extant literature. Thus the need of review focussed on Sustainable Manufacturing concepts is imperative and hence is the requirement of this paper justified.

3. METHODOLOGY

This section of paper explains the comprehensive scheme for literature review of Sustainable Manufacturing concepts in following subsections.

Time horizon
The year 1993 is considered as the starting point of data collection because this is a considerable time gap for research review till 2016.

Selection of database
The articles were collected from renowned international publishers that are Taylor & Francis, Emerald, Elsevier, Springer, IEEE etc. As majority of well-referred journals of industrial management are published in these databases.

Searching and sorting for articles
The database search is done for hundreds of articles. Each of the articles was examined properly to ensure that its content was relevant from the perspective of the aims of our research. The search, examination and selection of the articles is based on the criteria that only those of which main contribution revolves around Concepts of Sustainable Manufacturing will be selected. The result of this process was that 78 articles were selected for final stage evaluation.

Article classification
All the selected research articles were classified under following contents related to research methodology:

- Number of publication per year: it shows the trend of Sustainable Manufacturing Concepts literature across the 24 years. It presents the annual publication frequency of articles.
- Journal wise: it shows the journal wise article classification.
- Countries: it shows the details of country-specific studies. The studies which were not extremely specific to any particular country were categorized as collective.
- Different Concepts of Sustainable Manufacturing: no of articles per related concept are shown.
- Research tools and techniques used for these Sustainable Manufacturing Concepts: no of articles as in percentage of articles.
- Industries in which research is already done: almost all type of manufacturing industries are worked out under this section.

4. DESCRIPTIVE ANALYSIS (QUANTITATIVE ANALYSIS)

Classification based on number of publication per year
It presents the annual publication frequency of the total articles combining all the issues targeted. It is obvious from Figure 1, which in year 2014 the research held is the maximum with the topic.

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From 2014 to 2016 it is somewhat decreasing. Before 2014 it is also higher in 2013, 2012 and 2008. Before 2005 it is rarely opted for research purpose.

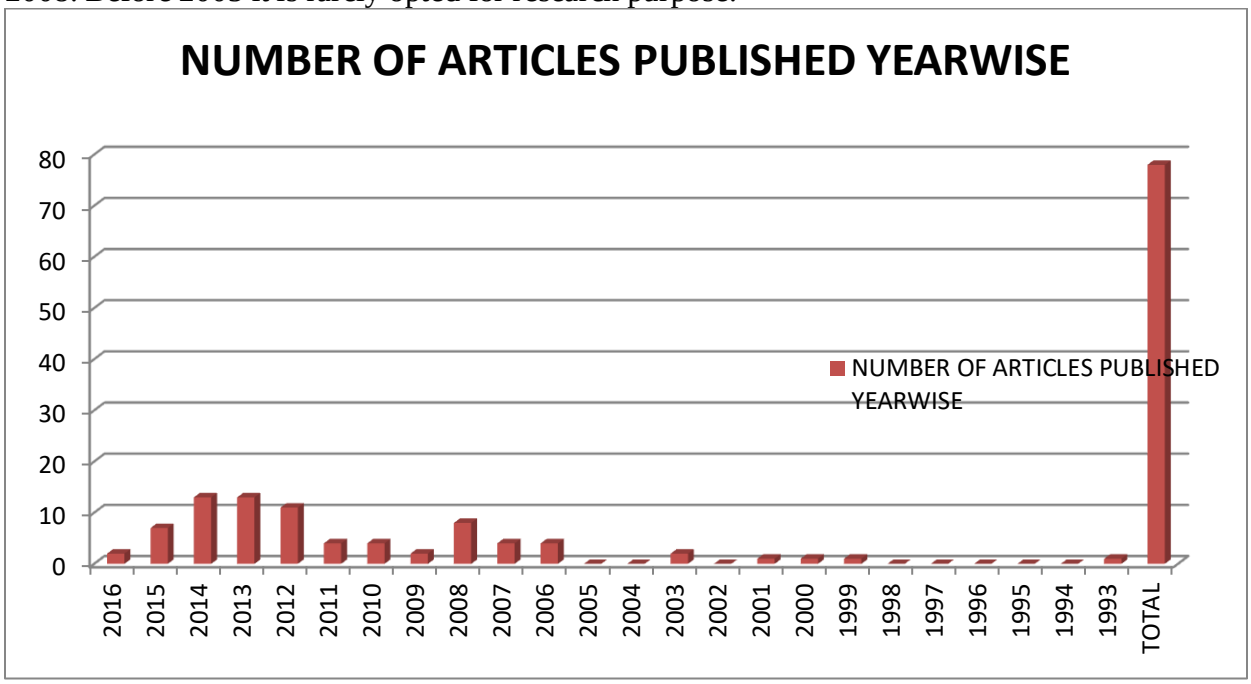

Figure 1: Classification based on number of publication per year

Journal wise classification

This shows the journals that included the articles to be reviewed. Figure 2 presents the year wise distribution according to journals. The Figure shows that from Elsevier total 24 articles selected. From Emerald 14 articles, from Taylor & Francis 10articles, from Sustainability 6 articles, from Springer 5 articles, from Elementa 2 articles, from IEEE 2 articles, from Others 15 Journals 1 articles From Each is published during the duration chosen.

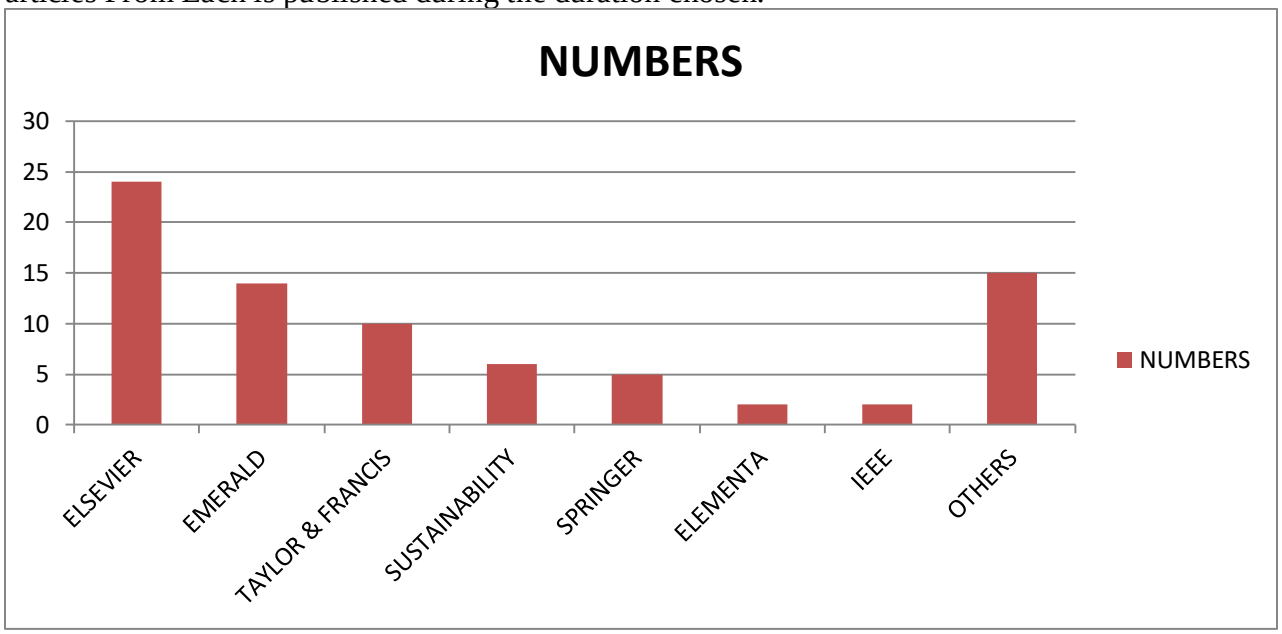

Figure 2: Journal wise classifications

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Countrywide classification

This shows the countries in which work is done on relevant articles. Figure 2 presents the percentage of articles to be worked or reviewed countrywide out of 100% for all the countries under article considerations.. The Figure 3 shows that among the chosen articles 35% are from INDIA, 6% from UNITED STATES, 5% from UNITED KINGDOM, about 14% articles are covering MORE THAN ONE country, and there is no country name mentioned in 19% articles out of total.

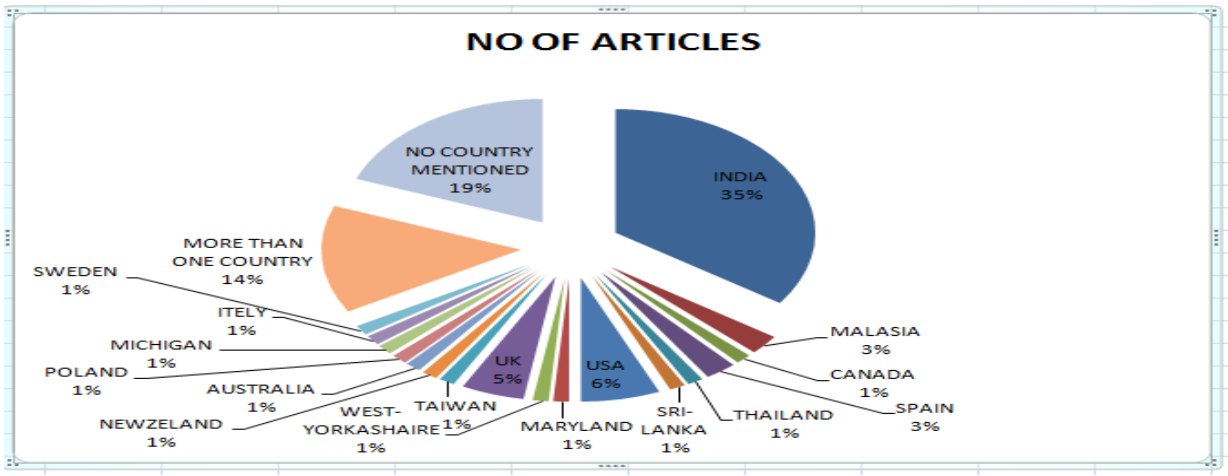

Figure 3: countrywide classification

Classification related to different related concepts of sustainable manufacturing

This shows the classification of different sustainable manufacturing related concepts with no of artices in each concept. Figure 4 presents that under this classification 15 articles comes under heading Sustainability, 12 under Green Supply Chain Management, 12 for Sustainable Manufacturing, 7 for Environmentally Concious Manufacturing, 5 for Green Manufacturing,4 for Sustainable Product Design, 3 for Environmentally Concious Technology, 2 for Lean Manufacturing and all others have 1 article each related to each concept.

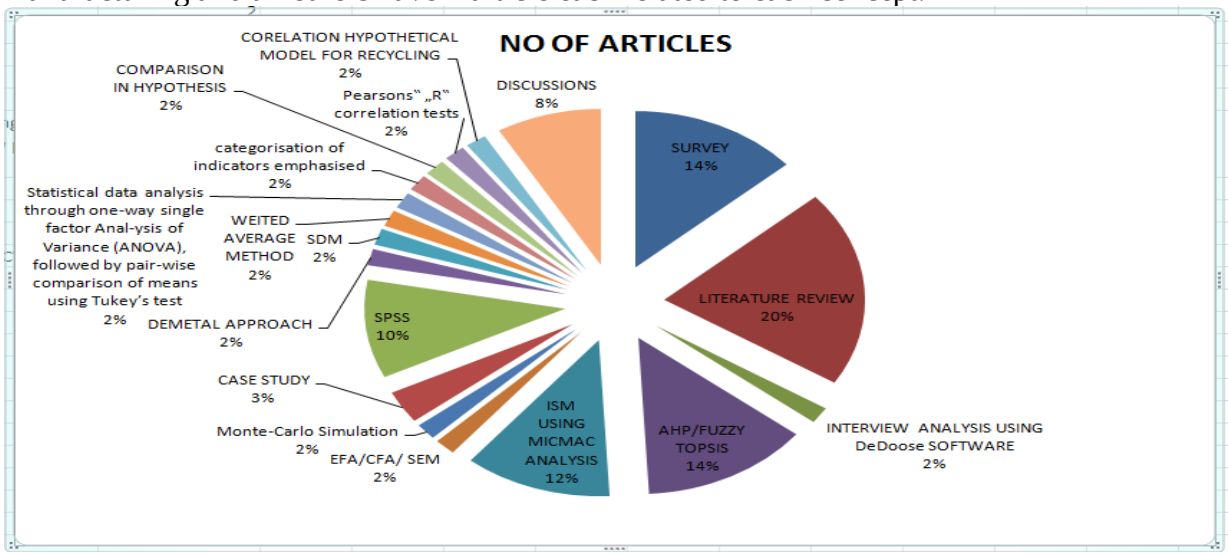

Figure 4: Classification related to different related concepts of sustainable manufacturing

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Classification for Research tools and techniques used for different Sustainable Manufacturing Concepts

This section shows the percentage of no of articles for particular research tool and techniques used in selected total articles. Figure 5 shows that 20% out of total used Literature Review, 14% used Survey, 14% used Fuzzy Topsis, 12% used Micmac Analysis, 8% used Discussion Technique, 10% used SPSS, 3% used Case Study, 2% each for Various Remaining techniques as Statistical Analysis, comparison, Dematel Approach etc.

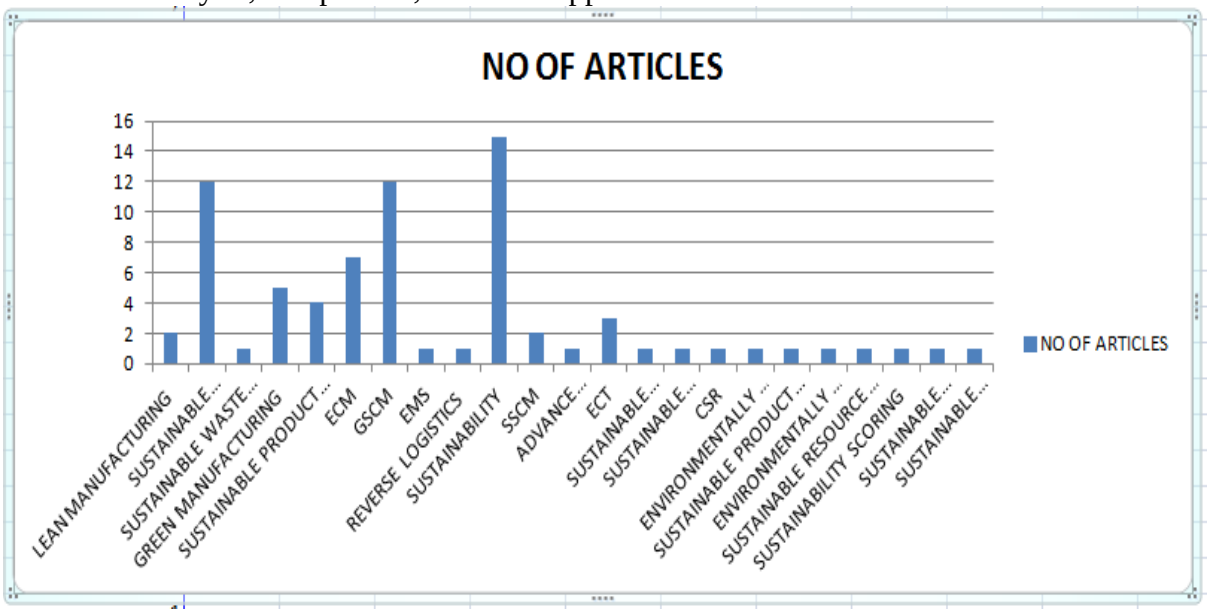

Figure 5: Classification for Research tools and techniques used for different Sustainable Manufacturing Concepts

5. QUALITATIVE THEMATIC ANALYSIS

Based on the theme of this paper as "Sustainable Manufacturing Concepts: A Literature Review", a Qualitative Analysis of the selected 78 research papers is provided as follows:

Some Conceptual Research in Eleven Classifications

This section Through Table 1 Describes the no of articles which specifically provide views about particular concepts, there may be any article can cover more than one concepts, or may be any article out of 78 which does not fall under any specified concept, that may only give a broad view rather than specified view.

At serial number 1 the concept is related to the description of drivers and barriers of any broad concept like green supply chain, green manufacturing, environmentally conscious manufacturing or technology etc. Serial number 2 specifically for sustainable manufacturing word by word.3 gives comparison of any two or more than two techniques.4 gives performance analysis of Sustainable Manufacturing.5 gives articles related to validation only through case studies. 6 gives waste management approach in articles.7 gives Life cycle approach for manufacturing purposes in articles.8 gives additive manufacturing provision.9 gives interrelation in two concepts rather than comparison.10 gives implementation of concept in an industry and finally 11 provides any specified model development.

Table 1: Some Conceptual Research in Eleven Classifications

S.No.	Concepts	Articles
1	Drivers and Barriers Assessment	[1],[4],[10],[11],[12],[13],[14],[16],[17],[19],[20],[21],[23],[24],[26],[27],[28],[29],[31],[33],[36],[37],[40],[48],[49],[50],[51],[55],[56],[75]
2	Any Assessment only for Sustainable Manufacturing	[3],[15]
3	Comparison of Two Techniques	[26]
4	Performance Analysis of Sustainable Manufacturing	[35]
5	Validation Through Case Study	[23]
6	Waste Management	[4],[18],[19]
7	Life Cycle Approach	[5],[21],[43],[53],[66],[67],[70],[72],[74]
8	Additive Manufacturing	[6]
9	Interrelation In Two Different Concepts	[10],[24],[55]
10	Implementation of Concept	[16],[17]
11	Model Development	[12],[20]

6. CONCLUSIONS

This paper provides new avenues of further research in Sustainability Manufacturing Concepts. Through Descriptive and Thematic Analysis researcher find that Six plus major publishers are reviewed in various countries over a span of 24 years. Where different specified and broad concepts are identified and reviewed through which following conclusions are reached:

1) "Sustainability manufacturing "this term is rarely used as it is in articles instead its related terms are used.
2) There is lot of work is done in the field of life cycle approach as Table 1 suggests.
3) In the reviewed articles survey and case study combination is not used for research purpose except in only one article.
4) Drivers and Barriers assessment is provided but identification of these is missing somewhere in articles.
5) In tools and techniques section survey and review are the major one to dealt with. So there could be much emphasis could be given to others also.
6) Industrywise classification is left in this research.

So the further researches could be pursued keeping all the above points in mind by the researcher.

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