Applications of Leagility in Manufacturing and Service Industries

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Abstract
Leagility is a new paradigm which combines both lean and agile concepts together. The aim of current study is to constitute a vast literature of leagility in manufacturing and service sectors categorizing the existing studies and to explore the limitations and future research directions. There are 40 research articles selected for this study and classified based on year, research methods, publisher, journal and application on leagility. Then the identification of limitations and future research directions from the articles are reviewed. The finding suggests that leagility is explored more in supply chain and it requirements to be looked into other sectors. The theoretical background is made by developing more conceptual models, frameworks and empirical testing in manufacturing, automobile, healthcare and Information Technology (IT). The validation of the models has been examined by real-time case studies. The reader can understand that leagility is applied mainly in supply chain as decoupling point and emerging concept in market. For researcher, it would have a widespread of ideas for research.

Keywords: Leagility; Lean and Agility; Leagility in supply chain; Leagility in Service; Leagility in Manufacturing

1. Introduction

The current business scenario has been continuously facing challenges like enhance consumer delight, modifying enterprise practices, minimizing expenses of organization and obtaining competitive advantage [1]. Customer satisfaction is the biggest challenges faced by companies to fulfill the requirement in forms of capacity, variation, quality, rate and period. An organization requires special care and attempts to confirm the existence of business in significance when customer demand varies in an unpredictable way [2]. Handling uncertainties is a critical work and various management perceptions have been anticipated to obtain this objective [3]. Quick delivery, minimization of cost, satisfying current demands and flexible system are essential to the alternative best practice of manufacturing system to improve the performance. To overcome the above challenges, firms use the most commonly applied paradigms like leanness and agility. Lean principle emphases on the removal of all kinds of non-value activities all over the organization while agile emphases on organizational behavior with consideration to market changes in a quick way. Leagility is the combination of both principles by taking advantage of lean and agile as quick reaction to the current demand of the market with effective utilization of limited resources [4]. Leagile concept first emerged in supply chain and then it spread to manufacturing sector. Leagile manufacturing benefits mainly to increase competitive advantage, improved consumer relationships, improve the quality of service, enhance sales, enhanced use of resources, improve employee spirit by dropping stock storage and have control over all other expenses and elimination of all non-value added activities.

Leagile is an emerging concept and many researchers and professionals are contributing to the exploration of a conceptual framework and empirical analysis over the past two decades. In contrast to the growth of publications, none has made studied the literature review research articles of leagility and this would be a motivation for the present study. The present study efforts to make an organized
literature review of leagility from the research articles from Emerald, Taylor and Francis, Inderscience, Elsevier, Springer and Google Scholar. The following are the research questions of the current review as
RQ1: How has the leagility in different industries been looked at with regard to various parameters like year, publisher, research method and application oriented?
RQ2: What are the limitations and gaps of the existing literature?
RQ3: What are the scopes for future approach to leagility concepts in different sectors?

The rest of paper is as organized as follows: Section 2 is the brief literature on leagility. Section 3 gives the research methodology of the study. Section 4 is about the results and discussion which includes categorization, limitation and scope for future research from the articles. Section 5 is mainly focus on discussion of results and it extents the future research directions. Finally, Section 6 is incorporated the conclusion.

2. Literature review on Leagility
[5] have overlooked to describe ‘leagile’ by combining the lean and agile concepts. They have measured the performance of supply chains using leagility concept by considering market demand and lead time reduction, eliminating wastages and making improvement in scheduling. They also have explicated the importance of a decoupling point in a supply chain for leagility, which is the transition argument between the buffer stock and the unstable demand of products. Leagile has been defined as “the combination of the lean and agile paradigms within a total supply chain strategy by positioning the decoupling point so as to better suit the need for responding to a volatile demand downstream, yet providing level scheduling upstream from the decoupling point” [5].

Leagility framework can be separated into two divisions: one focuses on supply chains and the other one focuses on individual manufacturing units. [6] have anticipated a leagile framework which mainly operates based on both lean and agile at supply chain of manufacturing unit. The framework is about the decoupling point which divides the lean and agile process diversely. The supply chain structure is formulated based on the situation of decoupling point and decided where and when lean and agility is required. Leagility can be accomplished by aggregating the three dimensions which include efficiency, effectiveness and responsiveness [7].

3. Methodology
The systematic literature review has been made in three phases acquired from [8]. In the first phase, using key words like “Leagility”, “Leagile”, “lean and agile”, “lean and agility” are searched to collect research articles from Emerald, Taylor and Francis, Inderscience, Elsevier, Springer and Google Scholar until July 2018. In the second phase, the research articles collected are classified based on year, author, publisher, methodology, application and the medium of language used is English. The editor notes, book reviews, preface articles and conference papers are excluded, ending up with 40 relevant articles. During the last phase, the select 40 articles are grouped under four categorizations such as year of publication, research methods, publisher and journals and application oriented. The detailed description of these categorizations is given below and identified the research gaps and future research directions.
4. Results and Discussion

4.1 Categorization of the framework

After reviewing the articles, the following categorization context is adopted in the present a complete and whole analysis of leagility.

- Categorization based on year
- Categorization based on research methods
- Categorization based on publisher and journal
- Categorization based on application oriented.

4.1.1 Categorization based on Year (1999 to 2018)

Figure 1. Distribution of articles based on year

The year wise categorization of publication indicates the review of leagility is range from 1999 to 2018. It is about the two decades but the publication is more during 2009 to 2018. The distribution of leagility literature indicates much scope in recent years with five articles published in 2018. First leagility was integrated by [5] and applied it in supply chain, but its gradual attention gained after 2009. Figure 1 shows the emerging importance of leagility over a period of 20 years.

4.1.2 Categorization based on Research Methods

The categorization of the articles with the research methods are followed as conceptual, case study, empirical, comparative analysis, theoretical contribution, assessment, report analysis and applied research. The divisions of articles with research methods are given in Figure 2.
Figure 2. Categorization of paper with research methods

The literature of leagility is categorized with research method indicates that 52% of the articles on case studies, after that 17% of conceptual development and 10% of assessment. It implies that a majority of researches are done in case study from and few studies are conducted to develop a conceptual model in leagility. There is much scope for future research in developing a conceptual model for different fields and that would help in theory building. Further, the theoretical development and validity with empirical would help to generalize the leagility in various fields.

4.1 3 Categorization based on Publisher and Journal

Table 1. Literature categorization based on Publisher and Journal

| Publisher   | Journal                                           | Author                                                                 | No of papers per publisher |
|-------------|---------------------------------------------------|------------------------------------------------------------------------|----------------------------|
| Elsevier    | Int. J. Production Economics                      | [9]; [5]; [10]; [11]; [12]                                             | 10                         |
|             | European Journal of Operational Research          | [13]                                                                   |                            |
|             | International Journal of Operations & Production  | [14]                                                                   |                            |
|             | Management Systems                                | [3]                                                                    |                            |
|             | Journal of Manufacturing Systems                  | [15]                                                                   |                            |
|             | Procedia Manufacturing                            | [16]                                                                   |                            |
| Emerald Insight | Benchmarking: An International Journal    | [17]; [18]; [19]                                                      | 9                          |
|             | International Journal of Agile Management Systems | [20]                                                                   |                            |
|             | International Journal of Lean Six Sigma          | [1]                                                                   |                            |
|             | Journal of Business & Industrial Marketing        | [21]                                                                   |                            |
|             | Journal of Enterprise Information                 | [22]                                                                   |                            |
Leagility has gained importance in publishers like Taylor & Francis, Emerald Insight, and Elsevier. International Journal of Production Economics has five research articles, International Journal of Production Research has three research articles, and Benchmarking: An International Journal also has three research articles. These three journals have given importance and opportunities for the publication of research articles related to leagility. These three journals have repeated more than three articles on leagility. [5] have developed a concept of leagility by combining lean thinking and agile manufacturing, which is published in International Journal of Production Economics. The other journals who have gained importance on leagility are International Journal of Agile Systems and Management, International Journal of Logistics Research and Applications. Table 1 shows the distribution of articles based on publisher and journal.

| Publisher | Journal Title | References |
|-----------|---------------|------------|
| Inderscience Enterprises Ltd. | Int. J. Agile Systems and Management | [25], [26] |
| | Int. J. Industrial and Systems Engineering | [27] |
| | Int. J. Information Technology and Management | [28] |
| | Int. J. Process Management and Benchmarking | [2] |
| | International Journal of Operational Research | [29] |
| | Int. J. Services and Operations Management | [30] |
| Scientific Research Publishing | Open Journal of Business and Management | [31] |
| Springer Science | Journal of Intelligent Manufacturing | [32] |
| Taylor & Francis | International Journal of Healthcare Management | [33] |
| | Production Planning & Control | [34] |
| | International Journal of Logistics Research and Applications | [35], [36] |
| | International Journal of Management Science and Engineering Management | [37] |
| | International Journal of Production Research | [38], [6], [39] |
| Others | Advanced Materials Research | [4] |
| | African Journal of Business Management | [40] |
| | Decision Science Letters | [41] |
| | American Journal of Scientific Research | [42] |
4.1.4 Categorization based on Application Oriented

| Application Oriented                  | No of papers | %  |
|---------------------------------------|--------------|----|
| Supply Chain                          |              |    |
| • General                             | 16           | 40 |
| • Manufacturing                       | 3            | 7.5|
| • Fast Moving Consumer Goods (FMCG)   | 1            | 2.5|
| • Information Technology(IT)          | 1            | 2.5|
| • Personal Computer                   | 1            | 2.5|
| • Performance                         | 1            | 2.5|
| • Automobile                          | 1            | 2.5|
| • Inventory                           | 1            | 2.5|
| • Reverse supply chain                | 1            | 2.5|
| Healthcare                             | 3            | 7.5|
| Food processing                       | 2            | 5  |
| House appliance industry               | 1            | 2.5|
| Inventory                             | 1            | 2.5|
| Manufacturing                         | 5            | 12.5|
| Marketing                             | 1            | 2.5|
| Software development                  | 1            | 2.5|
| Total                                 | 40           | 100|

The categorization of research articles are based on the application describes the 65% of articles applied in supply chain, 12% on manufacturing, 7% on healthcare and 5% on food processing. Major portions of articles are published in supply chains which are further classified as general, manufacturing, FMCG, IT, automobile, performance, inventory and reverse supply chain. The future scope is more on other areas like manufacturing, healthcare, automobile, IT and other service industries for the development of conceptual model and it is validated by empirical test in the implementation of leagility. Table 2 shows the literature distribution based on application oriented.

4.2 Limitations

The following are the limitations derived from the research articles

- The case study findings would not be enough to the generalizability of the leagility ([3];[21]).
- Leagility is applied in various sectors and units will have different results ([36]; [34]; [11],[19]; [24],[22]).
- Secondary data analysis method is used, which has an issue associated with facts quality and accurateness [16].
- Leagility is utilized fully by healthcare in the case of cardio diabetes care case [33].

4.3 Scope for future research

The following are the future research directions derived from the articles published.

- The critical barriers are identified for future enhancement by specialized attention [17].
The validity of empirical results is increased by examining the organized and suggested factors to diverse types of firms [18].

Leagility is practiced in mass services and also applied professional services, service shops and mass services [19].

Leagility is applied with several methods to identify technical gaps in supply chain for improvement activities [4].

The suggested model of leagility is implemented to check the appropriate with real time case study [23].

The validity and reliability of leagility is tested by applying with different sectors for supply chain [34].

The comparative analysis of leagility with various industries on supply chains can be included leagility in diverse ways [3].

Leagility is applied with reverse logistics generally on recycling or other environmental dimensions [36].

ISM can be used to develop a initial model and its validation is tested by using Structural Equation Modelling (SEM) [2].

Leagility further applied in healthcare with disease like breathing infection, HIV, cardiovascular difficulties and tuberculosis [33].

The robustness, flexibility and appropriateness of leagility index is checked with different supply chain [15].

The definition of leagility is tested with the performance features of supply chain. The longitudinal and action research is required on the change practice of leagility [10].

Leagility model is further expanded with other sectors to improve the efficiency, consumer satisfaction and profit of the firm in better way.

Leagility can be incorporated with the other techniques like neural networks and reversed mapping to solve the real-time problems [21].

Leagility model can be utilized with other professional services like auditing, legal and financial and consultancy services [24].

The developments of model with the variables are examined with survey. Further the performance of supply chain is tested with long term [11].

In-depth interview can be extended further for the clarity in the application of leagility [16].

5. Futuristic Research Directions

From the present study, this the literature reviews of articles on leagility until July 2018 from reputed database is noted. Leagility is widely applied in supply chain with a decoupling point where combining leanness and agility for the reacting rapidly for consumer requirement by diminishing cost and waste [17]. This is the first study on leagility as a whole on literature review based on emerging importance in recent years. The present article elaborates the categorization based on year, journal, publication, application oriented, research method, limitation and future direction. The sample size of articles with respect to five publishers and so on. The summary and future directions of analysis are given below:

1. Leagility is mostly explored in supply chain, but not in manufacturing, service and IT ([3]; [34]). In supply chain, huge studies have emerged in conceptual model, empirical, case study, performance analysis, comparative analysis form and so on. Whereas in manufacturing, only a few studies have emerged, which include developing a model, making theoretical study, case study and so on. Validation and real time implementation would help to analyze leagility in an effective way.
2. Leagility should be applied in different fields such as automobile, home appliance, healthcare, marketing, reverse engineering, sustainability, IT, software development, textile, fast moving consumer goods, manufacturing (process layout, product design and batch processing) and so on.

3. Leagility is implemented with the change process by applying action research. This helps to increase the profit, market share, enhance competitiveness and satisfy customer demands to the dynamic market.

4. More conceptual models of leagility need to be developed and tested empirically in different sectors to expand the concepts for implementation, action and performance analysis.

5. The robustness, flexibility and appropriateness of the leagility index is tested with other supply chain for betterment of methods.

6. The comparative analysis of leagility in different sectors would help to incorporate concepts of leagility in effective ways.

7. The new definition of leagility would emerge when it is applied and tested empirically in different industries.

8. In-depth interviews are conducted to find out the opportunities and development of concept leagility in different sectors.

9. In healthcare, leagility should be applied to various departments, disease wise treatments methods, nursing, operation theatre, emergency care, pharmacy and so on. The procurement of instruments, medicines, equipment and resources like water, electricity and food can be attempted.

6. Conclusion

There has been a gradual growth of attention on the literature of Leagility in the last 10 years. By analyzing the articles from journals widely, it concluded that the concept of leagility gains importance in practitioners and researchers. The review reflects the widening of leagility by analyzing the articles which are classified based on year, research methods, application oriented, journal and publisher and the limitations and scope for future research are identified. Leagility concept is more explored in supply chain as separation of lean and agility with decoupling point. The study suggests that more articles should emerge to develop different conceptual models and to test them empirically. The theoretical background should be outlined from various aspects of findings of the study. The generalisability of concept leagility would emerge based more real-time case findings. The articles published by researcher are more than the practitioner and so this invites practitioner to contribute more research articles. Further, only one third of the selects articles are giving the limitations and future scope of research would be a drawback of the study. On the whole, leagility is explored in a tiny way and it needs to be explored in more different industries on aspects. The limitation of the current study is that the articles are collected only from Emerald, Taylor and Francis, Inderscience, Elsevier, Springer and Google Scholar. The future literature analysis can be extended by selecting articles from other publishers and by increasing the sample size.

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