ASCTM Approach for Enterprise Agility

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Abstract

Agility is perceived as the principal competitive medium for all organizations in an ambiguous and changing business environment. In the current business situation, enterprises are converging to a point where they need to be smarter, faster, flexible, and more reactive to changes in order to sustain in the demanding market. Competitiveness urges the companies towards agile practices in a determined manner. Agility can be achieved by improving the relationship between buyer and suppliers in a supply chain. Identifying appropriate approaches to create an agile supply chain is one of the best ideas that can help companies making a successful changeover to an agile enterprise so that they can sustain and prosper in the market for the long run. Accommodating market changes and triggering response strategies is quite challenging and to meet this challenge we use a structured model known as Agile Supply Chain Transformation Matrix (ASCTM). ASCTM can relate the business changes with suitable approaches for supply chain configuration and supplier-buyer relationship establishment and decides the business processes and infrastructures needed to support agility. The main purpose of this paper is to propose the ASCTM which aims for the creation of an agile enterprise. ASCTM tool is constructed with the help of modern Quality function deployment (QFD) tool for identifying and iterating business practices and the Analytic Hierarchy Process (AHP) which has proved a successful Multi Criteria Decision Making (MCDM) tool in modern day manufacturing.

Keywords: Agile supply chain transformation matrix, Analytic hierarchy process, enterprise agility, Quality function deployment, Multi criteria decision making

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1. Introduction

Today’s enterprises are required to possess the agile characteristics due to the turbulent and unstable global market place & higher degree of competitiveness, which demand volatile business strategies. Rapidity, excellence, flexibility, competency and responsiveness are the key elements of agile capabilities, which are necessary to meet the unique needs of clients and markets in order to make organizational profits. Supply chain agility opens an extensive ground to the industrialists to innovate the existing supply chain and add flexibility to compete in the thriving market. The meaning of agility in the supply chain is ardent, but the different ways to achieve that agility in practice is still under construction, although lots of researchers have cited the importance and the potential of supply chain agility. The concept of agility conferred by Dove (1996) [1], emphasizes about the Dimensions of agility and elaborates on its Construction & analysis tools. According to him an agile enterprise has to design its organization, processes and products in such a way that it can respond to changes appropriately within a specific time frame. By extending this study Naylor et al. (1999) [2] has compared the lean and agile manufacturing paradigms on supply chains by highlighting the similarities and differences between the two paradigms. He concludes that the paradigms are neither better nor worse than the other, but in contrast are complementary for a winning supply chain strategy. Martin Christopher (2000) [3] routes to achieve agility using appropriate hybrid strategies and confines that organizations which are implementing marketing strategies underpinned by agile supply chains will be well equipped for survival in the uncertain markets of the twenty-first century. Hoek et al. (2001) [4] investigated supply chain agility and introduced a preliminary framework for creating an agile supply chain. Swafford (2003) [5] underwent an empirical study and identified flexibility as a critical factor for influencing a company’s supply chain agility. Ren et al. (2009) [6] proposed a decision support framework for the evaluation and selection of business partners in the process of forming agile supply chains. Different companies require different degrees of agility, which results in different set of changes and combinations of strategies to achieve agility according to Goldman et al., 1994[7]. Baramichai et al. (2007) [8], developed a tool named agile supply chain transformation matrix (ASCTM) which is a systematic approach to achieve agility. It help companies to identify the most appropriate ways to improve their supply chain agility levels by contrasting the environmental dynamics and the company’s ability to change and keep pace by using a systematic approach.

2. Research gap & problem description

The researches on supply chain agility so far attempts to establish awareness on the significance and potential of creating supply chains but very limited efforts have spelled the roadmap to achieve supply chain agility in practice. In addition, the previous researches were mostly oriented to manufacturing and provided only the general guidelines to approach agility without supporting tools and techniques [8]. In reality, there exists a wide gap between the foresaid research attempts and a comprehensive methodology which will ideally suit most industries in the process of rebuilding a flexible supply chain. Our research paper is an attempt to bridge this gap by proposing a comprehensive technique called ASCTM for configuring an agile supply chain in a Small and Medium scale Enterprise (SME). Although ASCTM requires future validation, ASCTM tool will provide a basis for assessing the business situations and sketch a guideline for identifying the capability required for creating and improving supply chain agility for the future managers.

The ASCTM model is applied to a SME, where they offer a variety of fabricated products based on the pull production system. The organization receives huge varieties of orders from various quadrants for its quality but find it difficult to interface suppliers. Restructuring the purchase segment on agility platforms demanded a complete model like the ASCTM for enabling MCDM and in prioritizing business practices.

3. Methodology

The construction of the agile supply chain transformation matrix is illustrated with a conceptual framework as shown in Fig.1. This model is constructed in a 3 step procedure and has the distinct ability to work along with some supporting tools like Quality Function Deployment (QFD) and analytical hierarchy process (AHP) in its road map of building an agile supply chain.
3.1 Identifying the current business challenges & corresponding changes

Extensive exploration of past literature showcased the global challenges faced by manufacturing industries looking to have an agile edge [Table 1]. The ability to face these challenges can be accommodated by equipping proper business practices and acquiring the infrastructures needed to improve the competitiveness of the firm. Changes that are critical to determine may fall in categories like quality, design, volume, supply lead time, supply purchase availability, supply cost, and legal issues [11]. Through expert opinion, changes which could combat the identified challenges from the viewpoint of purchasing were surfaced for the industry under focus.

Table 1 Identified challenges

| S. No | Challenges                                           | Reference                                      |
|-------|------------------------------------------------------|-----------------------------------------------|
| 1.    | Technological suitability                            | Ching-Torng Lin et al, 2004.[12]              |
| 2.    | Supplier distribution                                | Manisra Baramichai et al, 2007.[8]            |
| 3.    | Organization integration & continuous improvement    | Richard A Lancioni ,2000.[13]                 |
| 4.    | IT Integration & Trust development                   | Khurana et al, 2010.[14]                      |
| 5.    | Collaborative relationship & customer satisfaction   | Kshitij Dashore et al, 2013.[16]              |
| 6.    | Strategic planning                                   | Akhilesh Barve, 2011.[15]                     |
|       |                                                      | Vimal kumar eswarlal et al, 2011. [17]        |
3.2 Priority weight calculation using analytical hierarchy process (AHP)

In 1980, Thomas L. Satty has presented a decision making method which is widely used in a variety of applications to support the pursuit of decision making. AHP is a multi-criteria decision making approach in which the factors are arranged in a hierarchy structure. In AHP, alternatives are determined by making pairwise judgments were the decision maker inspects two alternatives by considering one criterion over another and gives a preference. The preference scales used in the comparisons are predefined [9] as shown in Table 2 and assigns numerical values for different levels of preference. Once the comparison matrix is developed, its consistency check is done where the levels are checked on the limits. Based on Critical Ratio value (CR) shown [Table 3] and depending up on the size of the comparison matrix, CR ratio varies. If it exceeds, revision of pairwise comparisons is carried out else the decisions are synthesized to find the priority weights of each criterion and its attributes based on their importance.

Table 2 Preference Scale

| Intensity of importance | Definition               | Explanation                                         |
|-------------------------|--------------------------|-----------------------------------------------------|
| 1                       | Equal importance         | Two factors contribute equally to the objective     |
| 3                       | Somewhat more important  | Experience and judgment slightly favor one over     |
| 5                       | Much more important      | Experience and judgments strongly favor one over    |
| 7                       | Very much more important | Experience and judgments very strongly favor one    |
| 9                       | Absolutely more important| The evidence favoring one over another is of the     |
|                         |                          | highest possible validity                           |
| 2, 4, 6, 8              | Intermediate values      | When compromise is needed                           |

Table 3 CR Ratios for different size matrix

| N  | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|    | RI  | 0.00| 0.00| 0.58| 0.90| 1.12| 1.24| 1.32| 1.41| 1.45| 1.49| 1.51| 1.48| 1.56| 1.57| 1.59|

The following 4 step Satty method has been used to calculate the weights.

- Step 1: Prepare a pairwise comparison matrix
- Step 2: Allocate scale values for each comparison
- Step 3: Calculate the priority weights
- Step 4: Check for consistency (≤ 0.1 vertically)

Both the challenges and changes are required to score a weightage based on the importance. Using AHP, priority weights have been calculated and AHP pairwise comparison matrices [Fig 2, 3] for challenges and changes have been checked for its consistency which comes under the theoretical limit of ≤ 0.1.
3.3 Prioritization using QFD

QFD helps to develop the ASCTM model by providing a means of transforming customer requirements into technical requirement. The evolution of QFD started in the late 1960-70’s in Japan & rapidly migrated to US and very soon to the other nations. Enumerous researches on QFD have been done by different authors which enhances the possibility in quantitative analysis & prioritization [10]. A number of QFD extensions or modifications have been made to make QFD more representative and workable in recent days.

In the ASCTM model, QFD is applied at three different stages and uses the Satty scale. Stage I is the initial phase which assumes AHP results as its input and sidelines the potential changes which affects the company’s agility. Stage II identifies the best possible strategies that accommodate the potential changes observed from Stage I. Stage III is the final stage that prioritizes the required set of business practices needed to support the strategies. The addition of AHP approach into QFD makes the model highly compatible as the decision making is made with several iteration levels. Turbulent market scenario marks unpredictable changes to any supply chain segment and these changes must be addressed carefully with proper business practices. To survive in the competitive market scenario, organizations should take the advantage of those changes and prepare itself in facing those challenges. This model may help organizations to choose the right kind of approach to respond to the changes and make better stride in the markets. However, we have constrained the scope of our research to the purchasing segment where the company faces more difficulties on the upstream level of the supply chain. Though predicting these changes demand years of experience and adequate knowledge in the field it may be effective to use the common challenges at the initial stage and progress from thereon.

3.3.1 Prioritizing changes based on the challenges

The importance ratings of the challenges and the priority ratios of the changes were established in the rows and columns respectively [Fig.4] based on the likelihood of occurrences and the impact on the company’s business using the AHP approach. The final output in this phase is the prioritization of the changes according to their importance to the company. The Satty scale for pairwise comparison [9] has been used to reflect the actual relationship between changes and challenges as strong, medium strong, medium, medium weak and weak relationships. Table 4 shows the satty’s original matrix scale ratings with its associated score for QFD. The Satty’s original scale ratings [Table 4] are comfortably taken as the inputs for transforming the qualitative inputs to derive quantitative outcomes using the QFD.

| Table 4 Numeric value for the QFD input based on satty scale |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| STRONG          | MEDIUM STRONG   | MEDIUM          | MEDIUM WEAK     | WEAK            |
| 0.51            | 0.26            | 0.13            | 0.06            | 0.03            |
The roof of the QFD represents the correlation between the alternatives indicated. The relationship may be complementary or conflictary in nature and represented using + and – symbols respectively. The need to study the correlation emerges in some cases as a set of changes can occur concurrently and affect the QFD results.

![Fig. 4 STAGE I QFD matrix](image)

3.3.2 Identifying the ways to accommodate changes through the appropriate mix of strategies

Using the changes identified in the stage I, the second QFD matrix [Fig. 5] can be developed to determine the appropriate change response strategies and the ways used for accommodating changes under the group of strategies. In this stage the importance rating is taken as the input and listed in the rows of the matrix. The methods of accommodating change are identified for each change and grouped as strategies. Depending upon the implementation cost, ease of application and risk involved the following change response strategies have been spelled. As done earlier, AHP and other supporting tools are deployed to select the strategies by constructing the comparison matrix and calculating the priority weights.

Each change is analyzed based on the knowledge and market intelligence available and the best chance of accommodating changes. Business practices selected are grouped into two functional areas which are dynamic supplier buyer relationship and organizational agility potential. These blends of the business practices are inevitably necessary to achieve the agile enterprise. The first set of strategies aim towards the creation of adaptable and flexible relationship and the second set aims target towards the improvement of agility potential. As in the first stage, the importance score is calculated by adding each relationship weights in a same column, but here we have only one priority rating (changes) to calculate the importance score. All the scores are calculated in this phenomena and convenient scaling is done to show the significant differences between the strategies.
3.3.3 Prioritize the business practices and infrastructures

The relationship between the strategies needed and the business practices and organizational infrastructures is evaluated by considering the importance of each business practice and infrastructure in supporting the implementation of change accommodation. To achieve these business practices, companies are required to establish a good relationship and coordination between the suppliers. Classification of all essential business practices and infrastructures are segmented into three groups to support the use of supplier agile capabilities and to enhance the creation of the adaptable supply chain. The first group, namely supplier data helps to select the required suppliers using appropriate supplier selection and evaluation methods. The second group, namely IT integration orients the integration of suppliers on the information technology context and the last group, namely responsive manufacturing helps to improve the responsive manufacturing skills. The final weightages have been calculated for this stage and the scores are obtained to support the firm to identify and prioritize the business practices and infrastructure that needs to be established in order to improve the agility levels [Fig. 6].

![Fig. 5 STAGE II QFD matrix](image-url)

| CHANGES                              | Dynamic supplier buyer relationship | Organizational agility potential |
|--------------------------------------|------------------------------------|---------------------------------|
| Frequent change in demand            | 3.86 0.13 0.26 0.51 0.26 0.13 0.51 0.51 0.13 0.26 |
| Balanced lead time                   | 5.49 0.13 0.26 0.26 0.51 0.26 0.13 0.26 0.51 0.51 |
| Optimal design                       | 1.32 0.26                           | 0.51 0.26 0.13 0.26 0.51 0.13 0.26 0.51 |
| Increase in cost                     | 4.07 0.13 0.26 0.51 0.26 0.13 0.13 0.13 0.13 0.26 |
| Overhauling quantity processed       | 0.65 0.13 0.13 0.51 0.26 0.13 0.26 |
| Transparency in information system   | 1.52 0.51 0.26 0.26 0.26 0.26 0.26 0.13 0.13 |
| Importance score (S)                 | 2.17 4.35 5.95 3.07 4.57 3.96 3.21 2.33 3.84 5.03 |
| Scaled importance score (S * X 10)   | 21.7 43.5 59.5 30.7 45.7 39.6 32.1 23.3 38.4 50.3 |

**Fig. 5 STAGE II QFD matrix**
4. Results and recommendations

The results of the ASCTM [Fig.7] reflects the need of organization to adopt business practices with respect to purchasing on prioritization basis starting from supplier technology upgradation having the top most importance weightage of 87.25 till RFID which has the least importance weightage of 44.86. Based on the research results, the following recommendations were given to the industry for transforming in to an agile entity.

**Table: STAGE III QFD matrix**

| STRATEGIES                                      | SUPPLIER DATA | IT INTEGRATION | RESPONSIVE MANUFACTURING |
|-------------------------------------------------|---------------|----------------|--------------------------|
| Prioritizing supplier based on location         | 21.78         | 0.13           | 0.26                     | 0.26                      | 0.26                      |
| Importance score (S)                            | 43.36         | 0.26           | 0.26                     | 0.13                      | 0.13                      | 0.13                      | 0.13                      | 0.51                      |
| Supplier selection                              | 59.50         | 0.13           | 0.51                     | 0.51                      | 0.26                      | 0.26                      | 0.13                      | 0.13                      |
| CPC & CRM                                       | 30.67         | 0.26           | 0.51                     | 0.26                      |                           |                           |                           |                           |
| Supplier integration                            | 45.68         | 0.13           | 0.51                     | 0.26                      | 0.13                      | 0.13                      | 0.26                      | 0.13                      |
| Overcoming competition                          | 39.59         | 0.13           | 0.51                     | 0.26                      | 0.51                      | 0.51                      | 0.51                      | 0.26                      | 0.13                      |
| Matching demand and supply                      | 32.11         | 0.13           | 0.26                     | 0.26                      | 0.26                      | 0.51                      | 0.51                      | 0.13                      |
| Responsiveness to validity                      | 23.25         | 0.13           | 0.26                     | 0.26                      | 0.26                      |                           |                           |                           | 0.13                      |
| Adapt to the change                             | 38.42         | 0.26           | 0.26                     | 0.13                      | 0.26                      | 0.26                      | 0.13                      | 0.26                      | 0.13                      | 0.26                      |
| Flexibility in manufacturing                    | 50.33         | 0.51           | 0.26                     | 0.13                      | 0.26                      | 0.26                      | 0.13                      | 0.26                      | 0.26                      | 0.26                      |
| Importance score (S)                            | 46.35         | 73.81          | 87.25                    | 68.44                     | 76.25                     | 60.97                     | 44.86                     | 52.24                     | 62.60                     | 68.78                     | 56.85                     | 60.17                     |
| Importance score (S)                            | 46.35         | 73.81          | 87.25                    | 68.44                     | 76.25                     | 60.97                     | 44.86                     | 52.24                     | 62.60                     | 68.78                     | 56.85                     | 60.17                     |

**Fig. 6 STAGE III QFD matrix**
1. Significant technology upgrading is required in areas like Inventory Optimization, vendor management, Product Lifecycle Management, Operations Planning, information sharing systems and Business Intelligence to address the needs of purchasing and manufacturing arenas.

2. Use supplier evaluation procedures like AHP, ANP, TOPSIS and SMART which helps to select suppliers effectively based on flexibility, agility and responsiveness to boost progression of agile activities.

3. Consider the importance of IT in capacity planning, process design, routing and scheduling and use online amenities like E-catalogue, auctions, live order status tracking, inventory monitoring to reduce the human effort and cost.

4. Implement the agile concept to enable the upstream part of the supply chain to be cost-effective and the downstream part to achieve high service levels in a volatile marketplace.

5. Update the list of potential suppliers and promote supplier partnering in design through effective supply buyer collaborations.

6. Optimize supply chain lead times using techniques like job rotation, job evaluation, kanban pull systems and group technology.

The highlighted results are prone to frequent modifications in the dynamic business environment which can be addressed only if the firms thirst on new business practices to tackle market changes is constantly motivated.

5. Conclusion

Under this volatile market scenario, changes come every day and organizations need to enhance their agility in all possible directions continuously. In this study, ASCTM model has been validated in a SME which shows the applicability of the methodology and determines the prioritized business practices required to create an agile enterprise. The principle advantage of the methodology is that the approach provides an integrated framework, by building three modern QFD matrices, in order to simplify the assessment of the relationships between challenges, changes, strategies and business practices. The novelty of the model is that it constitutes an important effort to
bridge the gap between theory and practice. This allows avoiding the risk of misalignments in the process of building an agile supply chain. Suitability of the methodology to a real situation requires early bird efforts to identify the business challenges and the changes to construct the QFD matrix. The applicability of the methodology to real cases would be beneficial only if a precise taxonomy of challenges of the company are targeted to achieve agility. On the whole, ASCTM will absolutely open a horizon for practitioners to provide the basis for evaluating their business condition and to improve their ability to survive in the unstable global markets.

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