The Comprehensive Framework for Supplier’s Agile Performance Evaluation

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Abstract: Under today’s volatile business environment, companies are reaching the point where they need to be more agile – intelligent, fast, flexible, and responsive to changes. Leveraging supplier-buyer relationships to create agile supply chains is one of the strategies that can help companies make a successful transition to an agile enterprise. Under this new paradigm shift, companies need a new set of tools and methodologies to dynamically choose suppliers in order to maintain their competitive advantage. The goal of this research is to address this need by developing a comprehensive framework for evaluating suppliers’ agile performance. Two new sets of metrics, “change response proficiency” and “Agility intangible infrastructure,” are introduced. The first one addresses the ability of suppliers to respond to each specific change by considering the balance point across four dimensions, which are time, cost, robustness and scope. The second one addresses the organizational skills, information and knowledge and corporate culture that help companies enable their ability to respond to changes quickly and efficiently. Our model, based on Analytic Hierarchy Process (AHP) techniques, is developed and employed in this research to identify and prioritize the required metrics. This comprehensive framework builds upon the concepts developed through the Agility Program at Lehigh University in partnership with company project sponsors and the Commonwealth of Pennsylvania Department of Community and Economic Development. A real-life case study is used to illustrate the application of this new framework.

Keyword: supplier selection, agility, supply chain modeling, supply management

1 Introduction and Background

Speed, quality, flexibility, and responsiveness, which are the key components of agile capabilities, are necessary to meet the unique needs of customers and markets. Enterprises benefit from having such agile characteristics by anticipating uncertainties and enabling rapid changes to achieve greater responsiveness to the variability in their business. The fundamental challenge in designing agile systems at each operating level is to find the optimal balance in the agility space between the extreme of ideal lean and instant response [15]. Managing in this new framework depends on the availability of some special infrastructures, especially the improved data and information systems [16].

In this decade, there has been an increasing reliance on supply chain components to create value-added product and services and to help companies recognize and exploit profit opportunities in their industries [12] This reliance has transformed the purchasing and sourcing function to become a key contributor to the manufacturing function and overall business competitiveness.

Under rapidly changing environments where agility is a source of competitive advantage, companies must develop appropriate sourcing strategies and take appropriate actions that aim at achieving agile performance. This includes the selection of agile suppliers that have sufficient ability to respond quickly and efficiently to various types of changes. However, evaluating a supplier’s agile performance is a difficult task. While information related to cost, quality and reliability performance of suppliers is available, it does not exist for agile performance. To evaluate and select an agile supplier requires a systematic way to identify and collect information that can be used as a leading indicator for the supplier’s ability to respond to various types of changes.

In this paper, a set of new metrics, framework, and model for evaluating supplier’s agile performance are introduced. Because there are no exact approaches toward agility, our main objective is to provide companies with a tool that is customizable. Our proposed framework attempts to distinguish the agile suppliers based on their ability to respond quickly and efficiently to the different types of changes in the purchasing and sourcing requirements.

2 Literature Review

Agility

The meaning of agility has been the source of considerable debate and academic discussion as it differs at each of several levels within an enterprise. The concept of agility as a business strategy was presented by Dove [4] as the enterprise’s ability to thrive in a continuously changing and unpredictable business environment. An agile enterprise has designed its organization, processes and products in such a way that it can respond to changes appropriately within a useful time frame. This concept was refined by Naylor, et al. [14] and Christopher [3] with a major focus on agility in supply chains and how it relates to both the enterprises’ processes and the interfaces between those processes and the market.

We assert that an agile supply chain enables enterprises to be agile and an agile supply chain can be achieved only when its supply and distribution chain attain a sufficient level of agility. By focusing on the supply side, two
approaches can be used to create the agile supply chain [2]. The first approach is to have the reconfigurable structure and relationship that allows companies to efficiently and quickly rotate and re-link their supply chain as needed in order to locate and bring the required suppliers into the network. The second approach is to leverage their suppliers’ skills and capabilities to respond to changes in the sourcing requirement through the long-term relationship.

For companies that employ the second approach to create an agile supply chain, evaluating and selecting suppliers based on their agile performance becomes the most critical task. The framework introduced in this paper will be beneficial for the companies in this group, as it can ensure the selection of suppliers whose performance best matches their change requirements.

**Supplier Performance Evaluation**

The supplier performance evaluation and supplier selection problem is unstructured and complicated. The process involves the selection of the criteria, metrics, models and methodologies that will be used for evaluating and selecting suppliers based on both objective (quantitative) and subjective (qualitative) criteria.

Initially, research on supplier evaluation primarily emphasized cost- and quality-related factors. Later studies incorporated multiple factors into the evaluation process which include financial aspects, quality, price, technical compatibility, capacity of the firm, reputation, quality certifications, management outlook, and delivery performance [1]. Recent research has focused on evaluating suppliers based on their capabilities and practices that lead to a collaborative and long-term partnership. Companies need to form relationships with suppliers that can effectively meet the changing requirements of technology and innovation [5] new product design and developments [13], and manufacturing processes and capabilities [22] at low cost.

Little has been done to identify the criteria for evaluating suppliers based on their agile performance. In one study [4], the metrics to use for agile performance evaluation are identified. An agile enterprise must have broad change capability that is in balance across four dimensions: time, cost, robustness and scope. Agile enterprises need to be able to accommodate changes in many directions by adapting their systems as needed. However, this change accommodation will be effective only if it can be completed in a timely manner and the cost of implementing it remains competitive in comparison to the company’s competitors. In addition, being able to change quickly and economically is not sufficient for agility if the change is not robust. The stability of the change response is another important criteria needed for enterprises to be fully agile.

A limitation of the above study is the lack of approaches and guidelines for employing the four metrics. The framework introduced in our paper attempts to fill this gap. The criteria used in evaluating suppliers are systematically identified based on the changes facing by the buying company. This helps ensure the selection of suppliers that can respond to various types of changes in sourcing and purchasing requirements.

Because the selection of agile suppliers requires the evaluation of the supplier’s ability to respond to different types of changes in sourcing and purchasing requirements, it is application-specific and the set of criteria used in performance evaluation needs to be systematically identified based on the changes facing each company. Therefore it is necessary to employ the methods that provide the systematic ways to identify the set of metrics and allow the direct trade-offs among all criteria used in evaluating suppliers so that they can be integrated into a single overall score for ranking alternatives.

**The Analytical Hierarchy Process**

Many formal techniques have been established to incorporate both qualitative and quantitative criteria into the supplier evaluation and selection decision problems [18]. In this study, we apply the Analytical Hierarchy Process (AHP) approach to develop and construct the model for evaluating supplier’s agile performance. The most useful aspect of the AHP approach to our framework is on its ability to systematically relate the buying company change requirements to the evaluation criteria. The AHP approach also allows direct trade-offs among all of these criteria, which are then used to develop overall priorities for ranking suppliers.

**The Classification of Changes**

To achieve a sufficient level of agility, suppliers require a broad change capability in order to handle and manage different types of changes required by the buying company. To evaluate supplier’s agile performance, the buying company needs to recognize the likely changes in its business and the impact of these changes on sourcing and purchasing requirements so that it can appropriately identify specific competencies and capabilities needed from its suppliers.

By extending the study performed by Van der Vorst and Beulens [21] and Zsidisin et al. [23], we classify changes that are critical to the determination of the reliability, predictability and cost-effective supply of materials and components into seven categories as follows:
Quality: Changes in supplier’s quality standard or variation in the quality of supplied items per time period.

Design and Feature: Changes or variation in the design of an item acquired from supplier.

Volume and Quantity: Increase/decrease or variation in a supplier’s order quantity.

Supply Lead-time: Reduction or variation of the order lead-time.

Supply Availability: Unexpected disruption of a supplier or shortage of an item in the market.

Supply Cost: Cost reduction or market price increase of an item acquired from a supplier.

Legal: Changes in substantive legal status of a purchased item or service.

It is also useful to classify changes according to their characteristics. To handle each type of change, suppliers need to have specific expertise and competency.

The inherent or intrinsic changes are identifiable in advance since they are permanent and inherent to the normal course of conducting business. However, these changes we consider to be unpredictable in the sense that their patterns can vary from time to time within the predictable range. A made-to-order furniture manufacturer faces frequent changes in design and quantity of the purchased items but the specific design and quantity needed in each period cannot be predicted since they are dependent on what end-customers order in each time period. Companies that want to be responsive to inherent changes expect their potential suppliers to have sufficient ability to handle these changes without the need for extra resources or effort.

Foreseen changes are driven by external changes. Although the occurrences of the foreseen changes can be identifiable within a predictable time frame, they are not inherent in the normal course of the company’s business. For example, film and camera companies have to shift their businesses entirely to digital imaging products as a result of the digital technology revolution during the past ten years. Companies that want to be responsive to foreseen changes expect their potential suppliers to allocate some resources for preparing a plan that can be executed when these changes occur.

Unexpected changes can be attributed to variations and changes in the external business environment, which are unlikely to be predicted or anticipated in advance. Companies, which operate in a volatile business environment, may be aware of the occurrence of these changes but they know neither what the changes will be nor when they will occur. Companies need to be aware of these types of changes as they could suddenly break historical patterns and create new trends. Companies that want to be responsive to unexpected changes expect their potential suppliers to have capabilities to make changes to their products and processes from one state to another in a timely and cost-effective manner.

3 Framework

Here we present the framework to evaluate the supplier’s agile performance. The necessary tools, metrics, and model are introduced next.

The Supplier-Buyer Agility Strategy Map

The final decision on selecting agile suppliers depends on the criteria used in evaluating their agile performance. The determination of these criteria becomes one of the most critical tasks that needs to be executed systematically. To identify such criteria, we develop the Supplier-Buyer Agility Strategy Map that can be used with the Balance Scorecard Strategy Map introduced by Norton and Kaplan [7,8,9,10,11]. Through the Supplier-Buyer Agility Strategy Map, the criteria used for evaluating supplier’s agile performance can be identified and selected in such a way that they are aligned with the buying company’s change requirements, value proposition strategies and financial strategies identified in the Balance Scorecard Strategy Map. This alignment is important because most agile companies can survive and sustain only if their suppliers have sufficient ability to create and deliver changes according to their strategic requirements.

As illustrated in Figure 1, starting from its financial strategies, the buying company can determine how to differentiate itself from competitors to attract, retain and deepen relationships with targeted customers. Then, based on these differentiation strategies, the buying company can identify the changes that it needs to accommodate in order to achieve its customer’s value proposition including the impact of these changes on the sourcing and purchasing requirements. At this point, it is useful to recognize the types and the characteristics of each change because it will help identify the appropriate way to respond to it.

Next, with the list of these change requirements, the focus is shifted to the supplier’s change response ability. To fill this third level of Figure 1: Supplier-Buyer Agility Strategy Map, we use elements of Table 1: How to Accommodate Change through Supplier’ Internal Process. This table is an expansion of the work of Dove-[4] where we add the column on change accommodation. Figure 1 contains a sampling of change accommodations.
In addition to the creation of the change response abilities, the intangible assets needed for enhancing supplier’s change response abilities must be identified. Suppliers can exploit potential competitive advantage by aligning and integrating the intangible assets to improve their change response ability. The intangible assets can be categorized into three categories: information and knowledge capital, organizational skill, and corporate culture. These intangible assets are listed at the lowest level of Figure 1.

From the strategy map, supplier’s agile performances are driven by supplier’s change response ability and supplier’s intangible assets. Therefore, we incorporate these two factors into our supplier performance evaluation framework. However, since there are no exact ways to create agility, the details on what area within the supplier’s internal operation and what change response ability and what intangible assets to be included in the evaluation process must be specifically determined.

**The Metrics for Evaluating Agile Performance**

In order to determine the extent to which the supplier’s agile performance meets the need of the buying company, measurable criteria must be established. These criteria should reflect the supplier’s ability to respond to change including the availability of their intangible assets required for enhancing their change response ability. In this paper we propose two new criteria, the change response proficiency and the agility intangible infrastructure (whether the infrastructure exists or not).

Change response proficiency, reflects the extent to which the supplier’s internal operation can be adapted and adjusted to respond to changes. For a high level of change response proficiency, suppliers must be able to respond to change while keeping the balance across four dimensions: time, cost, scope and robustness. The priorities assigned to each of these performance dimensions differ according to the strategic focus of the buying company. We define these four performance dimensions as follows:

Cost: The cost incurred by the buying company in order to invoke supplier’s change response ability.

Time: The time required by supplier to implement change in sourcing requirements.

Robustness: The reliability and integrity of the purchased item, as well as the supplier’s process after the change has been implemented. For our approach, several factors can be used to determine the robustness including the quality of the purchased item after the capacity has been increased and the reliability of the supplier manufacturing process after the reconfiguration.

Scope: The extent of changes that can be achieved by suppliers regarding among others product development, manufacturing, distribution and logistics and material management. The scope of change is the most difficult aspect to measure because there are broad ranges of change that can be implemented and achieved. We provide guidelines for determining the scope below.

We base the scope of change on two aspects, range and adaptability [20]. Range, is the availability of different levels, states and options of supplier’s products and processes to meet the changing needs of the buying company without the significant requirement of additional resources. Adaptability, concerns the supplier’s capability to change its products and processes from one state to another in a timely and cost-effective manner to accommodate various types of changes.

In order to evaluate supplier’s range, relevant information needs to be gathered from the available sources (See Table 2: The Examples of the Criteria Used to Determining Supplier’s Range for an illustration). Table 2 can be built by obtaining directly from each individual supplier figures and numbers. This information though is not applicable for determining supplier’s adaptability.

Determining supplier’s adaptability requires forward thinking about the supplier’s ability to accommodate change that evolves from time to time. We feel that the better way to judge this adaptability is to use one of the three possibilities mentioned in [19], namely to use available information that might suggest the supplier’s ability to adapt to accommodate changes in various dimensions.

A supplier’s change ability can be driven by several factors [6, 17]. For our purposes, we classify these factors into six categories which we identity as the agility enablers: product design strategy, operational strategy, modular reconfigurable software, modular reconfigurable hardware, system control method, and location and facility layout. The assumption here is that suppliers with the right agility enablers are more likely to respond to the buying company’s change requirements. Therefore to evaluate the supplier’s adaptability, the buying company needs to determine what agile enablers are necessary. For this purpose we have developed a tool called Supplier Change Response Profile (see Figure 2: Supplier Change Response Ability Profile).

By relating the agile enablers to the specific change response ability they support and to the buying company’s change requirements in the profile, the buying company will have insight to the factors it needs to consider when evaluating supplier’s adaptability.

Additionally, we add the supplier performance score to this profile to facilitate performance benchmarking and supplier development activities. This score can reveal an
area where a supplier should improve to achieve a higher level of agility. The calculation of this score is explained in a subsequent section. The calculation of this score is the final step of the evaluation process.

The Hierarchic Model

Using the metrics and tools presented above we build an AHP-based model. We present the model below, and then we detail the methodology to construct and implement it.

Figure 3 details our model using six levels. The first level is the supplier’s agility performance. The second level lists the buying company’s sourcing and purchasing change requirements. This provides the opportunity to compare suppliers based on their ability to respond to each specific change requirement. The third level consists of two criteria, change response proficiency and agility intangible infrastructures, used for evaluating supplier change response ability. In the fourth level, the criteria identified in the third level are expanded. The supplier change response proficiency is expanded into four performance dimensions (time, cost, scope and robustness) while the supplier agility infrastructure is expanded into three areas of intangible assets. The fifth level details supplier’s change response abilities created and implemented through their internal processes. Finally, the supplier’s change response ability is decomposed into range and adaptability.

The Determination of Weights

The weight of each factor identified in the model needs to be calculated by pair-wise comparison. The buyer assigns the relative importance of each factor. Each factor has one or more child factors. The pair-wise comparison takes place among these child factors for each parent factor. For example, the weight assigned to supplier change response proficiency (Level 3) will be greater than the weight assigned to supplier agility intangible infrastructure if the buying company’s business focuses on the manufacturing operation instead of knowledge creation and technology development.

The Model Implementation

The last step in the agile supplier performance evaluation framework is to obtain the information from the suppliers, enter it into the model, and make a judgment of supplier performance on each area identified in the model. Our model identifies the better supplier for each change requirement (Level 2, Figure 3). This analysis provides the buying company the opportunity to pick multiple suppliers whose performance is ranked highest under different types of change. Our model can also provide the aggregate performance rank across all change requirements. The following discussion provides a guideline on how to implement the model.

For each change requirement the buying company needs to acquire the performance information from each supplier with respect to change response proficiency and agility intangible infrastructure. Each supplier will have its own score that is computed in comparison to the other suppliers. The model works from the bottom to the top. We will explain the agility intangible infrastructure score calculation for each supplier. The change response proficiency is computed similarly.

The suppliers are ranked and a priority is given for each factor. The priorities sum to 1. Then, the weights assigned by the buyer are used to compute the weighted agility intangible infrastructure score. The change response proficiency score is computed similarly. These two scores are then weighted and added in order to compute the overall priority score for each supplier with respect to each specific change requirement.

4 Example Illustration

A case study was performed at a composite medium-size plastics manufacturer. This company, Company A, focuses on achieving a high level of agility to satisfy their customers’ diverse needs for design, features, and short life cycle. Company A delivers value to its customers by being reliable and responsive and offering product differentiation. Company A relies on several suppliers instead of manufacturing in house so that it can focus only on its core competencies. The example we present involves the supplier evaluation for a specific retail box.

Step 1: Create Supplier-Buyer Agility Strategy Map as shown in Figure 1: Supplier-Buyer Agility Strategy Map.

Step 2: Create Supplier Change Response Ability Profile as shown in Figure 2: Supplier Change Response Ability Profile. This process requires collaborative efforts from several functional departments because supplier’s change response abilities are created through several processes that span different departments.

Step 3: Structure supplier’s agile performance evaluation model as shown in Figure 3: The Hierarchic Model for Supplier’s Agile Performance Evaluation. In this case, only three change requirements, which are variation of the order quantity, migration to the new product, design and immediate increase of the order quantity are considered.

Step 4: For each change requirement, calculate the factor weights. For conciseness, we illustrate only one table for one change (see Table 3: Supplier’s Agile Performance...
Evaluation With Respect To The Variation Of The Order Quantity, column A).

Step 5: Evaluate suppliers through pair-wise comparison to obtain their weighted priority score. Columns B and C of Table 3 are used to fill in columns D and E. To calculate the weighted aggregate priority score in columns F and G, we sum the weighted factors of the lower levels. So, for level 2, variation of the order quantity, we compute the weighted sum of all level 3 weighted priority scores.

Table 4: Supplier’s Agile Performance Evaluation can be interpreted in two ways. One is to use the individual scores for each change and select the suppliers based on each change (columns F and G for level 2). The other is to compute the weighted sum of scores to get the aggregate priority across all changes, which will rank the supplier (Level 1), and Company A selects the top suppliers (one or more based on the company’s strategy).

5 Conclusion

The Comprehensive Framework for Supplier’s Agile Performance Evaluation has been proposed. It requires forward thinking into the ability of the suppliers to handle change, something unique in the literature. The necessary tools, metrics, and modeling structures have been detailed. A concise example has been used to demonstrate the premise of this work.

While this framework has been utilized for evaluation purposes by the buyer, it can also be applied as a benchmarking tool by both the buyer and the suppliers. Purchasing managers may suggest benchmarks for the lower-ranked suppliers by setting standards across several performance areas, which can be derived from the higher-ranked suppliers. Also under conditions of multiple-supplier selection, our framework allows the buying company to make effective decisions on selecting the groups of suppliers whose competencies and capabilities can be combined to enhance agility performance.

6 References

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Figure 1: Supplier-Buyer Agility Strategy Map

The supplier's intangible assets needed for enhancing supplier's change response abilities

The supplier's change response ability

The buying company's differentiation strategies and change requirements

The buying company's financial strategies
Proceedings of the International Conference on Agile Manufacturing,  
July 19-20, 2006, Marriott Waterside Hotel, Norfolk, VA, USA

Figure 2: Supplier Change Response Ability Profile

<table>
<thead>
<tr>
<th>Change Response Ability</th>
<th>Planning</th>
<th>Product Development</th>
<th>Manufacturing</th>
<th>Distribution</th>
<th>Purchasing/Receiving</th>
<th>Performance Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variation of the Order Quantity</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td>$E_{5623}$ $0.437$</td>
</tr>
<tr>
<td>Variation of the Product feature and system components</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous quality improvement</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Migration to the new product design by adding new technology</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td>$E_{5424}$ $0.452$</td>
</tr>
<tr>
<td>Immediately increase in the order quantity</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td>$E_{5425}$ $0.457$</td>
</tr>
</tbody>
</table>

Supplier A

Supplier B

Supplier C

1 Product Design Strategy and Practice  
2 Operational Strategy and Practice  
3 Modular Reconfigurable Software  
4 Modular Reconfigurable Hardware  
5 System Control Method  
6 Location and Facility Layout

STEP: Standard for Transfer and Exchange of Product Model Data  
CAD: Computer Aided Manufacturing  
CAM: Computer Aided Manufacturing  
PDM: Product Data Management  
CAPI: Computer Aided Process Planning
Table 1: How to Accommodate Change through Supplier’s Internal Process

<table>
<thead>
<tr>
<th>Change Response Ability</th>
<th>The Criteria for Determining the Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>Quick planning and re-planning</td>
</tr>
<tr>
<td></td>
<td>Number of contingent plans that have been prepared in advance</td>
</tr>
<tr>
<td></td>
<td>Number of planning frequencies used</td>
</tr>
<tr>
<td>Flexible scheduling</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>Reconfigurable Manufacturing Processes</td>
</tr>
<tr>
<td></td>
<td>Number of production changeovers which manufacturing can execute cost effectively in a time period</td>
</tr>
<tr>
<td>Flexible Capacity</td>
<td>Range of production volumes over which manufacturing can operate cost effectively</td>
</tr>
</tbody>
</table>

Figure 3: The Hierarchic Model for Supplier’s Agile Performance Evaluation
### Change responses

| Creation (Build something new or remove something completely) | Planning and scheduling Add the new plan  
Product Design and Development Develop new technology for product, innovative design, Create the custom design according to the need of an individual customer  
Manufacturing Processes Develop the process innovation and technology invention  
Distribution and Logistics Add new delivery modes/options, Add new distribution channel and facility  
Purchasing and Material Management Locate and acquire the new material |
| --- | --- |
| Expansion/Contraction (Quantity and capacity changes) | Manufacturing Processes Expand / contract production capacity, increase production throughput  
Distribution and Logistics Expand / contract the delivery capacity, Increase the quantity of purchased material |
| Reconfiguration (Reorganizing a set of existing components and their interactive relationship) | Product Design and Development Create customizable and reconfigurable product (by reorganizing the components)  
Manufacturing Processes Reconfigure the production processes from manufacturing  
Distribution and Logistics Reconfigure the place, schedule and assortment of deliveries  
Purchasing and Material Management Reconfigure the purchasing schedule |
| Addition/ Subtraction (The addition and the removal of some unique capabilities) | Product Design and Development Create scalable product, Create extensible product  
Manufacturing Processes Add the processes to the existing production system  
Distribution and Logistics Add additional delivery modes and option  
Purchasing and Material Management Add additional supply source |
| Migration (Planned fundamental changes, transitions to next generation replacements) | Planning and scheduling Switch to the alternative plan  
Product Design and Development Redesign product  
Manufacturing Processes Process redesign  
Distribution and Logistics Switch to another delivery mode/option  
Purchasing and Material Management Switch to another suppliers |
| Augmentation (Incremental improvement of performance factors) | Product Design and Development Reduce the product development lead-time  
Manufacturing Processes Reduce manufacturing lead-time  
Distribution and Delivery System Improve the delivery reliability continuously  
Purchasing and Material Management Improve the supply ratability and the quality of the purchasing items continuously |
| Variation (Performance time operating surprises that need to be accommodated from time to time) | Planning and scheduling Flexible planning and scheduling  
Product Design and Development Create product that are customizable from time to time according to the customer and market requirement  
Manufacturing Processes flexible production volume  
Distribution and Logistics flexible delivery lead-time, flexible delivery volume  
Purchasing and Material Management Adapt and alter purchasing order quantity |
| Correction (Recovery, return to service) | Product Design and Development Correct the design  
Manufacturing Processes Production recovery  
Distribution and Logistics Return to service after the delivery failure  
Purchasing and Material Management Return and correct the purchasing products that aren’t meet the requirements |

### Table 1: How to Accommodate Change through Supplier’ Internal Process

<table>
<thead>
<tr>
<th>Change Response Ability</th>
<th>The Criteria for Determining the Range</th>
</tr>
</thead>
</table>
| Planning | Number of contingent plans that have been prepared in advance  
Number of planning frequencies used |
<p>| Flexible scheduling | Number of scheduling frequency used |
| Manufacturing | Number of production changeovers which manufacturing can execute cost effectively in a time period |
| Reconfigurable Manufacturing Processes | Range of production volumes over which manufacturing can operate cost effectively |</p>
<table>
<thead>
<tr>
<th>Factors/Criteria/Sub-criteria/Attributes</th>
<th>Weight</th>
<th>Supplier B</th>
<th>Supplier C</th>
<th>Supplier B</th>
<th>Supplier C</th>
<th>Supplier B</th>
<th>Supplier C</th>
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</thead>
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<td></td>
<td></td>
<td>0.5633</td>
<td>0.4371</td>
<td></td>
</tr>
<tr>
<td>Agility intangible infrastructures</td>
<td>3</td>
<td></td>
<td>0.333</td>
<td></td>
<td></td>
<td></td>
<td>0.1999</td>
</tr>
<tr>
<td>Information and knowledge</td>
<td>4</td>
<td>0.6</td>
<td>0.6670</td>
<td>0.3330</td>
<td>0.4002</td>
<td>0.1998</td>
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</tr>
<tr>
<td>Organizational skills</td>
<td>4</td>
<td>0.2</td>
<td>0.5000</td>
<td>0.5000</td>
<td>0.1000</td>
<td>0.1000</td>
<td></td>
</tr>
<tr>
<td>Corporate culture</td>
<td>4</td>
<td>0.2</td>
<td>0.5000</td>
<td>0.5000</td>
<td>0.1000</td>
<td>0.1000</td>
<td></td>
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<tr>
<td>Change Response Proficiency</td>
<td>3</td>
<td>0.667</td>
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<tr>
<td>Scope</td>
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<td></td>
<td>0.2624</td>
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<td></td>
<td></td>
<td>0.0494</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>6</td>
<td>0.5</td>
<td>0.7500</td>
<td>0.2500</td>
<td>0.3750</td>
<td>0.1250</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2: The Examples of the Criteria Used to Determining Supplier’s Range**
### Table 3: Supplier’s Agile Performance Evaluation With Respect To The Variation Of The Order Quantity

<table>
<thead>
<tr>
<th>Factors/Criteria/Sub-criteria/Attributes</th>
<th>Weight</th>
<th>Supplier B</th>
<th>Supplier C</th>
<th>Supplier B</th>
<th>Supplier C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agility performance</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variation of the order quantity</td>
<td>2</td>
<td>0.54</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Migration to the new product design or function</td>
<td>2</td>
<td>0.297</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unexpected increase in the order quantity</td>
<td>2</td>
<td>0.163</td>
<td>0.667</td>
<td>0.333</td>
<td>0.4002</td>
</tr>
</tbody>
</table>

### Table 4: Supplier’s Agile Performance Evaluation

<table>
<thead>
<tr>
<th>Agility performance</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority Scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weighted Priority Scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weighted Aggregate Priority Scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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