CHAPTER 10

RESULT ANALYSIS AND CONCLUSION

The proposed system is being designed with aiming of controlling the Bullwhip effect occurred in the activities of the supply chain management system. It has been found more efficient in comparison of existing MAS based SCM system. The existing MAS based SCM system consists of the multiple intelligent agents without having the case-based reasoning facility for extending its knowledge during its working.

10.1 RESULT ANALYSIS

The MAS based SCM system consists the intelligent agents which are being designed based on BDI architecture. This proposed system consists following concepts in comparisons of existing MAS based SCM system as given below:

1. **CBR-BDI intelligent agents**

   This type of the intelligent agent is competent of learning from the atmosphere connected with the supply chain activities. The intelligent agent based on the BDI (Belief-Desire-Intention) architecture is not proficient in getting the updates from the working environment. Such agents are not suitable for dynamic and complex nature of the current business activities. These days the status of the product demand and customer response changes with every moment. The knowledge should be gained through the updates in the business activities. So the CBR-BDI intelligent agents can work with more efficient manner in comparison of the intelligent agent built on BDI architecture. The proposed MAS based SCM system consists the several CBR-BDI intelligent agents such as Demand CBR-BDI intelligent agent, Supplier CBR-BDI intelligent agent and transport CBR-BDI intelligent agent which are capable of affecting its decision-taking process with case-based reasoning approach.
2. **Distributed case base**

Existing MAS based SCM system is reliant on the solitary case base. This particular case base consist the storage of cases with aiming of storing the past experiences. This approach is very simple in term of implementation point view. But such configuration suffers core restrictions of the CBR approach related to the case base size. As the case base grows up, then the speed and performance of such system go down. The sizes of the case base increases as the cases are being added to store the past problem solving experiences. The distributed case base concept resolves this problem efficiently. It allows the CBR users to store their experiences at different location instead of storing them at a single place. This mechanism does not formulate supplementary expansion in the solitary case base. The inaccessibility of single case base puts off the total working of the CBR application. But the distributed case base formulates the CBR application to be self-sufficient of single case base.

3. **Orchestration**

The supply chain based applications are being designed with aiming of handling the complexity of the global market scenario. Without handling the global market completion, any business organization does not run for a longer time period. Hence the automation of the business workflow is most needed for managing the complex market scenario. The Existing SCM applications have not introduced the supply chain orchestrator in the working of the supply chain activities. The main role of the supply chain orchestrator is the automation of the business activities in the supply chain activities. In the complex business scenario, the roles and responsibilities of the supply chain orchestrator cannot be neglected further. So the proposed MAS based SCM system includes the Orchestrator intelligent agent to play the roles and responsibilities of the supply chain orchestrator in managing the supply chain activities. Along with managed SCM activities, the bullwhip effect can be tackled with more efficiently in the working of the proposed MAS based SCM system.

These additional concepts generate more benefits and enhance the performance of the proposed MAS based SCM system in comparison of existing MAS based SCM system.
10.1.1 Face validation

The validity of the measurement technique may be defined as the degree to which it measures what it is invented to compute. There are the numbers of exceedingly significant spots to memorize about the mode that psychologists assess the soundness of a measurement technique. Initially, this process necessitates the empirical evidence. A measurement technique cannot be acknowledged valid or invalid before it has ever been used and the resultant scores have been methodically investigated. Subsequently, it is a continuing practice. In reality, each innovative study with that measurement method offer supplementary confirmation for or alongside its legality.

The face validation is being considered as the simplest and easiest way to determine the validity of the proposed research models. The face validity is an uncomplicated form of validity in which researchers decide if the experiment appears to assess what is proposed to quantify. Fundamentally, the researchers are basically captivating the legality of the experiment at face value by appearing at whether a test emerges to assess the objective variable.

10.1.2 Face validation process

To evaluate the validity of the proposed MAS based SCM system, the face validity phenomena are being applied. For this purpose, eight SCM experts were being selected in the face validation process. These persons have enough working experience in the supply chain field dealing the stainless steel strips and coils. These experts have the supplementary awareness of the bullwhip effect problem. These experts are being involved to tackle the bullwhip effect problem through the management strategies during their operations. They have never used any AI or MAS based applications for resolving the worst influences of the bullwhip effect problems. The designations of the experts are being given below:

1. AGM - Supply Chain Management
2. DGM - Supply Chain Management
3. Manager - Supply Chain Management
4. Senior Executive -Supply Chain Management
5. Executive -Supply Chain Management
RESULT ANALYSIS AND CONCLUSION

6. Sr. Buyer- Procurement (supply Chain Management)
7. Buyer- Procurement (supply Chain Management)
8. Academic

The well thought-out interviews were guided according to the following standard strategies. Before starting the initial round of interview, the proposed MAS based SCM system was being demonstrated. The demonstration consists the introduction of the MAS, CBR and the preview of working of the proposed MAS based SCM system. The initial round of interviews contained following type of questions related to the nature of the supply chain management system as given below:

- What are your major customers and major products sold in current SCM?
- How is the industry evolving for availing the concerned products?
- What are the characteristics of core market scenarios?
- What is concerned company’s marketplace situation?
- What is the concerned company’s history?

The next phase of the face validation is to identify the bullwhip effect issues faced in the supply chain activities with help of following questions a given below:

- When did you recognize that concerned company is suffering from bullwhip effect interrelated problems?
- What have you acknowledged as the major throbbing spot that you would reminisce of solving with this proposed system?
- What are the foremost objectives for this proposed system in tackling the bullwhip effect?
- What kind of benefits do you look ahead to this proposed system in tackling the bullwhip effect?

After concerning the issues related to the bullwhip effect, the next phase is being organized with aiming of knowing the current state of the solution of the bullwhip effect with the help of following questions as given below:

- How does the supply chain organization tackle the bullwhip effect in your organizations?
- What are the key IT tools you used to control the bullwhip effect occurring in the supply chain activities?
How does your supply chain planning & logistics or procurement work with aiming of reducing the bullwhip effect?

What is the supplier market structure for availing raw material required for maintaining the preferred product quality and affordable cost?

The last stage of the first phase involves the discussion about the proposed solution of the bullwhip effect Supply chain flexibility with answering following questions as given below:

- How would you evaluate the existing solution of the bullwhip effect in your supply chain activities on the operational stage?
- Can the proposed bullwhip effect solution adjust to foremost swings in product supply and product demand in the undersized era of time?
- How would you judge the ability of proposed MAS based supply chain in handling of complexity of the global business market nature on the structural level?
- How would you evaluate the suppleness of proposed MAS based supply chain for resolving the causes of the bullwhip effect on the organizational level?
- Is the proposed supply chain competent of countering to chief supply chain disorders, supporting achievements and divestitures within the assessment of proposed supply chain, essentially redesigning retailer strategy, setting the order batch size?

After the interviews, the experts were asked to reply the queries in the self organized questionnaire on the basis of their knowledge and experience. The questionnaire was intended to confine the experts’ judgment containing the following types of aspects as given below:

- Effectiveness of the proposed model and prototype
- Prospective benefits of the proposed model and prototype
- Throughout of the proposed model and prototype
- Validity of the proposed model and prototype to the actual practice

These aspects have confirmed the actual significance of the proposed MAS based SCM system in our research work. These aspects cover every view of the proposed system.
### 10.1.3 Face validation result

Four levels of the satisfaction are being considered as the number from 1 to 4. The level ‘Very High’ is being valued as 4. ‘High’ is being valued as 3. ‘Low’ is being valued as 3. ‘Very Low’ is being valued as 1.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Outcome</th>
<th>Degree of Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced Decision-taking Capacity</td>
<td>It helps in making different types of supply chain decisions involved.</td>
<td>2 5 1 3.125</td>
</tr>
<tr>
<td>Supply Chain Transparency</td>
<td>It captures the extent to which information about SCM entities is willingly accessible to users.</td>
<td>5 3 3.625</td>
</tr>
<tr>
<td>Role of Supply Chain Orchestrator</td>
<td>It is liable for supervising &amp; arranging activities required to improve supply chains</td>
<td>3 3 2 3.125</td>
</tr>
<tr>
<td>Coordination in SCM Activities</td>
<td>It makes multiple SCM entities working together for joint decision making</td>
<td>5 2 1 3.375</td>
</tr>
<tr>
<td>Multiple Pricing Strategies Support</td>
<td>More profits are achieved with correct policy</td>
<td>2 6 3.25</td>
</tr>
<tr>
<td>High Order Fill Rate</td>
<td>It enhances the customer satisfaction with timely delivery.</td>
<td>4 2 2 3.25</td>
</tr>
<tr>
<td>Maintaining Reduced Batch Size</td>
<td>It make more product availability chance to customers timely</td>
<td>4 1 3 3.125</td>
</tr>
<tr>
<td>Effective Demand Forecasting</td>
<td>Efficient production forecast &amp; high inventory utilization achieved.</td>
<td>6 2 3.5</td>
</tr>
<tr>
<td>Mode of operating proposed system</td>
<td>It define the level of operating by the user</td>
<td>5 3 3.625</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
<td>Rating</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Managing flexible customers needs</td>
<td>It helps in handling modified customers needs for more satisfactions</td>
<td>2 4 2 2.75</td>
</tr>
<tr>
<td>Apply efficient retailing strategies</td>
<td>It gain the organization profits and motivates customers</td>
<td>5 1 2 3.250</td>
</tr>
<tr>
<td>Efficiency to tackle bullwhip effect</td>
<td>It help in maintaining customers contentment, timely product availability with more profits</td>
<td>7 1 3.625</td>
</tr>
<tr>
<td>Portability</td>
<td>It helps in running software on different machine without any modification</td>
<td>6 1 1 3.375</td>
</tr>
<tr>
<td>Scalability</td>
<td>It provide uncomplicated way to upgrade it in future</td>
<td>4 2 1 3.125</td>
</tr>
<tr>
<td>Reliability</td>
<td>Whole operation can be completed without failure</td>
<td>5 2 1 3.125</td>
</tr>
<tr>
<td>Cost effective</td>
<td>It attracts more customers to buy it and use it</td>
<td>4 1 1 2.875</td>
</tr>
<tr>
<td>Usability</td>
<td>It makes the software user-friendly for IT-illiterate people</td>
<td>3 3 2 3.125</td>
</tr>
<tr>
<td>Maintainability</td>
<td>Low Maintenance cost promote user to work easily</td>
<td>6 1 1 3.625</td>
</tr>
<tr>
<td>Extensibility</td>
<td>More functionality can be added easily in future</td>
<td>4 3 1 3.375</td>
</tr>
<tr>
<td>Interoperability</td>
<td>It exchange information with other for smooth working</td>
<td>3 4 1 3.125</td>
</tr>
<tr>
<td>Reusability</td>
<td>It motivates other developer to use its code with alteration for different purpose.</td>
<td>6 1 1 3.375</td>
</tr>
</tbody>
</table>

| Overall Rating                  | 3.273                                                                      |

Table 10.1 Face Validation Result
The factors are being rated by those eight experts. The table 10.1 shows the result of the face validation process on the basis of the particular facts provided by eight experts.

![Level of satisfaction regarding SCM Constraints](image1)

**Figure 10.1 Feedback regarding SCM Constraints**

![Level of satisfaction regarding software constraints](image2)

**Figure 10.2 Feedback regarding software Constraints**
10.1.4 Practical implications of the research

With the help of the face validation process, the basic benefits are being generated by the proposed MAS based SCM system instead of existing system are being listed as given below:

- **Learning capacity**
  In comparison of Existing MAS based SCM system, the CBR-BDI intelligent agents are capable of learning from the environment in the proposed MAS based SCM system. The existing system contains the intelligent agent

- **Enhanced decision-making capacity**
  The proposed MAS based SCM system has efficient decision-taking power based on the case-based reasoning approach which makes it to capture the decision regarding the situations faced instead of rule-based reasoning approach.

- **Storing past experiences**
  This system maintains the case base to store the information regarding the working environment for storing the past problem solving experiences. This system is able to store the experience of past problem solving experience in the form of case. The knowledge used in past problem solving process are not being wasted.

- **Utilization of past problem-solving experience**
  The proposed MAS based SCM system can utilize past experiences to generate the solution to past problem with having knowledge their past problem solving experiences.

- **Revising the proposed decisions before applying**
  Using the concept of case-based reasoning, the proposed system is capable of revising the proposed solution after knowing the feedback of past solutions.

- **Preventing error propagation in the future**
  This system does not allow propagating the past errors occurred in recent solutions through the revision of proposed solution.

- **Capable of handling inaccurate & missing data**
  It is able to generate the solutions in situations of inaccurate data and missing data. The rule-based reasoning system can only generate the more efficient
solution based on accurate data. In some situations there are either missing some fields or inaccurate data in the some situations.

- **Availability of multiple case base**
  This proposed system is not dependent on the single case base. It involves multiple case bases located in different locations.

- **Supply chain activities orchestrated**
  The SCM activities are being orchestrated for maintaining the coordination between the intelligent agents’ activities.

All these points provide the basic comparison between the Existing & proposed MAS based SCM system. Hence on the basis of these points, it is stated that it is more efficient in comparison of the Existing MAS based SCM system.

### 10.2 CONCLUSION

The bullwhip effect in the supply chain activities is making its way to the top of executives’ agendas. Tackling the bullwhip effect is being required to afford the extremely aggressive and turbulent environment for running the supply chain activities. The common focus of supply chain operations is delivering the precise product at the accurate place at the right time in spite of alteration in product supply and customer demand. But supply chains can distribute supplementary planned flexibility for fulfilling the customer requirements. For this purpose the Multi-agent system are being found more suitable for handling such situations. The proposed MAS based SCM system consists the multiple CBR-BDI intelligent agents in implementing the case-based reasoning capability for efficient decision-making capabilities.

With the approach of case-based reasoning, the multi-agent system becomes more powerful for managing the supply chain activities. With the help of the case-based reasoning, the SCM managers are capable of deriving the most efficient decisions instead of using rule-based reasoning approach. This approach does not allow propagating the past errors made in the past SCM decisions at various levels. The existing MAS based SCM system has ignored the role of the supply chain orchestrator. This entity plays very important roles in the modern complex supply chain management system.
With the help of the Orchestrator agent, the proposed MAS based SCM have implemented the roles and responsibility of the Supply Chain Orchestrator for managing and coordinating the SCM activities. The proposed system can reduce the bullwhip effect more efficient manner. The usage of the distributed case base enables the intelligent agent to access the cases stored at different locations. It makes the proposed system to work in distributed mode.

This research work is totally focused on the problem of bullwhip effect with aiming of running the SCM activities smoothly. It is needed to manage the global business competitions.

10.3 FUTURE SCOPE

This study raises new questions regarding supply chain blueprint ethics and it put forward numerous suggestions for future research. The broad area for further study is in roles and responsibilities of the supply chain orchestrators. Since the studied sample was excessively diminutive for any generalization of the conclusions which may be tested on a wider assortment of companies in different industries. This would allow validating and expanding them supplementary in the aspect of controlling the bullwhip effect.

This study leaves the concept of the opponent of the efficient working of the supply chain orchestrator empirically untouched. There is immense possibility of this work in the future. As the environment of the SCM activities turns into supplementary multifaceted then there will be additional huge need of supply chain orchestration. The responsibility of the supply chain orchestrator may impact on the throughput of whole supply chain management system. To obtain more well-organized coordination between the SCM activities is the major worry of developing the SCM for managing the global business competitions. This aspect was not validated because of their nonattendance in well-built appearance in the researched case. The aspect of the supply chain orchestrator could become the major theme of the further study.

This research work also proposes some very specific research questions trying to determine the predicaments faced in this work. One of them would be a study on the multi-case base reasoning approach. In all probability the superlative technique for supplementary research would be an expansive way of utilizing the multi-case base reasoning approach in the distributed decision-taking procedure.
In the current time stage, the business activities are going to take place at different locations. Hence the system should be capable of managing these activities in the distributed mode. The distributed case base will also play very good impact on the performance of the case-based reasoning based applications.

A more methodical approach to case base maintenance should be developed to make certain that the excellence, reliability, and exposure of the case base are most favorable. It may be essential to expand a quantitative computation of the accomplishment of a repair for large distributed case base for running the CBR application for long time period. Extra multifaceted illustration of case failure could be used to flush out the case base of mistaken cases, possibly by interactively allowing the decision maker to define failure from the problem’s constraints.