

MAS-SCM^{AS} for Auto Sector: The Framework

Ritu Sindhu¹, Abdul Wahid², G.N.Purohit³

¹(Research Scholar, Banasthali University, Rajasthan)

²(A.Prof.Gautam Buddha University, Greater Noida)

³(Dean, Banasthali University, Rajasthan)

Abstract:

The purpose of this study is to describe in detail the development status of the innovative Multi-Agent based supply chain management (MAS-SCM^{AS}) for auto sector. This study was undertaken in view of the significance of improvement in efficiency of automobile sector and the development of a good multi-agent system framework to achieve that. The factors affecting the efficiency or OEE of the industry and the efficiency properties were identified. It was clearly revealed that the available model do not fulfill the needs in the supply chain management of automobile industry and there is a scope for evolving new model resulting in better efficiency.

Keywords: MAS-SCM^{AS}, Multi-Agent systems, Supply Chain Management.

1. Introduction

The backbone of any company is its model. It is the skeleton, which governs the overall working of the plant. Because the model plays the major role hence the model for the

company should be well planned and defined. The model should be built in such a way that it takes care of all the departments of the company well. The model of our concern here is the MAS-SCM^{AS} model. SCM stands for supply chain management. Supply chain management (SCM) is the management of a network of interconnected businesses involved in the ultimate provision of product and services packages required by end customers. Supply chain management spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point of origin to point of consumption (supply chain).[3] "MAS stand for multi agent systems. Agents are the software designed to perform specific functions in the organization. These software are really very effective as they are automatic and do not rely on the humans. They are less prone to mistakes as they do what they are programmed to. MAS-SCM^{AS} model

comprises of introduction of multi agents in the working of the company. The SCM multi agents perform the SCM tasks which were earlier done manually [4]. Automation acts as an additional feature as they decrease the number of errors and increase in the efficiency because of better planning, co-ordination and negotiation that comes into action because of these agents.

The framework acts as a series of steps that tell us about the pattern in which all the phases were executed to build the whole MAS-SCM^{AS}. Thus our framework allows review and revision at any sphere of time and innumerable number of times. The whole MAS-SCM^{AS} model as the name suggests is MAS based SCM in automobile sector, and is built to perform the SCM with help of multi agents which are the intelligent systems which analyze the situation of the SCM and act accordingly to take essential decisions in the system.

2. Multi-Agent Systems

Agent-based systems technology has generated lots of excitement in recent years because of its promise as a new paradigm for conceptualizing, designing, and implementing software systems. In this article, I present some of the critical notions in MASs and the research work that has addressed them. Multi agent systems refer to

the system which comprises of multi agents. An agent is the software that is designed to perform a specific task in an organization. In traditional systems or in companies using traditional methods all work was done manually and hence there used to be a lot of errors and also a lot of delays used to take place. To overcome this problem faced by the companies, agents were designed. Agents being automated used to perform what they were programmed to perform and hence were less prone to errors and in all ways increased the efficiency. The multi agent systems what we are dealing with are the SCM multi agents i.e. those agents which work for the SCM of a company [5]. The MAS-SCM^{AS} aids the company with well automated software which leads to a better coordination between the various departments of the organization and therefore boosts up the efficiency. Another add on feature is that these agents are very time saving and lead to better time utilization and hence more work is accomplished in very less span of time. These agents also lead to better utilization of the workforce that now is much more available in number due to the automation of the work. MAS are the intelligent system software which enact in accordance to the

present existing scenario in the industry and hence makes essential decisions as required.

MAS are a group of multi agents which consist of various agents which have divided the whole work of SCM into their respective individual tasks which whole together sum up to form the complete task of SCM. These problem solvers, often called *agents*, are autonomous and can be heterogeneous in nature. The multi agent systems must have the following features:

- It should be able to reduce the testing and maintenance cost.
- It should be able to ensure that quality work is being done.
- The agents must be able to take timely actions according to the current situations.
- It should reflect the level of maintainability.
- The agents should be able to make better use of resources.
- Different companies should be able to mould the agents according to their needs.
- The agents must be fault free.
- They should be easily implementable.
- The agents should be easily to install.

- They should be used to enhance the performance of the company.

3. Supply Chain Management

A SUPPLY CHAIN is a network of supplier, manufacturing, assembly, distribution, and logistics facilities that perform the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these products to customers. Supply chains arise in both manufacturing and service organizations. Supply Chain Management (SCM) is a systems approach to managing the entire flow of information, materials, and services from raw materials suppliers through factories and warehouses to the end customer. Supply chain management has emerged as the new key to productivity and competitiveness of manufacturing and service enterprises. The importance of this area is shown by a significant spurt in research in the last five years and also proliferation of supply chain solutions and supply chain companies (e.g. i2, Manugistics, etc.). All major ERP companies are now offering supply chain solutions as a major extended feature of their ERP packages. Only effective and efficient supply chains can fulfil customers' needs for products and services. Companies

and/or specific departments are mere supply chain elements in integrated value networks. To satisfy customers' demand supply chain processes need to be aligned and coordinated. Agile supply chain management has become an effective and significant measure to enhance competitive advantage of modern enterprises [1],[2]. So, the effectiveness of a supply chain management is an important factor of determining enterprise's success or failure. In the fierce market competition, supply chain management will determine its vicissitudes. For supply chain management is a very complex systems engineering, we need high efficiency information system to support it. But there are various kinds of enterprises in the supply chain.

4. MAS-SCM^{AS}: The Framework

Taking into account the need and significance of a roadmap or framework for developing a MAS-SCM^{AS} and 'essentials and desirable features', an integrated and prescriptive framework MAS-SCM^{AS} is hereby proposed. MAS-SCM^{AS} has been attempted to be highly implementable and prescriptive in nature. It has been structured into a hierarchical description including provinces, generic guideline, MAS-SCM^{AS} development process etc. to be followed in order as follows.

4.1 Premises

The following premises have been considered when the proposed framework is being used to design the MAS-SCM^{AS}:

- Four basic factors used to measure the influence of MAS-SCM^{AS} in a company i.e. rate of production, rate of availability and rate of quality which cover all the factors that affect the efficiency of a company.
- An integrated approach to measurement of overall efficiency is feasible and would prove to be optimal.
- A common set of features for the desired model may be used to form the basis for its development.
- Determining the effect of the MAS-SCM^{AS} on the major phases of the working i.e. planning, coordination and negotiation.

4.2 Generic Guidelines

The guidelines before following the process to develop the multi agents may be listed as follows:

- Assure compliance/adherence to collect a common set of essential and desirable features.
- Access the work to be accomplished by each agent and then collect a

common set of essential and desirable features.

- Identify and persist preferably with all the attributes of good agent.
- Correlate the identified attributes with desired features and accordingly design the agents.
- Assure to control all the extraneous and intervening factors that may affect the efficient working of multi agent system.

4.3 MAS-SCM^{AU} Development Process

The development process of the MAS-SCM^{AS} is comprised of eight phases together with prescriptive steps for each and has been depicted pictorially in MAS-SCM^{AS} process model in the figure below. Such a framework has been proposed on the basis of integral and basic components for designing good quality MAS-SCM^{AS}. The first phase starts up with the requirement analysis phase. The second phase Conceptualization of Design and development for the desired system is treated as an important task. Design and Development has been put forth as a third, followed by the phases termed as validation, Expert Review, testing, review and revision and Finalizing and Packaging. An attempt has been made to symbolically represent the spirit of designing and to make the

framework prescriptive in nature followed by a brief description of each of the phases and steps.

4.3.1 Requirement Analysis

In this phase we gathered all the requirements of the project. This is a very crucial phase as in this all the requirements required throughout the project are to be analyzed first and then arranged accordingly. The requirements are analyzed with the help of industry visit. Industry visit plays a very important role throughout the process of MAS-SCM^{AS} development. In this phase it helps us know about the various requirements that we will have in the development of our proposed framework and all what sources of information are required. A lot of data is also required for the study of the research topic; this is also laid down as a requirement and hence is fulfilled in this phase as well.

4.3.2 Conceptualization

The foremost task of any comprehensive problem solving activity is conceptualization. That is the initial brainstorming activity envisaged and undertaken to understand the problem, jot down ideas for solution and to realize problem-related facts, which in turn may be precisely stated and represented in meaning format, under the aegis of specifications.

A set of five steps has been prescribed, in the special context of development of MAS-

SCM^{AS}, to implement the foremost phase. The first step ‘Assess Needs and

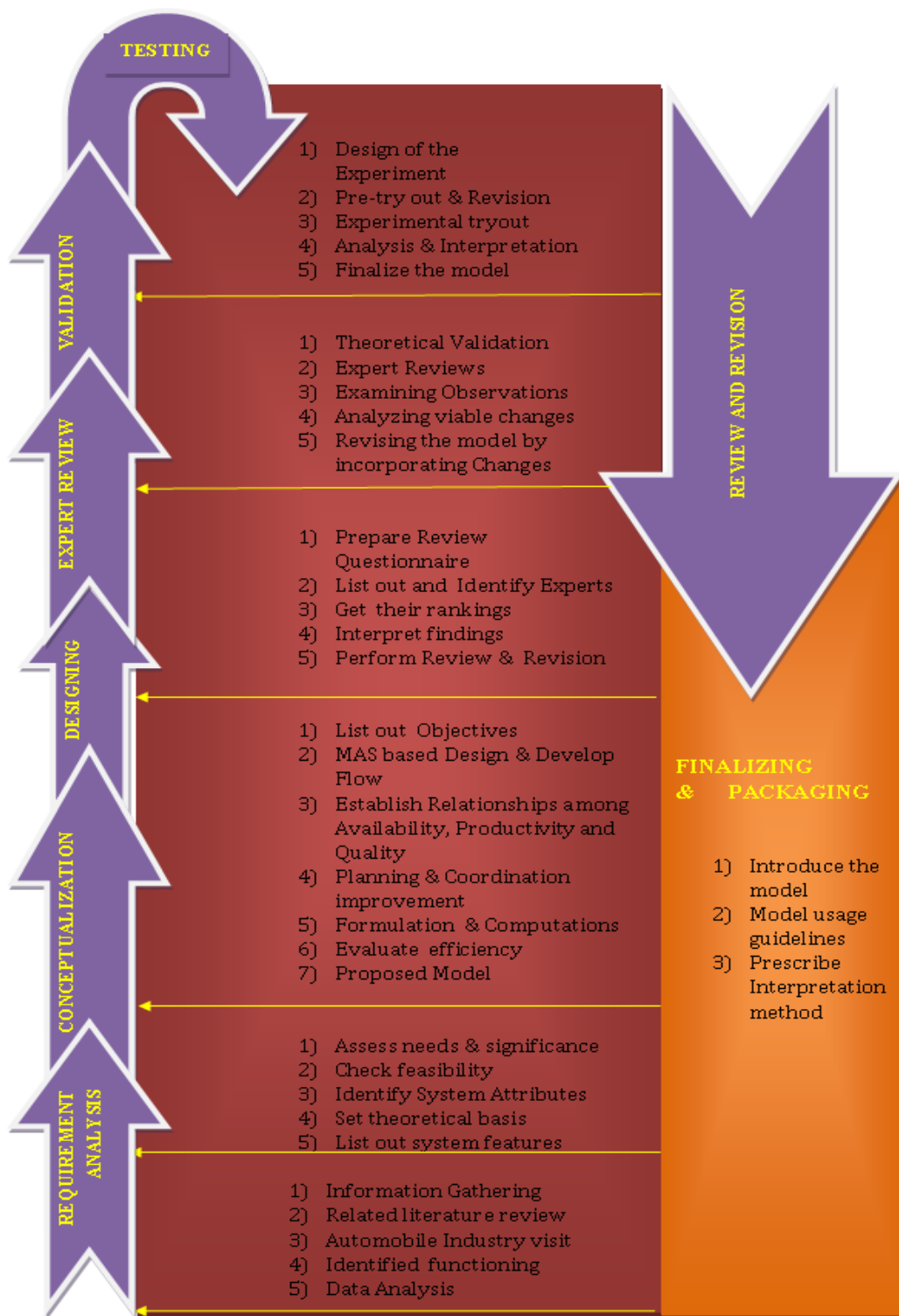


Fig: 1 MAS-SCM^{AS} :The Framework

Significance', refers to understanding the requirement of the framework that is supposed to be developed followed the contributions of such a development, apart from the fulfilling of the requirements. The second step '*Check feasibility*' refers to counterchecking that the framework to be designed with all the above stated features is actually feasible or not. The third step '*Identify System Attributes*' deals with the identification of the features with which the framework has to be bombarded with. The fourth step '*Set Theoretical Basis*' deals with the specification of the theoretical viability for model development. The final step '*List out System Features*' refers to listing the system features i.e. laying down the features of the system for which model is being developed.

4.3.3 Design and Development

Framework plays a crucial role for a company's optimum efficiency. Designing is the most important and critical step towards the development of desired quality design model. This phase is based on five steps described as follows. The first step '*List out Objectives*' refers to the exploration and to keep in mind the objectives to be achieved, throughout the development process. The objectives of the desired framework may be formally defined in terms

of these functions, the attributes of the entities being measured and the goals for the measurement. Having a clearly defined and documented objective statement for the framework may help to ensure a well-defined framework based on customer goals, eliminate misunderstandings about how the MAS is intended to be used, and communicate the need for it. The second step '*MAS based Design and Develop flow*' refers to the designing and developing the product flow by installing the multi agent system in between them. The new product flow makes full use of the multi agents from the raw material phase till the delivery of the finished good. The third step '*Establish Relationships among Availability, Productivity and Quality*' refers to the establishment of relationships between rate of availability, rate of quality and rate of production. The fourth step '*Planning and Coordination Improvement*' describes the improvement incurred in the planning and coordination of the work of the company with the effective use of the MAS-SCM^{AS}. The multi agent system reduces the time incurred in planning and is less prone to commit errors and hence improve the planning and coordination between various departments of the industry. The fifth step '*Formulation and Computations*' refers to

the formulation of the multi agent system that accomplishes the desired task. This involves processes such as evolving a mathematical expression that on use will produce a quantitative value. The next part is computations; in this the efficiency is calculated with the effect of MAS. The sixth step '*Evaluate efficiency*' refers to the efficiency calculation after the MAS has been successfully installed. The next part comes out to be Pre-try out and Post-try out in which the efficiency is calculated. Then the efficiency improvement is evaluated. This efficiency is that efficiency which is improved because of the applying of the multi agent system into the company. The final step '*Proposed Model*' refers to the implementation of the proposed model which is developed by us. This model helps the companies to efficiently perform their SCM with the help of MAS.

4.3.4 Expert Reviews

The next phase in the MAS-SCM^{AS} development was expert reviews. In this phase the expert of the domain area are consulted to provide their reviews about our model for improvements. Following are the activity incorporate in this phase

- Prepare a review Questionnaire
- List out and Identify experts
- Get their rankings

- Interpret findings (statistical analysis)
- Perform review and revision.

4.3.5 Validation

The next phase in the development of the MAS-SCM^{AS} is the validation. Theoretical validation of proposed framework provides the supporting evidence as to whether a measure really captures the internal attributes that purports to measure. Work on theoretical validation has followed two paths referred in literature as follows:

- Measurement-theory based approaches such as those proposed by Whitmire, Zuse, and Poels and Dedene.
- Property-based approaches (also called axiomatic approaches), such as those proposed by Weyuker and Briand et al.

4.3.6 Testing

This phase refers to the phase in which the MAS-SCM^{AS} model is tested out in the company. The testing phase is carried out in various steps as listed below: The first '*Design of the Experiment*' refers to the phase in which the whole design of the experiment to be performed for testing is carefully made. The second '*Pre try out and revision*' refers to the step in which the MAS-SCM^{AS} system is checked before actually installing the whole system. The

third ‘*Experimental try out*’ refers to the step in which the experimental i.e. actual implementation is made of the MAS-SCM^{AS} by installing the multi agents. The fourth ‘*Analysis and interpretation*’ refers to the step in which analysis is made by the whole testing phase i.e. both pre try out and experimental try out phase. The final ‘*Finalize the Model*’ refers to the step in which we finalize the model by making all the necessary things available in the model.

4.3.7 Finalizing and Packaging Document

The final phase of the development of the MAS-SCM^{AS} is the documentation phase. In this phase all the documentation is done i.e. all the steps right from the start of the project. This all is done through the following steps:

- Introduce the model
- Define the usage guidelines
- Specific Application area

5. Conclusion and scope for further research:

The present research found many complimentary jobs to be achieved with regard to desirable features of MAS-SCM^{AU} and its constitution. A similar situation was seen with respect to scope of evaluation. The researcher sees considerable scope for

further exploratory works so that a clear picture may emerge.

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Authors Profile:

Ritu Sindhu: Ph.D Scholar, Banasthali University, Rajasthan. Completed her B.Tech (CSE) from U.P.T.U, Lukhnow, M.Tech (CSE) from Banasthali University, Rajasthan.

Abdul Wahid: Presently working as a A.Professor in Gautam Buddha University, Greater Noida He completed his Ph.D. in Computer Science from Jamia Millia Islamia (Central University), Delhi.

G.N.Purohit: Dean, Banasthali University, Rajasthan.