Chapter 10

Contributions, Recommendations and Conclusion

Major contribution of this research, limitations and suggestions for future research are presented in this Chapter.

10.0 INTRODUCTION

The objective of the present research is to examine existing performance measurement frameworks in SCs, identify their strengths and gaps and to develop appropriate models for SC performance measurement. The objectives of research are met satisfactorily through extensive literature review, exploratory survey, and through the rational use of operations research techniques with existing highly cited frameworks of performance measurement. The research work resulted in development of performance frameworks for different area of SC. The exploratory survey conducted gave an insight to the SCPMS practices of Indian industries. This Chapter, in addition to summarising the research contributions, also presents   limitations of the research. Suggestions for future research   are also discussed as part of this Chapter.

10.1 Major Findings and Contribution

The performance measurement frameworks developed through this research can facilitate improved SCM capabilities to organisations. The major contribution and findings of the present study are summarised in the succeeding sections.

10.1.1 Strengths, limitations and opportunity for improvement of existing frameworks of SCPMS

Most cited frameworks and models for performance measurement developed in last twenty years are studied and their strengths, application and limitations are identified and recorded. The extensive literature review, exploratory research and expert opinion resulted in the following contributions:

1. Proposed a new framework for SCPMS development

2. Proposed a revised definition for SCPMS

3. A list of desirable characteristics of SCPMS derived from different sources

4. Comparative analysis of most cited performance measurement frameworks made to bring out their benefits, salience, gaps and limitations

Understanding Strengths, limitations and opportunity for improvement of existing frameworks of SCPMS gave a focus and direction to the present research.

10.1.2 SCPM practices of Indian industry

An exploratory survey was conducted to analyse the performance measurement practices of Indian industries. The respondents were practitioners from a cross section of the industry. The study gave clarity of understanding the objectives of implementing SCPMSs and metrics (measures) used in SCPMSs. Based on multivariate analysis, the first factor that emerged from factor analysis is 'Strategic Orientation' followed by 'Internal Focus' and 'Motivation and Control'.

The exploratory study indicates a departure from previous surveys on Indian SCs that Indian SCs started expanding to SC wide PMSs from department wise PMSs. Many organisations started using balanced measures in addition to financial performance measures. The industry sectoral differences are diminishing in SC wide performance measures.

10.1.3 Development of models for integration in SCPMS

As part of this research work, models have been successfully developed incorporating DEA, AHP, Fuzzy logic and other mathematical tools with most cited PMS frameworks such as BSC, modified BSC, performance prism and SCOR. In addition, a new framework with taxonomy of measures proposed for SC flexibility. Following are the list of performance measurement frameworks developed as part of the present research:

1. Performance measurement framework for of strategic planning and resource deployment in SCs using AHP and BSC

2. Framework for strategic alignment in SCs using AHP and Performance Prism

3. Framework for SC flexibility performance measurement using Fuzzy AHP

4. Measurement of flexibility and its benchmarking using DEA in SCs

5. Framework for sustainability performance measurement in SCs (Green SCPMS)

6. Performance measurement framework for reverse SC (Maintenance Management) using DEA

7. Taxonomy of flexibility performance measures and a framework for its prioritisation

Validation of these models are done through expert opinion and testing through sample and realistic data. The proposed frameworks are presented as research papers published in reputed international journals and at international conferences. The comments and criticism received from journal paper reviewers and conference participants helped to strengthen the frameworks.

10.2 Limitations of the Study

Today's SCs are becoming more complex and dynamic interdependent networks with additional functions such as sustainability, return (reverse logistics) etc. (Shaik & Abdul-Kader, 2014). Therefore, developing PMS frameworks spanning the entire SCs has always been a challenge. On the other hand, technology and new approaches to SCPMS are presenting a plethora of models and frameworks for SCPMs. The survey conducted (refer Chapter 7) indicates that more and more SCM professionals are looking into SCPMSs as a necessity but the survey also indicates lack of SC wide implementations of SCPMSs. SCPMs are often discussed in academia and research but rarely implemented (Maestrini et al., 2017). Succeeding paragraphs in this section is looking at the major limitations of this research.

10.2.1 Generic nature of the frameworks

The SCPMS frameworks developed through this study are of generic in nature. The intention is to keep the framework as comprehensive and as inclusive as possible so that its application is universal. However, for a particular SC, there will be a need to modify the frameworks and tailor-make it for that specific industry and organisation. This will require expert intervention and further validation.

10.2.2 Validation of the frameworks

Validation of the developed frameworks are done based expert opinion and exploratory survey which are not fully adequate. Time and resource limitation restricted actual

implementation and validation of the frameworks. There is a need to validate the frameworks through actual implementation.

10.2.3 Use of sample data

Approximation and use of sample data are used to demonstrate the capabilities of the frameworks developed. The objective is to propose frameworks and demonstrate its application and not to focus on numerical results. Real time, actual data will strengthen the proposed frameworks and even validate the same.

10.2.4 Exploratory Nature of the Survey

The questionnaire-based survey conducted was exploratory in nature to gather preliminary understanding (refer chapter 9). The sample size is relatively small and is not representing many industry sectors. Some of the respondents appear to be not aware of the SC wide performance measurement practices in their organisation, instead they responded based on their knowledge of their department wise performance measurement practices.

10.2.5 Bias in responses

The number of respondents participated in the AHP based analysis is limited to one to three. Although the respondents were carefully selected based on their experience and expertise, it is rare for one person in an organization to supervise the entire SC. Associated bias is thus a possibility.

10.3 Future Research Agenda

There has been considerable research carried out and literature available in the field of SCPM since 1990. The empirical and theoretical validity of some of the frameworks are yet to be established. The PMS frameworks available are concentrating on performance measurement of SC functions, however an enterprise wide performance management system across the SC network with inter-firm performance focus is only partly realised. SCs are becoming increasingly complex, dynamic and the explosion of technology contributes to an interesting future research agenda.

10.3.1 Risk measurement and management

In SCM, risk is less well understood and less well developed. The increased frequency and the severe consequences of past supply chain disruptions have resulted in an increasing interest in risk (Heckmann, Comes, & Nickel, 2015). Literature review indicates lack of a clear and adequate quantitative measure for SC risk. Application of risk theory to SCM is still in its early stages and that the models of SC risk which have been proposed need to be tested empirically (Ho, Zheng, Yildiz, & Talluri, 2015). Quantification and modelling of supply chain risk would be an interesting area of research. The impact of time aspects in SC risk is generally accepted but incorporating the same in SC risk measurement models is another area for future research.

10.3.2 Knowledge management and business intelligence

Business intelligence and knowledge is shifting from being one of the important strategic resources for a firm to being foundation for new business models (Douligeris & Tilipakis, 2006). Relationship between managing knowledge and performance improvement in SCs is relatively an unexplored area (Fletcher & Polychronakis, 2007). Knowledge management is considered as a tool for SC integration; however, there is scope for studying how knowledge management influences SC performance. The knowledge collection and storing process, within the SC, would be an interesting topic for research. The issue of knowledge obsolescence and knowledge overloading are other areas of possible future research (Marra, Ho, & Edwards, 2012).

10.3.3 SC Analytics

SCs are increasingly using data analytics, cloud-based information systems and increased use of mobile computing devices. The amount of information produced and communicated is increasing in an exponential manner creating opportunities and challenges for organisations to utilise this big data for their advantage. Big data can provide unique insights into various SC functions (Wang, Gunasekaran, Ngai, & Papadopoulos, 2016). Impact and effectiveness of these latest tools and technologies in SC performance is a relative unexplored area and there is scope for research in this area. SC analytics is an emerging area within SCM.

10.3.4 Changing focus of SCs

There is an argument that the purpose and focus of SCs are shifting from SC surplus (profit orientation) to sustainability and stakeholder satisfaction (Delai & Takahashi, 2011; Tang & Zhou, 2012). PMSs for this new scenario will be an interesting area for research. Cost to environment (ecological footprint) is going to be added to the cost of products and services. Macro-societal concerns such as global warming, energy scarcity, carbon-footprint monitoring etc. have started influencing SC design and decisions (Stock, Boyer, & Harmon, 2010). Investigation of influence of these macro-societal issues on SC performance would be an area of research interest.

10.3.4 Behavioural SCM

There is an argument in literature that research on SCM has often overlooked the effect of human behaviour (Schorsch, Wallenburg, & Wieland, 2017). Human behavioural components play an important role as the hard facts of SCM, such as processes and technologies. Therefore, monitoring and managing behavioural dimension including external stakeholder management should be a central consideration is SCM and there exists an opportunity of research in this area. Research opportunities exists on how information is acquired by decision makers and on the role of feedback and the perception of future outcomes. PMS can influence behaviour and can be a vehicle for organisational change (De Toni & Tonchia, 1996). Another interesting area of research would be to study the influence of SCPMS on organisational culture.

10.4 Conclusion

The goal of this thesis is to explore performance measurement practices in SC context and to develop appropriate models for SCs. Through extensive literature review, expert interviews, exploratory survey and experimentation using mathematical and heuristic modelling the objectives of the research are achieved. The performance measurement frameworks developed, and the insights gained through this study can facilitate improved SCM capabilities to organisations.

SCs are undergoing a transformation process due to the impacts of rapid technology changes, focus on sustainability, power of social media and globalisation. Behavioural SCM is

another emerging area. Suggestions for future research considering the dynamic and volatile nature of SCs are also presented in this Chapter.

The models presented in this thesis are accepted for publication in research journals of repute and presented at international conferences. The research benefits practitioners of SCM, researchers, academicians and students of SCM. The research findings thus add to the body of knowledge and fills gaps in SC performance management theory and practice.