IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Optimisation of Closed-Loop Supply Chains under Uncertainty**	
Project Number	**IMURA0764**	
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Research Clusters:

Highlight which of the Academy's CLUSTERS this project will address? *(Please nominate JUST **one.** For more information, see www.iitbmonash.org)*	
1	*Material Science/Engineering (including Nano, Metallurgy)*
2	*Energy, Green Chem, Chemistry, Catalysis, Reaction Eng*
3	*Math, CFD, Modelling, Manufacturing*
4	*CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control*
5	*Earth Sciences and Civil Engineering (Geo, Water, Climate)*
6	*Bio, Stem Cells, Bio Chem, Pharma, Food*
7	*Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng*
8	*HSS, Design, Management*

Research Themes:

Highlight which of the Academy's Theme(s) this project will address? *(Feel free to nominate more than one. For more information, see www.iitbmonash.org)*	
1	*Advanced computational engineering, simulation and manufacture*
2	*Infrastructure Engineering*
3	*Clean Energy*
4	*Water*
5	*Nanotechnology*
6	*Biotechnology and Stem Cell Research*
7	*Humanities and social sciences*
8	Design

The research problem

In the current business scenario, instant changes in market demand, global sourcing of materials and new manufacturing technology have forced many organisations to change their supply chain planning approaches in order to deal with the real-world uncertainty. In today's competitive and cost-cutting business environment, along with the efforts that go into the planning, design and operation of their forward supply chains, organisations need to consider the impact of reverse logistics (RL) too, for reasons of social responsibility, environmental benefits as well as significant economic advantages. A large number of successful organisations, especially in emerging economies, focus solely on forward supply chains but often experience a lack of adequate control over their RL processes. With increasing awareness of product take-back and recovery, issues such as product acquisition, network design, inventory control with return flow and reduction of bullwhip effects are becoming important areas of research. However, in integrated supply chain networks, many business variables such as customer demand and collection rates for used products are highly uncertain and usually characterised by probability distributions/possibility measures. Therefore, it is important to develop most effective methods that provide accurate demand forecasts, inventory levels and estimation of collection rate of used products through contextual factors so as to reduce the impact of uncertainty. To address these important research issues under uncertainty, this research will focus on the optimal design and planning of closed-loop supply chains (CLSCs) in real decision-making environments.

Project aims

The main aim of this project is to understand and optimise the performance of CLSCs under uncertainty. It involves network design, strategic planning and operational decisions under various constraints of supply-demand, inventory levels, manufacturing/remanufacturing capacity, collection of used products and desired service levels. Considering the inherent complexity of CLSCs under uncertainty, this project will develop analytical and simulation models to optimise the performance of the integrated supply chain system in actual decision-making settings that would lead to development of an optimal strategy with risk management constraints under uncertainty.

Expected outcomes

The expected outcomes of the project are as follows:

- An extensive literature survey for an in-depth study of CLSCs and identification of important problems in the proposed area of RL under uncertainty.
- Design of optimisation models for CLSCs that will take into consideration various operational issues, different management objectives and trade-offs between profit, risk and customer satisfaction.
- Development of mathematical and simulation models to account for the integrated aspect of optimising the CLSC network under uncertainty using the advanced techniques of applied operations research and artificial intelligence. The proposed models will be illustrated and validated using case studies where appropriate.

How will the project address the Goals of the above Themes?

This project will address two Academy's themes:

(1) Advanced computational engineering, simulation and manufacture and
(2) Humanities and social sciences (Management)

Capabilities and Degrees Required

M. Tech. in Industrial Engineering or MBA or Master degree in related disciplines.

It is highly desirable to have candidates
- with a strong knowledge in industrial engineering/operations research;
- who have undertaken courses in statistics/business analytics;
- who are aware of operations management/business research methods;
- who have experience in coding in any programming languages.

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

Select up to **(4)** keywords from the Academy's approved keyword list **(available at http://www.iitbmonash.org/becoming-a-research-supervisor/)** relating to this project to make it easier for the students to apply.

Data Science, Optimisation, Algorithms; Modelling and Simulation; Smart Manufacturing; Management