Project Title:	**Optimization of Closed-Loop Supply Chains in an Uncertain Environment**	

Project Number	IMURA0410	
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Research Academy 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. <mark>Advanced computational engineering, simulation and manufacture</mark>
2. Infrastructure Engineering
3. Clean Energy
4. Water
5. Nanotechnology
6. Biotechnology and Stem Cell Research

The research problem

Define the problem

In the current business scenario, instant changes in market demand, global sourcing of materials and new manufacturing technology force many companies 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, organizations needs to consider the impact of reverse logistics (RL) too, for reasons of social responsibility, environmental benefits and also significant economic advantages.

A large number of successful companies, especially in emerging economies, focus solely on forward supply chains but 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 effect

are becoming important areas of research.

However, in integrated supply chain networks, there are many business variables like customer demand and collection rates for used products are highly uncertain and usually described using probability distribution/possibility measures.

Therefore, it is important to develop the most appropriate 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. This research will focus on the design and planning of closed-loop supply chains (CLSC) in real decision-making environments.

Project aims

Define the aims of the project

The aim of this project is to understand and optimize the performance of CLSCs. It involves network design, strategic planning and operational decisions subject to various constraints of supply-demand, inventory levels, manufacturing/remanufacturing capacity, collection of used products and desired service levels.

Considering the inherent complexity, this project aims to develop analytical and simulation models to optimize the performance of the integrated system in real decision-making environments that would lead to development of an optimal strategy under uncertainty and several risk management constraints.

Expected outcomes

Highlight the expected outcomes of the project

The expected outcomes of the project are as follows:

- An extensive literature survey for an in-depth study of CLSC and identification of important problems in the proposed area of RL under uncertainty.

- Design of optimization models for CLSC that will take into consideration various operational issues, different management objectives and tradeoffs between profit, risk and customer satisfaction.

- Development of mathematical and simulation models to account for the integrated aspect of optimizing the closed-loop network under uncertainty using the advanced techniques of applied operations research.

The proposed work will be illustrated using case studies as and when required.

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

Describe how the project will address the goals of one or more of the 6 Themes listed above.

The research project is based on formulation and analysis of quantitative models for CLSC with product remanufacturing. The methods of operations research, optimization and simulation techniques will be used extensively in developing and solving the CLSC models under uncertainty.

Capabilities and Degrees Required

List the ideal set of capabilities that a student should have for this project. Feel free to be as specific or as general as you like. These capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.

Complex models for the integrated forward-reverse supply chains with several management constraints will be studied. Thus it will be highly desirable to have candidates

- with a strong knowledge in industrial engineering (strong preference),
- who have undertaken courses in optimization techniques such as linear programming, integer programming, stochastic programming, etc (strong preference)
- who have knowledge of algorithm development (strong preference),
- who are aware of probability theory and statistics (strong preference)
- who have experience in coding in C/C++/Java (desirable)
- who have a working knowledge of CPLEX (desirable)

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.