

Format for CSR Proposals of Social Relevance

1. Title of Project: Planning towards Vaccinating Indian Citizens Against the Global Pandemic through Optimal Design of Vaccine Production Supply Chain

2. Background/Motivation: The COVID-19 CORONAVIRUS world-o-meter records 159 million cases of affected patients with 3.3 million cases of reported deaths (May 10, 2021) with USA, India, Brazil appearing as most affected out of this pandemic. One of the ways to save the people out of this global crisis, as declared by WHO, is to vaccinate them with available and approved vaccines. As of 18 February 2021, at least seven different vaccines across three platforms have been rolled out in countries. Vulnerable populations in all countries are the highest priority for vaccination. At the same time, more than 200 additional vaccine candidates are in development, of which more than 60 are in clinical development. WHO aims to end the acute phase of the COVID-19 pandemic by:

- speeding up the development of safe and effective vaccines against COVID-19;
- supporting the building of manufacturing capabilities; and
- working with governments and manufacturers to ensure fair and equitable allocation of the vaccines for all countries.

India, being a populous country, is facing an acute deficit of vaccine as on today, which triggers the need for a proper planning of the vaccine production supply chain to vaccinate all her citizens within the current limited infrastructure.

3. Objectives of the project: The objective of this project is to

(i) **Plan for India** - Given a target of vaccinating Indian citizens at different cities in India within a time frame, what could be the optimal design of the vaccine supply chain starting from its production to final vaccine shot to a citizen considering the constraints on the raw material supplier, production capacity, inventory storage etc. with vaccines currently available in India.

(ii) **Plan for India and abroad** – Considering the additional target of providing help to global citizens outside India, how a supply chain can be designed to meet the global need with licenses of producing other vaccines also in India.

(iii) **Handling Uncertainty in the model** – Considering many of the parameters of the models uncertain, e.g. raw material cost, supply, how to design an agile supply chain which can act to such uncertain scenarios.

4. Brief Methodology: Some salient features of this project are mentioned below:

- Realistic data collection on the vaccine related industry numbers related to production, raw material etc. and their corresponding prices.
- Design of Supply Chain topology through combinatorial optimization approach considering capacity and prices at the different echelons e.g. raw material supplier, production, transportation and import / exports.
- Usage of NP-hard Mixed Integer Linear or Mixed Integer Nonlinear solvers to obtain solutions.
- Feature engineering using machine learning based unsupervised techniques for accurate transcription of the uncertain space.

5. Target population/Beneficiaries: Companies working with vaccines, Pharma companies, Municipal corporations, State and Central Government agencies.

6. Expected Outcome/Deliverables:

This project connects with the United Nations goals of good health and well-being and gender equality. This kind of robust supply chain models are going to help the policy makers to take informed decision on controlling the further spread of the pandemic in the country by implementing proper vaccination plan for its citizens. This helps directly in designing smart and sustainable country, where people will be able to live healthy.

Deliverables: Optimized supply chain models capable of simulating all supply chain parameters e.g. number of facilities and their capacities at different echelons of supply chain (raw material, manufacturing and inventory layers) and the material flow decisions across these echelons in the entire supply chain.

7. Timeline and Budget:

	Year 1	Year 2	Year3
Budget (in Rs lakhs)	9.0	7.0	7.0
Milestones	1. Data collection (data from current industry practice),	1. Deterministic supply chain model for India with her plan of exporting vaccines abroad	1. Supply chain design under model parameter uncertainties, 2. Final Report submission.

	2. Deterministic supply chain model for India		
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8. Proposer Name & Designation:

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