Minimizing Risk of COVID-19 Spread in Essential Services with help of Reliability Centred Analysis

PI Details –
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1. Context

Currently India is under lockdown due to COVID-19 pandemic. Under lockdown the government of India has exempted few listed 'essential' services in its notice. One of these services is supply of grocery items to consumers/ customers. These items shall be supplied to public through Kirana Shops or e-commerce. The Kirana shops are still in better reach for most Indians. These Kirana shops can be a place for spread of contagion COVID-19. However, these services are essential to run so that people can eat and live while fulfilling their basic needs. Therefore, it is essential that these services are maintained for peaceful lockdown period. Due to virus outbreak, safety risk has increased and it should be addressed by identifying and addressing hazards, which can be responsible for spread of the virus.

The analysis may be extended for health workers, Policeman and others. For proper analysis, more stakeholders need to be involved in it and their views should be incorporated. This study may be used as initiation of proper bigger study. This study may also be improved over time with feedback and ideas received from various stake holders.

2. Problem Statement

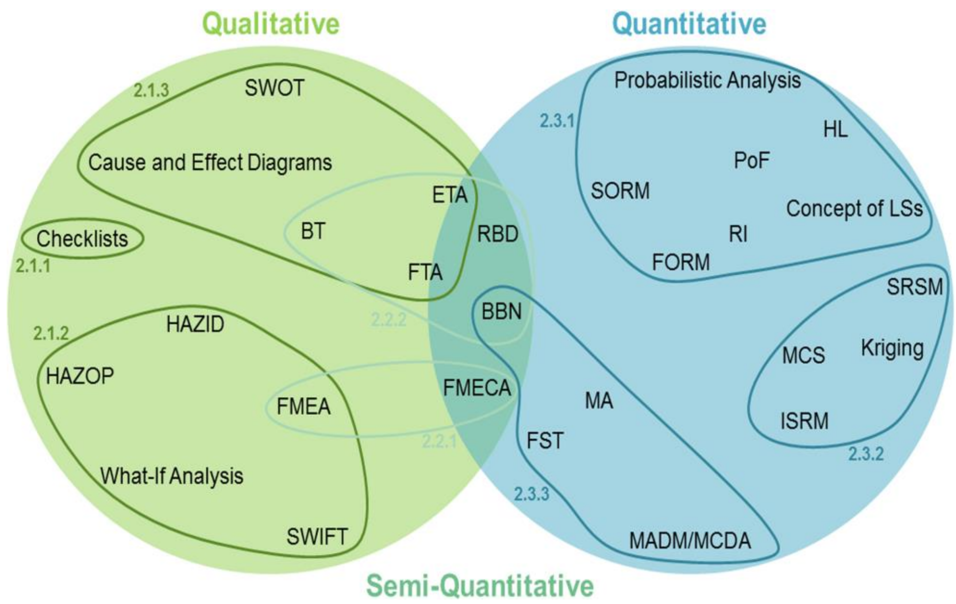
Recent covid-19 pandemic created a worldwide emergency. Any human or object may have the virus. COVID-19 spreads quickly from human to human as virus load exposure is higher. COVID-19 spreads lesser quickly through objects unless those objects have recently been exposed to larger loads of virus from infected persons. The objects will not transfer or spread the virus unless they are touched. The virus spread is possible when both infected and healthy person breath same air or talk face to face at closer distances (say less than one meter). The virus can spread from shop to others and others to shop. Both way it's spread can lead to catastrophe.

The virus symptoms are not observable in many cases. In such cases, it will not be detected until tested. As testing is not carried out unless symptoms are observed so detection is eluded in such cases.

3. Proposed Solution

Reliability analyses (RAs) can be performed for different systems and components, such as mechanical, electronic, or software, as well as at various stages of the human/engineering process. Due to the broad application of reliability, attempts at categorisation are being made. Furthermore, two different levels at which reliability can be applied are defined: component and system level. These already introduce the bottom-up and top-down approaches, which can be found in some reliability methods as well.

Considering the different reliability methods themselves, there are two main categories into which they can be grouped: qualitative methods and quantitative methods, depending on the availability and quality of data. The methods covered in the following, as well as the chosen categorisation, are visualised in the form of a Venn diagram, presented in Fig. 1.



The aim of hazard identification (HAZID) analysis is to determine potential hazards, as well as their causes and consequences. This risk identification method should be applied as early as possible, so that changes and adaptions, which may avoid the hazard or at least reduce the effects to the system, can be integrated in the early system process. A typical HAZID worksheet starts by naming the investigated component or area, followed by the potential incident. Then, the potential causes and consequences will be determined and the severity of the latter will be categories. Finally, recommendations for corrections or precautions will be given.

A hazard and operability (HAZOP) study, another risk assessment tool, will also be used for the identification of hazards, their potential causes and effects; however, this analysis rather focuses on deviations from the normal operation mode as initiating event. The HAZOP procedure itself could either start with the guide word or the considered element. A HAZOP worksheet contains, besides the guide word and element, the explicit meaning of the deviation, the potential causes and consequences, already existing safeguards, as well as recommended necessary actions and further comments.

More adaptable tools for identifying risks are the what-if analysis or structured what-if technique (SWIFT). The SWIFT starts with collecting potential hazards and uses in addition a checklist, containing typical errors and failures that could also make up hazards. The hazards are then organised in a worksheet, comprising the hazard itself, mentioned in the column headed What-if?, its potential causes and effects, as well as presenting safeguards and giving recommendations, similarly to HAZID and HAZOP.

Not only focusing on hazards, the failure mode and effects analysis (FMEA) aims to identify FMs in the system function or equipment, their potential impacts and causes, as well as determining existing controls and precautions. Thus, while being originally a risk assessment tool, FMEA can also be used for RA. Three different types of FMEA exist: concept/functional FMEA, design/interface FMEA, and detailed/updated FMEA, implying that FMEA can be used throughout the entire life cycle of an asset.

Qualitative reliability methods in the form of a diagram can be structured from the top down or the bottom up. Such a top-down approach is used in the cause and effect diagram, which is also called the fish-bone diagram due to its shape. The top event, a failure or incident, makes up the head of the fish on the right side. Different cause categories, containing several specific factors, are then added in form of fish-bones to the diagram, allowing a structured risk assessment.

The same deductive (top-down) approach is used in the fault tree analysis (FTA), strictly speaking a risk assessment tool, which is visualised in a fault tree diagram (FTD).

The tip of the tree is the incident or failure which is then broken down into immediate, intermediate, and basic causes. The relationship between causes and the top event are represented by logical gates, such as AND and OR.

An event tree analysis (ETA), also a risk assessment technique, can be performed in the opposite direction, meaning from the bottom up. Such an inductive approach uses the incident or failure as the starting point for identifying all potential event sequences which may result from the initial event. The different levels in the corresponding event tree diagram (ETD) can directly represent safeguards and the two branches of that part of the tree are the options for the success or failure of this safety barrier.

A combination of risk assessment methods FTA and ETA is given in the bow-tie analysis (BTA). The diagrammatic form of such a BT has the failure or incident in the middle, which is then broken down to the left into its causes, representing the FTA, and to the right into its consequences, such as in the ETA. In both directions safety barriers can be included, safeguards for control and precaution in the FT-part, and safety functions for mitigation in the ET-part.

Besides those linear diagrammatic methods, the strengths, weaknesses, opportunities, and threats (SWOT) technique analyses influence factors and identifies risks in two dimensions. Based on the shape of a compass rose or four-quadrant format, the internal factors i.e. strengths and weaknesses are in the north, while the external factors i.e. opportunities and threats are in the south. In the east-west direction, the factors are distributed such that the positive factors lie in the west and the negative ones in the east.

4. Results

This work will present a analysis of hazard analysis reliability-based methods for risk assessment, which can be used for future precaution and control the spread of COVID-19.

5. Expected Outcome

This model is competent to closely predict accurate trends of COVID19 cases.

6. Time Duration : 1 to 2 Years

7. Proposed Budget: Rs. 20 Lakh

8. Project Staff: One SRF/JRF