Economic loss estimation along transportation corridors

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Unscheduled events may have sudden and significant impacts on the economy of a region. The damage to the production facilities and lifelines may spread across boundaries of regions or even countries via inter-industry relationships and can have serious economic impacts on other regions. The estimation of the damage of a disaster plays a role in risk assessment and it is necessary that all damage is included to provide a complete analysis of the consequences of a disaster. The report gives an overview of existing loss estimation models and presents a method to estimate the economic loss of a temporary disruption of the infrastructure.

Economic loss
Damage incurred as a result of an unscheduled event can be classified in tangible loss (monetary terms) and intangible loss (relative value). Tangible damage can be further classified in direct and the indirect damage. Direct damage may be thought of as a loss in asset value, whereas indirect damage can be considered to be the loss of income and/or production and impacts on the environment that cannot be readily stated in monetary terms. In this research, economic loss is refers to 1) the direct costs of the increase in transport costs due to damage to infrastructure 2) the indirect costs of the loss of trade through inter-industry links.

Theoretical framework
This research defines a method that combines the transport and economic system in order to estimate economic loss as a result of an unexpected event. The approach is based on the Input-Output approach and the classic four-step transport model.

Transport system
The transport model is useful in forecasting the load of the flow, both passenger and freight, on the network and in estimating changes in the network or transport modes. The freight and passenger transport will be modelled with the classic four-step model. The major advantage of this model is that it classifies the four main decisions 1)will I make the trip 2) where do I go 3) Which transport mode will I use and 4) which route will I take, in sub models. The answers of these questions are given in trip generation, distribution, modal split and assignment, respectively. The classic four-step model will be used in loss estimation, because it provides the load on the network and gives insight in the importance of a road in the network.

Economic system
The basis of the economy of a region is the circular flow, which represents the relationship between the households and firms in an economy. The literature describes several methods that describe the economy of a region, examples are the Input-Output (I-O) and the Computable General Equilibrium (CGE)approaches. The I-O approach is a commonly used method that quantifies systematically the interrelationships between the sectors of an economic system. The method is general accepted and will be used in the economic loss estimation method that is represented in this report.

The economic loss method
The basis of the method is the classic four-step model and the Input-Output approach. The input is the Input-Output table, the location of the activities and the existing infrastructure (see Figure 1).

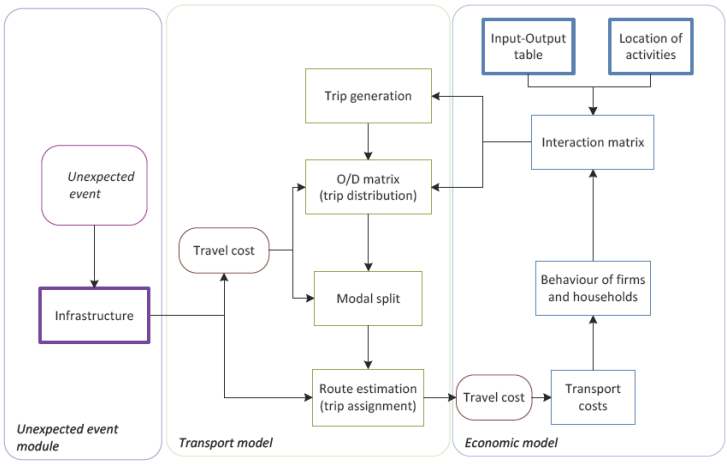

Figure 1 Economic loss estimation method

The role of the economic system is to describe the economic activities and the interaction with each other. The transport system gives insight in the distribution of the economic activities in the region. The travel costs are the basis for the loss estimation as a result of an unexpected event.

Long-run equilibrium
The initial position is a situation where both systems are in a long-run equilibrium situation. Long-run equilibrium is reached when the characteristics of the trips (distance, travel costs) between origin-destination pairs the behaviour of the households and firms is stabilised. This means that the travel costs will increase simultaneous in the region as a result of inflation or economic growth.

Effects of a disruption of the infrastructure
A disruption of the infrastructure due to an unscheduled event has two initial effects on the transport system. These are:
1) The infrastructure of a transport mode (e.g. road, rail track) is damaged, which means that trips need to be made with other modes that are still intact.

2) Trip makers need to choose another route, because a link in the route is not available as a result of the unscheduled event.

Both effects result in an increase of the travel costs of the trip, which will lead to higher transport costs for persons or freight. Households and firms react on this increase an will change their behaviour. For example, commuter traffic can choose not to make the trip because the travel costs are too high or the shopping traffic will choose another destination. The choices of the households and firms lead affect the trip generation and trip distribution. The next step of the method is the modal split with the modes that are still intact and the assignment of the trips over the network. This results in another shift in travel costs and therefore transport costs. These are the first round effects of the disruption of the infrastructure. The second round will result in another shift in travel costs. This can be continued until the difference in travel costs is negligible and a temporary equilibrium is reached where economic loss per day is stabilised until the infrastructure is reconstructed.

Economic loss

The economic loss of a temporary disruption of the infrastructure is divided in direct and indirect losses. The direct losses are based on the increase of the travel costs and indirect losses are based on the decrease of the gross output of the economic sectors in the region. The method has been applied to analyse the economic loss of a landslide, with hypothetical scenarios in the Valtellina valley in Italy. If a road in the valley is disrupted by the landslide, the method gives an estimation of the economic loss of the region.

Conclusion

The theoretical framework can be used to estimate the economic loss of a temporary disruption of the infrastructure. It can be used as a tool for risk analysis and prevention efforts for unscheduled events. Examples are the assignment of vulnerable spots in the region and the prevention of the economic vulnerable infrastructure in the region.