



Research Programme
- Short Call 2022 –
- Final Report -

Lead Applicant Name	Jim Allen
Host Organisation name	Cundall
Project Title	A Roadmap for Landslide Risk Mapping in Ireland
Contract Number	2022-sc-018

This report covers the period 1st December 2020 to project end date (31/08/2024)



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2. (a) Project information:

Final project report (*max 2500 words, excluding figures and headings*):

Executive summary (extended abstract, e.g. for use by policy/other stakeholders):

Landslides are one of the most common and most damaging natural hazards in Ireland, after flooding. Some recent high-key examples include Derrybrien peat slide in 2013 that created massive environmental damage; landslide occurred in 2018 during wind farm construction in north Roscommon which resulted in a construction worker casualty; three high-profile large peat slides occurring in 2020, and frequent landslides occurring along road and rail cuttings that cause significant direct physical damage and indirect economic effects. Some graphical examples are presented in Figure **Error! No text of specified style in document.**-1.



Figure **Error! No text of specified style in document.-1** a) Dawn of Hope peat landslide, taken from blogs.agu.org; b) rockfall at Waterford train station, taken from independent.ie.

Landslide risk assessment is one of the key geohazard research activities worldwide, with its importance being continually emphasised by the negative impacts of climate change (Gariano & Guzzetti, 2016). In simplified terms, landslide risk assessment (LRA) typically starts with the collation of landslide inventory and ancillary geological and climatological data. From these, a landslide susceptibility assessment is first carried out, showing the spatial distribution of landslide hazard (*i.e. where are landslides likely to happen?*). This is then updated with temporal-magnitude analysis (*i.e. how big and how frequent?*) to arrive at full landslide hazard (H) map. A separate workstream identifies the assets at risk and their value (E) as well as vulnerability V (*i.e. if landslide occurs, what happens to the asset at risk?*), jointly known as consequence analysis (C). Risk (R) is then expressed as a combination of hazard and consequence, or $R = H \times C$. A plethora of different methods exists for each step in the process, resulting in a vast array of different qualitative and quantitative landslide hazard and risk maps (Corominas et al. 2014). The simplified graphical representation of the process is shown in Figure **Error! No text of specified style in document.-2**, reproduced from Fell et al. (2005).

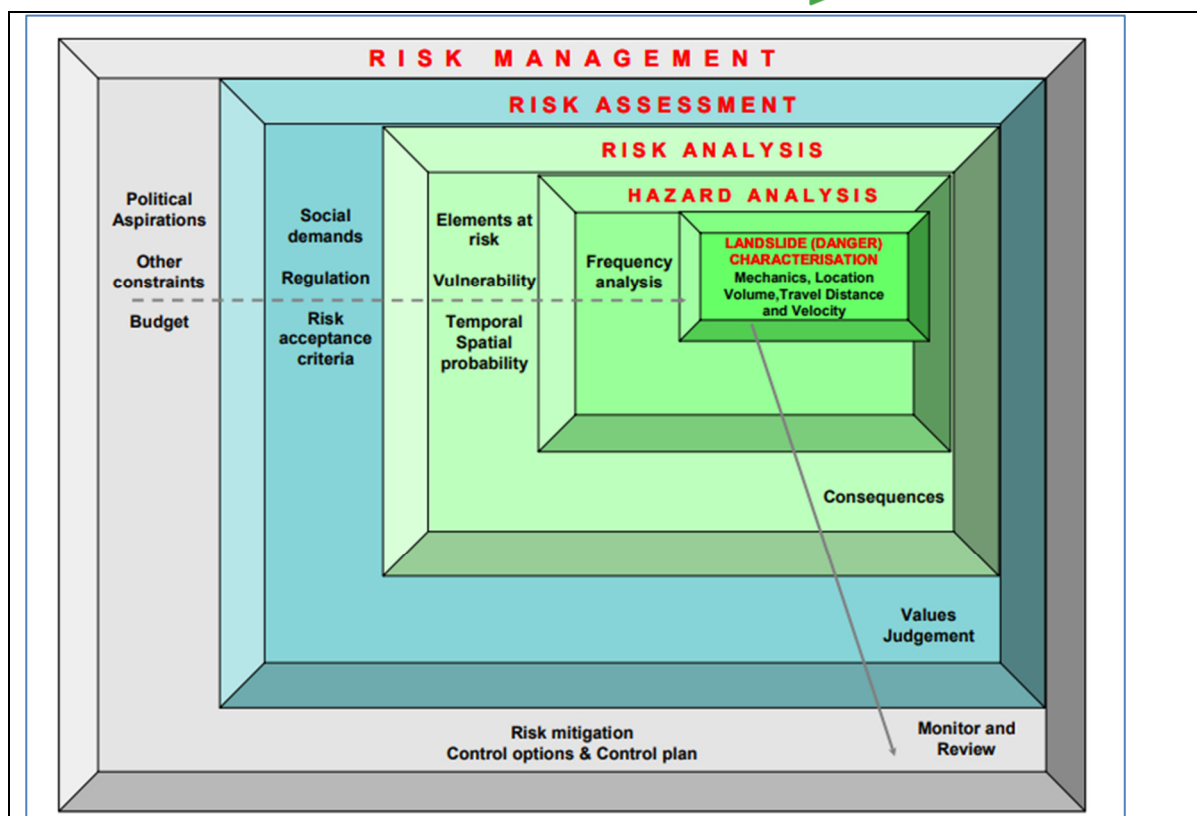


Figure Error! No text of specified style in document.-2 Landslide risk management process, reproduced from Fell et al. (2005).

While the landslide hazard and risk analyses are a fertile topic in academia, they are typically carried out on a minute well-described study areas. The application of many methods however proves inadequate once it is translated to regional and national scale, with typical problems revolving around lack of input data and the definitions/quantifications of risk and asset values. A recent overview (Martinovic, 2017) showed that current national risk maps in Europe have typically only been developed in areas where data collection is advanced and landslides are identified as a major natural hazard, such as France, Italy and Switzerland.

GSI has understood the importance of LRA and is leading a phased development of a national landslide risk assessment for over a decade; pulling significant efforts in tandem with the academia, consultancies and other third parties. To date, the national landslide inventory is published and is being continually updated. The landslide susceptibility assessment (spatial probability of landslides) has also been carried out and the output, landslide susceptibility map, published. The hazard assessment (temporal and magnitude assessment) pilot study for three minor selected areas has also recently been carried out.

Much more work is however still required to complete the hazard assessment phase. Consequence analysis and risk assessment are also yet to be started. This project submission aims to provide further research on national hazard and risk assessment that will add value to the existing GSI's landslide risk assessment efforts. It also ties in completely within the GSI's official Research Roadmap (2016a), where "Risk mitigation for geological hazards" is singled out among three key challenges.



(i) Results, scientific/engineering targets reached beyond the state of the art and conclusions (please include additional information in Section 3 below)

This project has reviewed both existing Irish landslide projects and research streams alongside the existing landslide inventory and susceptibility map. It has then identified synergies between the projects, methods and datasets and drawn conclusions on how the identified synergies can be utilised to assist in the further development of landslide hazard and risk mapping for Ireland.

The project also considers the gaps, threats and opportunities for Irish national landslide risk and hazard assessment based on a review of hazard assessment methodologies adopted across a number of European countries.

The project has identified that Ireland is already well progressed in the development of data driven quantitative assessment methods compared to the qualitative/empirical methods currently in use in some other European countries.

(ii) Project Implementation (milestones, deliverables, project management)

The project concludes in the preparation of a technical report 'A Roadmap for Landslide Risk Mapping in Ireland'

(iii) Outputs to date

Technical Report: A Roadmap for Landslide Risk Mapping in Ireland.

Document Reference: GSI-CDL-XX-XX-RP-GE-60200

Dated 30 August 2024

(iv) Impact

- Relevance/application to GSI programmes, where applicable

The technical report provides clear recommendations for the next steps required in order to identify at-risk assets, their vulnerability to landslide impact and the consequence of such impact.

The report also present recommendations for methodologies that could be considered for adoption in the production of landslide hazard maps, i.e:

1. mapping of different landslide hazards (i.e. peat slides, coastal landslides etc.) separately.
2. Further data collection, collation and refinement (i.e. type of data required, methods of collection, combining separate data sets into single database etc.)
3. Recommendations to consider tiered hazard and risk mapping based on likelihood of hazard actually manifesting.



- Other impacts

The report endorses the adoption of a data-driven, quantitative approach to the development of landslide hazard and risk mapping in Ireland. This reflects the approach now being taken and developed across numerous European countries and already underway in Ireland.

Publications:

Technical Report 'A Roadmap for Landslide Risk Mapping in Ireland'

Document reference: GSI-CDL-XX-XX-RP-GE-60200

Date: 30 August 2024