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Polish practice in carrying out sensitivity, vulnerability and risk analysis for the identification of hotspots on transport infrastructure due to climatic factors

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Carrying out sensitivity, vulnerability and risk analysis for the identification of infrastructure hotspots due to flooding

- The objective of the task was to identify infrastructure hotspots in a selected area.
- It employed data collected and generated in the process of assessing and mapping flood hazard and flood risk in Poland.
- This process included:
  - Preliminary assessment of flood risk - the objective was to designate areas endangered by flooding in the selected area of interest (i.e. areas at significant risk of flooding or where the occurrence of high risks is likely)
  - Flood risk maps and flood hazard maps incl. numerical data generated in the ISOK project were applied (ISOK - IT system of the Country's Protection Against Extreme Hazards, holds information about natural hazards, threatened areas, mainly from floods)
  - Flood risk management plans have also been deployed.

Value governance framework for road infrastructure in Poland

AREA	OBJECTIVES	RISK	PLANNING	DELIVERY	MONITORING	ASSESSMENT
IMPACT	Influence on the economy, customers, stakeholders; outcomes (monetized)	Uncertainty of impact on the value for customers (e.g.: social, environmental costs)	Network level lead indicators	Project/asset level lead indicators	Compliance lag indicators	Improvement lead indicators
SERVICES	Levels of service	Uncertainty of LoS delivery	Network level lead indicators	Projects/assets level lead indicators	Compliance lag indicators	Improvement lead indicators
ASSETS	Assets' related outputs and outcomes (e.g.: life-time value)	Uncertainty of assets' performance and condition	Network level lead indicators	Project/assets level lead indicators	Compliance lag indicators	Improvement lead indicators
INTERVENTIONS	Supply related Demand related	Uncertainty of intervention selection	Optmized Decision Making	Capital, Operational, Traffic management	Compliance lag indicators	Improvement lead indicators
ACTIVITIES	Accountability of business units	Uncertainty of time, cost, quality	Forecasting	Programming, procurring, contracting, supervision	Compliance lag indicators	Appropriateness, conformance and performance
RESOURCES	Methods, standards, systems, competences, funds	Uncertainty of adequacy	Methods, competences, data, tools, funds	Standards, competence, data, tools	Compliance lag indicators	Adequacy, conformance and performance

Methodology description

- Following the guide's methodology, the analysis included an assessment of the infrastructure's sensitivity and exposure to climate change and, consequently, its climate change vulnerability. Vulnerability (V) is the result of multiplication of exposure (E) by sensitivity (V=ExS)
- Sensitivity in this case is related to the size of the road traffic and the type of road infrastructure. Exposure is determined by the height of the flood wave (flooding depth) and by the likelihood of flooding.

Methodology description

- The task involved the application of GIS software .
- In GIS the depth of water is included in the depth layers for individual flood scenarios. In the depth layers there is a "Głębokość" (depth) field, which contains depth intervals divided into four classes described by following attributes:
- 1: = < 0.5 m (less or equal to 0.5 m),
- 2: 0.5-2 m (from 0.5 m to 2 m),
- 3: 2-4 m (from 2 m to 4 m),
- 4: > 4 m (above 4 m).

Flood risk analysis

- These ranges have the following reference to flood risk:
- (1) water depth less than or equal to 0.5 m – indicates a low risk for people and building objects, but high risk in terms of transport (moderate risk up to 0,2 m. and low risk up to 0,1 m.),
- (2) water depth greater than 0.5 m and less than or equal to 2 m – indicates an average risk to people due to the possible requirement for evacuation to higher floors of buildings, high due to material losses and very high risk in terms of transport;
- (3) water depth greater than 2 m, and less than or equal to 4 m – indicates a high risk to people and very high due to material losses; not only the ground floors but also the first floors of buildings may be flooded; extremely high risk in terms of transport,
- (4) water depth greater than 4 m – indicates a very high risk to people and a very high risk of total material loss, extremely high risk in terms of transport.

Outcomes

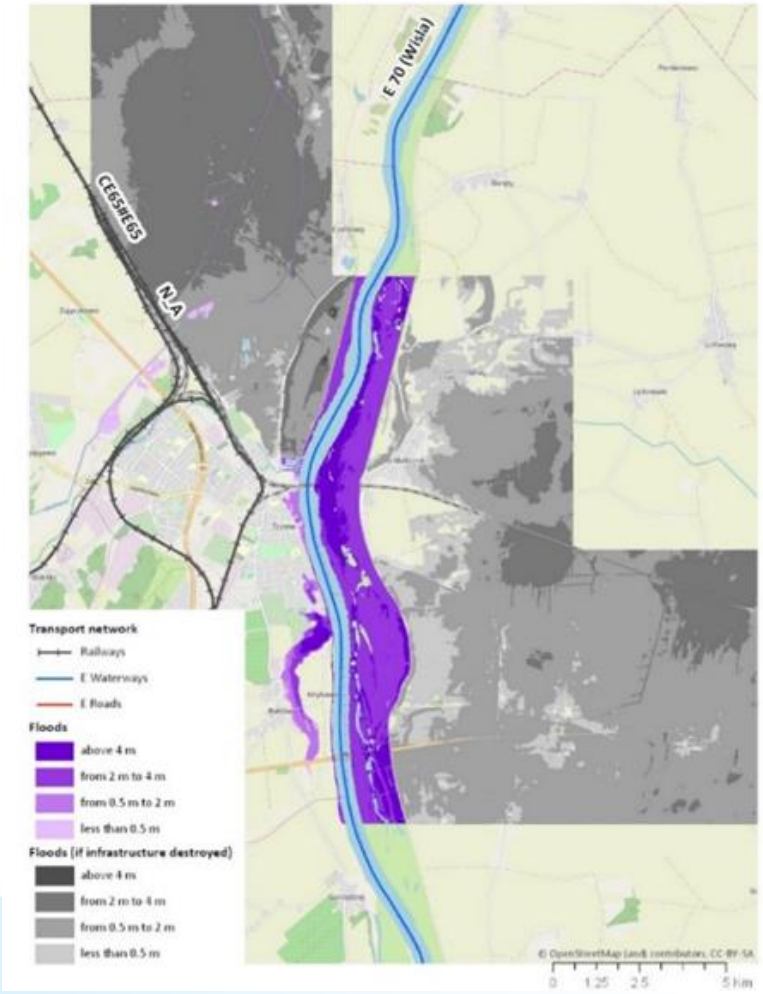
- Applying such an analysis, risk maps were developed that portray levels of flooding risk across a geographical area. Data include the likelihood of flooding at Q=0,2%, Q=1% and Q=10%. These specific maps may include information concerning flood water depth, water flow velocity and directions of flood water flow.
- The above-mentioned probabilities of floods may be related to the forecasted climate changes. The likelihood of flooding is changing in a very precisely defined range according to the adopted climate change scenario.
- As a next step, a layer portraying specific sensitive infrastructure network – Trans-European Transport Networks (TEN-T) that was selected – is added to the risk map on flooding. This data includes the type of roads, their width, the type of their surface and some additional data.

Results

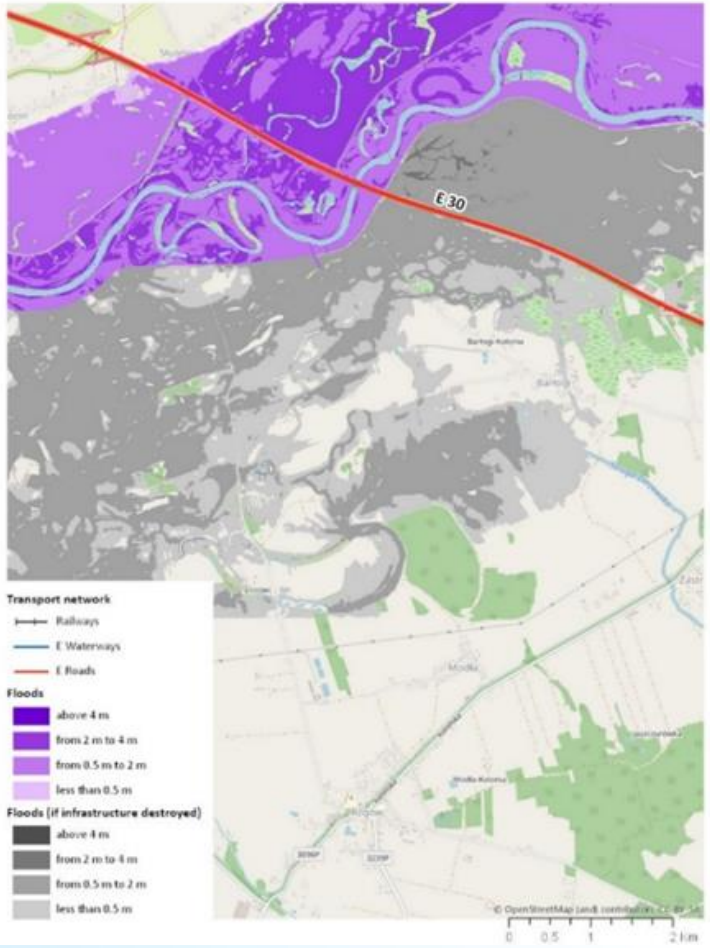
- Following the sensitivity and vulnerability analysis, TEN-T network hotspots due to flooding have been identified and included on GIS maps. Also, numerical data in GIS format are provided, which in turn may be subject to further processing using available GIS tools.
- Report contains examples of GIS maps with analysed hotspots. The figures present two scenarios:
- one in which the flood embankments are damaged and
- another in which they are retained.

Detailed information contained in the GIS system, such as a velocity of water, directions of water flow etc. was not presented on the maps.

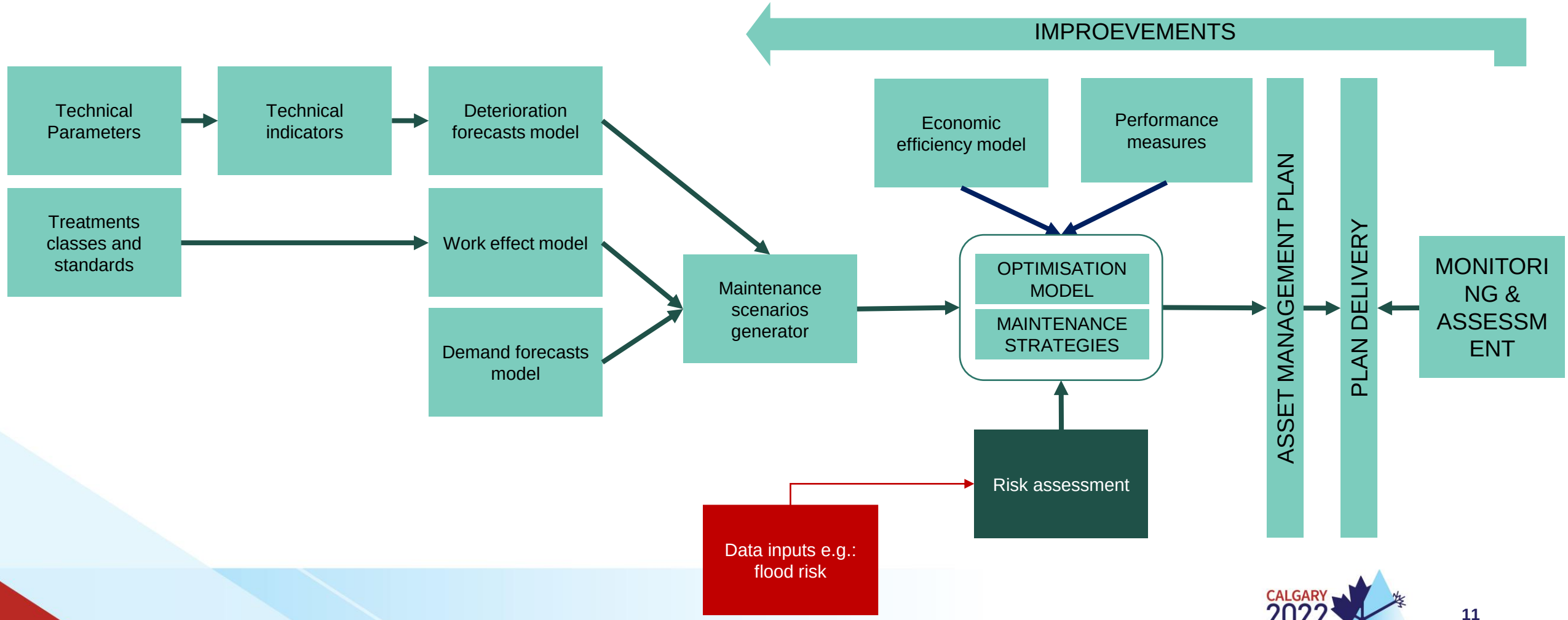
Map portraying levels of flooding risk on selected hot spots



Map portraying levels of flooding risk on selected hot spots



Resilience within the ODM method



- **Thank you**
  for your attention