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CONNECTA

Technical Assistance for the Deployment of Smart and Sustainable Mobility in the Western Balkans

CONNECTA-TRA-CRM-REG-MOB-07

Road Technical Committee

7/12/2022, Brussels

Resilience for the road sector in the Western Balkans

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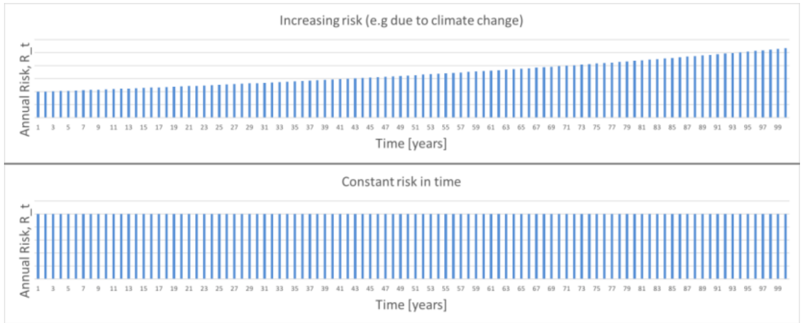
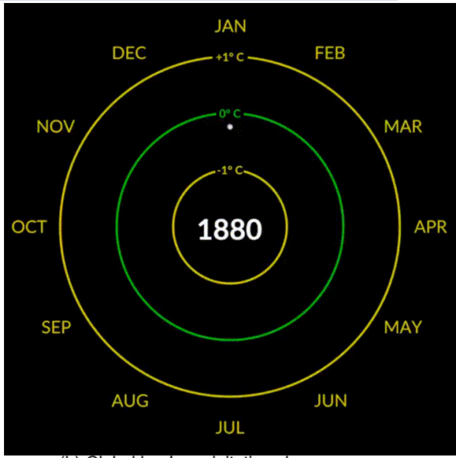
CONTENT

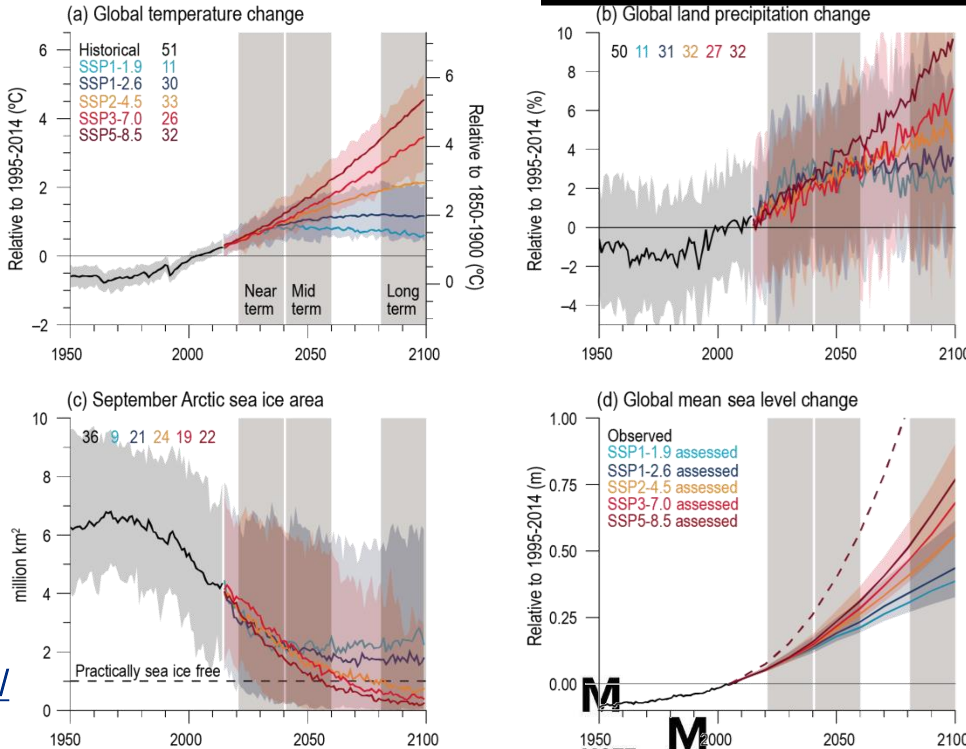
Introduction – the bad news

Climate change is omnipresent. All projections are predicting sea level raise, ice retreat, temperature and precipitation increase. Consequently, risk increases in time.





source: https://www.cee.ed.tum.de/



We are filling it not only through weather extremes and singularities, but indirectly:

- agriculture
- industry
- transportation
- **linked natural processes**
- …

source: https://www.ipcc.ch/

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Introduction – in the Western Balkans

The Western Balkans region is no exception to the climate change witnessed in several extreme events (source https://public.emdat.be/data) in the past decade:

- Croatia flooding 2010, 2014 (0.1 bil. $ damage)
- B&H flooding 2010 and flooding and landsliding 2014 (0.5 bil. $ damage)
- Serbia flooding and landsliding 2014 (2.3 bil. $ damage)
- North Macedonia flooding 2013 and 2016
- Sporadic but frequent rockfall events in Montenegro, Serbia, N. Macedonia, Croatia

source: jutarnji.hr

source: osce.org

source: osce.org

source: marh.mk

Platije, Montenegro (2019)
source: vijesti.me

Makarska, Croatia (2010)
source: tportal.hr

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Introduction – the impact on transport infrastructure

- Over the last decade, **climate resilience** in the context of infrastructure is becoming one of the major considerations and areas of combating against climate change impacts.
- According to the Climate-Resilient Infrastructure Officer Handbook, climate-related shocks and stresses are **increasing in frequency and magnitude**, causing damages to infrastructure systems and disruptions in the provision of services. Yet there is **not sufficient investment** needed to infrastructure systems' climate resilience.
- Worldwide, **all types of infrastructure will be affected by negative climate impacts** and therefore will be exposed to variety of risks. Increasing its resilience to these impacts will have a crucial role in avoiding substantial direct and indirect economic and financial damages.
- Climate change risks fall into two categories:
    - **Chronic stresses** – Hazards due to long-term changes in average climatic conditions, which are typified by their slow onset occurrence.
    - **Acute shocks** – Hazards due to extreme weather events.

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Methodologies – infrastructure adaptation framework

Adaptation Framework

To enable transportation infrastructure to adapt to climate change and minimize the impact of extreme weather events, it is important to understand how roads are planned and managed and to identify weaknesses and strengths in dealing with climate change.

The most cost-efficient way to achieve this is to perform Risk Based Road Asset Management (ISO 55001). This includes:

1. Identifying scope, variables, risks and data with the focus on climate change scenarios for the given territory and exposure and sensitivity analysis of road assets to climate change.
2. Assessing and prioritizing risks. This stage includes vulnerability analysis carried out to identify critical elements of road infrastructure.
3. Developing and selecting adaptation responses and strategies (risk mitigation measures). This stage outlines the identification, selection and prioritization of adaptation responses identified within stages 1 and 2.
4. Integrating results into decision making processes. Namely, the results of the stages 1-3 should be effectively incorporated into asset management and investment plans, traffic management strategies and other strategic documents and standards.

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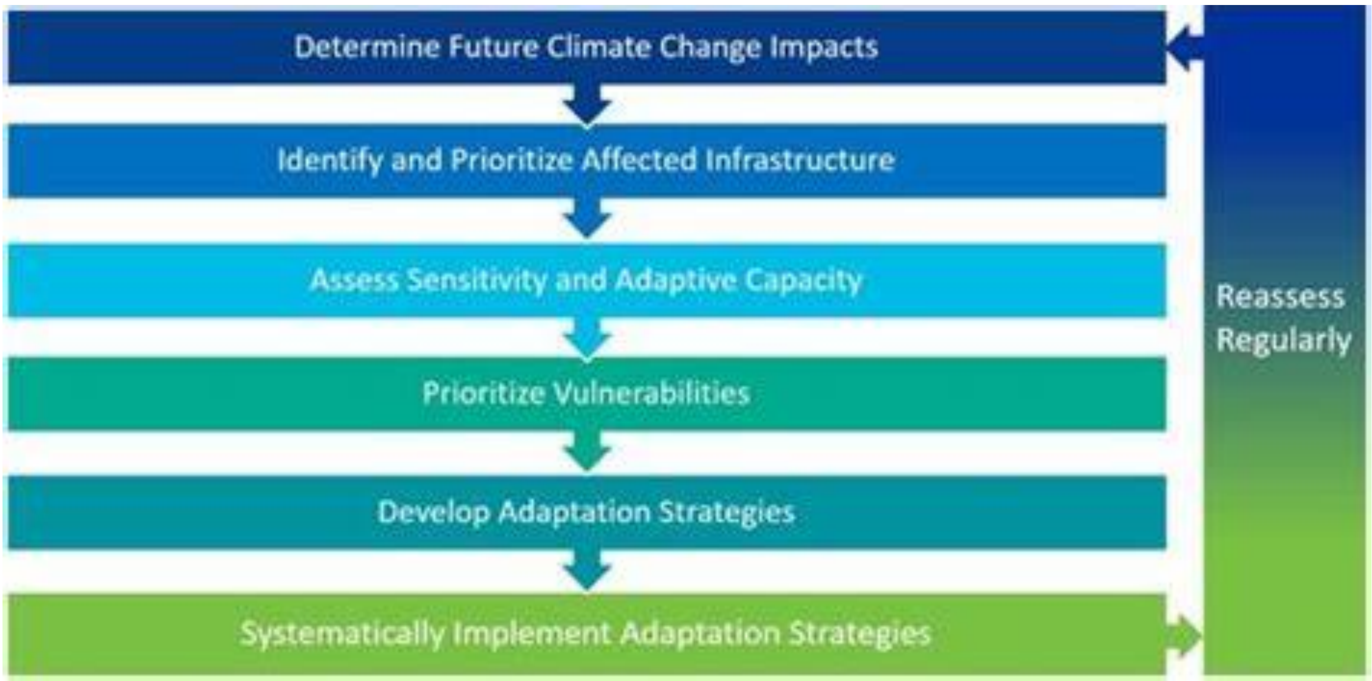
Methodologies – framework for risk-based assessment

Risk Based Asset Management



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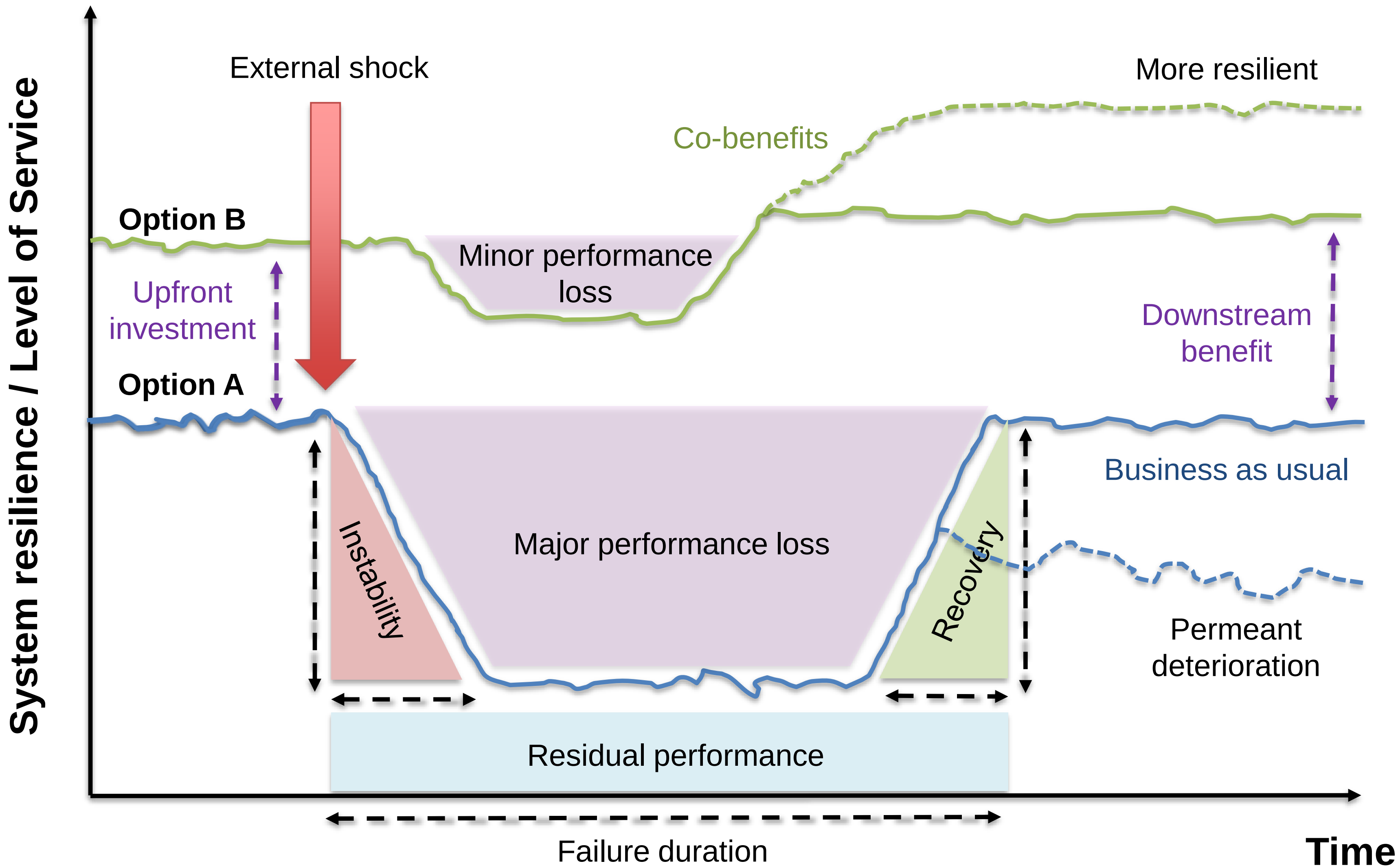
Methodologies – assessing the asset performance loss



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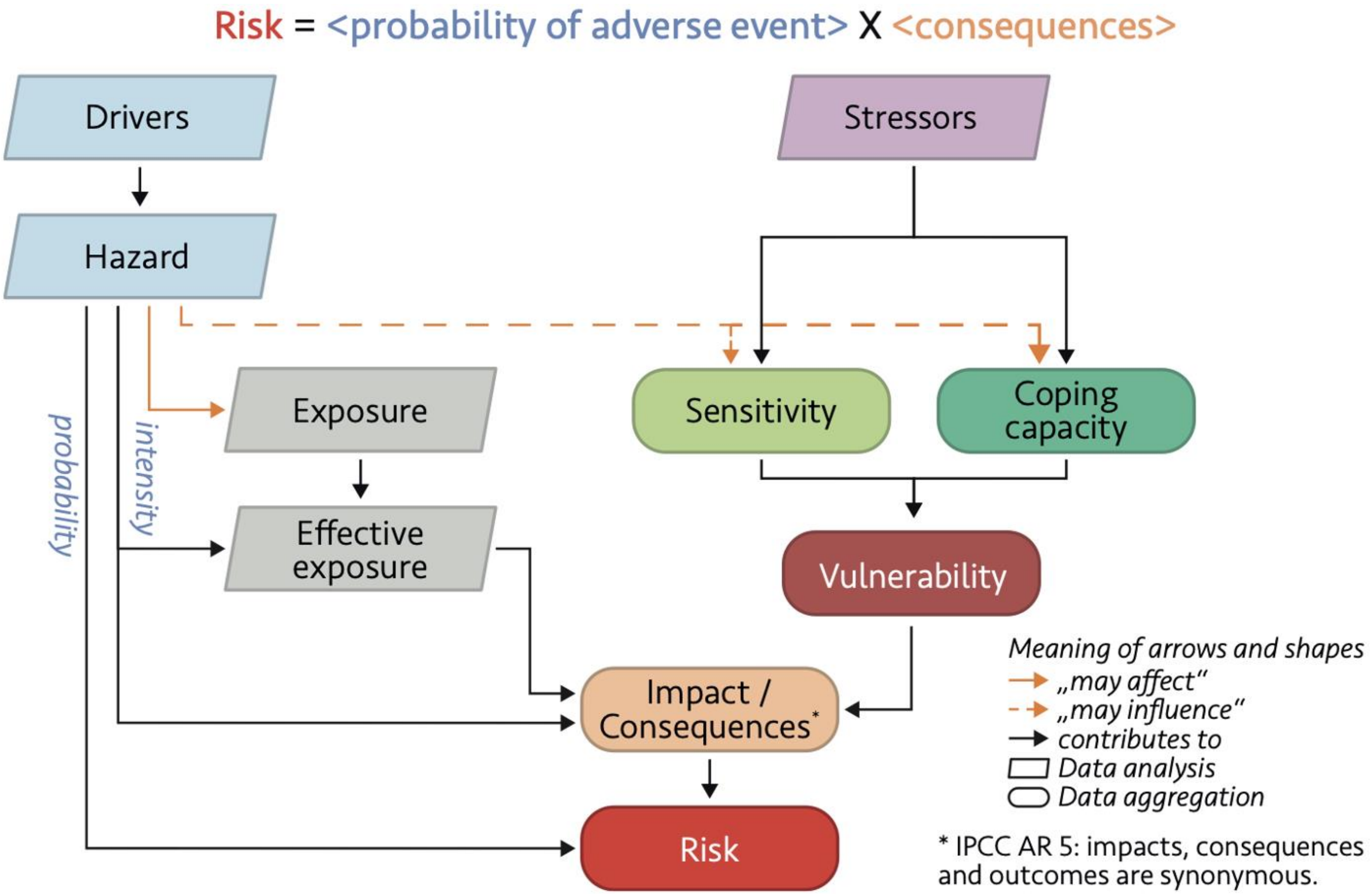
Methodologies – sensitivity and vulnerability analysis



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Methodologies – example of analysis for North Macedonia

Climate hazards

Greater frequency and intensity of extreme events -> **extreme rainfall events, floods, landslides**.	Rise in average temperatures and extreme temperatures -> **higher temperatures, heatwaves**	Variability of seasonal rainfall patterns -> **longer dry seasons, drought**.

Exposure

River flooding. The exposure to river flood hazard in North Macedonia is classified as **HIGH**, which means that potentially damaging and life-threatening river floods are expected to occur at least once in the next 10 years.	**Drought**. The exposure to drought hazard is classified as **MEDIUM**, which means that there is up to a 20% chance that droughts will occur in the coming 10 years.
Landslides. The landslide susceptibility of North Macedonia is classified as **HIGH**, which means that this area has rainfall patterns, terrain slope, geology, soil, land cover and that make localized landslides a frequent hazard phenomenon.	**Extreme heat**. The exposure to extreme heat hazard is classified as **MEDIUM**, which means that there is more than a 25% chance that at least one period of prolonged exposure to extreme heat, resulting in heat stress, will occur in the next five years.

Vulnerability

Sensitivity. (1) Limited capacity of water drainage systems in urban areas to accommodate high volume of rainfall in short periods. (2) Inadequate construction materials and limited integration of risk-informed design options.	**Coping capacity**. (1) Limited capacity of key agencies to translate forecasts into meaningful guidance and anticipatory actions to protect infrastructure during extreme events. (2) Insufficient legal framework to ensure risk-informed infrastructure design.

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Technical Solutions for the road sector – type of measures

- The defining characteristic of climate-resilient infrastructure is that it is **planned, designed, built and operated in a way that anticipates, prepares for, and adapts to changing climate conditions**. It can also withstand, respond to, and recover rapidly from disruptions caused by these climate conditions. (OECD)
- Given the context-specific nature of climate adaptation, the measures used to achieve this will vary widely. In general, there are two broad categories of adaptation measures in this context:
  - **Structural adaptation measures**: e.g., changing the composition of road surfaces so that they do not deform in high temperatures, building seawalls or using permeable paving surfaces to reduce run-off during heavy rainfalls.
  - **Management (or non-structural) adaptation measures**: e.g., changing the timing of maintenance to account for changing patterns of energy demand and supply, investment in early warning systems or purchasing insurance to address financial consequences of climate variability.

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Technical Solutions for the road sector – road pavement

Risks & Mitigation

The main risks to the road surface associated with climate change are, depending on the climate zone, extreme heat and insolation, higher occurrence of heavy rain and temperature fluctuation around the freezing point.
Very high temperatures are manifested by an increased risk of asphalt rutting, flushing and bleeding of bituminous surfaces and/or cracking. As the temperature of the asphalt mixture increases, the binder phase loses stiffness and the irreversible deformations caused by static or dynamic traffic loading will accumulate at a faster rate. Possible solutions include following ones:

- Adjustment of bituminous mixture design (using of binders with higher softening point, including polymer modification of bitumen, selection of stronger aggregate skeleton);
- Adjustment of structural design of the pavement (flexible, semi-rigid and rigid/composite designs);
- Greater use of concrete due to its higher temperature resistance and other advantages (longer lifetime, possibility of increased load, lower need for maintenance) albeit slightly higher purchase costs.
- Changing the design of the concrete pavement mixture to reduce the amount of water required.
- Increase the reflectance (albedo) of the road surface e.g. by means of using bright, coloured elements on the road or reflective coatings of road surfaces.
- Cooling pavements with water.

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Technical Solutions for the road sector – road drainage

Risks & Mitigation

Drainage system capacity should be adapted to higher intensity and frequency of extreme rainfall events and complemented with water retaining facilities (e.g. dams, reservoirs) and structural protection measures (dikes, embankments).

The design for culverts should be adjusted to accommodate higher water volumes within a short period of time. In terms of defining the capacity design of the drainage system, the intensity-duration-frequency curves (IDF curves) should be used, taking into account the influence of climate change and updating these IDF curves with the rainfall characteristics projected in future climate scenarios.

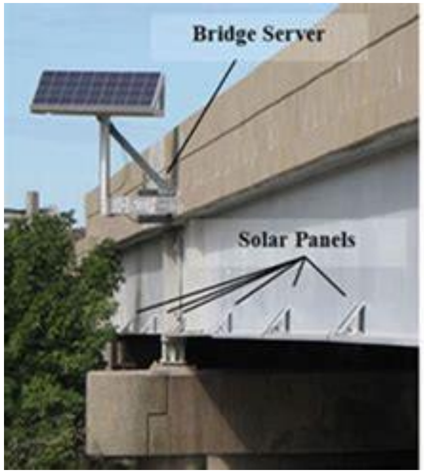
Technical Solutions for the road sector - bridges

Risks & Mitigation

The main climate change concerns relevant to design, construction and management of existing bridge structures are higher occurrence of flooding, higher river discharge, erosion and slope instabilities and temperature fluctuation.

The standards for bridge structures which are currently used show considerable resistance to these effects; nevertheless, the research of new climate-proofed standards is ongoing.

Nevertheless, it is considered necessary to install weather stations and telematics on bridges measuring water level, vibration sensors, traffic regulating equipment etc.



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Technical Solutions for the road sector - vegetation

Risks & Mitigation

Vegetation along roads contributes to environment protection, in particular reducing noise and pollution, and can also have an adaptation function, for example protecting road from direct sunlight.

On the other hand, improper use of vegetation along road can be a risk factor of traffic disruption when extreme weather events occur and may also influence road safety.

The recommendations towards building up climate resilient roads therefore include replacement of mature trees with hedges (using elastic woody plants suitable for and more adapted to a given climate zone) and planting the vegetation at a sufficient distance from the road.

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EU Framework

- **Candidates for European Union** (EU) membership commit to transposing the EU legal framework into its national legal system. At the EU level, the umbrella document related to adaptation to climate change is the new EU Strategy on Adaptation to Climate Change , amending the **EU Strategy on Adaptation to Climate Change** enacted in 2013.

- The new Strategy was adopted in 2021. It sets out how the European Union can adapt to the unavoidable impacts of climate change and become climate resilient by 2050. It is largely focused on **investing in resilient, climate-proof infrastructure**. It states that in order to minimise the risk of disasters and be cost-effective over its lifetime, infrastructure investments should be climate resilient.

- The EC developed extensive climate proofing guidance for new major infrastructure projects called **Technical guidance on the climate proofing of infrastructure in the period 2021-2027**. These guidelines provide comprehensive recommendations on how to integrate the climate vulnerability and risk assessment from the beginning of the project development process.

- The **EU taxonomy (**Regulation (EU) 2020/852) represents a new comprehensive classification system for standardising "green" economic activities and is primarily designed for use in the financial sector. It consists of six main environmental objectives, that are simultaneously tested for an investment/measure.

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EU Framework – additional resources

Do No Significant Harm assessment for EU-funded projects – in line with the EU Taxonomy

- 2 step process to ensure that climate change impacts are incorporated and ensure that investments / policies are not “mal-adaptation”:
  - Does the action require a thorough assessment of the measure in terms of the 'Do no significant harm' principle?
  - Is the measure expected to lead to an increased adverse impact of the current climate and the expected future climate on the measure itself or on humans, nature or property?

- Additional questions related to water resources, climate change mitigation, etc. with guidance on all aspects being currently drafted by the European Commission
- EU Taxonomy information here: https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en
- Do No Significant Harm approach described here: https://ec.europa.eu/info/sites/default/files/2021_02_18_epc_do_not_significant_harm_-technical_guidance_by_the_commission.pdf

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Best Practices - 1

- Based on **Western Balkans Investment Framework** (WBIF) Grants for Technical Assistance Guidelines issued in January 2021, which defines **eligibility criteria for the projects to be financed**, tracking climate finance commitments is a responsibility of donors or financiers, not of the Beneficiaries. In this context, the assessment of contributions to climate finance (mitigation and adaptation) **examines whether climate change is the principal objective** of a project, one of the (significant) objectives or it is not an objective at all.
- The grant application should provide information on potential contribution of the project to **GHG emissions reduction and assessment of climate risks**, including the measures that would improve the climate resilience of the project.

Parameter	Elaboration
Average temperature rises and increased risk of heat waves	• Regions where average temperature is already high; • Urban centres, where the 'urban heat island effect' will exacerbate high temperatures; • Regions with limited freshwater supplies.
Mean sea level rise, coastal flooding and erosion	• Coastal areas and islands.
Decreased seasonal precipitation, increased risks of drought, wildfire	• Regions where rainfall is already scarce; • Locations where current demand for water almost matches supply or outstrips; • Locations where water quality is poor; • Regions prone to wildfire; • Trans-boundary river basins where tensions over water use already exist
Increased seasonal precipitation and more rapid snow melt – increased risk of river flooding, flash floods, or soil erosion	• Regions with high rainfall; • Estuaries, deltas, river floodplains; • Mountainous regions; • Locations prone to landslips; • Urban centres with storm water systems not designed to manage intense rainstorms; • Contaminated environments (land, water).
Possible increase in storm intensity and frequency	• Areas at risk of storms; • Urban centres at risk from storms.

Best Practices - 2

Operators in the UK shall carry out **climate change risk assessment for each new environmental permit application** (for certain installations and projects), if they expect to operate for more than 5 years. When completing the permit application form, they must calculate their **climate change risk test result**.

The screening tool - three questions to which there are different answers with different weights. A combined score of five or more requires the operator to complete and submit a climate change risk assessment as part of the application form. If the screening result is lower than five, the operator does not need to submit his risk assessment with the application form, but must still keep it as part of his environmental management system.

The next step for the operator is to find measures to manage the significant risks identified. These measures could:

- manage risk by introducing control measures to address climate change hazard, its impact on business or environmental impact
- risk transfer, such as insurance
- eliminate the risk, for example by changing the hazard elimination procedure

The UK Environment Agency provides examples in the sectoral guides for climate change risk assessment, which can guide operators in developing their climate adaptation plans.

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Best Practices - 3

Enhancing Environmental Performance and Climate Proofing of Infrastructure Investments in the Western Balkan Region from an EU integration perspective" (CLIMAPROOF)

The project CLIMAPROOF was financed by the Austrian Development Cooperation (ADC) and implemented by UNEP (2017-2021).

ClimaProof aimed to increase technical capacities of the relevant national authorities in the field of climate proofing of road infrastructure and green infrastructure.

For large infrastructural projects detailed and specific climate projections during the planning phase will be prepared which will allow integration of adaptation measures in both the planning and realisation phase, thus maximizing resilience to climate variability and extreme weather events.

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Best Practices - 4

Technical assistance preparation of climate resilience design guidelines for the public enterprise for state roads in North Macedonia - Climate resilience design guidelines (2019)

Guidelines provide detailed and practical instructions on how to conduct a climate change and natural hazard road network vulnerability and risk assessment. The methodology distinguishes between two main groups of actions: i) risk impact assessment, and ii) identification and prioritisation of engineering/ non-engineering solutions for risk reduction/ mitigation.

The identification of road sections under the most critical need for intervention is performed through four steps incorporating 9 tasks spanning across three layers: hazard, risk, engineering screening and the planning layer. The Guidelines defines engineering and non-engineering measures, as well as institutional and legal recommendations.

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Best Practices - 5

Moravian Corridor (“Moravski koridor”), Serbia (expected to be completed in mid-2024)

The construction of a new highway in Serbia can be mentioned as an example of a good practice in the Western Balkans region. As this **highway passes through an area that often has serious problems with floods**, this climate impact is seriously taken into account during design and construction processes. Construction of the highway "Moravian Corridor" E761 from Pojate to Preljina is underway. That corridor will connect the central parts of Serbia with the two most important highways in Serbia, which are part of the European road network: the E75 highway, through which it connects in the north with Belgrade and Central and Western Europe and in the south with North Macedonia and Bulgaria, and with the E763 Belgrade - South Adriatic highway.

Realisation of the Moravian Corridor Project includes:

- construction of a highway with a total length of 112.37 km and 40 bridges;
- hydro-technical regulation of the river Zapadna Morava;
- "digital corridor".

The contractor Bechtel ENKA will build a **large flood protection system to protect the area around the highway from flooding**, **erosion and subsequent water pollution**. This will be the first flood mitigation system of this magnitude to be built along the highway in the Balkans.

Conclusions

- At the regional level it is needed to identify main gaps and set strategies to overcome them.
- In case of natural hazards and climate change, it is essential to include expert groups capable of delivering primary inputs for all subsequent assessments.
- Climate related methodology needs to enter legislation after reaching overall consensus, and after being given a positive feedback from the end-users.
- Road enterprises have long term plans (5y) and can incorporate strategies towards database generation, digitization, automation etc…towards a global asset management approach!
- Even though more expensive, long-term solutions and planning should be encouraged
- An investment today needs to be compared to loss avoided in the future
- Multiple benefits are also crucial for prioritizing investments, which also requires networking with potentially interested groups

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Questions and Discussion

Any comments/suggestions?

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Thank you!

CONNECTA Project team

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