Adaptation to CC for national roads in Poland

Results of Stages I, II and beginning of Stage III

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Adaptation to CC for national roads in Poland

• Who are we?

• The Project

• Stage I: Summary and main conclusions

• Stage II: Summary results

• Stage III: starting with workshops…

• Suggestions
Who are we?

JASPERS
Joint Assistance to Support Projects in European Regions

- Partnership between the European Commission (EC) and the European Investment Bank (EIB).
- Managed by the EIB on the basis of a Framework Partnership Agreement with the EC.
- JASPERS assists beneficiary countries in preparing high quality investment projects to be co-financed by the EU Funds (European Regional Development Fund, Cohesion Fund, Connecting Europe Facility and Instrument for Pre-Accession).

Who are we – The Project – Stage I – Stage II – Stage III – Suggestions
Who are we?

1. Energy and Solid Waste
2. Rail, Air and Maritime
3. Roads
4. Smart Development
5. Water and Wastewater

Sources of value added
- Contributions to sector strategy / planning
- Contributions to removal of barriers to realise projects
- Cost savings in projects (through optimal dimensioning and selection of rational options)
- Faster approval through improvement of project documents (*)
- Better chance of realising expected project benefits after implementation through improvement of overall project quality
- Increased capacity of counterparts
Who are we?

GDDKiA

17 650 km of National Roads
- 1,627 km of motorways
- 1,809 km of expressways

Who are we?
- The Project
- Stage I
- Stage II
- Stage III
- Suggestions
Who are we?

GDDKiA

Traffic intensity on national roads

<table>
<thead>
<tr>
<th>Road category</th>
<th>Length - 2010</th>
<th>AADT 2010</th>
<th>Length 2015</th>
<th>AADT 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorways</td>
<td>848</td>
<td>23285</td>
<td>1556</td>
<td>26509</td>
</tr>
<tr>
<td>Expressways</td>
<td>550</td>
<td>19567</td>
<td>1484</td>
<td>21232</td>
</tr>
<tr>
<td>Main trunk roads</td>
<td>11203</td>
<td>10434</td>
<td>10536</td>
<td>9995</td>
</tr>
<tr>
<td>Trunk roads</td>
<td>4646</td>
<td>4978</td>
<td>4446</td>
<td>5260</td>
</tr>
<tr>
<td>TOTAL</td>
<td>17247</td>
<td>9888</td>
<td>18022</td>
<td>11178</td>
</tr>
</tbody>
</table>

Who are we – The Project – Stage I – Stage II – Stage III – Suggestions
The Project

Planned project steps

Stage 1: **Analysis** of survey results, data **validation** and road network **vulnerability** assessment including **climate change projections**

Stage 2: Assessment of **costs and impacts** of extreme weather events

Stage 3: **Workshop** of all related stakeholders to identify adaptation responses based on **risks assessment**

Stage 4: Build the "**business-case**" on national road network adaptation for decision-makers

Stage 5: **Action Plan** for the recommended **adaptation measures**
Stage I

- **Analysis** of survey results, data **validation** and road network **vulnerability** assessment including **climate change projections**

- **Assessment of** costs and impacts of extreme weather events

- **Workshop** of all related stakeholders to identify adaptation responses based on **risks assessment**

- **Build the “business-case”** on national road network adaptation for decision-makers

- **Action Plan** for the recommended adaptation measures

- **Sept 2017**

- **Sept 2019**
Background

- Beyond the project level - Need to understand the overall network vulnerability to CC
- In 2016 GDDKiA conducted a survey on weather-related affections of national road network:
  - Period covered January 2004- April 2016
  - Send to all 16 regional offices
  - Data provided:
    - 3,300 extreme weather events required actions of road service teams

In 2017 Jaspers Advisory and GDDKiA established horizontal project: “Adaptation to CC for national roads in Poland”
Stage I: Survey results analysis

**Percentage distribution of weather causes of registered events**

<table>
<thead>
<tr>
<th>Event</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire</td>
<td>0.2%</td>
</tr>
<tr>
<td>Heat and high temperatures</td>
<td>2.4%</td>
</tr>
<tr>
<td>Frost and low temperatures</td>
<td>4.1%</td>
</tr>
<tr>
<td>Intensive rainfall</td>
<td>22.3%</td>
</tr>
<tr>
<td>Hail</td>
<td>0.5%</td>
</tr>
<tr>
<td>Intensive snowfall</td>
<td>15.5%</td>
</tr>
<tr>
<td>Ice accretion on road and road...</td>
<td>2.7%</td>
</tr>
<tr>
<td>Lightning discharge</td>
<td>3.0%</td>
</tr>
<tr>
<td>Reduced visibility (fog)</td>
<td>3.0%</td>
</tr>
<tr>
<td>Strong wind</td>
<td>32.6%</td>
</tr>
<tr>
<td>Flood</td>
<td>8.4%</td>
</tr>
<tr>
<td>Other</td>
<td>5.3%</td>
</tr>
</tbody>
</table>

**Annual average number of registered events per 100km of a given road class**

- Motorways: 0.83
- Expressways: 0.87
- Main trunk roads: 1.53
Stage I: Survey results analysis

**Percentage distribution of the different Classes effects of registered weather events**

<table>
<thead>
<tr>
<th>Class</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>19.7%</td>
</tr>
<tr>
<td>I</td>
<td>12.5%</td>
</tr>
<tr>
<td>II</td>
<td>23.9%</td>
</tr>
<tr>
<td>III</td>
<td>1.3%</td>
</tr>
<tr>
<td>I+II</td>
<td>35.2%</td>
</tr>
<tr>
<td>I+III</td>
<td>0.5%</td>
</tr>
<tr>
<td>II+III</td>
<td>1.5%</td>
</tr>
<tr>
<td>I+II+III</td>
<td>5.3%</td>
</tr>
</tbody>
</table>

**Time of occurrence of registered weather events**

<table>
<thead>
<tr>
<th>Month</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>17.9%</td>
</tr>
<tr>
<td>II</td>
<td>6.4%</td>
</tr>
<tr>
<td>III</td>
<td>4.5%</td>
</tr>
<tr>
<td>IV</td>
<td>2.8%</td>
</tr>
<tr>
<td>V</td>
<td>11.9%</td>
</tr>
<tr>
<td>VI</td>
<td>10.7%</td>
</tr>
<tr>
<td>VII</td>
<td>15.7%</td>
</tr>
<tr>
<td>VIII</td>
<td>7.3%</td>
</tr>
<tr>
<td>IX</td>
<td>3.4%</td>
</tr>
<tr>
<td>X</td>
<td>4.7%</td>
</tr>
<tr>
<td>XI</td>
<td>4.2%</td>
</tr>
<tr>
<td>XII</td>
<td>10.8%</td>
</tr>
</tbody>
</table>
Stage I: Survey results analysis

Distribution of events caused by heavy rainfall

Distribution of events caused by heavy snowfall

Distribution of events caused by strong wind
Initial conclusions summary

- Identified main climate hazards affecting national road network (intense rainfall, intense snowfall and strong winds – over 70% of all registered events). Confirming initial KLIMADA assumptions. (Other hazards with longer-term effects e.g. heatwaves could not be captured by present study)

- Higher number of events occurred on national roads other than motorways and expressways (build based on higher design standards and operated under higher maintenance standards, other national roads often presenting poorer condition status).

- Most of events occurred in May-July and December-January.

- Data enabled GIS environment representation as key for further vulnerability analysis.

- About 10% of all recorded events resulted in complete blocking of the road (i.e. high impact on users and economy). Most commonly caused by heavy rain, heavy snow and flooding.

- A solid prelude to further work under the Jaspers supported project “Adaptation to climate change for the national roads in Poland”.

- A basis to state that adequate and well-planned adaptation measures can translate into direct benefits for GDDKiA, road users and the economy.
Stage I: Climate change forecasts

- Observed trends:
  - Systematic temperature (T) increase since late nineteenth century (in particular since 1989).
  - Precipitation (P) changed but no unidirectional tendencies and high geographical variability.
  - Frequency increase of severe weather events.
- Few studies devoted to climate change forecasts in Poland.
- Lack of a platform with easy access to climate change scenarios and climate data:
  - KLIMADA 2.0 project by IOŚ-PIB on-going
- Climate forecasts:
  - Increase in annual average T (in particular, in winter) with increase of Ndays with Tmax>25°C and decrease of Ndays with Tmin<0°C;
  - Changes in P, differing forecasts, generally increase (winter P would increase while summer would decrease), increase in Pmax24h and increase of Ndays with P>10 mm/day and P>20 mm/day;
  - Decrease in Ndays with snow cover and reduction in maximum snow cover;
  - Increased frequency and intensity of wind.
Stage I: Climate change forecasts

Trends and forecasts: some graphs....

Difference in number of days with Tmax > 25°C between 1971-2000 and 2041-2070. Source: KLIMADA.

Trends of number of days with precipitation ≥ 50 mm. Source: KLIMADA.

Incidents (yearly number) of whirlwinds in Poland. Source: IMGW.

Difference in days with P > 10 mm/day (left) and P > 20 mm/day (right) between 1971-2000 and 2041-2070. Source: KLIMADA.

Who are we – The Project – Stage I – Stage II – Stage III – Suggestions
Stage I: Vulnerability assessment

Current vulnerability: initial conclusions

**Vulnerability**

\[ \text{Vulnerability} = \text{Sensitivity} \times \text{Exposure} \]

- **Sensitivity** = Identifying the relevant climate hazards: *interventions of road maintenance service teams, infrastructure damage and/or traffic disruptions*
- **Exposure** = Considering location: *number of registered events and climate data and projections considerations*

Number of registered events and impact levels caused by all weather hazards.

All weather registered events sensitivity levels.

Who are we – The Project – **Stage I** – Stage II – Stage III – Suggestions
Stage I: Vulnerability assessment

Current Vulnerability Assessment: initial results – three main hazards

Who are we – The Project – Stage I – Stage II – Stage III – Suggestions
Stage II

- **Analysis** of survey results, data **validation** and road network **vulnerability** assessment including **climate change projections**

- **Assessment of costs and impacts** of extreme weather events

- **Workshop** of all related stakeholders to identify adaptation responses based on **risks assessment**

- **Build the “business-case”** on national road network adaptation for decision-makers

- **Action Plan** for the recommended **adaptation measures**
Stage II: Costs and impacts assessment

Overview of impacts

- Infrastructure assets
- Infrastructure operations
- User operations

- Others
- Fires
- Heat and high temp
- Low temperatures
- Heavy rain
- Hail
- Heavy snow
- Lighting
- Limited visibility
- Wind
- Flooding

Damage cases by extreme and affected party

Stage II: Costs and impacts assessment

Impacts on road infrastructure

Average cost per type of damage (PLN)

- Slopes damages and landslides: 44,342 PLN
- Drainage system damages: 4,810 PLN
- Pavement and road surface damages: 36,312 PLN
- Bridges and structures damages: 113,300 PLN
- Other damages: 25,660 PLN
- Maintenance cleaning: 3,570 PLN

Based on a sample of 88 events from registers from Katowice, Krakow, Opole, Rzeszow, Warsaw and Wroclaw GDDKiA branch offices. (*) 3 records needed to be excluded from average to avoid distortion.

<table>
<thead>
<tr>
<th>Types of road infrastructure elements</th>
<th>Number of actions</th>
<th>% of all actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slopes damages and landslides</td>
<td>30</td>
<td>35.3%</td>
</tr>
<tr>
<td>Drainage system damages</td>
<td>7</td>
<td>8.2%</td>
</tr>
<tr>
<td>Pavement and road surface damages</td>
<td>9</td>
<td>10.6%</td>
</tr>
<tr>
<td>Bridges and structures damages</td>
<td>5</td>
<td>5.9%</td>
</tr>
<tr>
<td>Other damages</td>
<td>9</td>
<td>10.6%</td>
</tr>
<tr>
<td>Drainage &amp; Pavements</td>
<td>2</td>
<td>2.4%</td>
</tr>
<tr>
<td>Slopes/landslides &amp; Drainage</td>
<td>7</td>
<td>8.2%</td>
</tr>
<tr>
<td>Maintenance cleaning &amp; Other damages</td>
<td>7</td>
<td>8.2%</td>
</tr>
</tbody>
</table>

General average cost of an event with registered damages (based on the sample):

92,000 PLN (*)
(aprox. 20,500 EUR)

Who are we – The Project – Stage I – **Stage II** – Stage III – Suggestions
Stage II: Costs and impacts assessment

The case of 2010 flooding

Number of actions undertaken to repair damages caused by flood in 2010

Average cost per type of damage (PLN)

<table>
<thead>
<tr>
<th>Damage type</th>
<th>Number of actions</th>
<th>% of all actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slopes damages and landslides</td>
<td>11</td>
<td>5.1%</td>
</tr>
<tr>
<td>Drainage system damages</td>
<td>7</td>
<td>3.2%</td>
</tr>
<tr>
<td>Pavement and road surface damages</td>
<td>17</td>
<td>7.9%</td>
</tr>
<tr>
<td>Bridges and structures damages</td>
<td>31</td>
<td>14.4%</td>
</tr>
<tr>
<td>Slopes/landslides &amp; Drainage &amp; Pavements</td>
<td>9</td>
<td>4.2%</td>
</tr>
<tr>
<td>Drainage &amp; Pavements</td>
<td>67</td>
<td>31.0%</td>
</tr>
<tr>
<td>Slopes/landslides &amp; Drainage</td>
<td>12</td>
<td>5.6%</td>
</tr>
<tr>
<td>Slopes/landslides &amp; Pavements</td>
<td>5</td>
<td>2.3%</td>
</tr>
</tbody>
</table>
Stage II: Other impacts

Impacts on road operations: the winter maintenance

![Graph showing average costs and number of snow days](image)

Impacts on users and society

- 66% of all registered events incurred traffic disruptions and only 8.7% caused traffic blocking

<table>
<thead>
<tr>
<th>Weather Factor</th>
<th>Traffic flow disturbance</th>
<th>Total blocking of traffic flow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Up to 1 h</td>
<td>1-12 h</td>
</tr>
<tr>
<td>Strong Wind</td>
<td>18.8%</td>
<td>39.6%</td>
</tr>
<tr>
<td>Heavy Snow</td>
<td>1.5%</td>
<td>43.9%</td>
</tr>
<tr>
<td>Heavy Rain</td>
<td>5.1%</td>
<td>17.1%</td>
</tr>
</tbody>
</table>

- Statistics: number of accidents is higher under most favourable weather conditions

Who are we  –  The Project  –  Stage I  –  **Stage II**  –  Stage III  –  Suggestions
Stage III

- **Analysis** of survey results, data **validation** and road network **vulnerability** assessment including **climate change projections**

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**Who are we** – **The Project** – **Stage I** – **Stage II** – **Stage III** – **Suggestions**
Stage III: Workshops....

Katowice GDDKiA Branch – 15/11/18
Stage III: Workshops….

List oddziaływań na drogi krajowe

Oddziaływania związane z wydłużonym/intensywnym opadem deszczu:
- uszczelnienia dróg (nawierzchni, el. ziemnych i in.) towarzyszące oraz systemowych;
- zwiększony odpływ z przylegających terenów powodujący powodzie;
- powodzie;
- zwiększone niestabilność nachylen i osuwiska;
- zwiększone podmokle dróg, mostów i fundamentów obiektów;
- pogarszanie się stabilności podłoża z powodu podwyższonej wilgości;
- redukcja ograniczeń;
- Częstotliwość przyczepności nawierzchni (silność) – zaburzenia płynności ruchu.

Oddziaływania związane z opadami śniegu:
- zwiększone/zmniejszone zapotrzebowanie na odśnieżanie i utrzymanie zimowe;
- zwiększone ilość topniejącego śniegu prowadzące do powodzi;
- zwiększone ilość zaburzeń płynności ruchu.

Oddziaływania związane z wietrzem i burzami:
- różne zagrożenia: polewanie drzewa, zniszczenia infrastruktury, łatające i spadające przedmioty;
- uszkodzenia zjawisk drogowych, ekranów akustycznych itd.;
- ograniczenia ruchu w odledniącym terenie (np. wysokie pojezdy itd.);
- zwiększone liczba dachowań wywołana wiatrem i burzami;
- zaburzenia płynności ruchu.

Who are we – The Project – Stage I – Stage II – Stage III – Suggestions
Brainstorm on climate vulnerabilities, issues and potential adaptation responses

- Legislation not precise for Road management and Nature conservation to share responsibilities
- Different administrations responsible for adjacent land to road network with different maintenance levels
  
  "A1 motorway accused to cause flooding to adjacent land"
- Current procurement practice (contract award on lowest-price) leading to low-quality designs and low-cost effectiveness solutions....
- .....
Another main project pillar

| Stage 1: Analysis of survey results, data validation and road network vulnerability assessment including climate change projections Sept 2017 |
| Stage 2: Assessment of costs and impacts of extreme weather events |
| Stage 3: Workshop of all related stakeholders to identify adaptation responses based on risks assessment |
| Stage 4: Build the “business-case” on national road network adaptation for decision-makers |
| Stage 5: Action Plan for the recommended adaptation measures Sept 2019 |

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Raising awareness

Knowledge Sharing

International cooperation

Who are we – The Project – Stage I – Stage II – Stage III – Suggestions
Suggestions
Thank you!

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