EARPA Foresight Group Future Mobility of people and goods (FG FMPG)
Annex to the Position Paper
August 2021

As a result of the situation due to COVID-19 and its different impacts on the mobility of people and goods, the FG FMPG shares thoughts on how to deal with the unknown, can also be named as "Black Swan events". Black Swan events are defined as unexpected / surprise events, with large magnitude and consequences, rationalized in hindsight[1]. A first exercise done at the Autumn meeting in October 2020 consisted in the identification of potential Black Swan events and their implications. The second part consists in suggesting needed resilience plans, recommendations, and actions.

In this document, we aim at providing an outline as to where the EARPA members' primary engagement and interest can be channelled and prioritised as the resilience topic as such covers a wide scope.

Potential Black Swans

The results of the brainstorming session on potential Black Swans by the FG FMPG members are shown in the following table, sorted in different clusters.

Cluster	Black Swans
Weakening EU	- Separation of EU (for example Brexit) - Major conflicts within the EU leading to lack of quorum for important decisions
Politics/economics global	- A severe trade war / conflict - Collapse of trade agreements on global level - Handling of primary resource availability - "The End of Growth"
Health-pandemic	- Cities / regions lockdown - Another virus with far reaching consequences - Large scale spread of hazardous substances
Climate/natural hazards (and climate change)	- Heavy weather events like floodings, storms, droughts. - Climate and natural hazards (floods, volcanos, large scale fires etc)
Man-made cause - mobility	- Unexpected hardware failures in large systems (banking, flight control, ...) - Interruption of transport infrastructure on EU main lines for various reasons without sufficient bypass routes - Different standards -> misunderstanding - High dependency on large Data Centres, risk of failures by fire or other destruction - Collapsing bridges - Low product quality due to a combination of low material quality, operator mistakes, tooling wear

[1] The 'black swan events' are discussed by Nassim Nicholas Taleb in his book 'Fooled By Randomness (2001)' to refer to *unpredictable* events. While we acknowledge this nature of these event, for our exercise (and in this report), we use the term to refer to '*risks*', that can potentially be identified with the objective to prevent or mitigate their undesirable consequences.

Man-made cause - non-mobility	- Industrial disaster e.g., nuclear - Degradation of education level - human knowledge transfer from brains to digital clouds, being too complicated and slow to access, leading to incorrect decision making (resilience is based on high and relevant education - Energy supply cut (gas, oil, electricity, etc.)
Conflict/aggression	- Terrorism - Civil war - Cyber warfare - Massive hacking of connected road transport systems or vehicles - General blackout (from accident or terrorism) - Geopolitical events (linked to immigration, etc.)

Black Swan categorisation and EARPA relevance

In order to identify the relevance for EARPA the FG FMPG suggests the following classification of Black Swans as listed in the table above:

Duration:

- Long term trend-break (permanent)
- Short/medium term trend-break (temporal)
- Aggression events

Influence

- External forces
- Area of influence

Mobility or non-mobility related:

- Mobility area
- non-mobility area (anything except the mobility sectors)

In addition to the above, there are additional factors, such as probability and severity that need to be taken into account when events are evaluated and investigated further.

Black Swan examples classified by cause contribution by mobility sector/non-mobility, duration & EU/global

Black Swan classification	**Global**		**EU specific**	
	Mobility	**non-mobility**	**Mobility**	**non-mobility**
Long term trend-break (permanent)	-Climate/natural hazards (climate change)	-Politics/economics global -Health-pandemic -Climate/natural hazards (climate change)	-Climate/natural hazards (climate change)	-Weakening EU -Climate/natural hazards (climate change)
Short/medium term trend-break (temporal)	-Man-made cause mobility	-Health-pandemic -Man-made cause non-mobility -Climate/natural hazards	-Man-made cause - mobility	-Man-made cause - non-mobility -Climate/natural hazards
Aggression events	Conflict/aggression (system design)	Conflict/aggression	Conflict/aggression (system design)	Conflict/aggression

Resilience strategies

The FMPG group suggests setting up a list of actions that could be agreed by the EARPA members. The full list of actions/strategies collected in the brainstorm session can be found in the annex. These resilience strategies could be classified into the following types:

Prepare (Analyst) – knowledge on potential risks, impacts and measures:

- Anticipating policy making (methods and knowledge creation)

Be aware (Observer)– be able to monitor impacts when the unforeseen happens:

- Monitoring & Early warning system

Mitigate (Co-developer) – reduce sensitivity to identified risks:

- Resilient by design
- Redundancy of the system

Note: the aspect of recovery was not discussed at the meeting, could form an additional dimension

In the following table, the actions to be performed by the EU mobility sector are indicated using the same segmentation as used in the previous table. In addition, the following colour scheme is used in this table to indicate the role and degree of relevance for EARPA:

- The **white** cells are of interest for EARPA/automotive sector as **observer** and **analyst** of (potential) impacts for demand and competitiveness
- The **grey** cells are of interest for EARPA/automotive sector as **observer** and **analyst** of (potential) impacts for demand and competitiveness and as **co-developer** for the redesign of the mobility system to reduce Black Swan risks and their impacts.
- The **dark grey** cells are of increased interest for EARPA/automotive sector as **analyst** of (potential) impacts for demand and competitiveness and as **co-developer** for the redesign of the mobility system to reduce Black Swan risks and their impacts.

Resilience strategies for the EU mobility sector by segment

resilience solution	External forces (for EU)		Area of influence (for EU)	
	Mobility	non-mobility	Mobility	non-mobility
Long term trend-break (permanent)	prepare be aware	prepare be aware	prepare be aware mitigate	prepare be aware
Short/medium term trend-break (temporal)	prepare be aware	prepare be aware	prepare be aware mitigate	prepare be aware
Aggression events	prepare	prepare	prepare mitigate	prepare

From the list of collected examples in the annex, the following actions/strategies can be derived with high relevance for EARPA:

Prepare:

- Making the EU more resilient also calls for integrating research partners from across Europe more and more. EARPA should extend our network member base to the "new" EU13 and strive to foster the balance between participating countries in proposals and projects. The better the entire EU stands together and learns to work together, the more resilient it becomes.

- More eco-systems should be considered, rather than "ego-systems". There is a need to re-balance individual and common interests. For instance, all (including automotive) supply chains rely heavily upon supply and transportation both between continents and within the same. With a larger emphasis on collaboration and ecosystems, the possibilities to redirect resources such as transport units and vehicles, and support both society, industrial partners, and individuals increase.

Be aware:

- Specific KPIs could be created to assess the resilience and flexibility levels of systems by design, e.g. potential weaknesses pre-identified and number/kind of redundancy measures implemented depending on their impact, etc.

Mitigate:

- Circular economy and 10R strategies (Refuse, Rethink, Reduce etc.) become more important.
- Reduce ownership of goods,
- Don't rely only on technology to address the challenges; also consider education, human aspects, change of habits.

Conclusion

This appendix to the EARPA Future Mobility for People and Goods position paper outlines a structure for the EARPA members in order to be more prepared, and make our society more prepared, for future shocks. Although triggered and initiated by the Covid crisis, we strongly believe that the methodology is generic and applicable to different types of future interruptions of the society and the mobility system.

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Annex – detailed examples

Prepare - Anticipating policy making - increasing awareness and knowledge on risks and solutions

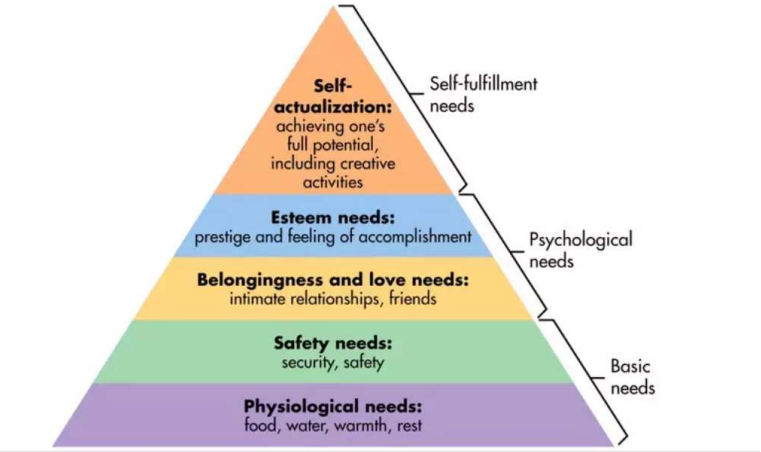

Figure 1: Maslow's Hierarchy of Needs

- An energy hierarchy of needs, akin to Maslow (see above). Where does Mobility come in this pyramid, e.g. above or below the energy we need to maintain our knowledge?
- More eco-systems should be considered, rather than "ego-systems". There is the need to re-balance individual and common interests.
- EARPA could further consider uncertainty in future decisions and promote this concept amongst the PPPs and other organisations. A useful reference is Kay & King "Radical uncertainty: Decision making for an uncertain future" which was written using lessons learned from the financial crisis.
- When dealing with unknown unknows, a better preparation is needed to handle disruptions after they have occurred. Disruptions need to be detected as early as possible, for further analysis, prediction and action. This vision is linked to the Digital transformation in the Position paper.
- Consider how to deal with partial closing of borders (of cities, regions or countries) in the road transport sector. Plans and strategies are already being discussed in different contexts and EARPA could support such discussions with research.
- The real complexity of mobility needs to be faced (in contrast to today's attempts of often solving mobility challenges on local, urban levels). EARPA can contribute by co-developing the tools which are needed to evaluate the holistic consequences of any measure in providing scientific basis for political decision making.
- Making the EU more resilient also calls for integrating research partners from across. EARPA should continue to extend its member base to the "new" EU13 and strive to foster the balance between participating countries in proposals and projects. The better the entire EU stands together and learns to work together, the more resilient it becomes.
- Ensure that new mobility solutions (e.g., light vehicle/scooter) encourage shifting away from using / owning an own car rather than shifting active movers (walking, cycling) to "passive" transport modes.

Be aware - Monitoring & Early warning system

- Adopt analytical and digital tools to assess risks, early warning systems and tools to simulate and model solutions, etc.
- Create resilience dashboards and indicators to be monitored.

- Specific KPIs could be created to assess the resilience and flexibility levels of systems by design, e.g. potential weaknesses pre-identified and number/kind of redundancy measures implemented depending on their impact, etc.

Mitigate - Resilience by design - Reduce dependency

- Black swans might make it difficult for the EU to gather raw material. In order to rely less on the raw materials from non-EU countries, efficiency in operations, sustainability and concepts like circular economy become more important.
- Technologies need to be designed to be more robust in a sense that they are simpler to adopt and kept circular. Example: materials (plastics, metals) that are more/fully recyclable and do not require processing chains as profound as they are now.
- Reduce ownership of goods and explore business models (e.g., car sharing, subscription) that rely and built upon the development of ecosystems (leaving the ownership with the producer who can more efficiently operate and maintain quality of the product, reuse materials as much as possible, reduces the use of raw materials, etc.).
- Avoid too much dependency on technologies, electricity, internet, energy etc. and consider alternatives or redundant systems
- Don't rely only on technology to address the challenges; consider also societal aspects as education, change of habits or human intrinsic motivation.
- Reconfigure global supply chains; use more local (European) based industrial partnerships.
- Redesign workplaces (e.g., teleworking), adapt workforce, train, get more flexible, etc.
- Consider infrastructure investments where needed; seek for smart options where existing capabilities can be (re)used and integrated.
- Seek for opportunities to adopt use cases, solutions, business models that have been successful in other cities or regions.

Mitigate - Resilience by design - Redundancy within systems

- Keep the know-how related to older or simpler technologies.
- Resilience could be created by adding slack resources, additional options, better planning, etc.
- Technology needs to develop to become even more efficient. However, systems may need to operate at less than 100% efficiency to increase resilience.