Preparation of broadband projects

The analytical framework

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Michael Schaller

JASPERS-REGIO CBA Forum meeting on Broadband
Brussels, 15 May 2019
Structure of the presentation

• I JASPERS: Who are we?
• II JASPERS Smart Development Division (SDD)
• III JASPERS Assistance to Major Projects – Broadband
  • Demand, option, institutional, technical analyses
  • Financial, economic and risk analyses

Note: data shown in this presentation is for illustrative purpose, it is not project specific
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Partners and governance

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
- Supervised by a Steering Committee composed by representatives of the EIB and the EC
- Coordinated with EC and beneficiary countries through periodic tri-partite meetings and an annual stakeholders’ meeting
JASPERS areas of activity

**Project preparation Advisory**
- Project advisory in EU20+ IPA
- Expansion to other EU MS based on demand
- Focus on Major projects and sectoral issues
- Non-major projects on strategic sectors (e.g. innovation)

**Independent Quality Review**
- Independent expert appraisal of cohesion-funded
- Major projects as envisaged by EU Regulations and relevant Implementing Acts (Art. 102 (1), (2) CPR)

**Capacity building and cross-sectoral issues**
- All EU28 and IPA
- Multi-country capacity building (Networking Platform)
- In-country capacity building and training
- Advisory on cross-sectoral topics (e.g. Environment, State Aid, Climate, CBA)
JASPERS sectors

1. Energy and Solid Waste Division

2. Rail, Air and Maritime Division

3. Roads Division

4. Smart Development Division (incl. RDI)

5. Water and Wastewater Division

6. JASPERS Networking and Competence Center – Capacity Building, Knowledge Sharing and Advisory on Horizontal Issues (i.e. State aid, climate change, PPPs, CBA, EIA, etc.)
Services

Comprehensive support to projects

Support for strategic planning and to solve sectorial issues

Key activities:

- Upstream involvement – from project inception to MPA approval
- Hands-on approach – regular interaction with the MA and beneficiary
- Proximity to beneficiaries – to facilitate efficient and effective cooperation
Impact

Sources of value added

• Contributions to sector strategy / planning
• Contributions to overcome pit-falls (state aid, environmental, compliance with EC directives and guidelines etc.)
• Cost savings in projects (optimal dimensioning/ options analysis)
• Faster approval through improvement of project documents (*)
• Improvement of project quality: higher expected project benefits
• Increased capacity of counterparts

(*) During the 2007-2014 period, projects supported by JASPERS were approved by the EC four month faster, on average, than projects not supported by JASPERS

650 JASPERS-supported projects approved since 2007

For a total project cost of above EUR 120 bn

And EU grant volume EUR 68 bn
Impact (2)

Countries with JASPERS activity
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Smart Development Division (SSD)

- **12 experts** (engineers, economists, environmental expert) in the following areas:
  - Research, Development, Innovation,
  - **Information and Communication Technology (ICT),**
  - Health and Education, Urban Development
  - Integrated or multi-sectoral projects (SMART CITIES and others)
- In the current programming period has provided support to **8 major broadband projects:**
  - France (Bretagne, Martinique, La Reunion)
  - Ireland
  - Italy
  - Greece
  - Slovakia
  - Croatia
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7 steps of project preparation

1. Presentation of the socio-economic, institutional and political context

2. Definition of objectives

3. Project identification

4. Technical feasibility & Environmental sustainability

5. Financial analysis

6. Economic analysis

7. Risk assessment
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Presentation of BB project context

- The existing situation of ICT maturity in the country, compared with EU average
  - Socio-economic factors (GDP, affordability)
  - IT-literacy, use of digital services (including e-Government services)
- Political drivers (national broadband plans and digitalisation strategies)
- Connection with the EU objectives (incl. Digital Agenda, Gigabit-society)
- Market structure and competition
- Market failure requiring public intervention
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Objectives

• Objectives set based on potential market interest (confirmed in public consultation)

• … and in line with policy objectives:
  • compliance with the EU and national strategies and policy documents
  • Included in the Operational Programmes (priority axis, budget and indicators)

• Defined in relation to other initiatives (e-Government, Education, Research etc.)

• Clear quantification with a system of results indicators, including baseline and targets (coverage, penetration, services to provide)
7 steps of project preparation

1. Presentation of the socio-economic, institutional and political context

2. Definition of objectives

3. Project identification
   • Project activities
   • Body responsible for project implementation
   • Who has standing

4. Technical feasibility & Environmental sustainability

5. Financial analysis

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7. Risk assessment
Project identification

- What is the target for intervention (areas of digital divide)?
  - Rural vs. Urban
  - White vs. grey NGN areas
- Who (which user group(s)) is targeted by the project?
  - General public, Public institutions, Businesses
- Who manages and implements the project Institutional set-up (during, implementation, operation)?
- Who implements the project
  - Where do actors intervene (type of services to provide)
  - Business model (Public/Private DBO, concession, bottom-up)
- How is the project organized?
  - Geographical split, Procurement lots, Technical considerations
7 steps of project preparation

1. Presentation of the socio-economic, institutional and political context

2. Definition of objectives

3. Project identification

4. Technical feasibility & Environmental sustainability
   - Demand analysis
   - Option analysis
   - Technical design, cost estimates and implementation schedule
   - Environmental considerations, including EIA and climate change

5. Financial analysis

6. Economic analysis

7. Risk assessment
Demand

• Defines interest in the project results
• Start with current demand situation (numbers)
  • Coverage of different services (fixed, mobile, NGA)
  • Penetration/uptake (households, public institutions, companies)
  • Regional differences (urban vs rural)
• Main market players (wholesale and retail level) and their market shares
• Existing broadband offerings: capacity and price levels
• Followed by estimation of future demand estimation (penetration)
  • Public consultations, mapping, operator investment plans
  • Statistical evidence of broadband adoption in the country
  • New services and technologies that can trigger demand
  • Affordability and realistic pricing strategies
• Future demand estimations drives scope (budget and technologies)
Option analysis

• Selection of the best option through analysis of all realistic options at the (1) strategic and (2) technological level.

• Two-step approach recommended:
  1. Comparison of strategic project options. Normally based on MCA, using e.g. no-project scenario, business as usual, different institutional or business models, location etc.

    Leads to the best option and a list of feasible technological alternatives best suited to meet the identified objectives of the project.

  2. Comparison of the short-listed technological alternatives, preferably including quantitative methods (least cost (OPEX and CAPEX), ENPV).
Technical aspects

• Chosen technology option result from the option analysis (fiber dominates)
• Technology neutrality applies. All technologies meeting objectives should qualify.
• Indicative network map should be modelled and described, based on knowledge of existing infrastructure and identified gap (at the level of backhaul, access and last mile).
• CAPEX should be estimated
  • Based on quantified analysis of equipment/civil works needs
  • Comparison with recently procured projects in the same sector/country (benchmarking), e.g. cost per home passed.
• OPEX should be estimated
  • Benchmarking exercises, in particular for staff and asset maintenance requirements
• Reinvestment cost should be estimated
  • Periodic asset replacement need (normally active equipment)
Implementation aspects

- Realistic? If implementation could go beyond 2023, consider phasing
- Important with timely ex-ante activities:
  - Clear roles and responsibilities (Beneficiary, MA, regulator..)
  - Mapping, public consultations, operator interest
  - State aid and Environmental clearance
  - Establish strong and well defined PIU and management structure
  - Procurement preparation
- State aid approval will take time. EC approval will take time. Procurement will take time.
- Well defined penalties clauses necessary in case of delays are important
- Well defined and realistic roll-out plan needed. Delays will occur (technical, permits etc.). Allow for unexpected delays.
- Strong contract management team to avoid implementation delays
- Delays often due to political interference, or unclear institutional set-up and governance. Technology standard and rarely cause for delays
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5. Financial analysis
   - Assess project’s profitability
   - Verify financial sustainability
   - Outline the cashflows which underpin the calculation of socio-economic costs and benefits.

6. Economic analysis

7. Risk assessment
JASPERS CBA model for Broadband

• CBA model for broadband first published in 2013 on JASPERS website and included in the EC CBA Guide
  • Need for consistency in the use of CBAs
  • The model was applied in JASPERS supported projects

• Rationale for revision:
  • Regulatory context of the 2014–20 perspective
  • New policy initiatives, i.e. increased focus on ultrafast and Gigabit broadband
  • Shift in the projects’ scope from backhaul to access networks
  • New studies on economic outcomes
  • Change in the geographic scope of JASPERS supported countries (previously mostly CEE)
  • Lessons learnt from the application of the 2013 CBA model
  • Includes also the financial section
Financial analysis: methodology
Reference period and residual value

- Annex I of the EC Delegated Regulation 480/2014 provides reference period ranges
- If the useful lifetime exceeds the reference period, a **residual value** should be computed
- It should be based on the **net present value of cash flows in the remaining life years of the operation**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Reference period (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Railways</td>
<td>30</td>
</tr>
<tr>
<td>Roads</td>
<td>25-30</td>
</tr>
<tr>
<td>Ports and airports</td>
<td>25</td>
</tr>
<tr>
<td>Urban transport</td>
<td>25-30</td>
</tr>
<tr>
<td>Water supply/sanitation</td>
<td>30</td>
</tr>
<tr>
<td>Waste management</td>
<td>25-30</td>
</tr>
<tr>
<td>Energy</td>
<td>15-25</td>
</tr>
<tr>
<td><strong>Broadband</strong></td>
<td><strong>15-20</strong></td>
</tr>
<tr>
<td>Research and Innovation</td>
<td>15-25</td>
</tr>
<tr>
<td>Business infrastructure</td>
<td>10-15</td>
</tr>
<tr>
<td>Other sectors</td>
<td>10-15</td>
</tr>
</tbody>
</table>

- Use of residual value: the reference period is aligned with useful lifetime (as cash flows generated beyond the reference period are incorporated into the analysis)
- Practically, the same approach can be applied in case of **business contracts** with private partners exceeding the maximum reference period.
Financial analysis: analysis of profitability

Financial analysis should be based on incremental cash-flows b/w the “with-” and “without-project” (“counterfactual”). In case of broadband projects: often this would mean no investment.

Analysis for different ownership and operating models:
- Consolidated cashflows
- Owner cashflows
- Operator cashflows

<table>
<thead>
<tr>
<th>Business model switch</th>
<th>FNPV(C)</th>
<th>SUSTAINABILITY</th>
<th>FNPV(K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start-up and technical costs</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Land</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Buildings</td>
<td>-</td>
<td>-</td>
<td></td>
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<tr>
<td>Equipment</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Machinery</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Replacement costs</td>
<td>-</td>
<td>-</td>
<td>-*</td>
</tr>
<tr>
<td>Residual value</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Operating costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personnel</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>General expenditure</td>
<td>-</td>
<td>-</td>
<td></td>
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<tr>
<td>Intermediate services</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Raw materials</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Other outflows</td>
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<tr>
<td>Loan repayments</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Interests</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Taxes</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Inflows</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenues</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Operating subsidies</td>
<td>+</td>
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<td></td>
</tr>
<tr>
<td>Sources of financing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Union assistance</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public contribution</td>
<td>-</td>
<td>-</td>
<td>-*</td>
</tr>
<tr>
<td>Private equity</td>
<td>+</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Private loan</td>
<td>+</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Only if they are self-financed by the project revenues. Otherwise, if new sources of financing (either equity or debt) are needed to sustain them, these sources must be displayed within the outflows at the time they are disbursed.

** Operating subsidies shall not be accounted in order to avoid double counting with the operating costs outflow.
Financial analysis and state aid rules

• After Omnibus regulation, article 61 does not apply to projects subject to state aid
  • these projects are exempted from the need to calculate the maximum EU grant based on the pro-rata application of discounted net revenue …
  • … but there is no basis either which would prevent the Member States from using this approach

• For major projects, still necessary to calculate financial profitability indicators – in this case, the mechanism of profitability indicator is rather an ex-post verification.
## Financial analysis: Return on capital

### CONSOLIDATED (OPERATOR + OWNER) (All national sources)

**Cashflow projections (constant 2019 prices)**

<table>
<thead>
<tr>
<th>Project expenditures and revenues</th>
<th>Unit</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital expenditure</td>
<td>EUR</td>
<td>7,700,000</td>
<td>25,300,000</td>
<td>30,900,000</td>
<td>18,000,000</td>
</tr>
<tr>
<td>Operational expenditure</td>
<td>EUR</td>
<td>0</td>
<td>694,375</td>
<td>3,185,417</td>
<td>6,475,000</td>
</tr>
<tr>
<td>Revenue</td>
<td>EUR</td>
<td>0</td>
<td>2,016,000</td>
<td>4,262,400</td>
<td>8,640,000</td>
</tr>
<tr>
<td>Residual value</td>
<td>EUR</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Replacement costs</td>
<td>EUR</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Net project cashflow without project</strong></td>
<td>EUR</td>
<td>-7,700,000</td>
<td>-23,978,375</td>
<td>-29,823,017</td>
<td>-15,835,000</td>
</tr>
</tbody>
</table>

- **FNPV(C)** EUR -6,564,803
- **FRR(C)** % 3.0%

### Notes:

- For public investment projects Article 19 of Regulation 480/2014 recommends FDR of 4.0%

- However, Article 19 also allows in justified cases for an alternative FDR to be used on the grounds of the nature of the investor or sector concerned, amongst other reasons.

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## Financial analysis: Return on investment

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<th>Cashflow projections (constant 2019 prices)</th>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>-29,823,017</td>
<td>-15,835,000</td>
<td>2,242,500</td>
</tr>
<tr>
<td>Interest payments</td>
<td>EUR</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>632,531</td>
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<tr>
<td>Principal repayments</td>
<td>EUR</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1,405,625</td>
</tr>
<tr>
<td>Loan fees</td>
<td>EUR</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Public contribution</td>
<td>EUR</td>
<td>4,290,000</td>
<td>13,310,000</td>
<td>16,130,000</td>
<td>9,300,000</td>
<td>0</td>
</tr>
<tr>
<td>Private contribution</td>
<td>EUR</td>
<td>770,000</td>
<td>2,530,000</td>
<td>3,090,000</td>
<td>1,800,000</td>
<td>0</td>
</tr>
<tr>
<td>Net project cashflow considering financial</td>
<td>EUR</td>
<td>-5,060,000</td>
<td>-14,518,375</td>
<td>-18,143,017</td>
<td>-8,935,000</td>
<td>204,344</td>
</tr>
</tbody>
</table>

| FNPV(K) | EUR     | 3,695,841 |
| FRR(K)  | %       | 4.8%      |

- Recommended to also present estimations of operator’s financial profitability to demonstrate its business case
  - Not mandatory if “private partner is chosen in a fair, transparent and open competitive procedure assuring the best value for money”(Annex III, point 2.2.3. of the Implementing Regulation (EU) 2015/207)
- Clawback mechanism is in place to avoid overcompensation

- In case of the public owner – often not meaningful (subject to budgetary balance)

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Financial analysis: Sustainability

<table>
<thead>
<tr>
<th>Financial sustainability</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sources of financing</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
</tr>
<tr>
<td>Public</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
</tr>
<tr>
<td>ERDF grant</td>
<td>2,310,000</td>
<td>7,590,000</td>
<td>9,270,000</td>
<td>5,400,000</td>
<td>0</td>
</tr>
<tr>
<td>EIB loan</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other public contribution</td>
<td>4,290,000</td>
<td>13,310,000</td>
<td>16,130,000</td>
<td>9,300,000</td>
<td>0</td>
</tr>
<tr>
<td>Private</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
</tr>
<tr>
<td>Private equity</td>
<td>770,000</td>
<td>2,530,000</td>
<td>3,090,000</td>
<td>1,800,000</td>
<td>0</td>
</tr>
<tr>
<td>Private loan</td>
<td>1,870,000</td>
<td>6,930,000</td>
<td>8,590,000</td>
<td>5,100,000</td>
<td>0</td>
</tr>
<tr>
<td>Total revenues</td>
<td>9,240,000</td>
<td>32,376,000</td>
<td>41,342,400</td>
<td>30,240,000</td>
<td>11,160,000</td>
</tr>
<tr>
<td>Initial investment</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
</tr>
<tr>
<td>Replacement costs</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Loan repayment (including interest)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total operating costs</td>
<td>EUR</td>
<td>694,375</td>
<td>3,185,417</td>
<td>6,475,000</td>
<td>8,917,500</td>
</tr>
<tr>
<td>Total outflows</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
</tr>
<tr>
<td>Net cash flow</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
</tr>
<tr>
<td>Cumulated net case flow</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
<td>EUR</td>
</tr>
</tbody>
</table>

Need to demonstrate:

- Financial sustainability of the operation
  - How the sources of financing (internal and external) will match disbursements
- Financial capacity of the beneficiary / operator
  - Share of the region’s budget (incorporation into the financial plans)
  - Financial ratings

Note: data is for illustrative purpose, not project specific
7 steps of project preparation

1. Presentation of the socio-economic, institutional and political context

2. Definition of objectives

3. Project identification

4. Technical feasibility & Environmental sustainability

5. Financial analysis

6. Economic analysis
   - Economic benefits
   - Economic profitability

7. Risk assessment
Economic analysis: scope of the model

- The model is linked to **infrastructure investments** (improving connectivity)
- Projects linked to **connectivity to schools, eGovernment or eHealth services** require sector- and **project-specific analysis**
- The model is a “living document” with recommendations.
- Flexibility to use **alternative types of benefits** or **modify** parameters (the methodology and assumptions used need to be explained; and in line with the EU regulations/guide)
- Simplicity.

<table>
<thead>
<tr>
<th>Quantitative</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumers</td>
<td>e-education</td>
</tr>
<tr>
<td>Business</td>
<td>Environment:</td>
</tr>
<tr>
<td></td>
<td>e-health</td>
</tr>
<tr>
<td></td>
<td>e-government</td>
</tr>
<tr>
<td></td>
<td>Social inclusion</td>
</tr>
<tr>
<td></td>
<td>Farming</td>
</tr>
</tbody>
</table>
Economic analysis: Household benefits

- Building a generic model for Broadband across EU countries is a challenge:
  - Estimates range across time, place, currency and scope
  - Applications continue to improve (e.g. smart home applications) likely to result in higher household benefits…
  - … but some can be achieved with basic broadband already

<table>
<thead>
<tr>
<th>Study</th>
<th>Consumer surplus estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EC average savings per household from buying cross-border online (2011)</strong></td>
<td>EUR745 per household per year or EUR62 per household per month (note excludes wider benefits from connectivity)</td>
</tr>
<tr>
<td><strong>UK benefits per household (SQW 2008)</strong></td>
<td>GBP23 (~EUR26) for poorest 10% of households to GBP148 (~EUR170) for richest 10% per household per month</td>
</tr>
<tr>
<td><strong>Impact on house prices of higher connection speeds (Ahlfeldt, et al, 2017)</strong></td>
<td>3% rise in property prices with a doubling in speed, tailing off as speeds rise. Implies consumer surplus per household of around GBP70 (~EUR80) per month with fibre connection</td>
</tr>
<tr>
<td><strong>NBER (Nevo) demand for Residential Broadband (2015)</strong></td>
<td>~USD85–114 (EUR74–100) per household per month for NGA, rising to USD175–279 (EUR153–244) for fibre connections (includes some business / work related benefit)</td>
</tr>
<tr>
<td><strong>KPMG – Delivering Britain’s Digital Future (2015)</strong></td>
<td>EUR38 for 8Mbit/s, EUR45 for 50Mbit/s and EUR50 for 100Mbit/s per household per month (this implies an incremental consumer surplus from basic to superfast is EUR7 and from superfast to ultrafast is EUR5)</td>
</tr>
<tr>
<td><strong>Huawei Study (Draca) on Fibre (2018)</strong></td>
<td>Total ‘consumer’ surplus – including business users – as high as 12-15% of total GDP</td>
</tr>
<tr>
<td><strong>DCMS (UK) Superfast Evaluation (2018)</strong></td>
<td>Increase in the sense of ‘well-being’ (which is here analogous to consumer surplus) is ~GBP19 (EUR22) per household per month in moving from basic broadband to NGA broadband</td>
</tr>
</tbody>
</table>
Economic analysis: Business employees benefits

- Broadband is a necessity: evidence, but also conflicting studies:
  - ‘No impact’ studies were discounted
- Impact on productivity b/w 3% and 10% but after prolonged period
- Addition assumed for teleworking benefits
- Other areas of benefit (e.g. innovation,) could be added

<table>
<thead>
<tr>
<th>Study</th>
<th>Productivity estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC (2008)</td>
<td>A constant increase in e-business adoption at 3% per year (2006 rates) yields an annual productivity improvement of 0.25% per year at the macro-economic level</td>
</tr>
<tr>
<td>Frontier Economics (2011) for European firms</td>
<td>Every 1% increase in telecoms capital stock is associated with a 0.05% to 0.06% increase in productivity</td>
</tr>
<tr>
<td>Grimes et al.: New Zealand (2011)</td>
<td>A productivity effect of broadband (relative to no broadband) of approximately 7% to 10% across all firms</td>
</tr>
<tr>
<td>Deutsche Telecom: Germany (2011, 2013)</td>
<td>The effects of broadband adoption vary between firms, and more extensive data might be needed to observe the long-run benefits of broadband usage</td>
</tr>
<tr>
<td>Haller et al.: Ireland (2015)</td>
<td>Neither productivity nor productivity growth is significantly affected by broadband adoption</td>
</tr>
</tbody>
</table>

**Business benefit per employee – productivity rise**

- For Superfast: business benefit per employee, rising at 0.6% (incremental) per year, is projected to reach 5% after 9 years and then stabilise
- For Ultrafast: business benefit per employee is projected to reach 6% after 9 years, rising with a steady profile of 0.7% (incremental) per year
- For Superfast to Ultrafast: the benefit will be the difference between the two, i.e. 1% after 9 years
### Economic analysis: ENPV and ERR calculations

#### Social Discount Rate benchmark for 2014 – 2020 in real terms
- 5% for Cohesion countries,
- 3% for non-Cohesion countries

#### Capital expenditure
- EUR: 7,700,000, 25,300,000, 30,900,000, 18,000,000, 0, 0

#### Operational expenditure
- EUR: 0, 694,375, 3,185,417, 6,475,000, 8,917,500, 7,551,558

#### Residual value
- EUR: 0, 0, 0, 0, 0, 0

#### Replacement costs
- EUR: 0, 0, 0, 0, 0, 0

#### Undiscounted socio-economic benefits

<table>
<thead>
<tr>
<th>Unit</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business employee benefits</td>
<td>EUR</td>
<td>0</td>
<td>600,000</td>
<td>1,584,000</td>
<td>4,080,000</td>
<td>7,200,000</td>
</tr>
<tr>
<td>Household consumer surplus</td>
<td>EUR</td>
<td>0</td>
<td>662,400</td>
<td>1,440,000</td>
<td>2,664,000</td>
<td>3,672,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>EUR</td>
<td>0</td>
<td>1,262,400</td>
<td>3,024,000</td>
<td>6,744,000</td>
<td>10,872,000</td>
</tr>
</tbody>
</table>

#### Total undiscounted socio-economic benefits
- EUR: 7,700,000, 25,994,375, 34,085,417, 24,475,000, 8,917,500, 7,551,558

#### Net undiscounted socio-economic benefits
- EUR: -7,700,000, -24,731,975, -31,061,417, -17,731,000, 1,954,500, 5,264,442

#### ENPV
- EUR: 127,473,118

#### ERR
- %: 12.6%

#### B/C ratio
- #: 1.51
7 steps of project preparation

1. Presentation of the socio-economic, institutional and political context
2. Definition of objectives
3. Project identification
4. Technical feasibility & Environmental sustainability
5. Financial analysis
6. Economic analysis
7. Risk assessment
   - Sensitivity analysis
   - Qualitative risk analysis
   - Probabilistic risk analysis
Sensitivity analysis

• Variables are changed one at a time to assess the impact on NPV:
  • Identify critical variables (NPV elasticity > 1) and to calculate “switching values” (% change in variable to make NPV switch sign)

• Scenario analysis: simultaneous changes in different variables

**E.3.2 Sensitivity analysis - variables tested**

<table>
<thead>
<tr>
<th>Variable tested</th>
<th>Financial net present value (FNPV/K) variation</th>
<th>Financial net present value (FNPV/C) variation</th>
<th>Economic rate of return (ERR) variation</th>
<th>Economic net present value (ENPV) variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Capital expenditure with 1% increase</td>
<td>-1.3%</td>
<td>-11.2%</td>
<td>-0.1%</td>
<td>-0.6%</td>
</tr>
<tr>
<td>2 Capital expenditure with 1% decrease</td>
<td>1.3%</td>
<td>11.2%</td>
<td>0.1%</td>
<td>0.6%</td>
</tr>
<tr>
<td>3 Operational expenditure with 1% increase</td>
<td>-39.7%</td>
<td>-22.3%</td>
<td>-0.1%</td>
<td>-1.3%</td>
</tr>
<tr>
<td>4 Operational expenditure with 1% decrease</td>
<td>39.7%</td>
<td>22.3%</td>
<td>0.1%</td>
<td>1.3%</td>
</tr>
<tr>
<td>5 Revenues with 1% change</td>
<td>59.8%</td>
<td>33.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Revenues with -1% change</td>
<td>-59.8%</td>
<td>-33.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Benefits with 1% change</td>
<td>-0.2%</td>
<td>0.2%</td>
<td>3.0%</td>
<td></td>
</tr>
<tr>
<td>8 Benefits with -1% change</td>
<td>-0.2%</td>
<td>-0.2%</td>
<td>-3.0%</td>
<td></td>
</tr>
<tr>
<td>9 Business employee benefits with 1% increase</td>
<td>0.2%</td>
<td>0.2%</td>
<td>2.3%</td>
<td></td>
</tr>
<tr>
<td>10 Business employee benefits with 1% decrease</td>
<td>-0.2%</td>
<td>-0.2%</td>
<td>-2.3%</td>
<td></td>
</tr>
<tr>
<td>11 Household consumer surplus with 1% increase</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0.7%</td>
<td></td>
</tr>
<tr>
<td>12 Household consumer surplus with 1% decrease</td>
<td>-0.1%</td>
<td>-0.1%</td>
<td>-0.7%</td>
<td></td>
</tr>
</tbody>
</table>

**E.3.2 Sensitivity analysis - switching values for critical variables**

<table>
<thead>
<tr>
<th>Critical variable</th>
<th>Switching value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Benefits</td>
<td>Maximum change before ENPV turns zero (%)</td>
</tr>
<tr>
<td>2 Capital expenditure</td>
<td>Maximum change before ENPV turns zero (%)</td>
</tr>
<tr>
<td>3 Operational expenditure</td>
<td>Maximum change before ENPV turns zero (%)</td>
</tr>
<tr>
<td>4 Capital expenditure</td>
<td>Maximum change before FNPV/K turns zero (%)</td>
</tr>
<tr>
<td>5 Operational expenditure</td>
<td>Maximum change before FNPV/K turns zero (%)</td>
</tr>
<tr>
<td>6 Revenues</td>
<td>Maximum change before FNPV/K turns zero (%)</td>
</tr>
</tbody>
</table>

* - Critical variables are those for which a change of 1% in value results in a change of at least 1% in FNPV/K or ENPV
Risk analysis and Risk Matrix

Qualitative risk analysis:

Risk Matrix

Probability × Severity = Residual Risk level

Prevention + Mitigation

Evaluation scale:
Probability: A. Very Unlikely; B. Unlikely; C. About as likely as not; D. Likely; E. Very likely
Severity: I. No effect; II. Minor; III. Moderate; IV. Critical; V. Catastrophic
Risk level: Low; Moderate; High; Unacceptable
Risk categories

- All mandatory risks (Table 2 of Annex III of Implementing Regulation (EU) 2015/207) should be assessed...

- ...but there is need to assess all relevant project risks

- Template provided in the ‘Qualitative risk’ worksheet

<table>
<thead>
<tr>
<th>Context and regulatory risks:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Change of orientation of the strategic policy</td>
</tr>
<tr>
<td>(ii) Change in expected behaviour of future private investors</td>
</tr>
<tr>
<td>(iii) Change in regulations in the retail market</td>
</tr>
<tr>
<td>(iv) Unsuccessful State-aid application</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Demand risks:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(v) Lower than estimated service take-up from retail- and/or wholesale providers</td>
</tr>
<tr>
<td>(vi) Low investments in 'last mile' network by service providers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design risks:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(vii) Inadequate design cost estimates</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Administrative and procurement risks:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(viii) Delays in project procurement</td>
</tr>
<tr>
<td>(ix) Risk of not obtaining required property rights</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operational and financial risks:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(x) Increase in operational cost</td>
</tr>
<tr>
<td>(xi) Insufficient committed funding on a national/regional level during the operational phase</td>
</tr>
<tr>
<td>(xii) Loss of key personnel during project operation</td>
</tr>
</tbody>
</table>
Quantitative risk analysis

- A probabilistic risk analysis for cases with significant residual risks

### Assumptions - Triangular Probability Distributions

<table>
<thead>
<tr>
<th></th>
<th>mEUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base-case ENPV</td>
<td>127.5</td>
</tr>
<tr>
<td>Variables</td>
<td></td>
</tr>
<tr>
<td>Investment</td>
<td>mEUR</td>
</tr>
<tr>
<td>Base-case (Present Value)</td>
<td>86.7</td>
</tr>
<tr>
<td>Minimum</td>
<td>%</td>
</tr>
<tr>
<td>Most Likely (Mode)</td>
<td>%</td>
</tr>
<tr>
<td>Maximum</td>
<td>%</td>
</tr>
<tr>
<td>Number of iterations</td>
<td>#</td>
</tr>
</tbody>
</table>

### Results of Monte Carlo Simulation - ENPV

<table>
<thead>
<tr>
<th></th>
<th>mEUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (Expected ENPV)</td>
<td>94.13</td>
</tr>
<tr>
<td>Median</td>
<td>102.02</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>50.42</td>
</tr>
<tr>
<td>Minimum</td>
<td>mEUR</td>
</tr>
<tr>
<td>Maximum</td>
<td>mEUR</td>
</tr>
<tr>
<td>Prob. {ENPV&gt;0}</td>
<td>%</td>
</tr>
</tbody>
</table>

![ENPV probability distribution](image)

![ENPV cumulative probability distribution](image)
Thank you

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j.knast@eib.org
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More Information

For info or further questions on this seminar and the activities of the JASPERS Networking Platform, please contact the JASPERS Networking and Competence Centre at the following email:

jaspersnetwork@eib.org

JASPERS Networking Platform: www.jaspersnetwork.org

JASPERS Website: jaspers.eib.org
1- Services

1. Support for the preparation of sector strategies and Master Plans
2. Support to project screening and prioritisation to maximise effectiveness of available funds in a sector
3. Support to project preparation through methodological advice and review and comments on intermediate and final project document
   - Capacity building through hand-on approach during project preparation support, dedicated training events, train-the-trainers workshop, and working papers
4. Integrated support in cross-sector projects (e.g. urban development projects in the context of the Smart Cities concept)
5. Support to the preparation of programmes and schemes (e.g. calls for proposals for non-Major projects, energy efficiency schemes)
6. Support for the definition and standardisation of project approval criteria and clarification of issues arising during the approval process
7. Support for the removal of bottlenecks to realise projects (e.g. advice on State-aid)
8. General methodological guidance (e.g. on cost-benefit analysis, climate change adaptation)
9. Appraisal of projects to ensure their soundness, quality, and compliance with relevant regulations (e.g. Independent Quality Review to facilitate approval)
10. Support to project implementation through advice on procurement strategies, draft tender documents and establishment of Projects Implementation Units
11. Preparation of technical assessments to serve as the basis for policy decisions and regulations
Indicative distribution of active assignments as of 31 September 2018

- Water and Wastewater: 30.5%
- Rail, Air and Maritime: 33.7%
- Smart Development: 8.4%
- Roads: 12.7%
- Multisector: 5.9%
- Energy and Solid Waste: 8.8%

- Hor. & Capac. Building: 24.90%
- Non-major projects: 13.10%
- Major projects: 62.00%
Local presence with 132 employees in 5 offices

- Proximity to beneficiaries reduces response time and facilitates knowledge sharing
- Local knowledge translates into good understanding of relevant issues
- Multi-lingual and multi-cultural environment