Concepts and practicalities of modelling OpEx Costs in Bottom-Up

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Outline

- The classical ways and its shortcomings
- Building a flexible and accurate OpEx model
- Dimensioning the operational resources
  - Case study OpEx calculation
- Application of the OpEx model in regulatory context for cost allocation
- Conclusions

3 steps

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CapEx/OpEx ratio derived from top-down figures
  - Calculate current opex/capex ratio from top-down model
  - Recalculate capex in bottom-up, add opex using ratio
- OpEx/CapEx ratio based on benchmark
  - Widely accepted value
  - E.g. average of ratio for several big operators (consultancy info)
Shortcomings

- Combination of top-down and bottom-up approach
  - Top-down is backward looking
  - Bottom-up is forward looking
  - This might cause problems when situation is changing (e.g. from stable situation to growth)
- Technological impact is neglected
  - higher CapEx cost might be compensated by lower OpEx cost
  - E.g. automation of certain tasks

Use OpEx driver per cost item

- Opex cost item = driver * factor
  - E.g. helpdesk staff cost = #subscribers * F1
  - E.g. office rental cost = #staff * F2
- Extremely difficult to estimate the required factor for different cost items
  - Benchmarking is needed again

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Total expenditures

- Capital expenditures (CapEx)
  - contribute to fixed company infrastructure
  - depreciated over time
  - includes
    - purchase of land and buildings
    - network infrastructure
    - software
- Operational expenditures (OpEx)
  - cost to keep company operational
  - do not contribute to infrastructure itself, not subject to depreciation.
  - includes
    - rented and leased infrastructure
    - personnel wages
1. fix the time frame to be considered
2. attach costs to the rectangles (actions)
3. attach probabilities to the diamonds (questions)
4. calculate cost of an entire process
   
   \[ \text{costA1 + p \cdot \text{costA2} + (1-p) \cdot \text{costA3} + \text{costA4}} \]
5. calculate total OpEx cost for network scenario
   \[ = \text{cost of continuous processes} + \text{cost of event driven processes} \times \# \text{occurrences over time frame} \]

**Case study workflow**

- Equipment characteristic (cost, availability, etc.)
- Dimensioned network (for all component types: number of installed, number in use)
- Operational/dimensioning (size and location of operational teams)
- Dimensioned OpEx processes
- Costs of OpEx resources (for all personnel classes: hourly cost, markup for training and tools, for all types of transport with cost)
- CapEx cost calculation
- Process-based OpEx calculation
- Total calculated cost

**Required input data**

- **Input per component type**
  - #, price, power, floor space, MTBF, MTTR
- **Input per personnel category**
  - salary (incl. taxes), weight factor
- **Input per action**
  - standard times
- **Input concerning distances**
  - network topology, location of operational teams
- **Input concerning continuous cost of infrastructure**
  - power cost, floor space cost, leasing cost

**Define cost of an action**

- **straightforward approach:**
  - cost of action = time needed to perform action \times wages of person taking care of it (incl. taxes)
- **several employee categories involved, with wages**
  - administrative personnel
  - technicians
  - engineers
  - sales people
- **total cost of personnel**
  - wages + training + tools and transport
  - wages \times (1 + \text{weight factor})
  - weight factor per category:
    e.g. technicians need more tools than administrative personnel
Assumptions and input data

- German reference network and the associated traffic for 2004
- WDM network, carrying 2.5 Gbps leased lines
- Equipment characteristics:

<table>
<thead>
<tr>
<th>equipment type</th>
<th>MTBF (h)</th>
<th>power (kW)</th>
<th>footprint (FTM)</th>
<th>price (€C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WDM line system (4R lambda)</td>
<td>2.00E+05</td>
<td>1</td>
<td>3 racks</td>
<td>12,00</td>
</tr>
<tr>
<td>fiber</td>
<td>7.00E+06</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>optical amplifier</td>
<td>2.00E+05</td>
<td>0.5</td>
<td>0.25 rack</td>
<td>7.00</td>
</tr>
<tr>
<td>SR transponder (2.5 Gbps)</td>
<td>3.00E+05</td>
<td>0.5</td>
<td>0 (inserted in OXC)</td>
<td>2.00</td>
</tr>
<tr>
<td>LR transponder (2.5 Gbps)</td>
<td>3.00E+05</td>
<td>0.5</td>
<td>0 (inserted in OXC)</td>
<td>2.50</td>
</tr>
<tr>
<td>unesehen OXC (512 ports)</td>
<td>1.00E+05</td>
<td>3</td>
<td>3 racks</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Input per component type

- WDM line system
  - Fiber: 50 m, 0.00 E-00, 2.7 E-05, 1.8 E-06, 0.0 E-00
  - Cx: 114 m, 0.00 E-00, 2.7 E-05, 1.8 E-06, 0.0 E-00
  - SR transponder: 4456 m, 0.00 E-00, 3.3 E-05, 1.8 E-06, 0.0 E-00
  - LR transponder: 7432 m, 0.00 E-00, 3.3 E-05, 1.8 E-06, 0.0 E-00
  - Unseen OXC: 17 m, 0.00 E-00, 1.8 E-05, 1.8 E-06, 0.0 E-00

Input per personnel category

<table>
<thead>
<tr>
<th>component type</th>
<th>weight factor</th>
<th>salary including taxes (€/yearly)</th>
</tr>
</thead>
<tbody>
<tr>
<td>source</td>
<td>3</td>
<td>90,000</td>
</tr>
<tr>
<td>sales personnel</td>
<td>3</td>
<td>78,000</td>
</tr>
<tr>
<td>technical personnel</td>
<td>3</td>
<td>64,800</td>
</tr>
<tr>
<td>NCC personnel</td>
<td>2</td>
<td>72,000</td>
</tr>
<tr>
<td>administrative/helpdesk personnel</td>
<td>2</td>
<td>81,000</td>
</tr>
<tr>
<td>research/engineering personnel</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>working hours per week</td>
<td>36</td>
<td>46</td>
</tr>
<tr>
<td>weeks per year</td>
<td>52</td>
<td>23</td>
</tr>
</tbody>
</table>
**Distances input**

<table>
<thead>
<tr>
<th>action</th>
<th>length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>average link distance</td>
<td>170</td>
</tr>
<tr>
<td>average number of links between stocks</td>
<td>2</td>
</tr>
<tr>
<td>total link distance</td>
<td>4427</td>
</tr>
<tr>
<td>number of nodes</td>
<td>17</td>
</tr>
</tbody>
</table>

**Extra inputs**

<table>
<thead>
<tr>
<th>parameter</th>
<th>value</th>
</tr>
</thead>
<tbody>
<tr>
<td>network component energy consumption cost (yearly)</td>
<td>0.08</td>
</tr>
<tr>
<td>cost power (per kWh)</td>
<td></td>
</tr>
<tr>
<td>rental cost (yearly)</td>
<td></td>
</tr>
<tr>
<td>cost floorspace per m² (monthly)</td>
<td>10</td>
</tr>
<tr>
<td>total fiber leasing cost (yearly)</td>
<td>0</td>
</tr>
<tr>
<td>total right of ways cost (yearly)</td>
<td>0</td>
</tr>
<tr>
<td>factor helpdesk calls: failure alarms</td>
<td>1.5</td>
</tr>
</tbody>
</table>

**Impact of resilience scheme**

- SR transponder
- LR transponder
- Optical amplifier
- WDM line system
- Unequipped OXC

**CapEx results**

- **Capex**
  - Cost (Euro)
  - WDM line system
  - Optical amplifier
  - SR transponder
  - LR transponder
  - Unequipped OXC

**Resilience scheme**

<table>
<thead>
<tr>
<th>resilience scheme</th>
<th>time to reroute traffic (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>unprotected</td>
<td>8</td>
</tr>
<tr>
<td>1+1 protection</td>
<td>0</td>
</tr>
<tr>
<td>1+1 protected</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Concepts and practices of modeling OpEx/Costs in Bottom-Up - Sohe Verbrugge
Vakgroep Informatietechnologie (INTEC) – IBBT Ontwikkelgroep
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Goal and challenges

- Goal of OpEx model in regulatory context
  - Build efficient network model
  - Describe and dimension network model efficiently (not necessarily like they exist today)
  - related to technology (not fixed ratio)
  - for future network (ratios cannot be determined)
- Challenges
  - Define process descriptions
  - Can be based on process templates
Added value of BU opex model

- Reconciliation of bottom-up model versus top-down
  - Where does difference come from?
- Inefficiency in current processes
  - Model shouldn’t be changed
  - This is exactly the goal of bottom-up model
- Abstraction in bottom-up model
  - Model needs to be changed
  - All relevant details should be taken into account
  - This will allow easier comparison BU vs. TD

Direct, shared and common costs

- Direct costs
  - Direct resource/feature which would not have been consumed/used if the product/service/increment was not produced.
- Shared costs
  - Costs of the usage of resources which are shared amongst several products/services
  - Should be divided in a fair way
- Common costs
  - Costs for which the resources are not directly associated to the product or services sold.
  - Mainly seen as overhead

Cost-accounting

<table>
<thead>
<tr>
<th>cost</th>
<th>service</th>
<th>service</th>
<th>service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Variable</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Direct Fixed</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Shared Variable</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Shared Fixed</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Common Variable</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Common Fixed</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
</tbody>
</table>

Identification of shared network costs

- HOW TO ALLOCATE THE COST OF USING THE CONVERGED NETWORK IN A FAIR WAY?
Allocation of network costs

- non-telco specific costs
  - infrastructure acquisition, continuous cost of infrastructure and administration
- common costs: cannot be allocated a straightforward way
- network resources and the related costs to build and operate the network
  - network infrastructure, network software, telco specific continuous cost of infrastructure and OpEx associated with setting up the network
- shared costs, closely related to the infrastructure itself: allocated using 2phased scheme

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Allocation of network costs (2)

- costs associated to the operational processes of the network
  - maintenance, repair and operational planning
- shared costs: allocated according activity-based costing
- costs associated to the services
  - service provisioning, pricing and billing and marketing costs
  - direct costs: directly allocated
  - note: If billing or marketing activities are performed jointly for multiple services, shared costs: allocated equiproportional among all services (not peak or bandwidth based)

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Conclusions

- Evolution in OpEx models
- Development of BU OpEx model
  - Gives insight in OpEx drivers
  - Results are closer to reality then using traditional approaches
  - Case study for OpEx calculation in optical network layer
- Benefits for regulatory purposes
  - Reconciliation becomes possible
  - Allows sensitivity analysis, becomes different parameters are identified

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References

- **Process-based OpEx cost model**

- **Cost allocation of shared network costs**
Regulatory Cost Accounting & Reporting
In Telecoms
Crowne Plaza Hotel, Vienna • Monday 3rd - Thursday 6th July 2006

Don’t miss this chance to evaluate:
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- Construct and implement LRIC models for data and mobile networks
- Assess the requirements of Accounting Separation at the product level
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