Techno Economic Methodology for the Evaluation of Telecommunication Investment Projects.

Sensitivity and Risk Analysis Incorporation

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International Telecommunication Union- Telecommunication Development Bureau
Market, Economics & Finance Unit
Expert Dialogues:
28-29 October 2004
Geneva, Switzerland
The challenge

Market
- Demand
- Willingness to pay
- User behaviour

Technology
- Technology variety
- Open provisioning
- Service integration

Strategy
- Where?
- When?
- How?
Consolidation of Results and Guidelines for deployment scenarios

- Guidelines
- Common conclusions
- Network Studies
- Common framework
- Information gathering / exchange
- Projects and field trials
- Other Sources

University of Athens Dept of Informatics & Telecommunications

28-29 Oct 2004 Geneva
Steps in Network Evaluation

– Definition of service basket
– Network scenarios
– First Simulations – Main Financial results
– Sensitivity and Risk Analysis
– Evaluation Recommendation and Guidelines
The TONIC Tool

- Based on Office 2000 platform
  - Excel & Access
- Automatic sensitivity analysis
- Compatibility with Risk Analysis Tool(s)
The TONIC tool & its database

<table>
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<tr>
<th>Component</th>
<th>Auto Update</th>
<th>Level</th>
<th>Type</th>
<th>M Rate</th>
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TONIC Tool database 1.0

- Services
- Classes
- Set Study Period

Data Source: C:\חק\Tonic\vs\vnc\models\UmtsDb\vnc

28-29 Oct 2004 Geneva
Cost model

- $P(0)$, the price in the reference year 0
- $n_r(0)$, the relative accumulated volume in year 0,
- $\Delta T$, the time for the accumulated volume to grow from 10% to 90%,
- $K$, the learning curve coefficient.

$$P(t) = P(0) \cdot n_r(0)^{-1} \cdot \left[ 1 + e^{\ln\left(n_r(0)^{-1} - 1\right) - \left[\frac{2 \cdot \ln 9}{\Delta T}\right] \cdot t} \right]^{-1} \log_2 K$$
Relative cost evolution as a function of $\Delta T$
with $n_r(0)=0.001$
"Ecosys" project

WP0 - Project Management and Coordination

WP1 Market dynamics

WP2 Techno-Economic methodology development

WP3 Tool development for T-E modelling

WP4 Broadband for all - Economics of new networks and services

WP5 Mobile and wireless network economics beyond 3G

WP6 Convergence

WP7 Dissemination and Exploitation
The new Tool “Ecosys”

• Based on Office 2002 platform
  – Multiplayer environments
  – Real Options implementation
  – New demand models
  – ….
Main Financial Results

- Net Present Value, NPV
- Internal Rate of Return, IRR
- Payback Period
- Financial indicators
  - Investments
  - Running Costs
  - Revenues
  - Cash Flows
  - Depreciation
  - Profits
  - Taxes
  - Retained Cash Flows
  - Cash Balance
  - Rest Value
Scalability of the tool

- Sensitivity Analysis
- Risk Analysis
Sensitivity Analysis

• What if…?

• Approach
  – select the most critical input parameters
  – establish boundaries for their variation with a
    « 95% confidence interval »

• Results
  – impact on NPV
    • at boundary input parameter values: new NPV
    • sensitivity factor: how NPV varies (slope at base value)
  – impact on IRR
    • at boundary input parameter values: new IRR
    • sensitivity factor: slope at base value, although variation usually non
      linear
Risk Analysis

• **Input:**
  - Uncertainty in market parameters
    - Market size
    - Market share
    - Broadband services characteristics
  - Uncertainty in Cost parameters
    - Cost units
    - Cost evolution
    - Area characteristics

• **Outputs:**
  - Probability measures for a reduced set of parameters
Method

Project setting

perform simulation

store result

compare results*

make decision

risk profile

for every decision vector
Risk Analysis

- Statistical Variation of the input parameters
- Using Monte Carlo Simulation
- Results: probability distribution, risk profile of the business case
- Extended basis for investment decisions
Risk Analysis - NPV

Forecast: NPV

1,000 Trials
Frequency Chart
988 Displayed

Certainty is 82.10% from 0 to +Infinity

-317,277,492  -86,334,971  144,607,551  375,550,072  606,492,594

0,000  0,010  0,019  0,029  0,038

-317,277,492  -86,334,971  144,607,551  375,550,072  606,492,594

0  9,5  19  28,5  38

1,000 Trials
988 Displayed

Certainty is 82.10% from 0 to +Infinity
Requirements for a T-E study

– Services Scenarios
  • Dimensioning

– Commercial Network Architectures
  • For these services
  • Database
  • Serving areas

– T-E Model Constructions
  • Study period (years?)

– Potential market

– Market Shares (e.g. operator)

– Pricing

– Runs- Results

– Sensitivity and Risk Analysis

– Evaluation of the results – Recommendation and Guidelines - Commercial viability
Example case
Location base Service LBS
Blend of …cases

- Positioning
- Tariff Model
- Business Profile
- Terminals
- Countries
## Country Types:

<table>
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<tr>
<th>Country Type</th>
<th>Large</th>
<th>Small</th>
<th>Description</th>
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<tbody>
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<td>Area size</td>
<td>370,000</td>
<td>132,000</td>
<td>Size of surface area of the country (km(^2))</td>
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<tr>
<td>Area dense</td>
<td>185</td>
<td>7</td>
<td>Size of dense urban area (km(^2)).</td>
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<tr>
<td>Area urban</td>
<td>2,960</td>
<td>4,000</td>
<td>Size of urban area (km(^2)).</td>
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<tr>
<td>Area suburban</td>
<td>37,000</td>
<td>10,956</td>
<td>Size of suburban area (km(^2)).</td>
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<tr>
<td>Area rural</td>
<td>303,400</td>
<td>109,956</td>
<td>Size of rural area (km(^2)).</td>
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<tr>
<td>Population dense</td>
<td>50,000</td>
<td>10,000</td>
<td>Number of inhabitants in dense urban area per km(^2)</td>
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<tr>
<td>Population urban</td>
<td>4,000</td>
<td>1,216</td>
<td>Number of inhabitants in urban area per km(^2)</td>
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<tr>
<td>Population suburban</td>
<td>1,000</td>
<td>174</td>
<td>Number of inhabitants in suburban area per km(^2)</td>
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<tr>
<td>Population rural</td>
<td>40</td>
<td>35</td>
<td>Number of inhabitants in rural area per square km (during busy hour)</td>
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<tr>
<td>Total Population</td>
<td>65,000,000</td>
<td>11,000,000</td>
<td>Total population</td>
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Tariff and revenue forecasts

- Services
  a) LBS services
  b) M-Guide Service
  - Study Period: 7 years

<table>
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<th>Parameters</th>
<th>Value</th>
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<td>Nr of Queries per day (2004)</td>
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<tr>
<td>Start Price per Query (€)(2004)</td>
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<td>End Price per Query (€) (2009)</td>
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<td>Nr of main Services</td>
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Demand models

![Graph showing demand models for different categories: Mobile_Users, Local_users_LBS, LBS_MGUIDE_users, Local_users_GPRS. The graph illustrates the growth from 2003 to 2009.](image-url)
### Main Financial Indexes

<table>
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<tr>
<th>M Euros (Large)</th>
<th>NPV</th>
<th>IRR (%)</th>
<th>Payback Period (years)</th>
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<td>263</td>
<td>39.8</td>
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<td>33.8</td>
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The chart illustrates the NPV, IRR, and payback period for large and small projects. The NPV is significantly higher for large projects, while the IRR and payback period are comparable for both sizes.
Main results

Small

Net present value 35.7 M€

Internal rate of return 33.8%

Payback period 5.4 years

Maximum Finance need 36 M€
Cash Balances Large and Small Country

Cash Balance SC
Cash Flows SC
Cash Balance LC
Cash Flows LC
Operational Expenditures (OPEX) SC

- Other Cost (Content)
- Employees
- Marketing
- Subsidization GPS Terminals

Year: 2003 to 2009
Revenues LC

- Advertising: 3%
- LBS Roamers: 11%
- LBS Local: 14%
- MGuide Roamers: 3%
- MGuide Local: 6%

2003 2004 2005 2006 2007 2008 2009
Sensitivity Analysis

NPV sensitivity ranges (single parameter change)

-40,000 -20,000 0.000 20,000 40,000 60,000 80,000 100,000

- Tariff
- Market Share
- Local users percentage other LBS
- LBS percentage
- Mobile Penetration
- Marketing
- Content Profit
- Advertising Revenues
- LBS Roamers percentage
- GPS Terminal Subs

Change in NPV in MEURO (compared to base case: 35.7 MEURO)
Risk Analysis

- Statistical Variation of the input parameters
- Using Monte Carlo Simulation
- Results: probability distribution, risk profile of the business case
- Extended basis for investment decisions
Risk Analysis - NPV

Forecast: NPV

10,000 Trials

Frequency Chart

9,845 Displayed

Certainty is 69.22% from 0 to +Infinity

-83,463,974 -30,140,537 23,182,901 76,506,339 129,829,777

-30,140,537 -83,463,974 23,182,901 76,506,339 129,829,777

-83,463,974 -30,140,537 23,182,901 76,506,339 129,829,777

Certainty is 69.22% from 0 to +Infinity
Risk Analysis – NPV (2)

Forecast: NPV

10,000 Trials

Frequency Chart

9,845 Displayed

Certainty is 33.97% from 35,698,326 to +Infinity
Conclusions LBS Case

- Acceptable business opportunities
- LBS can still be an attractive opportunity for companies with or without telecom background
- Payback period of 5 to 6 years, with a yearly ARPU of over than 27€ for more enthusiastic testbeds
- Worst-case scenario
  - *Risk analysis evaluation* shows that almost 30% of the project cases could have significant profits and 70% of them remain positive
  - *The uncertainty level is high mainly* relating to the LBS penetration and market share
- *One-year delay* of this project could be reasonable in order to answer some critical questions
Time for Questions & Answers

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