

3410
WATN 8 P1

UNIVERSITEIT GENT
FACULTÉIT INGENIEURWETENSCHAPEN

Internet Service Option on Trains: An Application in Belgium Railway

Jan Van Ooteghem
Ghent University – IBBT

12th Annual International Conference on Real Options: Theory meets Practice

UNIVERSITEIT GENT

IBBT TR@INS TRAIIn IP Network Services

Industrial partners
IBM, SIEMENS, Railtec

Research groups
IBBT, OMICY

User studies & Techno-economical evaluations

Use cases, requirements & architecture

Onboard communication, Satellite communication, Trackside communication

Interworking

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway p. 2 IBBT

UNIVERSITEIT GENT

Outline

Internet on trains, Business model, Real options

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway p. 3 IBBT

UNIVERSITEIT GENT

Virtual home/office on the train

Virtual home: Infotainment, Online gaming, Web surfing, Video on demand

Virtual Office: E-mail, Video conferencing, Business applications

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway p. 4 IBBT

UNIVERSITEIT GENT

Worldwide examples

US: Amtrak
UK: Virgin AT, Southampton New, Express
FR: TGV
DE: ICE
ES: AVE
IT: TAV
RU: RZD
SE: SJ
DK: DSB
BE: Thalys
NL: NS
GR: OSE
PT: CP
CZ: ČD
HU: MÁV
PL: PKP
SK: ŽSR
SI: SŽ
BG: BG
RO: CFR
UA: UA
BY: BSSB
LT: LT
LV: LV
EE: EE
FI: VR
IS: IS
NO: NSB
SE: SJ
DK: DSB
RU: RZD
UK: Virgin AT, Southampton New, Express
US: Amtrak

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway p. 5 IBBT

UNIVERSITEIT GENT

Used outdoor technologies

Technical challenge!

Satellite

- Inherent delay: RTT ca. 500 ms
- LOS required

1. Mobile networks: GSM, UMTS, CDMA

2. Wireless data networks: Wi-Fi, WiMAX, Flash-OFDM

3. Satellite networks: OVS-SZ, OVS-RC

Network from mobile operators vs. Dedicated network for Internet on the train

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway p. 6 IBBT



Potential coverage problems

Networks	URBAN	TUNNELS	RURAL
Mobile network	+++	++	+
Wireless data network	++	++	++
Satellite network	+	+	+++

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway

Outline

Internet on trains

Business model

Real options

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway

Flowchart business model

```

    graph TD
      subgraph Forecasting
        F1[Forecasting the number of train passengers] --> F2[Determining rollout scheme]
        F2 --> F3[Calculating potential revenues on train users]
      end
      subgraph Technology_assignment
        T1[Determining price, technology requirements] --> T2[Comparing technical scenarios]
      end
      subgraph Cost_benefit_model
        C1[Calculating cost / benefit model]
      end
      subgraph Evaluation
        E1[Optimal business model]
      end
      F3 --> T1
      T2 --> C1
      C1 --> E1
  
```

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway

Forecasting

Delayed adoption model

Adoption after each year

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway

Technology assignment

Class	Technology	Network
Class 1	UMTS	Mobile network
Class 2	UMTS + GSM/GPRS	Mobile network
Class 3	UMTS + GSM/GPRS	Mobile network
Class 4	GSM/GPRS	Mobile network
Class 5	UMTS	Mobile network
Class 6	UMTS + GSM/GPRS	Mobile network
Class 7	UMTS + GSM/GPRS	Mobile network

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway

Technology mapping

Name - UMTS - HSDPA - WiMAX

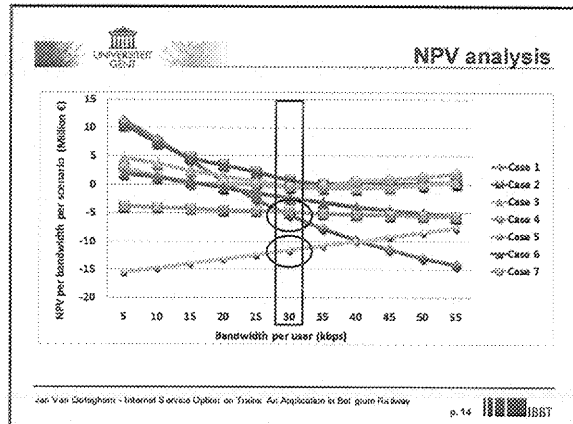
Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway



Cost/benefit model

		Wireless data networks	Mobile networks	Satellite networks
CapEx	Train equipment			
	Outdoor antennas • Indoor network	+	+	+++
OpEx	Network equipment	+++	+	+
	• Trackside network • NOC			
OpEx	General costs	++	++	++
	• Helpdesk • Sales (billing) • Marketing			
OpEx	Operations	+++	+	++
	• Maintenance and repair • Network management • License costs			
OpEx	Network connection	+	+++	++
	• Outdoor link			

Jan Van Ooteghem - Internet Service Options on Trains: An Application in Belgium Railway p. 13



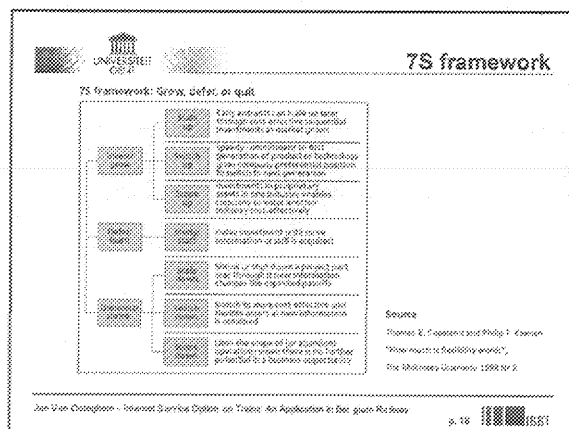
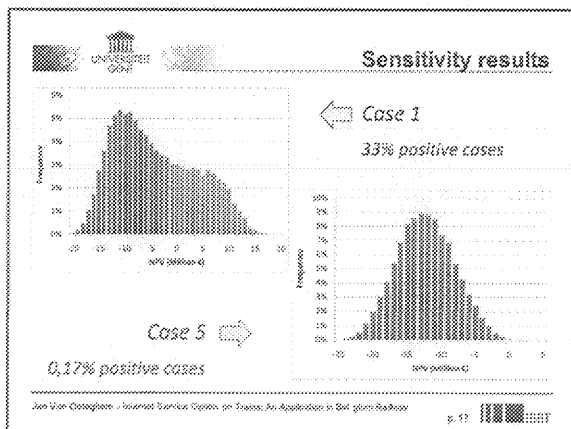
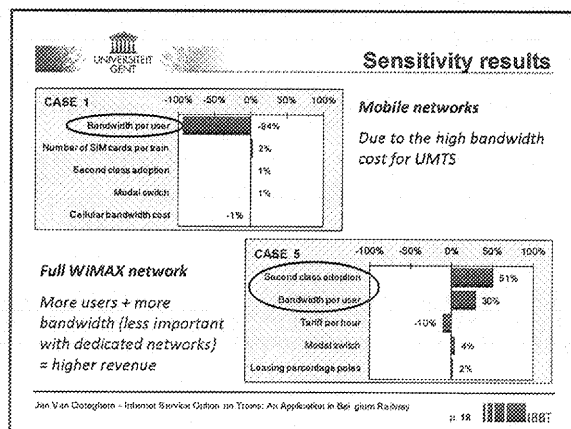
Outline

Internet on trains

Business model

Real options

Jan Van Ooteghem - Internet Service Options on Trains: An Application in Belgium Railway p. 15



Flexible rollout scheme

Decision variables to adapt the rollout scheme

- Evaluation parameters (NPV, free cash flow, payback time)
- Uncertain input parameters (take rate, investment costs)
- E.g.

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway p. 19

Rollout scheme possibilities

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway p. 20

Real option results

5 year analysis

10 year analysis

Option value **1,350,796 €**

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway p. 21

Real option results

5 year analysis

10 year analysis

Option value **985,275 €**

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway p. 22

Conclusions & future work

- Internet on the train
 - New trials and commercial rollouts show feasibility
 - Research necessary for higher bandwidths and services
 - Combination of technologies required
- Real options analysis
 - NPV analysis: combination of URETS+WIMAX networks
 - Sensitivity analysis: bandwidth and adoption most decisive
 - Real options analysis
 - By introducing flexibility, NPV increased (uncertainty reduced)
 - Best results obtained for full URETS and full WIMAX scenarios
- Future work
 - New simulations with better parameter values
 - Influence of business models on the overall costs

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway p. 23

Thank you for your attention

Questions?

Personal details:

Name: Jan Van Ooteghem
 Company: Ghent University - IBBT
 Phone: +32 9 351 49 81
 E-mail: jan.vanooteghem@intec.ugent.be

Jan Van Ooteghem - Internet Service Option on Trains: An Application in Belgium Railway p. 24



Real Options

Theory Meets Practice

12th ANNUAL INTERNATIONAL CONFERENCE ON REAL OPTIONS: THEORY MEETS PRACTICE

Rio de Janeiro, Brazil, July 9-12, 2008

DAY 1

Wednesday July 9, 2008

ENERGY/NATURAL RESOURCES, REAL ESTATE & INFRASTRUCTURE

8:00 Registration

8:20 Welcome/Orientation

ENERGY & NATURAL RESOURCES

8:25 WORKSHOP/PLENARY SESSION I

Real Options Applications in Natural Resources/Energy

Marco A.G. Dias, Petrobras, Brazil

9:00 Valuing, Optimizing and Understanding Managerial Flexibility:

An Application in Oil Expansion

Charles Dumont and Gregory Vainberg, McKinsey & Co, Canada

9:30 The Ethanol-Gas Flex Fuel Car: The Option Value of Choosing your Own Fuel

Carlos B. Pinto, Luiz Brandao and Mariana Alves, PUC-Rio, Brazil

10:00 Valuing the Option to Delay a Petrochemical Project in Brazil

Alberto M. Marques, Marco A. G. Dias, Petrobras, and Roberto M. da Silva Montezano, IBMEC, Brazil

10:30 Morning Coffee Break

11:00 Option Value in Nuclear Energy Projects

Ulrike Lauferts and L. Van Den Durpel, NRG, Netherlands

11:30 Valuation of Flexible Power Plants: An Application in the Brazilian Power Market

Alexandre Aronne, Haroldo G. Brasil, Fundacao Pedro Leopoldo, and Ivan Aronne, CDTN, Brazil

12:00 ROUNDTABLE DISCUSSIONS BY INDUSTRY

- A. Natural Resources/Energy/Real Estate Roundtable (G. Sick & L. Brandao)
- B. Innovation/Manufacturing/Technology Roundtable (D. Paxson & S. Matthews)
- C. Corporate Strategy & Portfolio Management (J. Kensinger & M. Pergler)

12:45 Luncheon

REAL ESTATE & INFRASTRUCTURE APPLICATIONS

2:20 WORKSHOP/PLENARY SESSION II

Real Options Applications in Real Estate/Infrastructure
Gordon Sick, University of Calgary, Canada

3:00 Optionality in Presale of Real Estate Development
Luiz Brandao, PUC-Rio, Brazil

3:30 Viability Study of a New Real Estate Venture in Brazil
Sergio M. Dos Reis, FNPP, Brazil

4:00 Afternoon Coffee Break

4:30 Optionality and the Role of Municipalities in Regional Development Projects in Finland
Mikael Collan, IAMSR, Ebo Akademi University, Finland

5:00 Internet Service Option on Trains: An Application in Belgium Railway
Jan Van Ooteghem, Ghent University – IBBT, Belgium

5:30 Flexibility in Fiber Deployment Network Planning: An Application to Belgian Network
Sofie Verbrugge, Gent University – IBBT, IBCN, Belgium

6:00 Closing Remarks

DAY 2

Thursday July 10, 2008

PORTFOLIO APPLICATIONS, MANUFACTURING/CONTRACT DESIGN AND STRATEGY

8:30 – 8:45 Welcome

8:45 PRESIDENT'S ADDRESS

On Multinationality Options and Performance

Lenos Trigeorgis, University of Cyprus and President, Real Options Group

PORTFOLIO APPLICATIONS

9:30 WORKSHOP/PLENARY SESSION III

Private Equity Acquisitions as Real Options Portfolios
John Kensinger, University of North Texas, USA

9:55 The Value of Land as Portfolio of Planting Flexible vs. Inflexible Crops
Nelson Ferreira, McKinsey & Co, Brazil

10:20 Morning Coffee Break

11:00 Valuing a Real Options Portfolio in the Petroleum Industry

Oscar M. Bravo, Luis Alfredo Mogollon and Jose Dario Parra, Ecopetrol S.A., Columbia

11:25 Performance Assessment of a Real Options Portfolio

Javier G. Castro, Tara N. Baidya and Fernando A. L. Aiube, DEI PUC-Rio, Brazil

12:00 Luncheon Keynote Address by Tom E. Copeland (MIT)

Financial and Real Options: My Complements and Your Substitutes

MANUFACTURING/CONTRACT DESIGN AND STRATEGY**1:50 WORKSHOP/PLENARY SESSION IV**

Innovation, Manufacturing & Technology Investments

Dean Paxson, Manchester Business School, United Kingdom

2:15 License Contracts with Embedded Options to Expand and Withdraw:

The Case of Disc Flex Filter in Japan

Haruyoshi Ito, Keio University, Kenji Yamada, Coteau Vert Co. Ltd, and Akane Iwasaki, Waseda University, Japan

2:35 Expansion Flexibility in Flexible Manufacturing Systems

Roberta Pellegrino, Politecnico di Bari, Italy

3:00 Flexible Processing Plant: Producing Vegetable Oil or Biodiesel in Brazil

Murilo Berni, FEAD Minas, Jose A. de Sousa Neto, and Haroldo G. Brasil, Strategor, Brazil

3:25 Afternoon Coffee Break**3:50 Auto ID (RFID) Deployment Configuration Design: An Application in Aerospace Logistics**

Victor Prodonoff Jr. and Tarik Driouchi, University of Cambridge, United Kingdom

4:15 Intuitive Real Options Implementation: Manufacturing Design at Boeing

Scott Mathews, The Boeing Company, USA

4:40 Entering a New Market in the Airline Business: Real Options and Games

Sergio Ramos, Kaiser Associates, and Ricardo Rochman, FGV-EAESP, Brazil

5:00 Risk and Flexibility in Global Manufacturing Strategy Design Decisions

Martin Pergler, McKinsey & Co, USA

5:25 – 6:15 Panel Discussion

Innovation/Technology, Corporate Strategy & Contracting:

Current Status and Future Prospects

Moderator: Dean Paxson (Manchester Business School, UK)

Panelists Include:

Francesco Baldi (ENEL, Italy)

Luiz Brandao (PUC-Rio, Brazil)

Tom Copeland (MIT)

Marco A.G. Dias (Petrobras, Brazil)

John Kensinger (U. N. Texas, USA)

Scott Mathews (The Boeing Company, USA)

Martin Pergler (McKinsey & Co, USA)

Sergio Ramos (Kaiser Associates, Brazil)

6:20 - 7:30 Networking Reception

Sponsored by ROG, Petrobras and McKinsey & Company

12th ANNUAL INTERNATIONAL
CONFERENCE ON REAL OPTIONS
Theory Meets Practice

July 9 - 12, 2004 - Rio de Janeiro

Organized by

