Dr. Fekete István
Mail: Fekete.Istvan@ln.matav.hu

Konkoly Rozália
Mail:Konkoly.Laszlone@ln.matav.hu

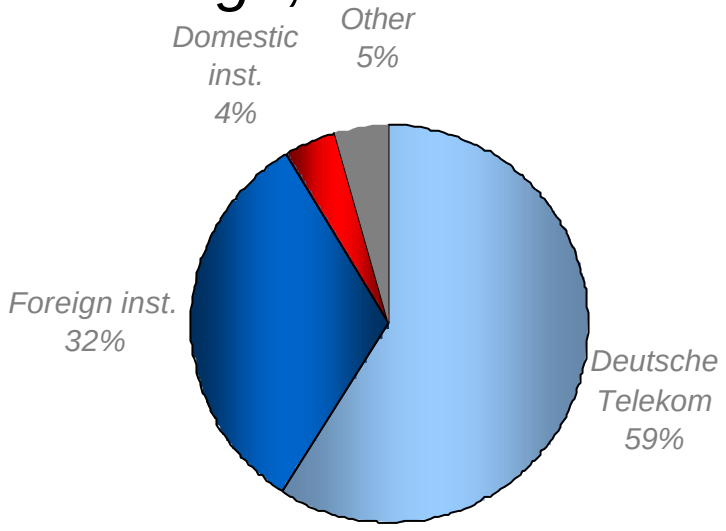
Price Optimisation by using Business Risk Analysis and Game Theory

www.matav.hu

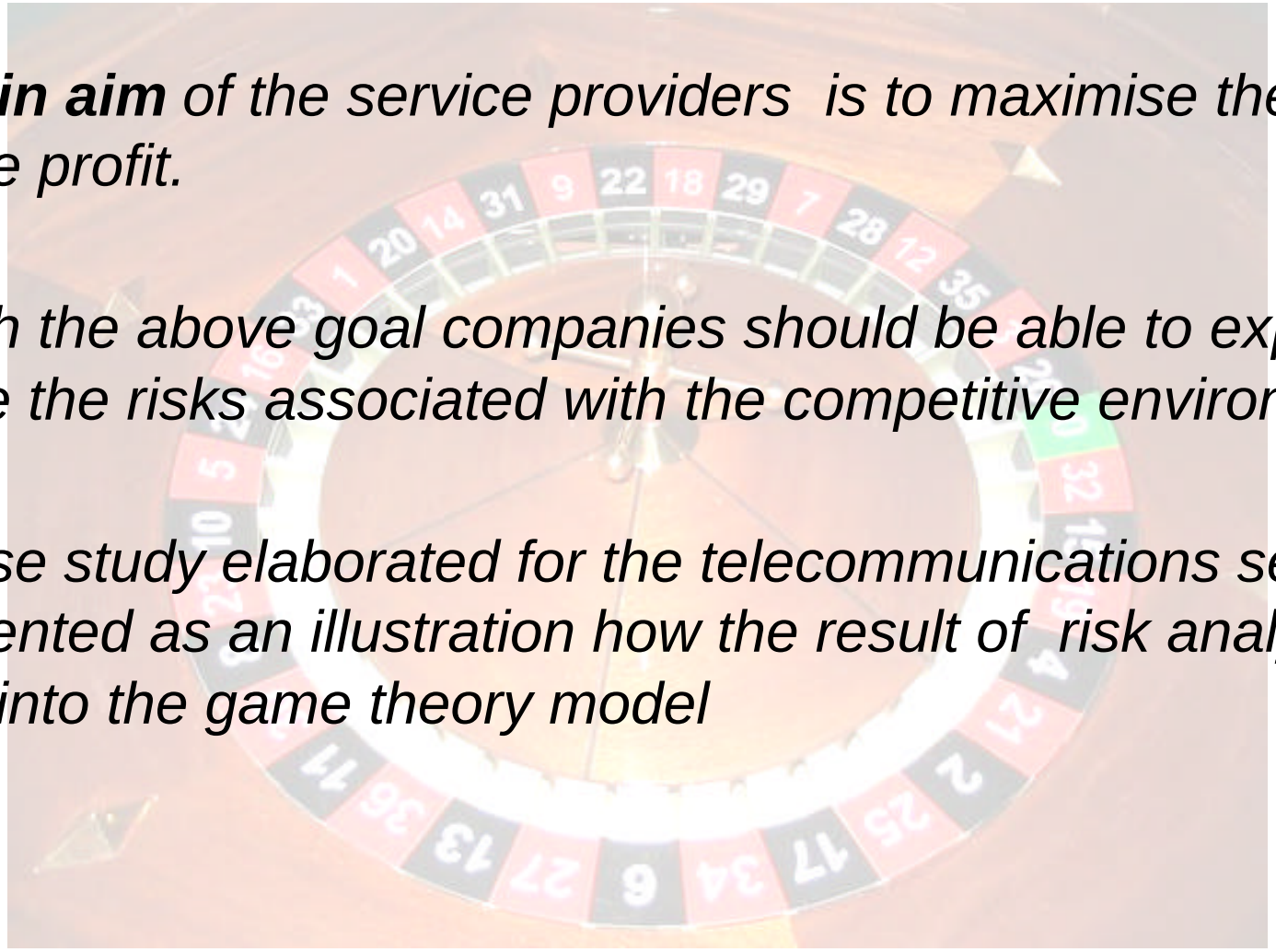
Matáv at a glance

- *Market leader in all core businesses*
- *Revenue up by 0.4% to HUF 297.8 bn, EBITDA margin reached 42.3% in Q2 2004*
- *100% stake in the leading Hungarian mobile operator*
- *Full scale telecommunications services in Macedonia*
- *EUR 3 bn market capitalisation*
- *Listed on NYSE and Budapest Stock Exchange, traded in London (SEAQ)*

Ownership structure - approx. (%)



Introduction

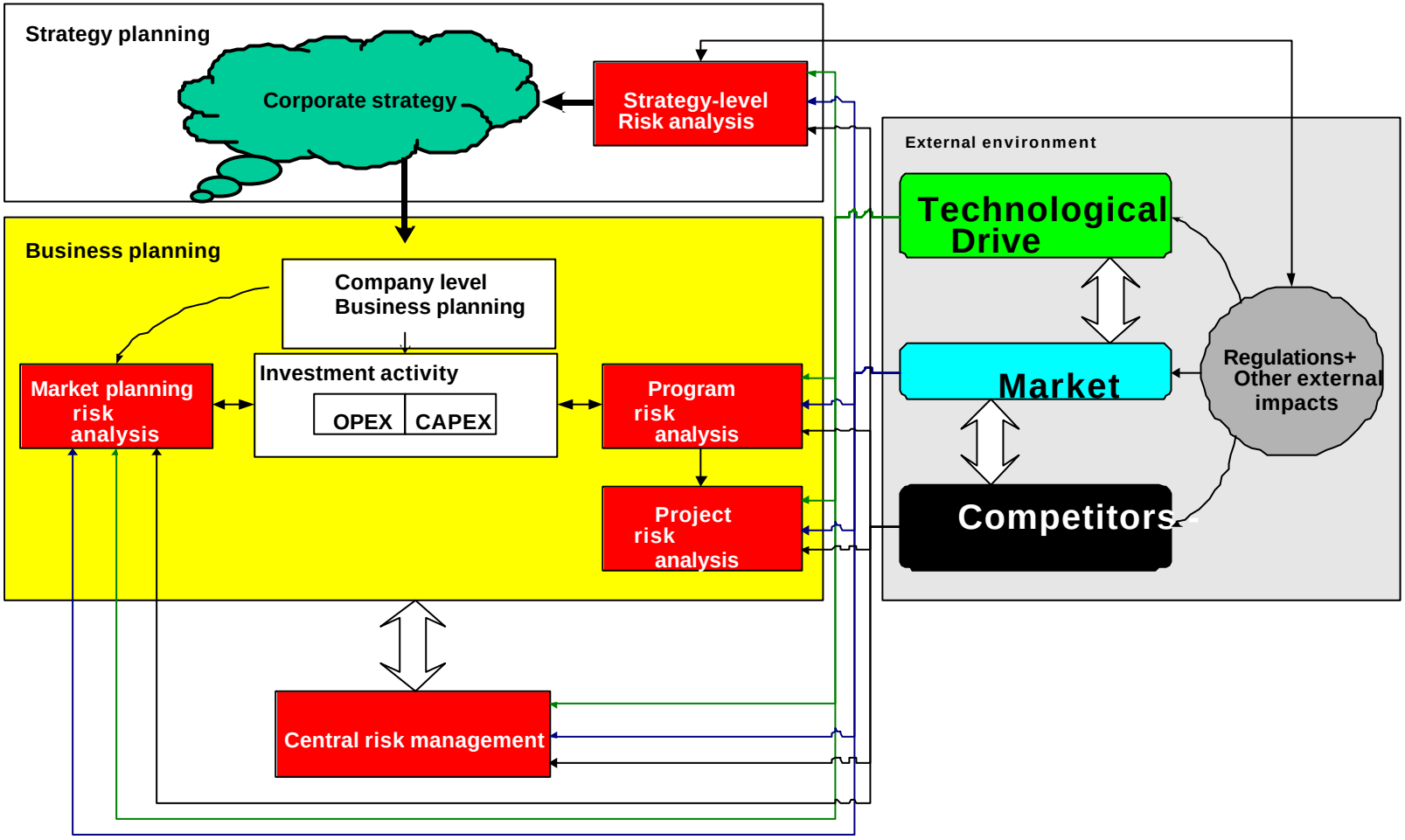


- ***The main aim*** *of the service providers is to maximise the available profit.*
- *To reach the above goal companies should be able to explore and evaluate the risks associated with the competitive environment*
- *The case study elaborated for the telecommunications sector will be presented as an illustration how the result of risk analysis can be built into the game theory model*

Business Risk Analysis

- ***The objective of business risk analysis*** *is to assess the external and internal risk factors having either positive or negative impact on the strategic and business decisions.*
- *The risk management plan can be prepared according to the results of the risk assessment.*
- *In the competitive market business risk analysis procedure substantiates the business planning process.*
- *Realising the need for such a methodology business risk analysis method has been developed at the Hungarian Telecommunications Company*

Application levels of business risk analysis during the business activity at a company



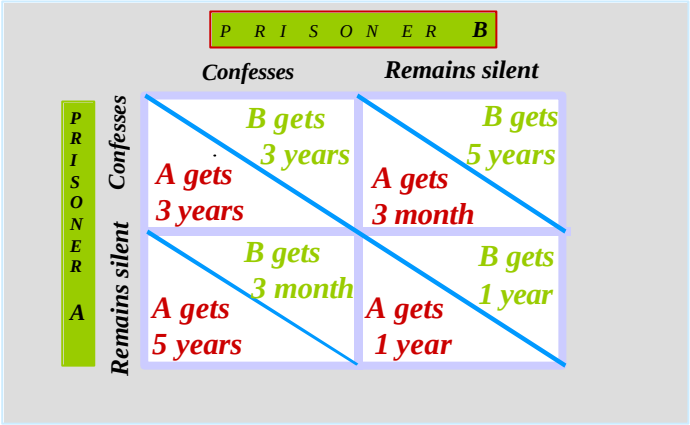
Components of the business risk management process

- *Identification of the risk factors*
- *Qualitative risk analysis, selection of critical factors*
- *Above certain limit a quantitative risk analysis is performed*
- *Identify and implement risk management proposals to manage the critical factors, control the implementation - perform risk controlling activities*

Key features of business risk management methodology

- *Reliable solutions even in case when historical data is not available or deficient*
- *Module type structure allows both joint and separate application of the particular modules*
- *Outputs of certain module can be used as input for other modules*
- *This feature makes the practical application of Monte-Carlo simulation, real -option and game theory much more simple*
- *Risk factors are always identified and assessed in the frame of workshops*

Oligopoly game theory- model competition in telecommunications



- *Discipline between mathematics and economics suitable for analysing the different players' behaviour and the interactions among them*
- *According to Neumann's theory an equilibrium state can be reached in the games.*
- *By using game models elaborated to the oligopoly market it is possible to determine how equilibrium could develop among the market players if they are in full compliance*

Case study -game model combined with Monte-Carlo simulation for leased line service

- *Schematic presentation of the model*
  - *investigated market segment: managed leased line service*
  - *case study covered the 3 companies having the biggest share on the Hungarian market*
  - ***the goal of the players** is to keep more and more percentage of the currently existing customers and by giving price reductions also to attract customers from other service providers*

- *Prior to game modelling risk analysis was performed.*

- *The main task of business risk analysis was to quantify the uncertainties involved in the cost calculation for the leased lines*

The process of risk analysis

- *Task was performed in two phases*
  - *First phase: experts of the given area explored the risk factors that impact the value of the cost elements*

Components	***Mega-Flex S* (Ft)**
Depreciation	*109 391*
Capital costs	*54 696*
O&M	*33 374*
System support	*15 820*
DIRECT COSTS, TOTAL	*213 281*
INDIRECT COSTS, TOTAL	*102 375*
TOTAL NET COSTS:	***315 656***

Cost calculation before risk analysis

The process of risk analysis (2)

- Example: The main risk factors explored that impact of the indirect costs

Main risk factors	Components of indirect costs
Legal and economical regulation	Cost of product life cycle management Invoicing cost
Presence of competitors	Cost of sales activity Cost of product life cycle management Invoicing cost
Efficiency of promotions activity	Cost of sales activity

The process of risk analysis (3)

- *As a next step in the first phase the qualitative evaluation of the risk factors was done by using a five grade probability and impact scale.*
- *The grade in the probability measures scale the probability of occurrence of an event induced by explored risk factors*
- *The grade in the impact scale measures the positive and negative deviation from the value of cost elements calculated before risk analysis, once the event occurred*

Scale values	***Domains***
5	*Deviation will be above 20% compared to the originally calculated value*
4	*Deviation will be between 10- 20 % compared to the originally calculated value*
3	*Deviation will be between 0-10 % compared to the originally calculated value*
2	*Deviation will be between (– 10), – 0 % compared to the originally calculated value*
1	*Deviation will be between (– 20), (– 10) % compared to the originally calculated value*

The process of risk analysis (4)

- *Second part: the critical factors of all elements were defined by using equation*

  *K = P*I where:*

  K: risk coefficient
  P: scale value in the probability scale
  I: scale value in the impact scale

- *The risk factor is critical, if the value of K is between 16 and 25*
- *If this value is between 5-15, the experts have a possibility to make a decision to put them among the critical ones*
- *The value under 5 is not critical.*
- *Every decision should be made by full consensus!*

The process of risk analysis (5)

- *An example to the critical factors (Element: capital cost)*

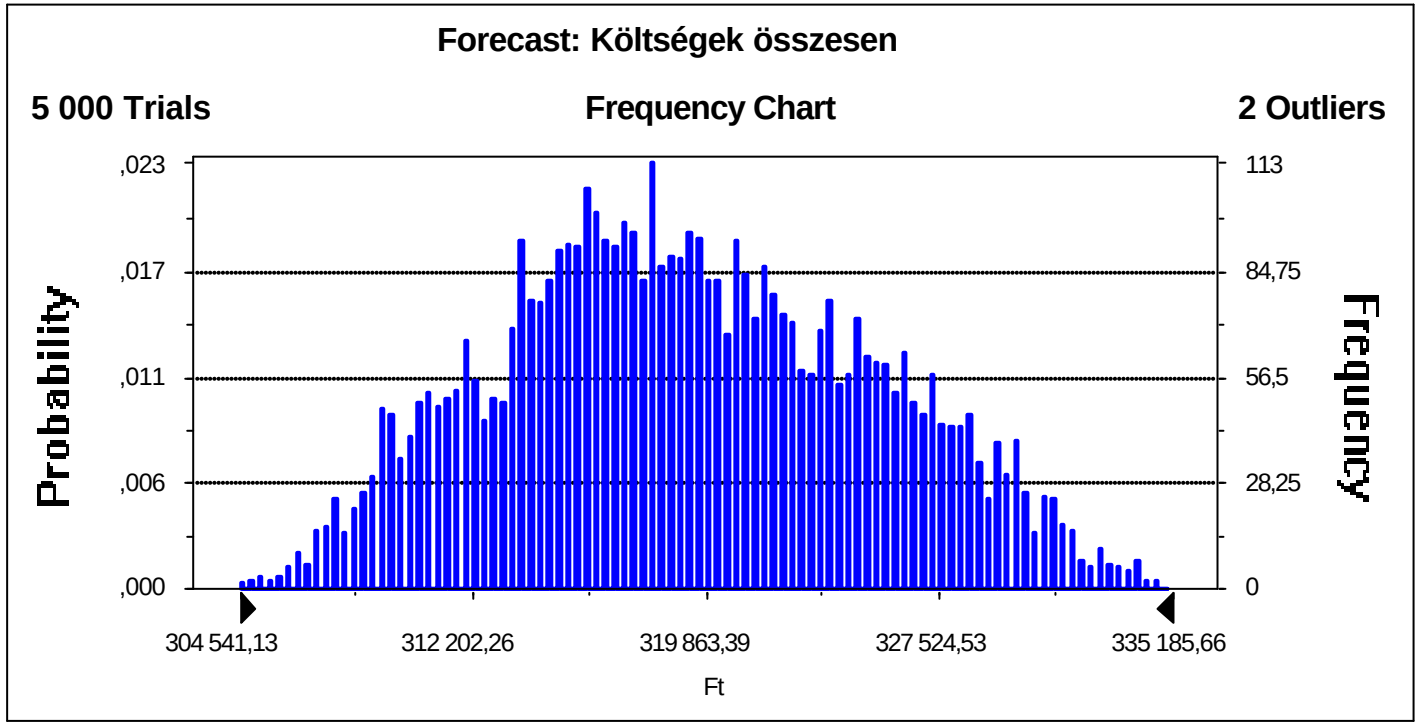
Event generated by critical factors	***Risk coefficient K***
Putting a new technology into operation	*12*
Appearance of a new software/hardware version	*20*
Changes of the procurement prices	*16*

In the second phase *a Monte-Carlo simulation model was built up.*

- *The minimum and maximum value of a probability variable (elements in the earlier phase) can be obtained from the results of the earlier phase*
- *We use Beta distribution for determining the probability density function of the probability variables and for calculating the correlation factors*

The process of risk analysis (6)

- *After running the Monte-Carlo simulation using **Crystal Ball Professional Edition** we got the probability distribution function for the **total net cost** of the investigated product as a forecast*



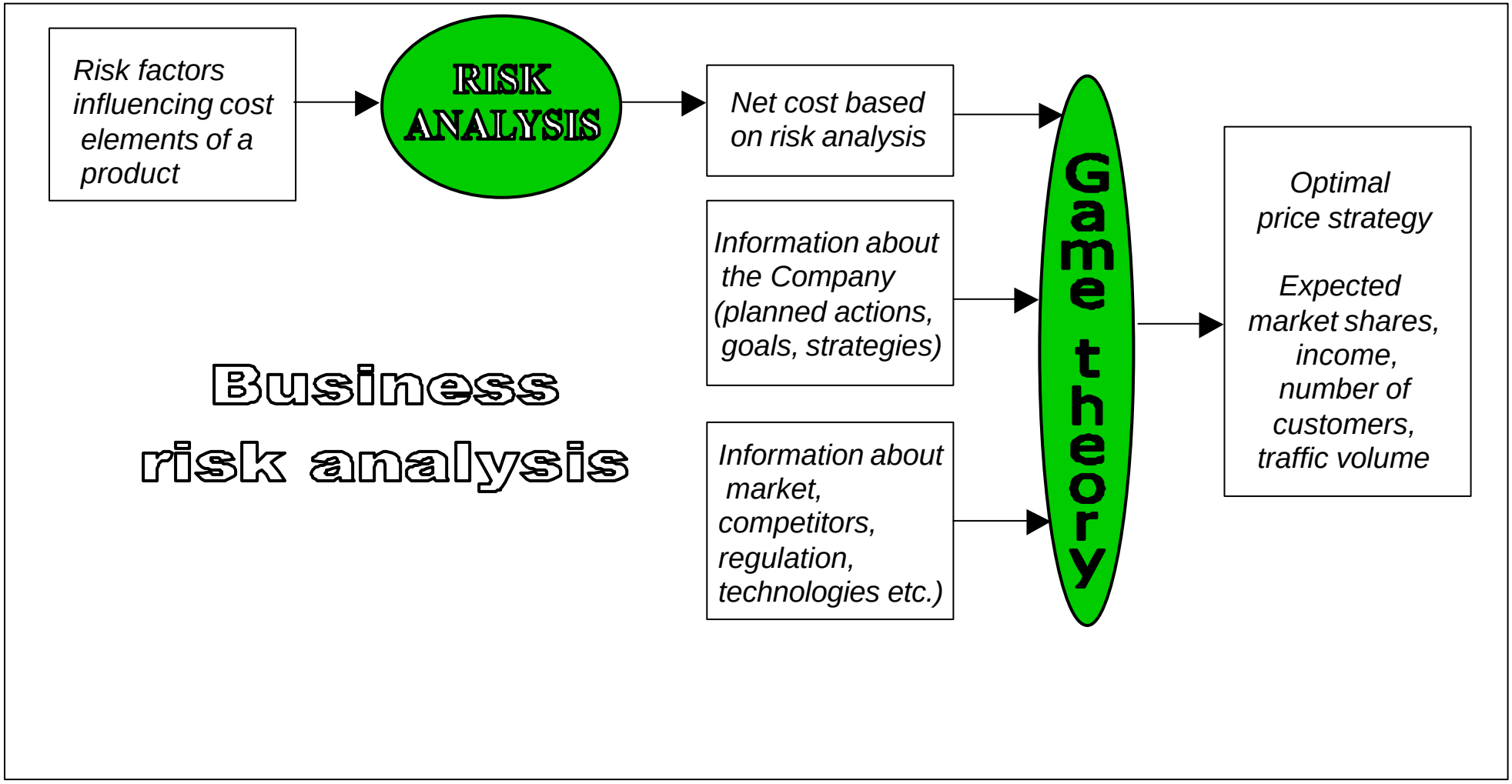
The process of risk analysis (7)

- *Values of Monte-Carlo simulation compared to the values calculated before risk analysis*

	Ft
Total cost before risk analysis:	*315 656*
Total cost after risk analysis:	*Mean value: 319 275*
	Standard deviation: 6 096
	(Range: 304 541 – 335 270)

- *The mean value for the net cost was used in the game theory model during the operative cash-flow calculation*

Relation between business risk analysis and game theory



Game theory model

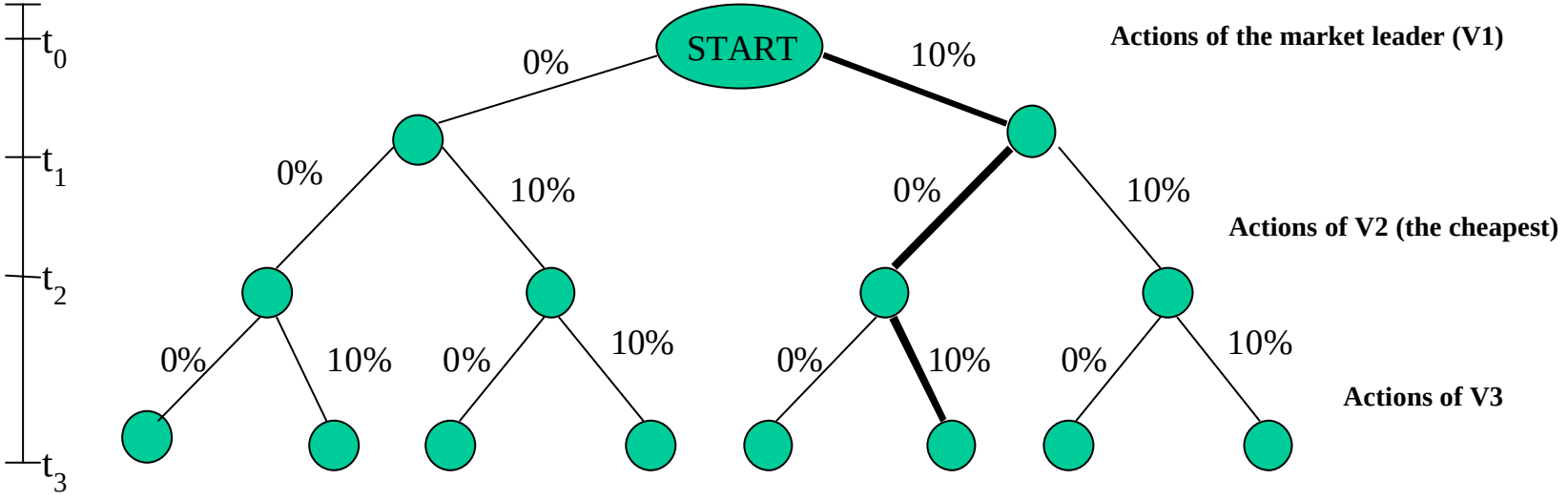
- ***Main goal:*** *to determine the value of the optimal price margin ensuring the maximal profit from sales activity in a competitive environment according to operative cash-flow*

- *In our case the following assumptions were made:*
  - *at the beginning the market leader determines its own price*
  - *later on the competitors may follow market leader*
  - *subscribers take into account other parameters concerning quality of services (e.g. service ability, time of installation)*

- *In the model we used the weighted sum of these figures to characterise the preferences customers will use when making a choice among the service providers*

Game theory model (2)

- ***The game in a simplified form***



Note: V2-212: pay-off function for V2 when V1 10 % price reduction, V2 0%, V3 10 % price reduction

Game theory model (3)

- ***Results gained from the model***
- *Tables show the profit arising from the operating cash-flow near to the equilibrium point*

V1 giving 0% price reduction

V1	*0%*	*V2*	
		0%	*5%*
V3	*5%*	***951 254***	***947 982***
		532 064	***529 233***
		771 084	***756 452***
	10%	***949 001***	***945 764***
		529 004	***524 808***
		775 479	***767 873***
	15%	***936 773***	***933 569***
		527 561	***522 263***
		778 258	***775 699***

V1 giving 5% price reduction

V1	*5%*	*V2*	
		0%	*5%*
V3	*5%*	***1 001 171***	***984 599***
		509 027	***505 332***
		746 211	***732 060***
	10%	***1 000 259***	***983 717***
		506 073	***503 678***
		750 120	***742 509***
	15%	***998 034***	***981 521***
		504 681	***502 136***
		748 667	***746 194***

Game theory model (4)

V1 giving 10% price reduction

V1	*10%*	*V2*	
		0%	*5%*
V3	*5%*	***1 032 253***	***1 021 990***
		493 942	***492 444***
		713 742	***700 005***
	10%	***1 030 490***	***1 016 253***
		491 083	***490 298***
		728 491	***721 355***
	15%	***1 025 685***	***1 015 474***
		489 740	***487 917***
		726 787	***724 391***

V1 giving 15% price reduction

V1	*15%*	*V2*	
		0%	*5%*
V3	*5%*	***1 034 293***	***1 029 547***
		485 676	***484 987***
		697 762	***684 173***
	10%	***1 036 543***	***1 025 394***
		482 866	***480 898***
		710 579	***703 527***
	15%	***1 028 254***	***1 020 553***
		481 559	***478 558***
		720 049	***717 690***

Winner strategies (0% dominant for V2, 10 % best solution for V2 and V3)

Game theory model (5)

- *In the tables we designated the cells representing the Nash equilibrium for V2 and V3 in case of a given strategy of V1 by changing the background of those cells.*

- *Nash equilibrium means a set of strategies from which it is no worthwhile to alter, because in cases when V2 or V3 alters unilaterally, it will surely provide worse result.*

- *From the tables it can be confirmed that the **winner strategy** set for V1,V2 and V3 companies will be the **10%,0% and 10 % price reduction respectively***

Results gained by using business risk analysis and game theory

- *Optimal price strategy can be determined using the main characteristics of the net cost distribution gained in risk analysis*

- *From this the optimal price margin can be derived. (m)*

  m = p/c where:

  p: price of the product containing the price reduction suggested the game theory model

  c: net cost of the product containing the result of risk analysis

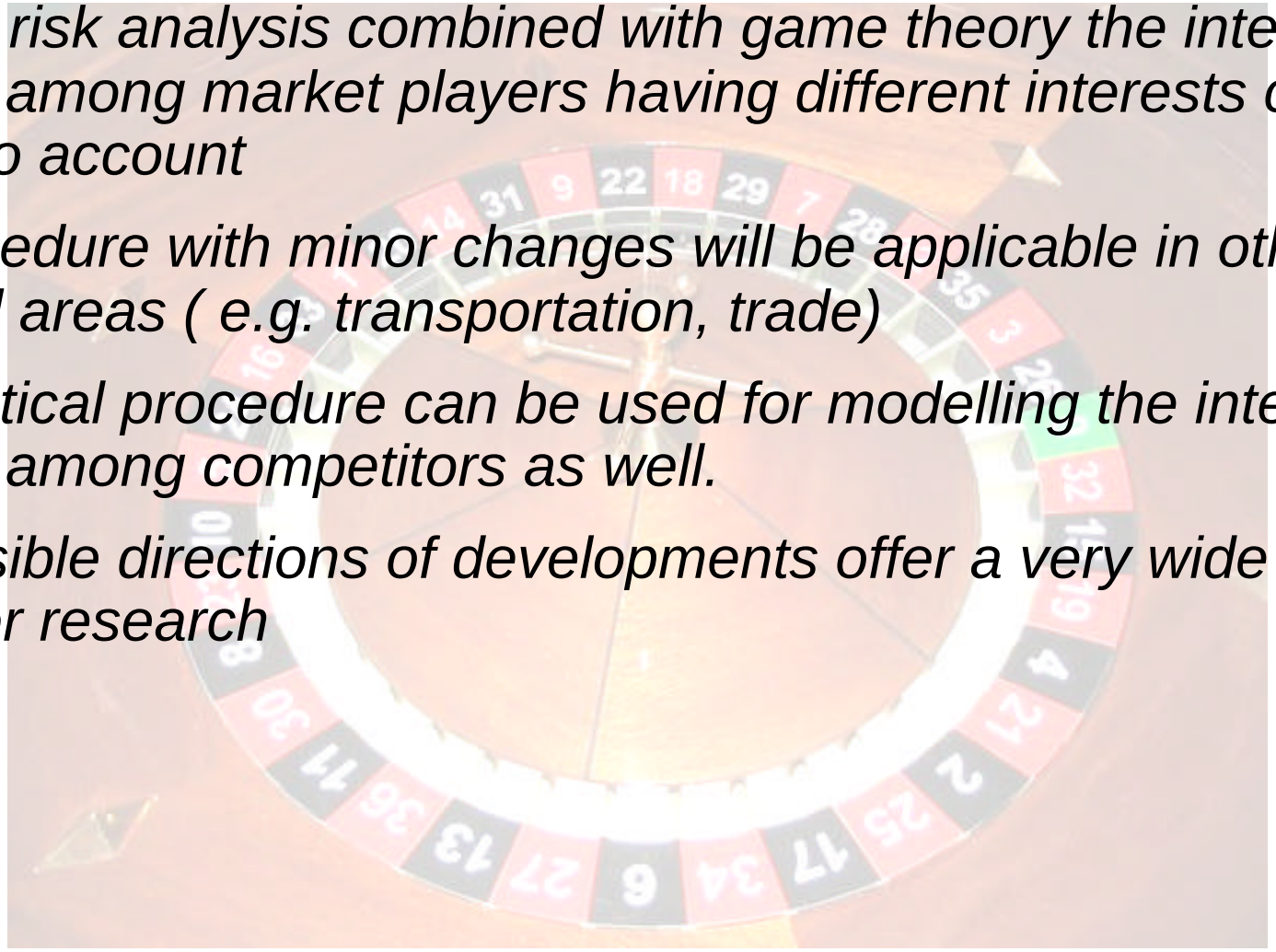
- *This information can be used both*

  - in the determination of the list price, and

  - it is also useful for the sales staff to decide on the range for price reduction that can be given e.g in case of tender.

Summary

- *By using risk analysis combined with game theory the inter-relations among market players having different interests can be taken into account*
- *The procedure with minor changes will be applicable in other industrial areas (e.g. transportation, trade)*
- *The practical procedure can be used for modelling the inter-relations among competitors as well.*
- *The possible directions of developments offer a very wide scope for further research*



Thank you very much for paying attention!

Questions? Comments?