On the Quantification of Value Networks: A Dependency Model for Interconnection Scenarios

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ETICS

Value Network Research

- **Internal view on firms:**
  - **Business models** → e.g. in [1], [2]
- **External view on firms** (inter-firm relationships):
  - **Value chains**: Sequential value creation
  - **Value Networks (VNs)**: Non-sequential value creation → e.g. [3], [4]
  - **Value Models (VMs)**: (Visual) representations of VNs → e.g. e3Value [5]
- Today, **Value Network Analysis** is subject to the available **qualitative mechanisms**

Quantification of VNs

- There are **no quantified answers** to questions like

  What is the power uptake of entity e in the VN? What VN is beneficial to entity e?

- **Contribution**:

  - A **quantified dependency model** for VNs, i.e. a measurement of entities dependencies on the VN through **dependency indicators**

  - Based on **known concepts**, e.g. Value Models, Porter's 5 Forces [6], etc.

  - **2-step process**: *(1)* Enhanced VN representation, *(2)* Dependencies quantification

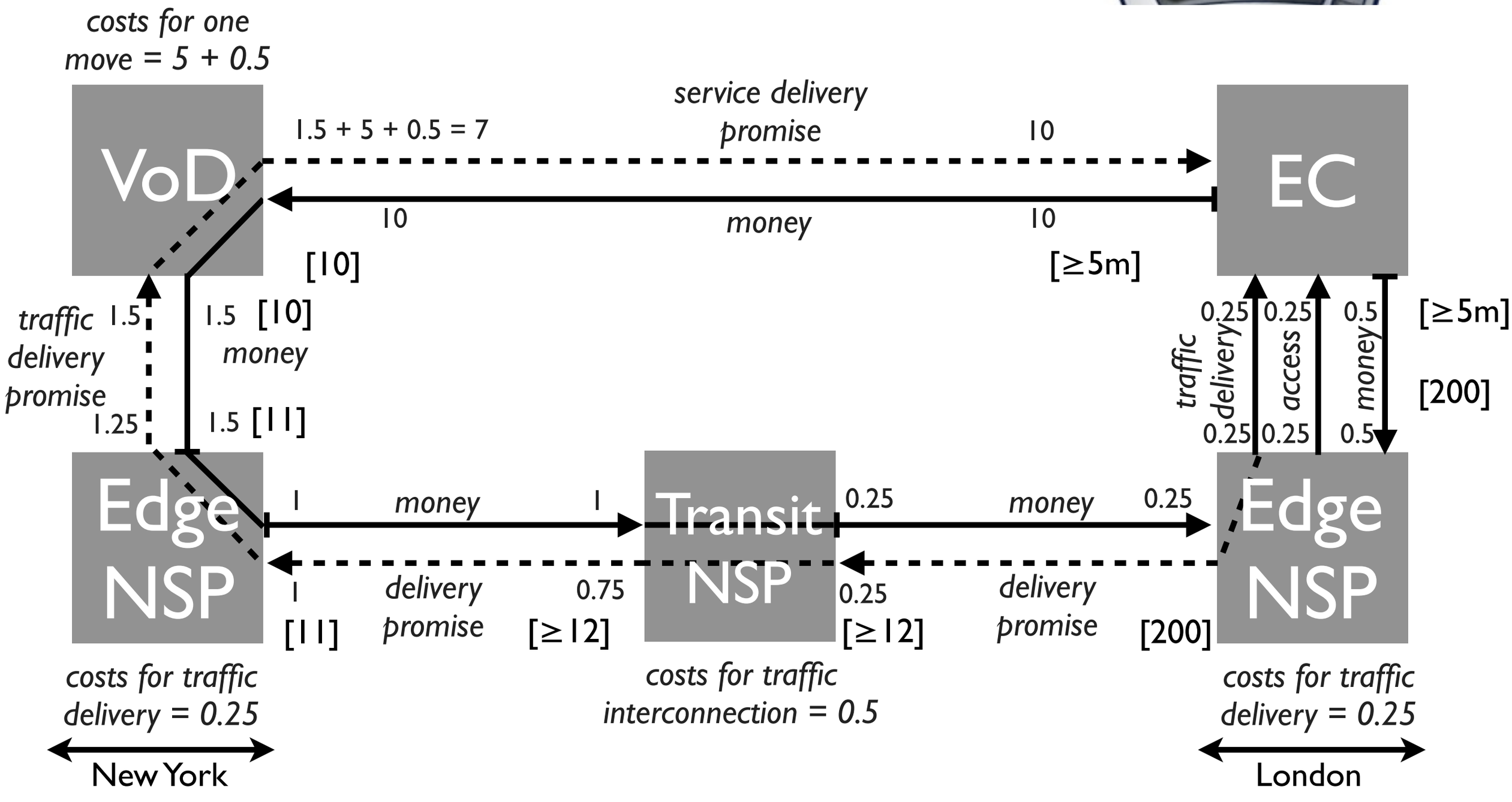
1. Value Network Dependency Models (VNDM)

- **Extension** of **Value Models** for the means of dependency quantification
  - **Costs** (common and assigned costs)
  - Resource **values**
    - **Cardinalities** as indicator for industry rivalry:

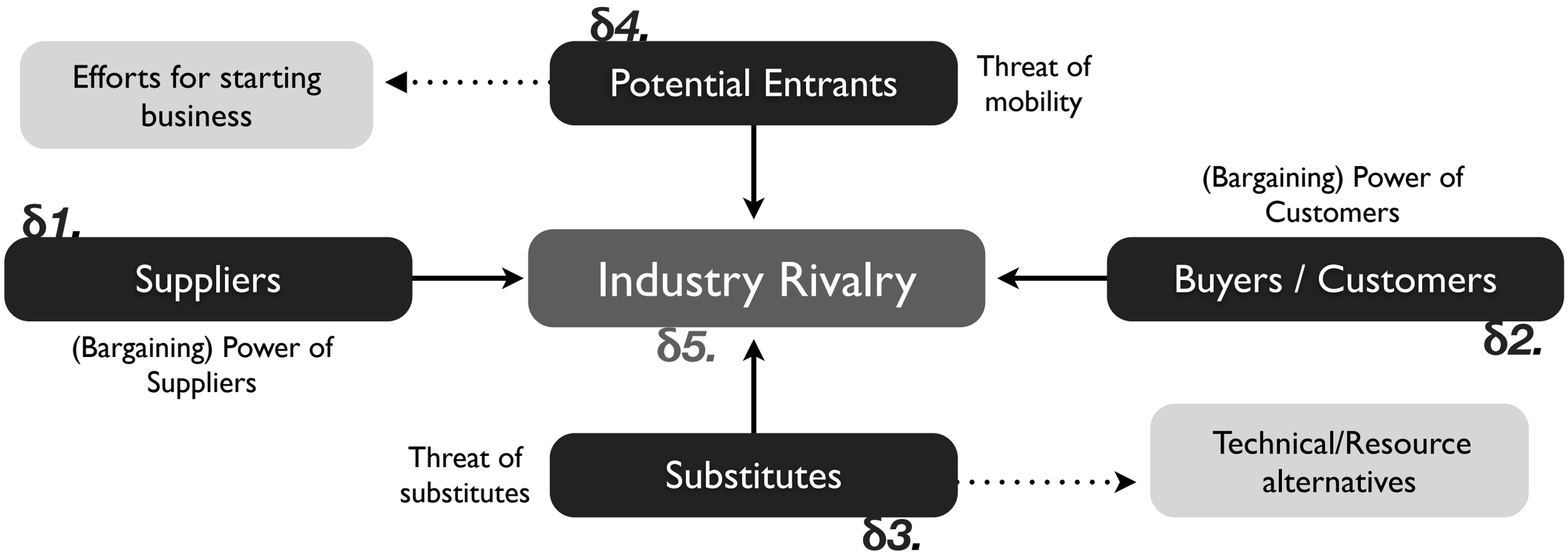
      i.e. the more instances of one entity, the more competition

- A simplified **resource type differentiation** of [7] is used, i.e. *money, uncustomised goods, customised goods, promises/requests/treaties/etc., and intangible assets*

Interconnection Services: Video on Demand (VoD)



2. Dependency Indicators: Porter's 5 Forces



- **Porter's 5 Forces** are adapted for **VN**s as **5 dependency indicators** (entities dependency on the VN)

- A **resource type** analysis forms the 6th indicator

δ1+2. Bargaining Power of Suppliers+Customers

- Based on the **value distribution** of an entity's (δ1: incoming; δ2: outgoing) relationships

  The higher the share of a relationship's value of all values of one entity's relationships, the higher the dependency on this relationship

- Measured with the help of the **Gini coefficient** from information theory (efficiently calculable):

$$p_r^{e,in} := \frac{\varphi(r)}{\sum_{k \in R^{e,in}} \varphi(k)} \tag{1}$$

$$gini(R^{e,in}) := \sum_{r \in R^{e,in}} (p_r^{e,in})^2 \tag{2}$$

$$\delta_1^e := \frac{gini(R^{e,in})}{\max_{j \in E}\{gini(R^{j,in})\}} \tag{3}$$

δ3+4+5. Substitution / Market Entrance / Rivalry

- **δ3. Substitution**: Relative costs for **substituting** the **relationship** of entity *e*

$$C_s(e) := \sum_{r \in R^{e,out}} (c_s(r) * p_r^{e,out}) \tag{4}$$

$$\delta_3^e := \begin{cases} 1 - \frac{C_s(e)}{\max\limits_{j \in E}\{C_s(j)\}}, & if \max\limits_{j \in E}\{C_s(j)\} \neq 0 \\ 1, & otherwise \end{cases} \tag{5}$$

- **δ4.** Pot. **Market Entrance**: Relative costs for **replacing** an **instance** of *e*

- **δ5.** *Industry **Rivalry** (**implicit**): Analysis of relationships' cardinalities,*

  i.e. the more instances of one entity, the more competition

  (value specific biases are eliminated similar to Equation (1))

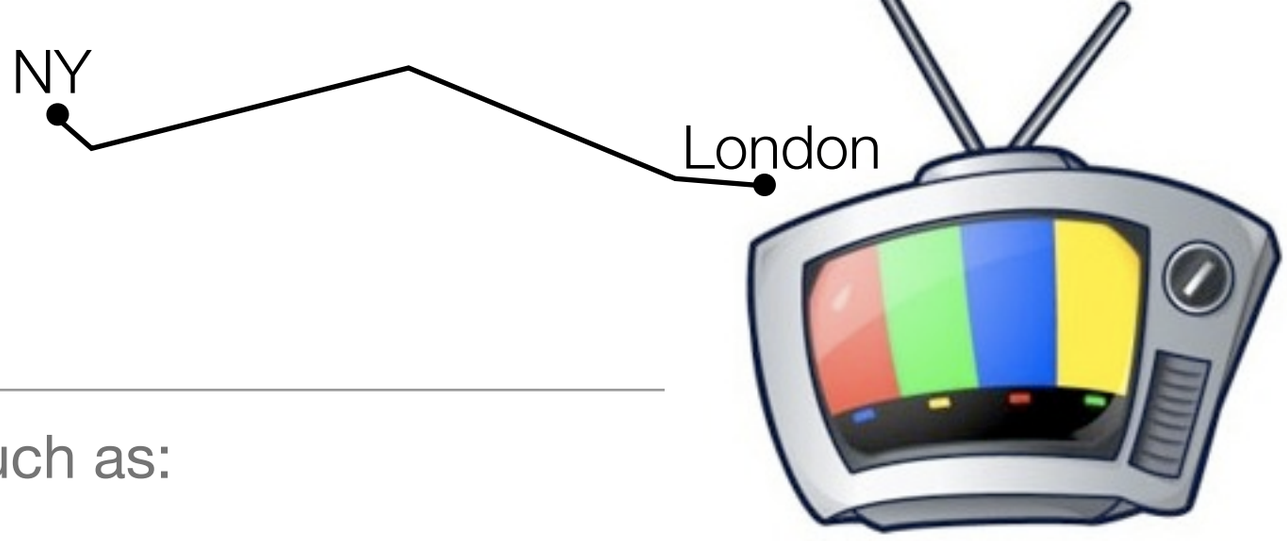
δ6. Resource Type Dependency

- **δ6. Resource type** dependency:

  The more specific goods (exchanged via a relationship r) are, the higher the dependency of one entity on relationship r.

- **Finally, aggregation and weighting of the indicators:**

$$\Delta^e = \sum_{i=1}^{6} w_i * \delta_i^e$$



Case Study: VoD

- **Several assumptions** necessary such as:
  - **$10** per streamed movie / **$5** for the movie producer / **$2** transmission + platform
  - **200** Edge NSPs (access) in London; **11** major Edge NSPs in USA; **12** known Tier-1 transit providers
  - Substitution costs assumed by an analysis of alternatives; Market entrance was inferred from infrastructure investment costs
- **Results**:
  - **High dependencies** for **end customers** (*0.67*), and **Transit NSPs** (*0.64*)
  - **Low dependencies** for Edge NSPs (VoD-NSP: *0.47*; EC-NSP: *0.31*)

Conclusion

- Literature has concentrated on qualitative VN analysis
- Our approach quantifies VNs through **6 dependency indicators**

  from **well-established concepts** (Porter's 5 forces, and other literature)

- **Case Study**: Quantification of a **VoD interconnection** scenario (with assumptions)
  - **Transit NSPs**: **Very dependent** on the VN → VN remodelling may be realistic
- **Future work:** Utilise this model for **bargaining solutions** + verify and optimise the project through the analysis of **historic VN evolvements**

Thank you ...

- ... any questions?

[1] Timmers, P.: Business Models for Electronic Commerce. Electronic Markets 8(2) (1998)

[2] Teece, D.J.: Business Models, Business Strategy and Innovation. Long Range Planning 43(2–3) (2010) 172–194

[3] Hakansson, H., Snehota, I.: No Business is an Island: The Network Concept of Business Strategy. Scandinavian Journal of Management (1989) 187–200

[4] Normann, R., Ramirez, R.: Designing Interactive Strategy: From the Value Chain to the Value Constellation. John Wiley & Sons (1994)

[5] Gordijn, J., Akkermans, H.: E3-value: Design and Evaluation of e-Business Models. IEEE Intelligent Systems 16 (4) (2001) 11–17

[6] Porter, M.E.: How Competitive Forces Shape Strategy. Harvard Business Review 102 (1979)

[7] Biem, A., Caswell, N.: A Value Network Model for Strategic Analysis. In: Proceedings of the 41st Annual Hawaii International Conference on System Sciences. (2008) 361–367