THE LAW OF CONSERVATION OF ENERGY TOWARDS DEFINING MARITIME CLUSTER DYNAMICS

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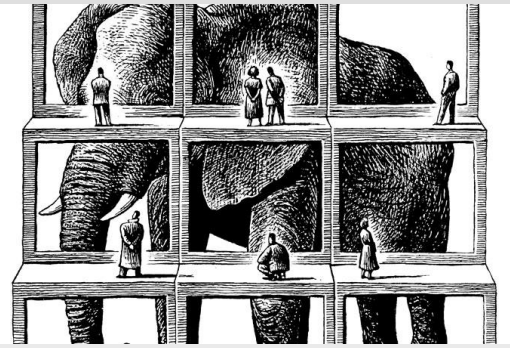
Context and methodology



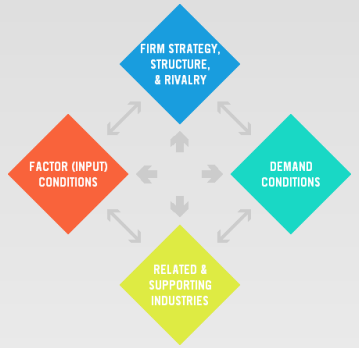
- Maritime clusters are the cornerstone of **competitiveness** for regional and national economies
- At the same time, it would seem that industrial clusters are **riddled with contrast**
- They provide a fertile ground for **strategic management,** but little is known of their **rudiments**:
  - Through literature review
  - A model formulation is attempted

➢ To address governing **cluster dynamics**

Cluster theory and paradox

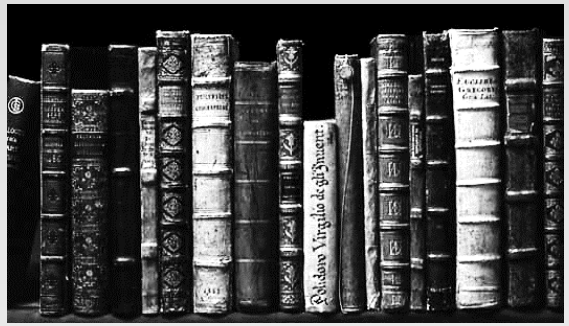
- **Paradox** is inherent in the theory of industry clusters
- Alfred Marshall (1890/1920) is widely accepted as the forefather of industrial cluster theory:
  1. better access to skilled labor
  2. specialized suppliers
  3. knowledge spillovers
- **Stochastic paradox** “are as it were in the air...” mention referring to trade skill-set acquisition deriving from localization

From Smith to Porter



- Adam Smith's '**invisible hand**' and '**domestic industry**' could signify components of a clustered industry
- Reconciliation of individual interest with **collective prosperity** (a central cluster characteristic)
- Porter's '**location paradox**', present when globalization can co-exist with locational complementarities
- Paradoxically, "competitive advantage within the global economy seems to be local"

Literature review extracts

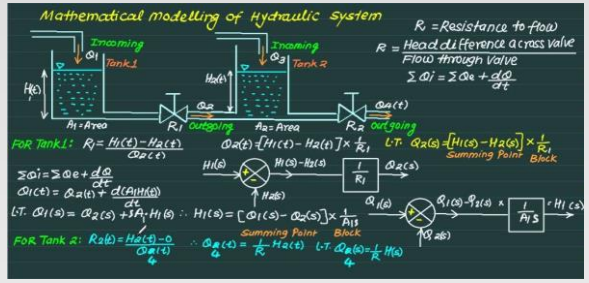


- Industrial clusters are a **function** of:
  1. Innovation
  2. Culture
  3. Trust and communication
  4. Competition and cooperation
  5. Oversight and policy
  6. Linkages and/to physical conditions
  7. **Intrinsic paradox**
- Literature addressing paradox is limited
- How could we begin to **explain/model** clusters' paradoxical components?

Case selection: maritime clusters

- To develop a model, a **cluster type** has to be selected, to specify a domain to analyze
- The maritime industry has a significant effect on **regional economies**
- Maritime clusters are:
  - **Indicative** agglomerations of firms, active in the maritime sector
  - Source of regional and national **competitive advantage**
  - Provide dynamic case studies for **strategic management** topics

Initial reasoning



- Within a given region, with finite resources, **many entities can be found to prosper**
- These cluster entities share **conflicting stakes**
- How are these finite resources distributed **with no depletion threatening** the health of the cluster or its members?
- **Paradoxical behavior**, at least for ‘orthodox’ economics
- Scarcity paradox, within an **isolated geographical system**
- Violation of the **scarcity principle**

Scarcity principle

- An **elementary** concept for modern economics
- ➢ Nevertheless, it is **violated** within a maritime cluster, where an **abundance of conflicting stakes** can thrive simultaneously
- Culture of trust **transforms stakes** to factually striving for innovation, **instead of zero-sum** eventualities
- Innovation is one of the components that **explains the scarcity paradox**, since new markets are created
- ➢ Does the **system of innovation violate** the scarcity principle?

Scarcity modelling

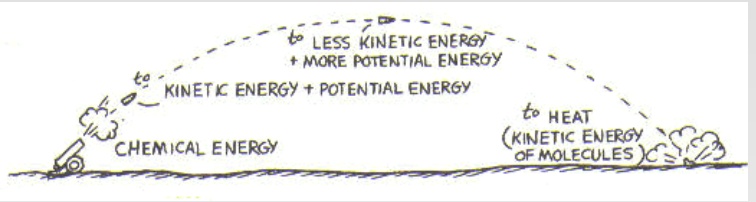
- Assumption that scarcity may be modelled through **fundamental laws** of other scientific domains
- Then we would search for a **conceptual parallel** with a stable amount of resources to be consumed, within a given region

➢ Scarcity is the **economics' equivalent** of the law of conservation of energy

➢ In an isolated system, the energy sum equals a constant

$$\sum_{i=1}^{n} E_i = const\ .$$

Conservation of energy



- **Fundamental** concept of physics
- Within a **closed system**, “the amount of energy remains constant and energy is neither created nor destroyed”
- “Energy can be converted from one form to another, but the total energy within the domain remains fixed”
- The **cluster equivalent** of the variable ‘**energy**’, is the variable ‘**resource**’
- How does a cluster manage resource allocation, without violating the first law of thermodynamics?

The energy analogy

- To answer the question, we must dig deeper within the components of the law:

$$\sum_{i=1}^{n} E_i = const\ , n\ \epsilon\ \mathbb{N}\ .$$

- Some examples of the energy variable:
  1. Kinetic (K)
  2. **Potential (P)**
  3. Mechanical (K+P)
  4. Thermal (microscopic mechanical)

- Would we consider **potential resources** within a maritime cluster?
- The function of innovation does exactly that, it **uncovers potential resources**
- They were there all along, but were not visible until **innovation came into focus**

The concept of potential energy

- Rankine **introduced** it in the 19th century
- **Philosophical basis** in Aristotle's dichotomous principles of **potentiality and actuality**
  - Potentiality: **possibility** (δύναμη, strength)
  - Actuality: **materiality of possibility** (ενέργεια, energy)
- If resources are concerned, all the **potential resources** are included within a region (potentiality)
- Innovation transforms **potentiality into actuality**

Modelling scarcity

- The scarcity principle

$$\sum_{i=1}^{n} R_i = R_1 + R_2 + \cdots + R_n = const,\ n \in \mathbb{N}\ .$$

- Whereas with **potential** resources we have two sums

$$\sum_{i=1}^{n} R_i + \sum_{j=1}^{m} PR_j = const\ .$$

- Both sums are equal to a constant

Modelling with potential energy

- Theorize that clusters may uncover **potential resources in perpetuity** ($n \longrightarrow \infty$), through **cyclical innovation**
- The **summation** of the potential resources would be **infinite**, and **equal to a constant**

$$\sum_{n=1}^{\infty} \mathrm{PR}_n = const\ .$$

- We can **assume** that there **exists a series** $\sum_{n=1}^{\infty} \mathrm{PR}_n$ which converges to the **same constant**

Conclusions

- Innovation seems to **reinforce the conceptual infrastructure** of the law of conservation of energy
- The model intrinsically supports and explains the maritime cluster's **culture of mutualism**
- Since the sum of resources has to remain **constant**, we consider **undiscovered potential resources** that **theoretically** may remain endless

➢ The model generates an **infinite summation that converges**:

$$\sum_{n=1}^{\infty} PR_n = const\ .$$

Limitations and future directions

- All **limitations** of modelling are included within
- Assumptions and allowances may **limit the applicability** of the model

➢ Extension of **thermodynamic principles** in the domain of strategic management modelling

➢ Investigate **specific cases of converging infinite series** that may model potential resources within a maritime cluster

Thank you for your attention!

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