Activity-based analysis of socio-technical systems and organisational dynamics

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ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΑΤΡΩΝ

Κοινωνικο-τεχνικά συστήματα

- Αντίδραση στις «ακρότητες» του τεχνολογικού αιτιοκρατισμού και του κοινωνικού αιτιοκρατισμού (κοινωνική μορφοποίηση της τεχνολογίας).

- Στοιχεία των κοινωνικοτεχνικών συστημάτων: τεχνολογία, άνθρωποι, οργανώσεις, φύλα, ομάδες ενδιαφερομένων, κλπ.

Κοινωνικο-τεχνικά συστήματα

- Δύο προσεγγίσεις:

  1. Έμφαση στις σχέσεις μεταξύ του τεχνικού συστήματος της παραγωγής και του κοινωνικού συστήματος της εργασίας (επίπεδο *οργανώσεων*).
  2. Έμφαση στις σχέσεις μεταξύ του τεχνικού συστήματος της παραγωγής τεχνολογίας και του κοινωνικού συστήματος της χρήσης της τεχνολογίας (επίπεδο *κοινωνίας*).

Κοινωνικο-τεχνικά συστήματα - Tavistock

Σχεδιασμός παραγωγικής διαδικασίας για αυξημένη παραγωγικότητα

Συμπεράσματα του Tavistock Group:

1. Απαιτείται συνδυασμένη βελτιστοποίηση του τεχνικού και του κοινωνικού συστήματος – απαλοιφή των ασυμβατοτήτων.
2. Ημι-αυτόνομες ομάδες εργαζομένων αποτελούν την καλύτερη οργανωτική μορφή της παραγωγής.

Κοινωνικο-τεχνικά συστήματα – Human-Centred Systems

- H.H. Rosenbrock, Ομάδα του UMIST

- Σχεδιασμός μηχανών με επίκεντρο τον άνθρωπο.
- Σχεδιασμός μηχανών που αναδεικνύουν και μεγεθύνουν τις ικανότητες των εργαζομένων – δεν αντικαθιστούν τους εργαζόμενους.
- Μηχανές «υφιστάμενες» των ανθρώπων.

Κοινωνικο-τεχνικά συστήματα – Τεχνολογική αλλαγή

- Πεδίο έρευνας:
  Πως πραγματοποιούνται μεγάλες τεχνολογικές αλλαγές (μεταβάσεις-transitions), π.χ. η μετάβαση από το ιστιοφόρο πλοίο στο πλοίο με ατμοκινητήρα, η μετάβαση από τις μεταφορές με κάρο στις μεταφορές με αυτοκίνητο.
  Περιλαμβάνεται στην ανάλυση και η πλευρά της χρήσης της τεχνολογίας.

Κοινωνικο-τεχνικά συστήματα – Τεχνολογική αλλαγή

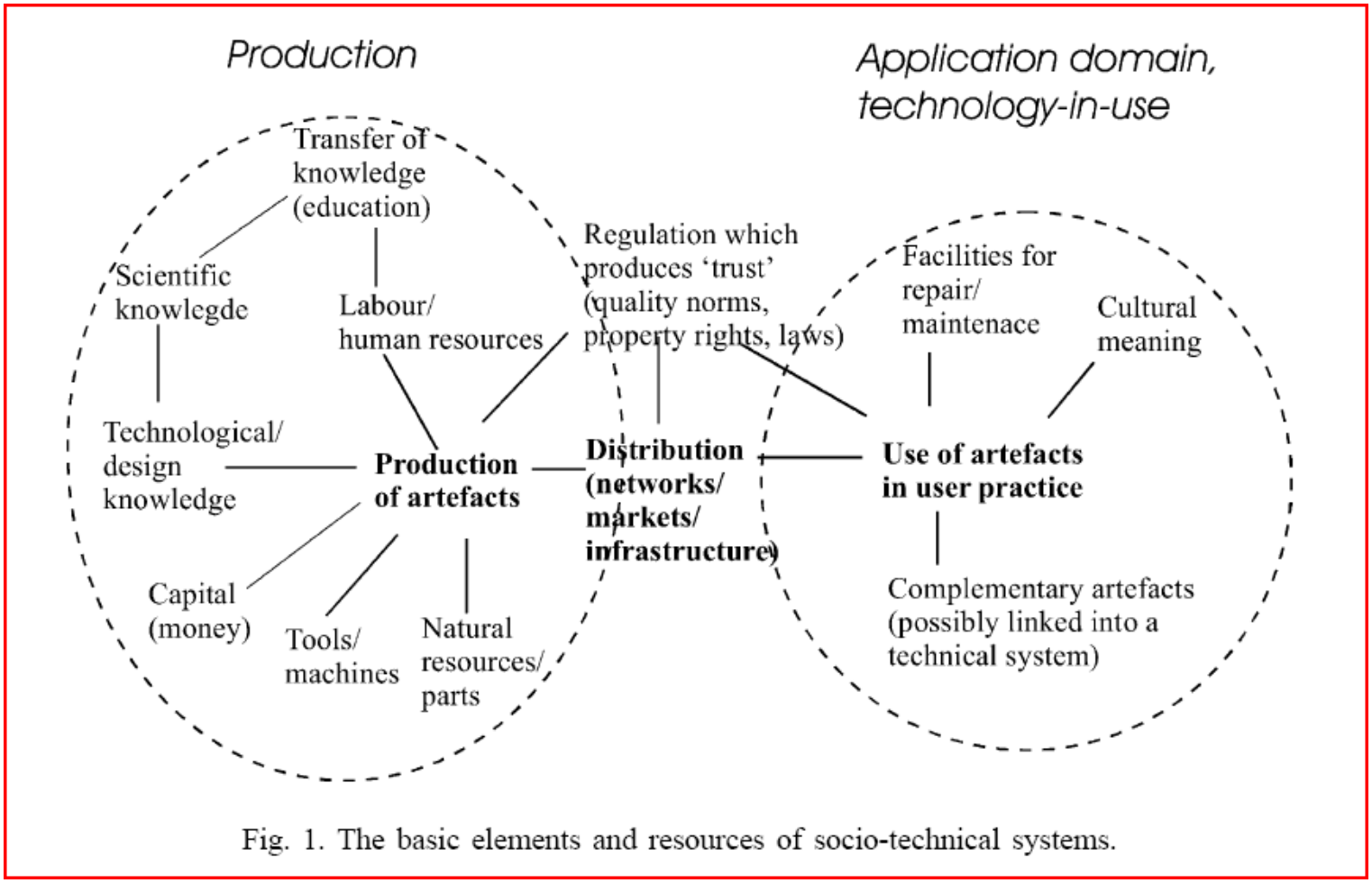


Fig. 1. The basic elements and resources of socio-technical systems.

Κοινωνικο-τεχνικά συστήματα – Τεχνολογική αλλαγή

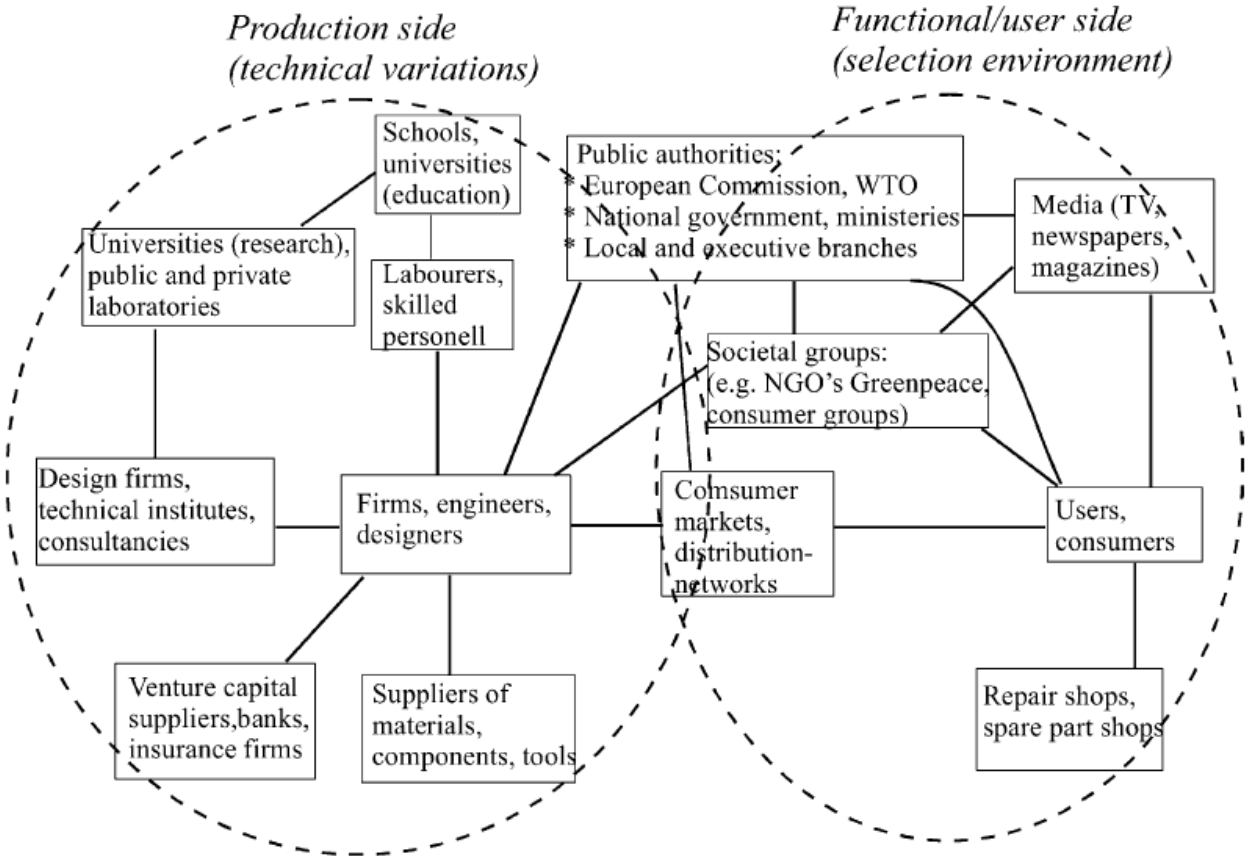


Fig. 2. Social groups which carry and reproduce ST-systems.

Understanding system innovation

- Socio-technical systems are intellectual devices to approach reality for understanding changes in "large-scale" societal processes in which technology is involved (*system innovations*)
- They have elements (inter)related to social and technological processes
- Different socio-technical system conceptualisations, as far as element composition and granularity are concerned
- *Models* of s/t systems and analytical processes to manage the complexity of reality

Understanding system innovation

- *Socio-technical systems conceptualisations:*
  - *are based on different ontological assumptions*
  - provide the basis for (plausible) explanatory narratives of how change is triggered, how it moves into specific directions, ...
  - focus inquiry processes for understanding change into specific *system elements* and *connections/relations*

Understanding system innovation

- Multi-Level Perspective (MLP): landscape, regime, niche
- "Arenas of Development" (AOD): *actor-worlds* (i.e. networks of humans, technologies, institutions, practices and visions)
- Social practice(s): artefacts, competencies and meanings

Understanding system innovation

HOW to gain knowledge about system innovation?

- MLP: identify niches that under pressure from social trends and institutions substitute regimes
- AOD: focus on human and non-human actors attracted by technologies to establish networks around them
- Social practice: find converging trajectories of artefacts, competencies, meanings and carriers/agents of change

Criticisms along the dimensions of agency-structure, production-consumption

Activity-based analysis of socio-technical systems innovations

BASIC IDEAS

- Socio-technical systems innovations are changes in the practices/activities of agencies associated with technology production and consumption processes
- We can construct knowledge about these innovations by examining changes in activities in a systematic way

Socio-technical systems as activity systems

- Conceptualisation of socio-technical systems as *activity systems*
- Ontological assumptions (practice theories)
  - world is made and remade in practice, using tools, discourse and our bodies
  - *interests* condition human behaviour
  - *power*, *conflict* and *politics* are very important in the analysis of social reality
  - power, conflict and politics are the determinants of large scale innovation

Activity Based Analysis (ABA) of socio-technical change

- Based on activity theory which has a systemic construct (activity) at its centre
- Activity theory maintains that in order to understand a variety of social phenomena, it is necessary to focus on the regimes of *mediated activity* at which individuals and organised associations of individuals are involved
- Relation between social and technical is formed during human objective-oriented activity that takes place for fulfilling a societal function - *the social and the technical are interwoven in a single construct*

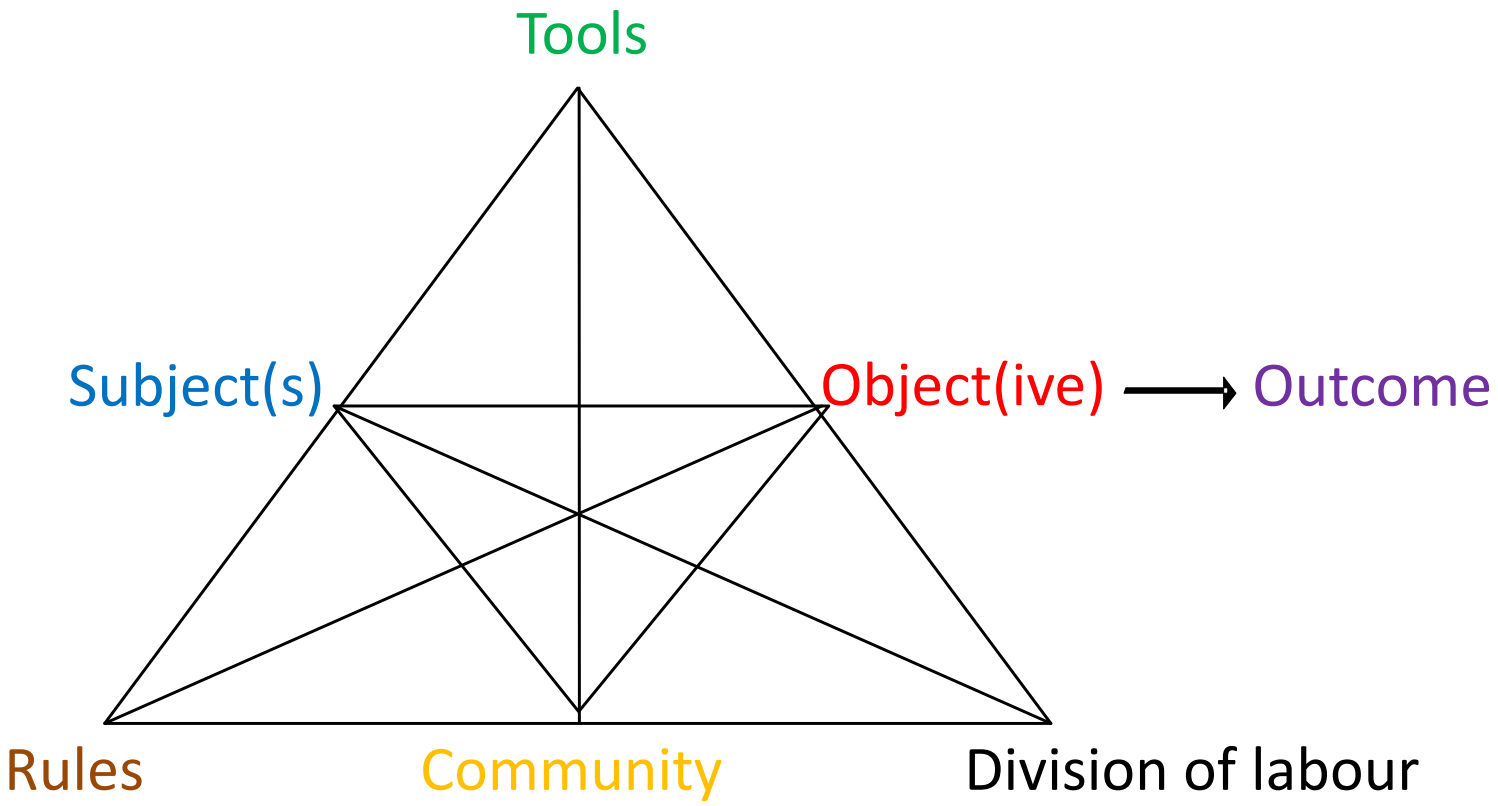
Activity theory perspective

- Change is the result of attempts to resolve inherent inconsistencies (***contradictions***) and tensions that develop between the *subject*, the *objective*, and the *mediating context* of the activity by dialectic and conflictual historical processes

Activity theory

- ***Cultural and Historical Activity Theory* (CHAT)** (Engeström, 1990)
- Activity + Context in a single construct
- *Mediation:* there is no direct interaction of agency and its historically-developed context/structure
- The inclusion of the subject, object and context in a single construct implies that ways of thinking and identities are not properties of individuals and organisations, but inherently social and cultural historical phenomena associated with activity
- Activity ("*magic triangle*" is the analytical lens of ABA)

Activity theory



Activity theory

- There is no objectless activity
- Each element performs a specific mediating function between the other two
- Activities are long term phenomena with no clear-cut beginning and end – they produce actions and are constituted by actions
- Activity systems enclose a *multitude* of points of view, histories, interests and practices that result in tensions and conflicts in the construction of the object – the objective orders behaviours within activity

Activity theory - contradictions

- *Contradictions* are historically accumulating structural tensions principally originating from interaction with, and influence from, other activity systems.
- An *expansive transformation* of the activity takes place when, after contradictions emerge, the object of the activity is reconceptualised to embrace a radically wider horizon of possibilities

Activity theory - contradictions

- *Primary contradictions* - manifested at the level of individual elements reflecting the tensions that stem from the difference between *use value* and *exchange value*
- *Secondary contradictions* - take place between two elements of an activity
- *Tertiary contradictions* - arise between new and old definitions of individual elements
- *Quaternary contradictions* - contradictions in the relations with neighbouring activities

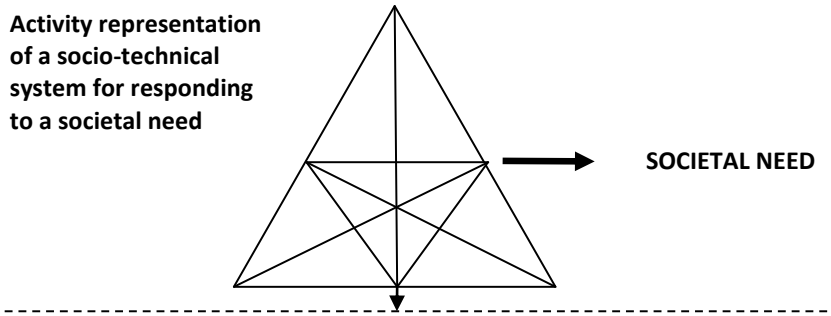
Socio-technical systems as activity systems

- Activities are in continuous tension due to diverse interests
- *Regimes* as relatively stable states in the evolution of the system are rather ideational constructs introduced for facilitating the analysis

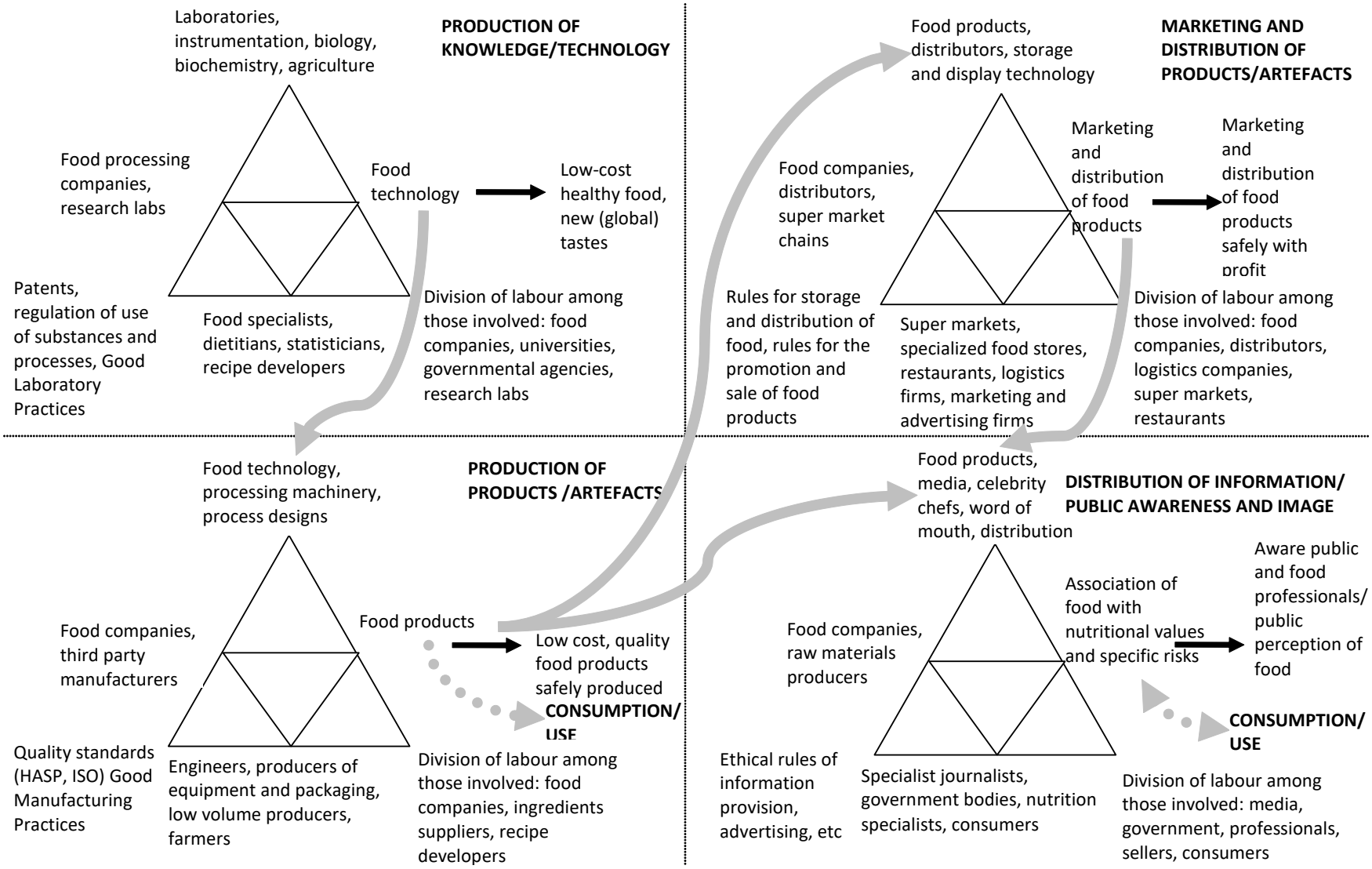
Socio-technical systems as activity systems - *ABA*

- *Constructivist epistemology*
- The "*magic triangle*" of activity moves up and down the activity hierarchy and across different activities, as the inquiry process unfolds
- Zooming-in to lower level activities is required to trace and understand change as a result of contradictions in a specific micro-activity
- "Lower level" activities (functional specialisation) are usually identified by considering the division of labour node

Socio-technical systems as activity systems - *ABA*



Μεταβάσεις – η προσέγγιση των συστημάτων δραστηριοτήτων



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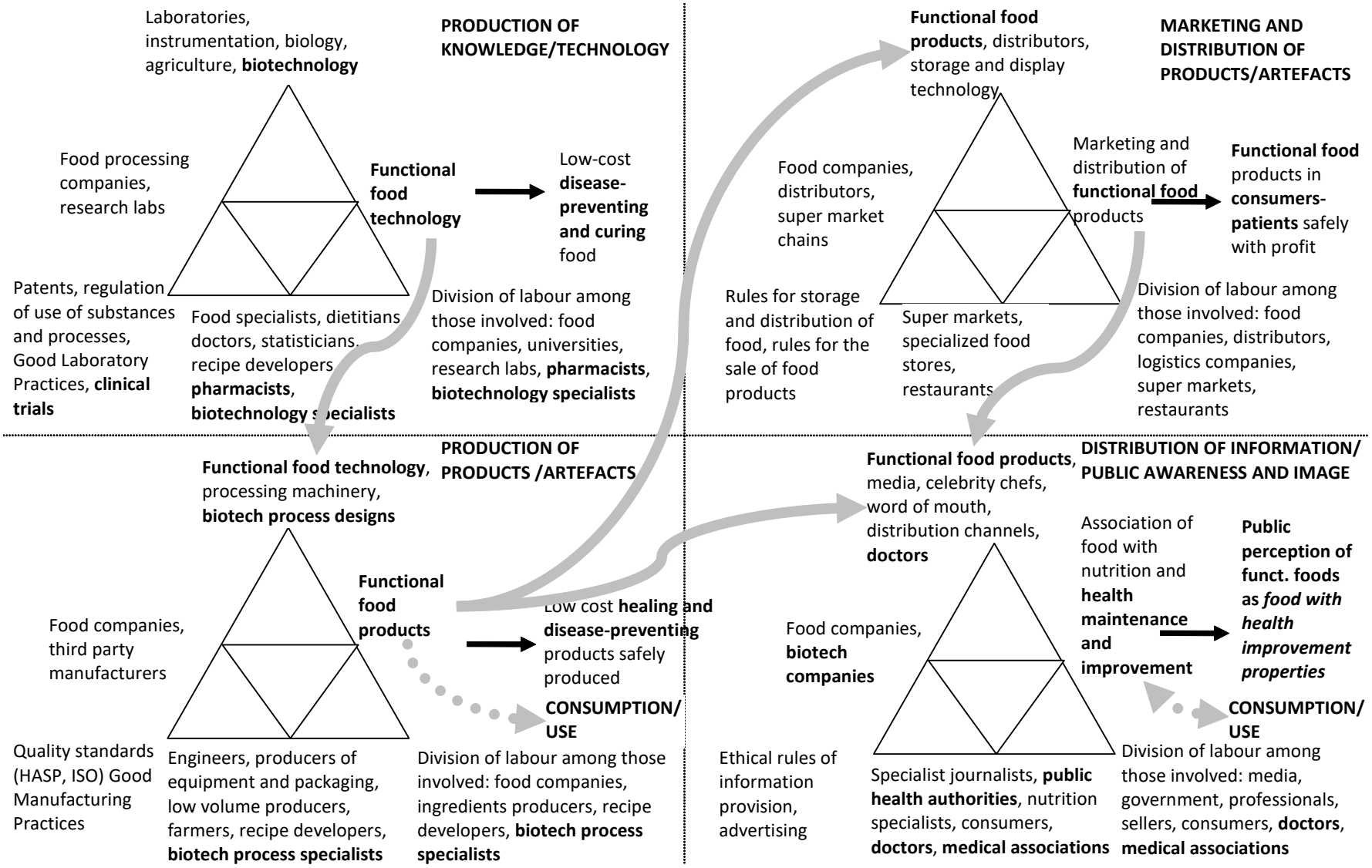

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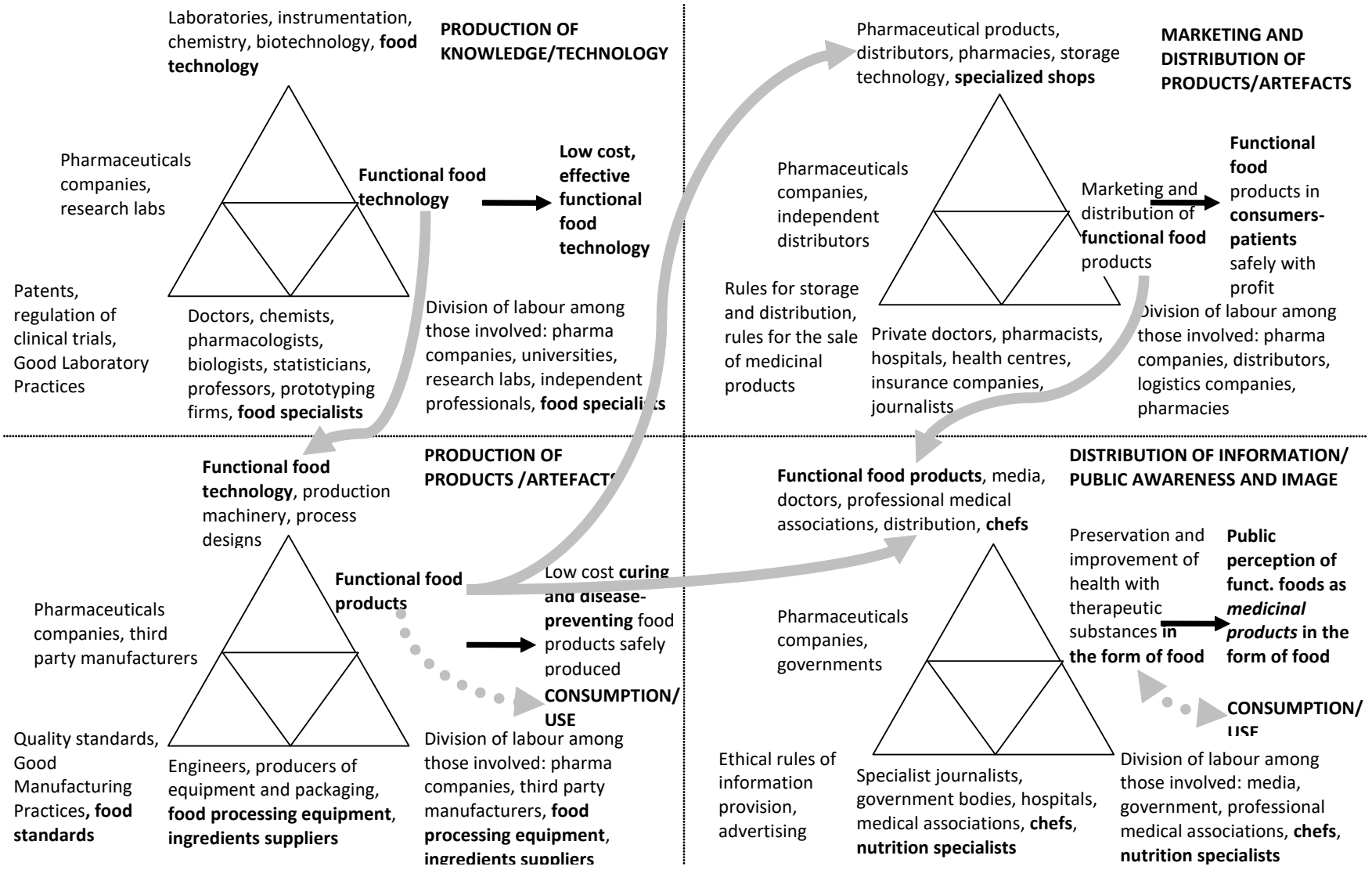

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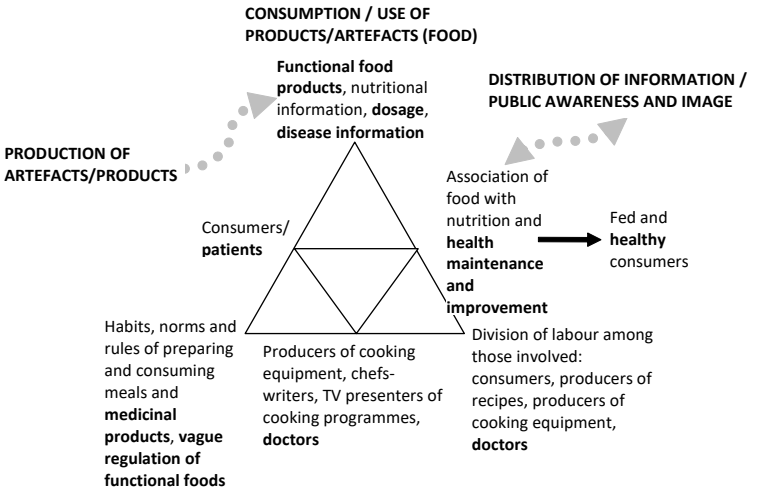
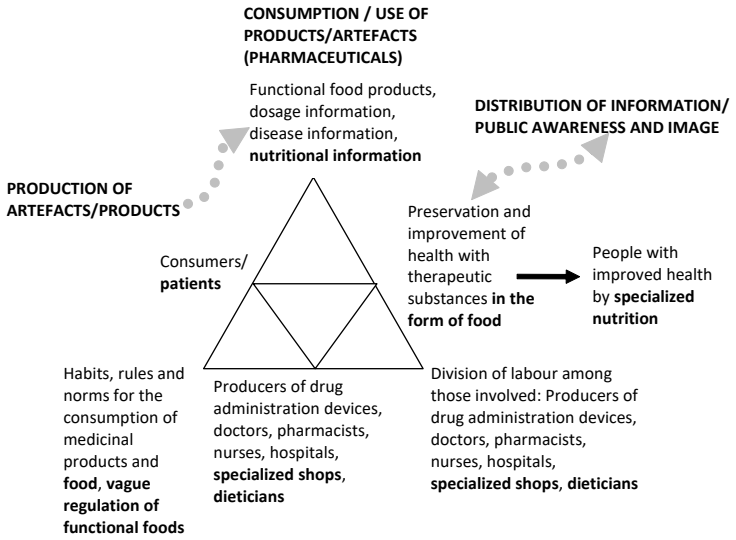
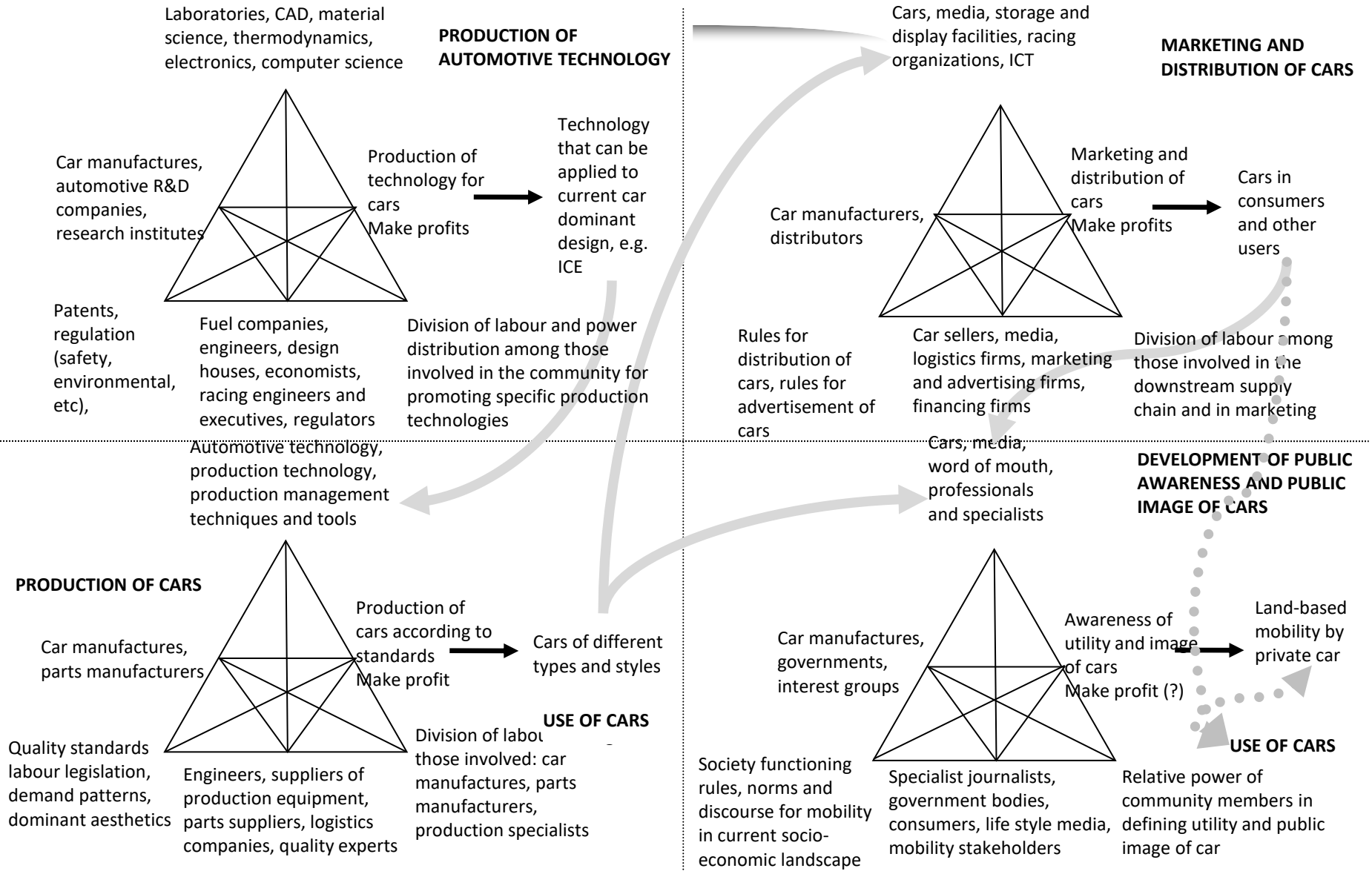
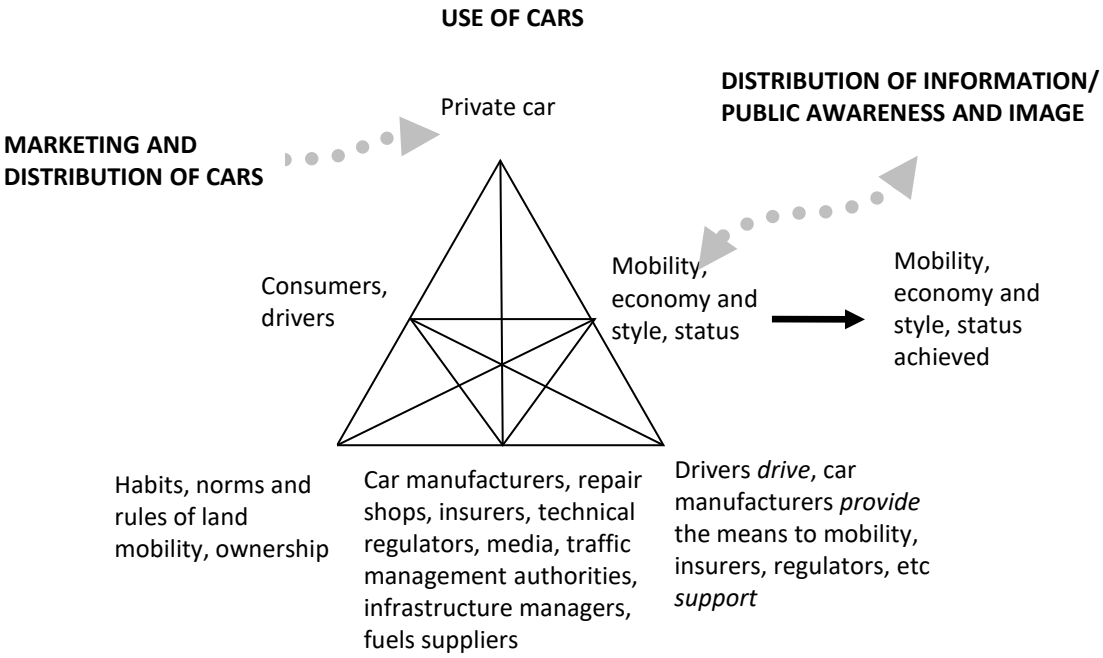





Laboratories, CAD, material science, thermodynamics, electronics, computer science
PRODUCTION OF AUTOMOTIVE TECHNOLOGY
Car manufactures, automotive R&D companies, research institutes
Production of technology for cars
Make profits
Technology that can be applied to current car dominant design, e.g. ICE
Patents, regulation (safety, environmental, etc),
Fuel companies, engineers, design houses, economists, racing engineers and executives, regulators
Division of labour and power distribution among those involved in the community for promoting specific production technologies
Cars, media, storage and display facilities, racing organizations, ICT
MARKETING AND DISTRIBUTION OF CARS
Car manufacturers, distributors
Marketing and distribution of cars
Make profits
Cars in consumers and other users
Rules for distribution of cars, rules for advertisement of cars
Car sellers, media, logistics firms, marketing and advertising firms, financing firms
Division of labour among those involved in the downstream supply chain and in marketing
Automotive technology, production technology, production management techniques and tools
Cars, media, word of mouth, professionals and specialists
DEVELOPMENT OF PUBLIC AWARENESS AND PUBLIC IMAGE OF CARS
PRODUCTION OF CARS
Car manufactures, parts manufacturers
Production of cars according to standards
Make profit
Cars of different types and styles
USE OF CARS
Quality standards labour legislation, demand patterns, dominant aesthetics
Engineers, suppliers of production equipment, parts suppliers, logistics companies, quality experts
Division of labou
those involved: car manufactures, parts manufacturers, production specialists
Car manufactures, governments, interest groups
Awareness of utility and image of cars
Make profit (?)
Land-based mobility by private car
USE OF CARS
Society functioning rules, norms and discourse for mobility in current socio-economic landscape
Specialist journalists, government bodies, consumers, life style media, mobility stakeholders
Relative power of community members in defining utility and public image of car


USE OF CARS
DISTRIBUTION OF INFORMATION/ PUBLIC AWARENESS AND IMAGE
Private car
MARKETING AND DISTRIBUTION OF CARS
Consumers, drivers
Mobility, economy and style, status
Mobility, economy and style, status achieved
Habits, norms and rules of land mobility, ownership
Car manufacturers, repair shops, insurers, technical regulators, media, traffic management authorities, infrastructure managers, fuels suppliers
Drivers *drive*, car manufacturers *provide* the means to mobility, insurers, regulators, etc *support*

Stimulating Innovation for Sustainability

Sources of contradictions in activities that may destabilize regime:

- Disturbance of the relation between use value and exchange value in object (externally induced)
- Introduction of novel actors in community that disturb the division of labour (and power structure)
- Changes in the rules that may disturb object (relation of use value and exchange value)
- Change in mediating instrument (artefact or ideational) and change in the definition of the subject of activity

Value in the activity perspective of socio-technical change

- Internal (*production*) perspective
  - Use value/exchange value
- External (*consumption*) perspective
  - “new conditions of existence” determine value (Durkheim)

THE EVOLUTION OF THE CAR MOBILITY SOCIO-TECHNICAL SYSTEM TOWARDS SUSTAINABILITY

Inertia – difficulty of change (Penna & Geels, 2015; Dijk et al., 2016)

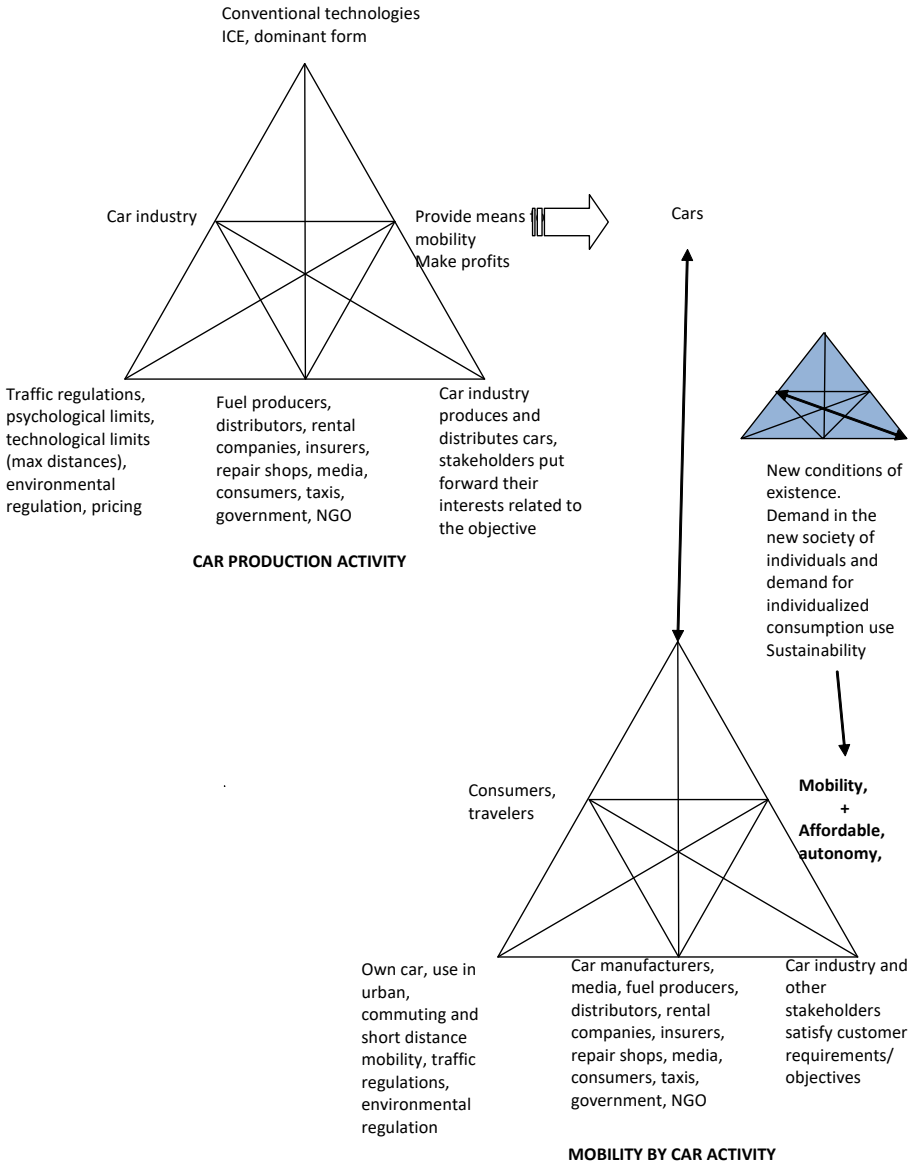
- No reframing of consumer perspectives
- No changes in social connotation of product technologies

→ "new conditions of existence" intensify user side regime

- No firms higher financial returns
- No technology spills over from other sectors
- No resource scarcity
- No regulation provides niche technologies with relative benefits

→ stable relationship between use value and exchange value

THE EVOLUTION OF THE CAR MOBILITY SOCIO-TECHNICAL SYSTEM TOWARDS SUSTAINABILITY



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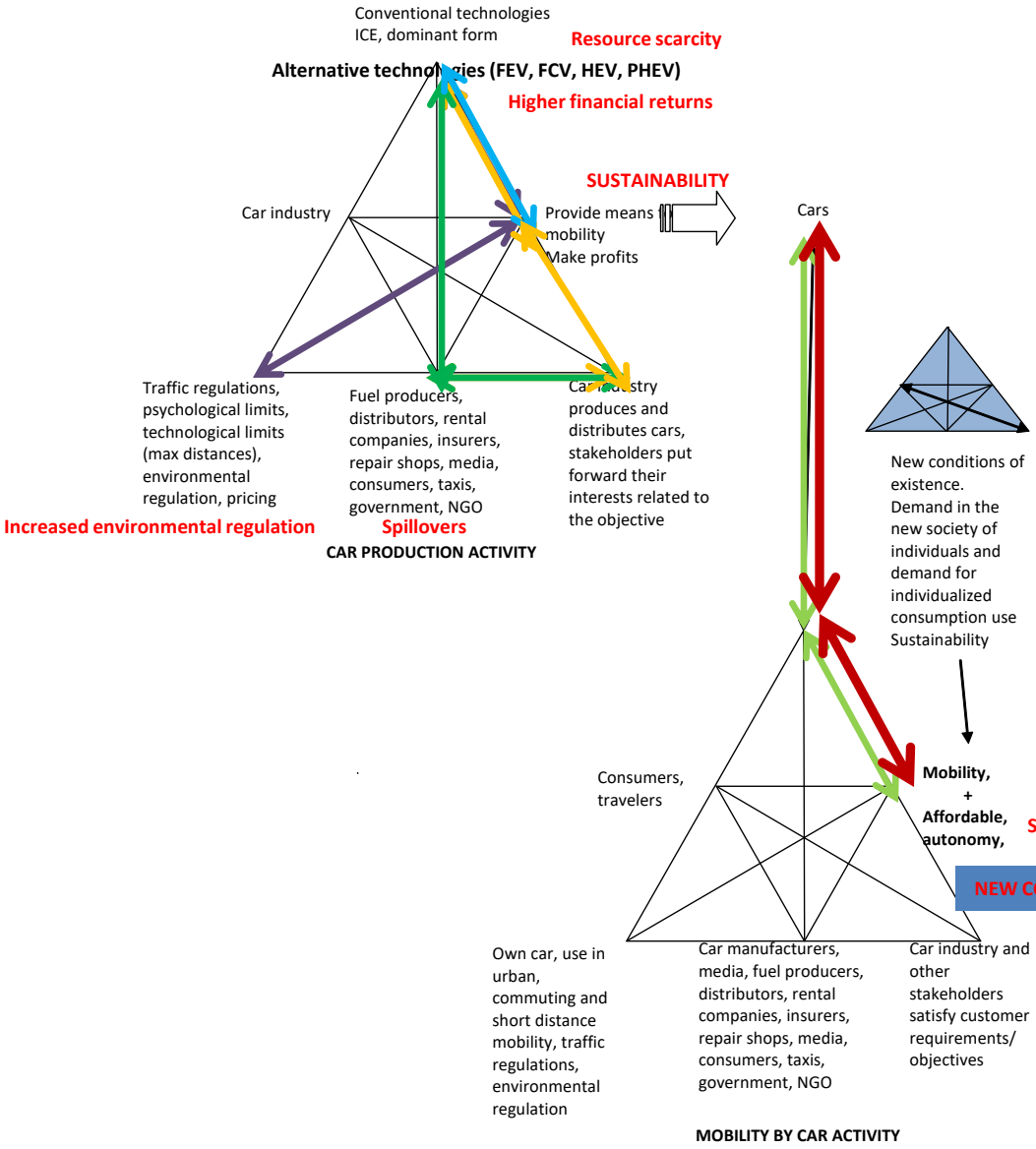

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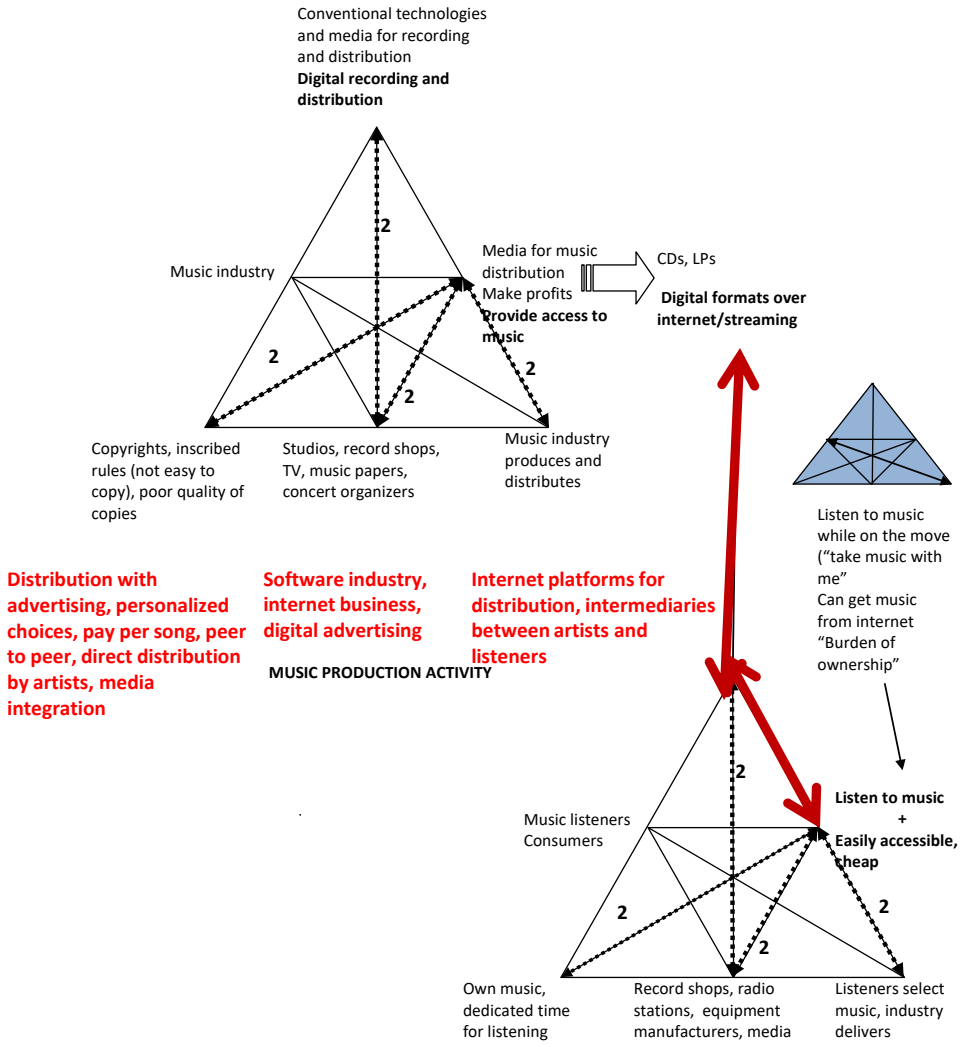


Socio-technical systems as activity systems - *ABA*

- The objectives of analysis are:

  i) the historically developed *contradictions* that initiated change in key activities

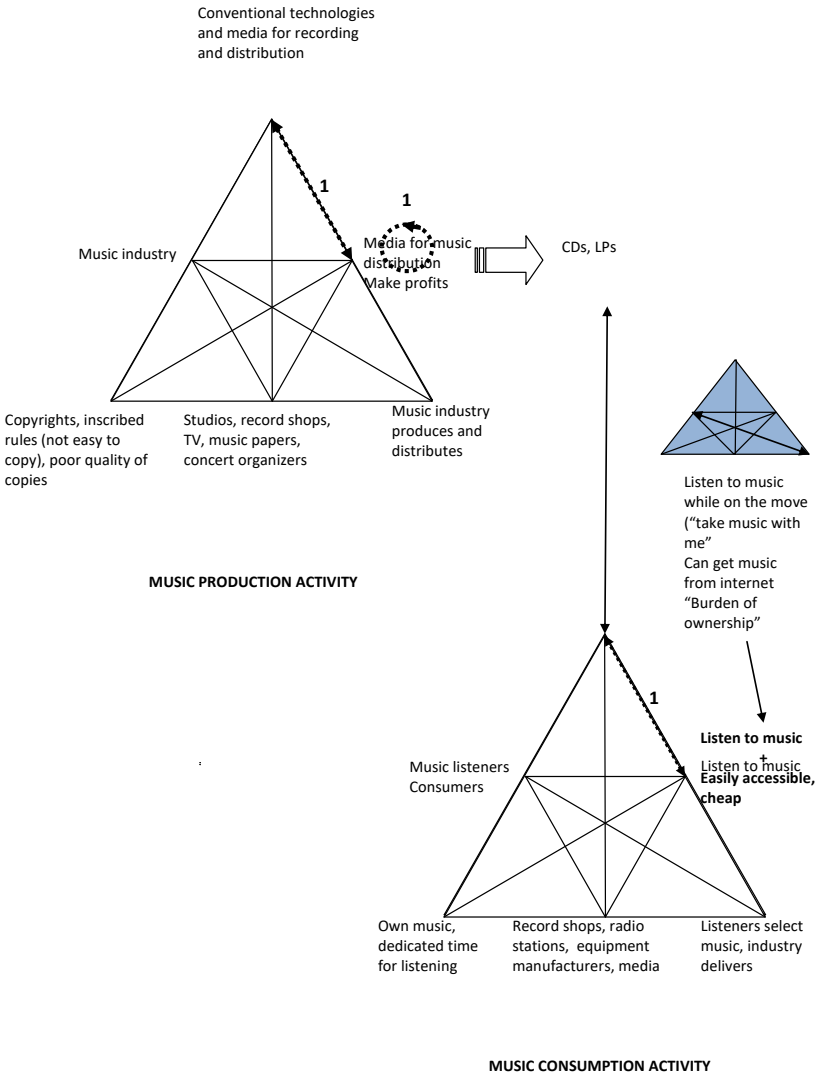
  ii) the *learning* and/or *adaptation* processes, through which these contradictions were resolved and resulted in the formation of a new activity configuration(s)

In CHAT and ABA, it is important to examine the historical development of a system/function/issue for understanding the dynamics of the elements in the related activities

THE EVOLUTION OF THE RECORDED MUSIC SOCIO-TECHNICAL SYSTEM TOWARDS STREAMING

- Personal stereos introduced music in the everyday activities of people, making listening a personal experience
- Downloading made possible for listeners to choose their own repertoire at the single song level
- Lifting the burden of ownership (financial, performance and social-based risks)
- Youth's approach to music is playful, short-term, social, very visual and mobile"

THE EVOLUTION OF THE RECORDED MUSIC SOCIO-TECHNICAL SYSTEM TOWARDS STREAMING



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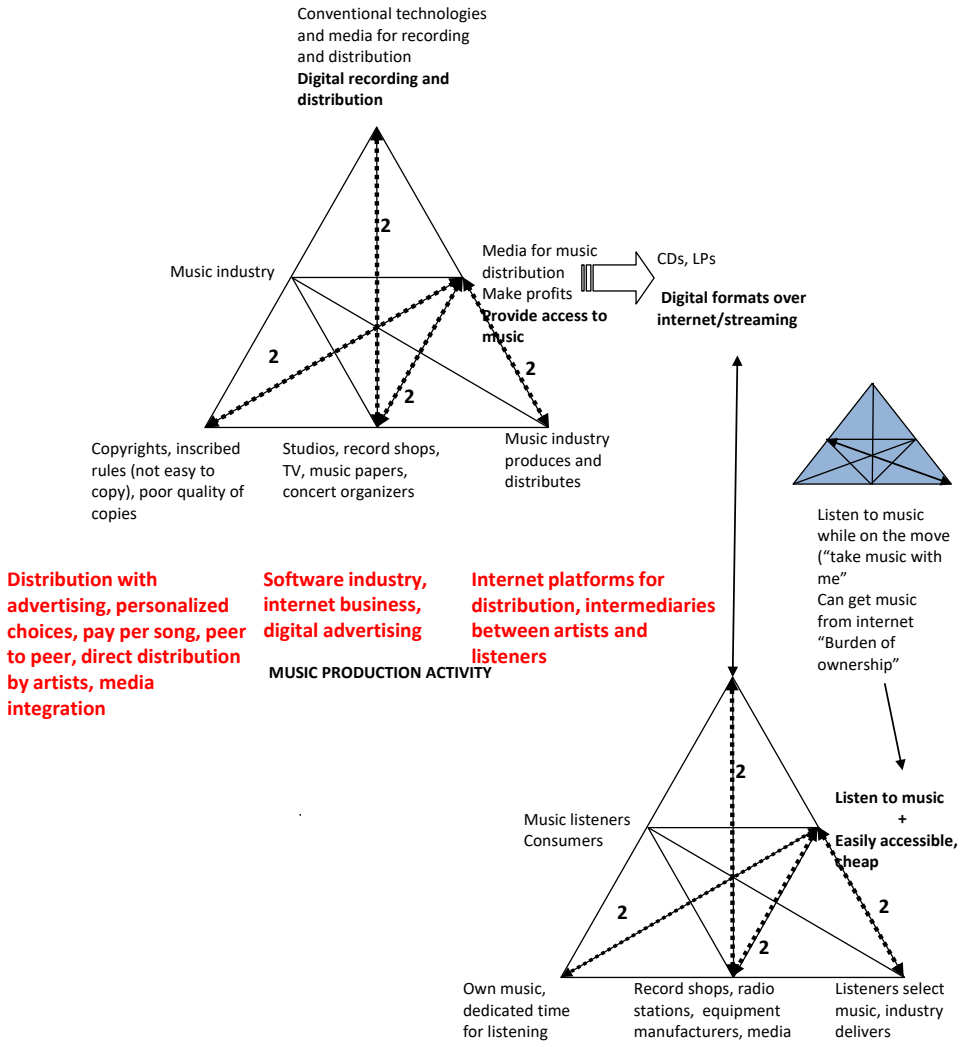
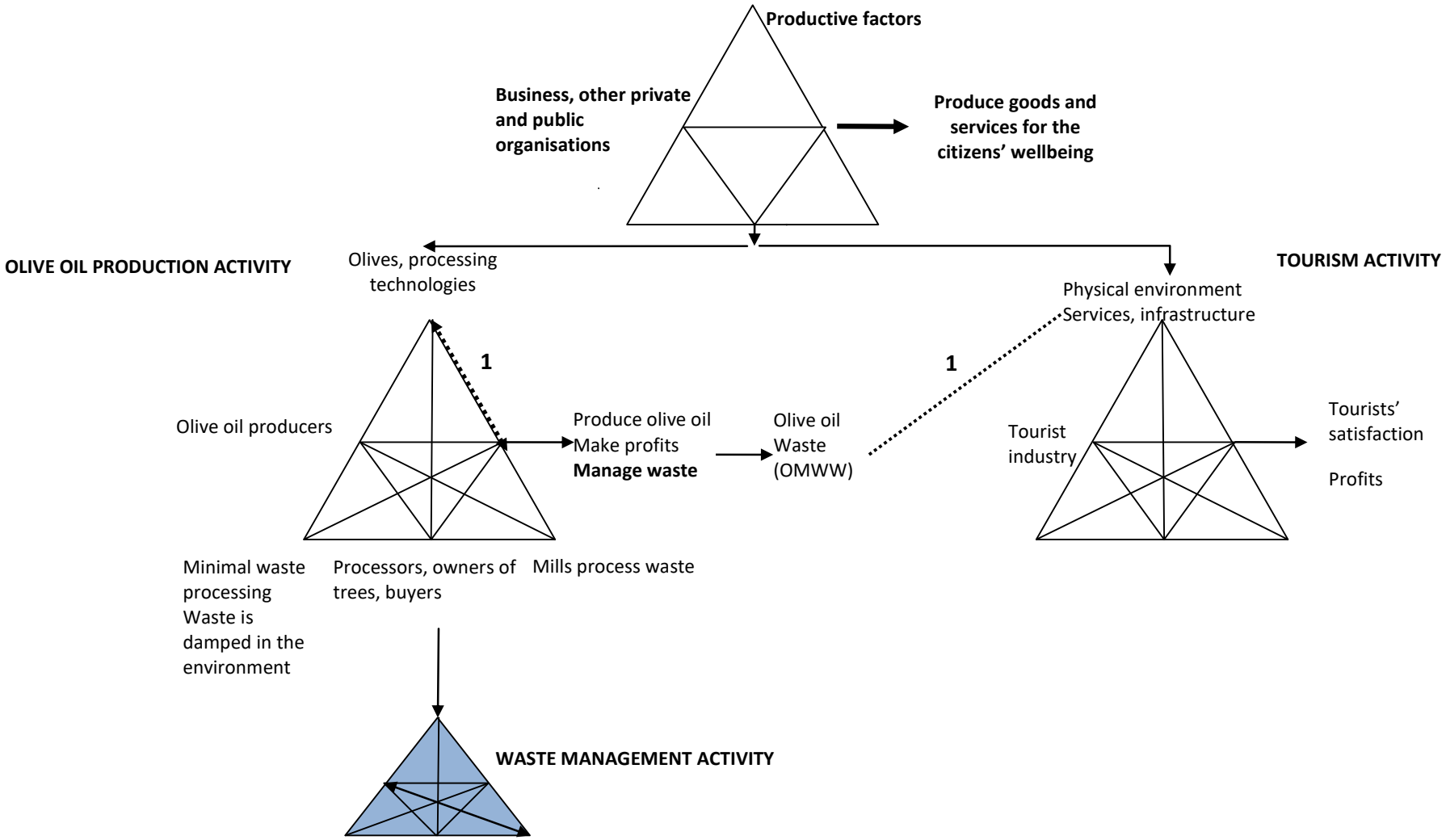


THE TRANSITION OF A REGION IN WESTERN GREECE TOWARDS SUSTAINABILITY: AN *ABA* ANALYSIS

- The economy of the region is based on services (70% of GDP) - tourism is a fast growing sector
- Importance of olive oil production – 59 olive processing facilities produce 21,000 tns of oil/year
- But also 129,675,000 lt of waste (Olive Mill Waste Water, OMWW)/year
- OMWW is burden to tourism and its management costs

THE TRANSITION OF A REGION IN WESTERN GREECE TOWARDS SUSTAINABILITY: AN *ABA* ANALYSIS



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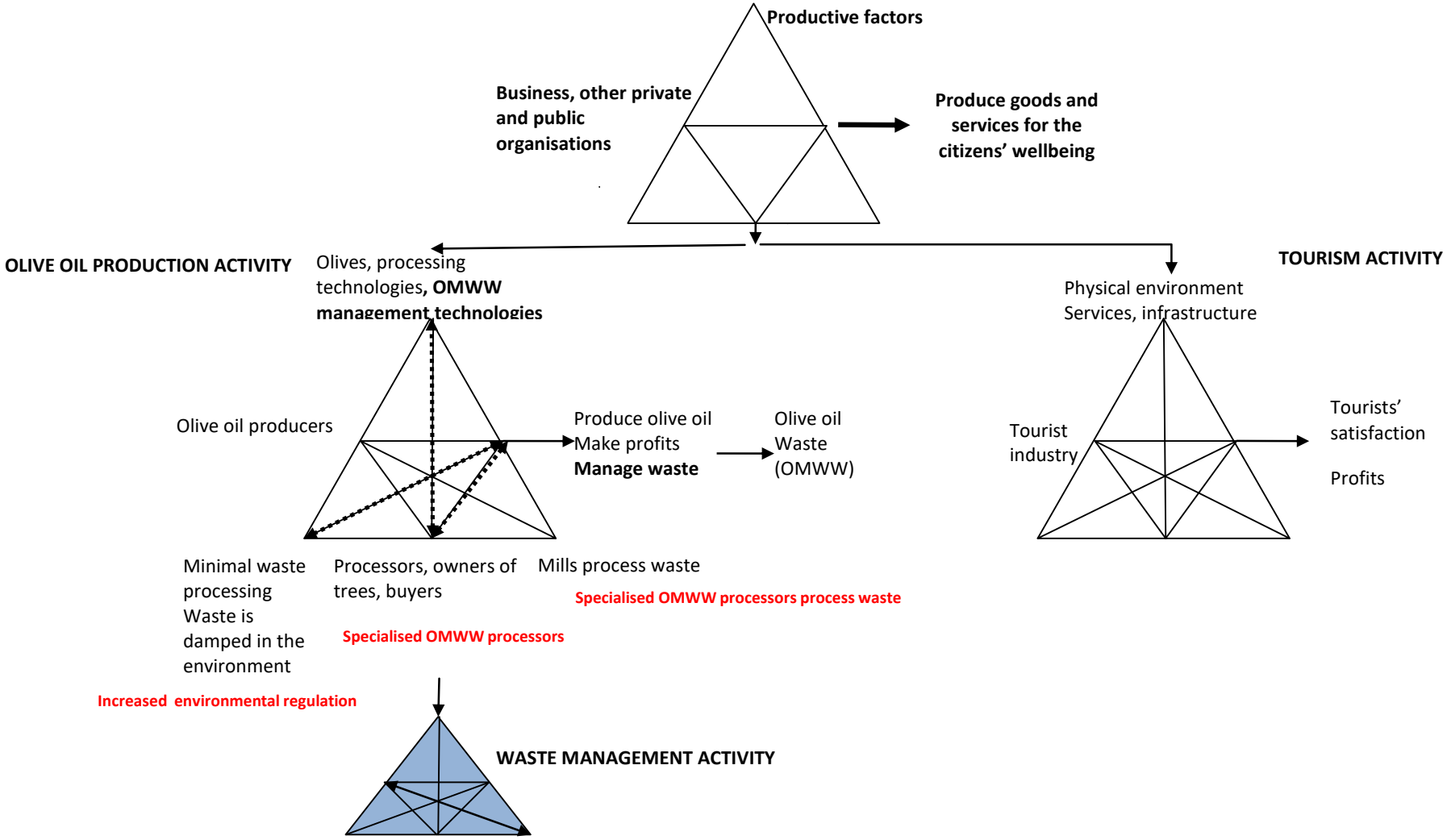

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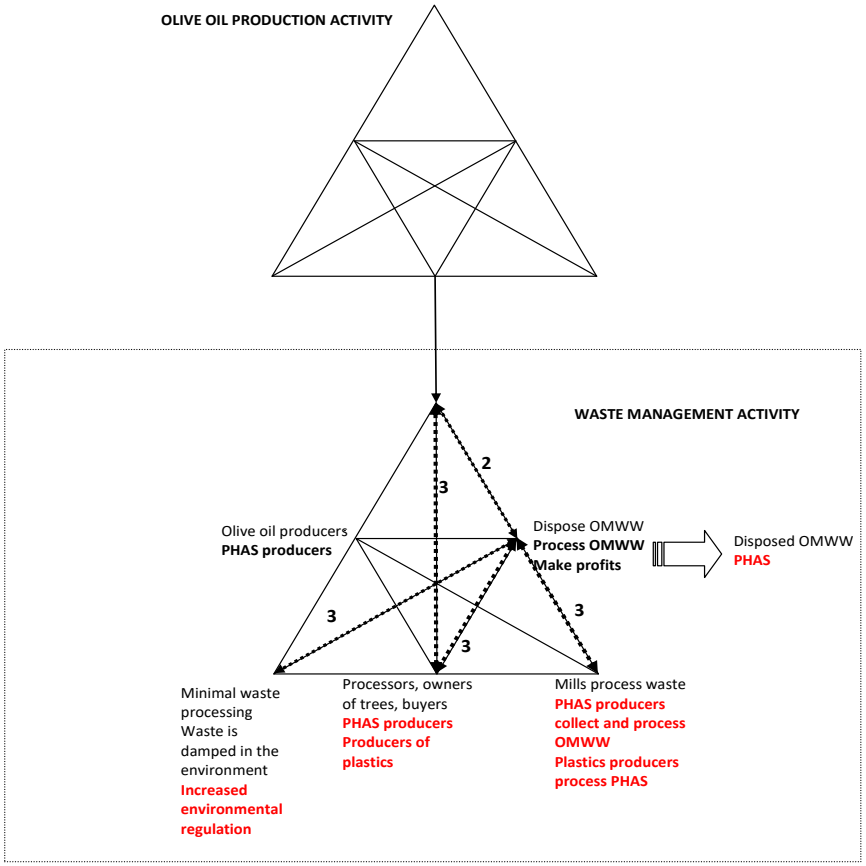


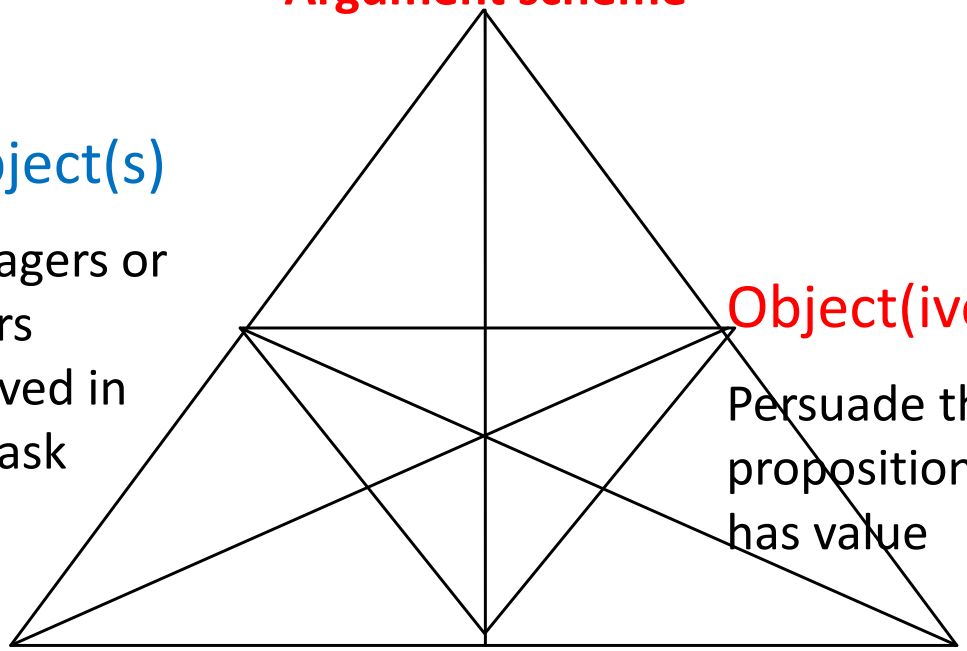
THE TRANSITION OF A REGION IN WESTERN GREECE TOWARDS SUSTAINABILITY: AN *ABA* ANALYSIS

- Circular economy changes
  - Adoption of new technologies –engineering training
  - New economic activity – collection and processing of OMWW
  - New markets for PHAs
  - Possible move of labour force
  - New financial instruments

Argumentation as activity

- ***Activity-based analysis (ABA)*** - the activity construct is applied to activities at different levels of detail for identifying contradictions and initiating remediating actions to facilitate change
- **ABA is used to understand how argument schemes mediate the relation between those placing arguments and their objectives**

Argumentation as activity



Argumentation practices in open innovation (activity theoretic analysis)

- Two short case studies (ORANGEX, COFFEE MOUNTAIN)
- Eight interviews with four executives of the two companies
- Document and web search and analysis of the innovation activity of the two companies
- Using interview transcripts, descriptions of the innovation processes of the two companies before and after the adoption of open innovation strategies were developed

Argumentation practices in open innovation (activity theoretic analysis)

- Indicative arguments and their supporting logic for the different stages of the innovation processes were also included in the documents.
- Descriptions were forwarded to the interviewees for comments and corrections to possible mistakes due to misunderstandings.
- The application of ABA to argumentation for innovation described below was based on the final version of these documents/descriptions.

Case A: ORANGEX

- Family-owned business, leader domestic company in non-alcoholic beverages market
- Weak innovation activity
- BEFORE: dominant argumentation repertoire based on the argument scheme of ***analogy*** (across product lines)
- AFTER: Open innovation model of *innovation community*
- Argumentation scheme based on ***expert opinion***

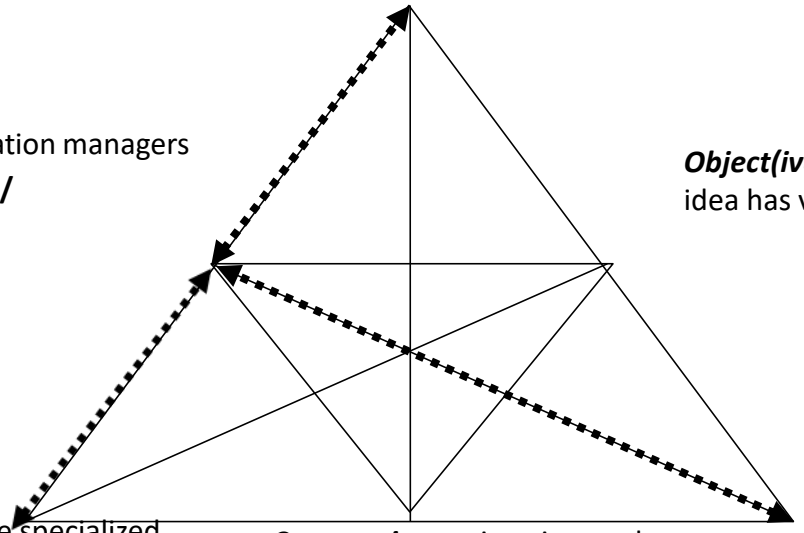
Case A: ORANGEX

Tools: Arguments based on analogy **based on expert opinion**

Subject:
Owners, innovation managers
Collaborators/ stakeholders

Object(ive): Persuade that idea has value

Outcome: Proposition is accepted



Rules:
Managers/owners have specialized knowledge, place and select arguments **and external partners**

Community: various internal and external customers, suppliers, stakeholders

Division of labour: **all** managers and owners place arguments and support or object other managers' arguments

Case B: COFFEE MOUNTAIN

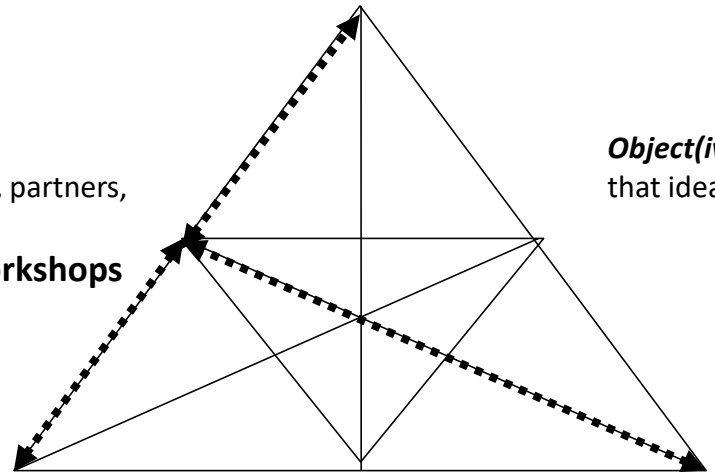
- Leader domestic coffee roaster & owner and franchisor of brand corner coffee shops
- More than 400 shops in Greece and abroad
- BEFORE: Dominant argumentation repertoire in innovation has been based on ***causal associations***
- *"…. this product will succeed because it complements that product that is a success".*

Case B: COFFEE MOUNTAIN

- AFTER: Moved into an open innovation model of *innovation community* (after the failure of a crowdsourcing model)
- Model implemented through workshops that the company organises for shop managers, franchisees and employees, and includes suppliers
- Argumentation scheme based on ***popular opinion***

Case B: COFFEE MOUNTAIN

Tools: Arguments
based on causal associations
based on popular opinion



Subject:
R&D department, partners, customers
More partners in workshops

Object(ive): Persuade that idea has value

Outcome:
Proposition is accepted

Rules:
Ad hoc placement and selection of arguments by R&D department, and partners

Interactive and more partners

Community: various internal and external customers, suppliers, stakeholders

Division of labour: R&D department and partners place arguments and support or object other managers' arguments

more partners

Conclusions

- High quality argumentation means that the way propositions and arguments are placed and the way they are evaluated and selected are consistent with the context of argumentation, which, in turn, is contingent to the innovation strategy chosen
- We introduced an *activity-theoretic* representation of *argumentation practices* and their *context* to analyse this contingency (through the identification of *contradictions*) and understand organisational deficiencies due to the misalignment between argumentation logic/scheme and its context

Summary - Conclusions

- Introduction of ABA to socio-technical system innovation

- ABA has a concrete theoretical base (CHAT, mediation, contradictions)
- ABA prompts to thinking about socio-technical change in operational terms (human activity)
- ABA has a structured process of analysis based on a structured operational unit of analysis (activity)
- Contextual mediating elements can be used strategically to bring about change in a manageable way
- Can be used to complement other conceptualisations of socio-technical systems
- Can be used in companion with quantitative (e.g. system dynamics) and qualitative (e.g. SSM) modelling

Increased environmental regulation

Internet platforms for distribution, intermediaries between artists and listeners

Software industry , internet business, digital advertising

Specialised OMWW processors

Providers suggest, listeners can make music

Specialised OMWW processors process waste

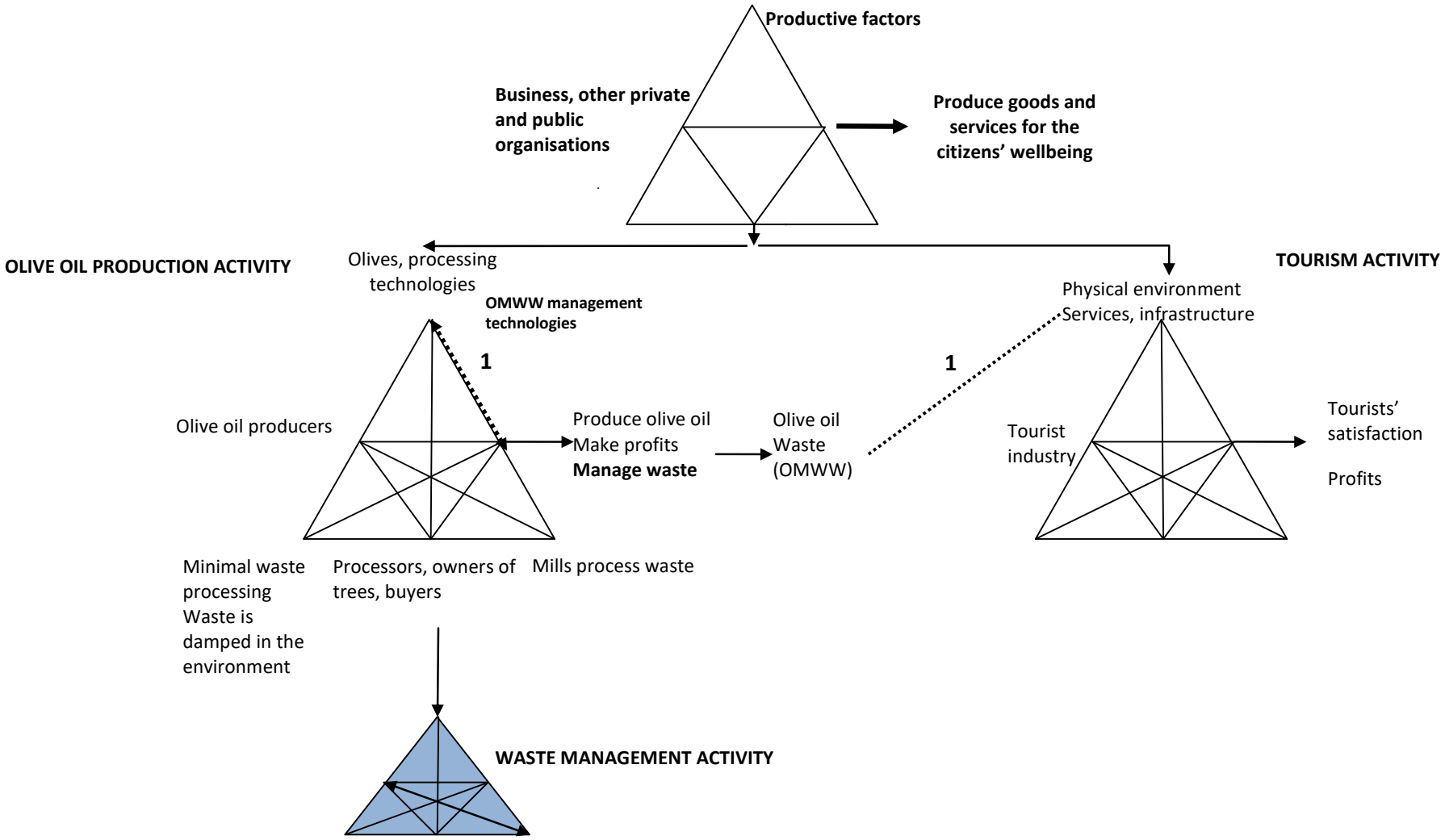
Distribution with advertising, personalized choices, pay per song, peer to peer, direct distribution by artists, media integration

Computer industry, music on demand, computer add-ons for music

Access music, easy selection, make own music

OMWW management technologies

THE TRANSITION OF A REGION IN WESTERN GREECE TOWARDS SUSTAINABILITY: AN *ABA* ANALYSIS



Understanding system innovation

- **Models support processes of analysis of real life situations**
- **A good model of system innovation processes must be *inclusive* (structure and agency, production and consumption processes)**