Conceptual Framework

Socio-technical change:

- **Main elements**

- **How it works?**

- **What kind of research problems it is possible to analyze?**

The notion of **socio-technical change** is part of a broader theoretical corpus: **Socio-Technical Analysis**

The **Socio-Technical Analysis (STA)** is a constructivist relativist theoretical framework that triangulates contributions from **SCOT, ANT and Economics of Technological Change.**

The STA is non-determinist, non-evolutionary, non-universal and non-neutral approach.

Some key concepts of the STA:

1- Socio-technical co-construction

2- Working/non-working

3- Socio-technical dynamic

4- Socio-technical pathway

5- Socio-technical alliance

6- Socio-technical change

What is Socio-Technical Change?

Socio-technical change is a systemic dynamic generated by a co-construction process between heterogeneous actors but also between actors and technologies. As a result of those interactions, actors also create their identities, give shape to ideologies, activate or hinder technological change based on the activation of particular processes and the production, reproduction, and circulation of concrete practices and –of course- artifacts and technological systems.
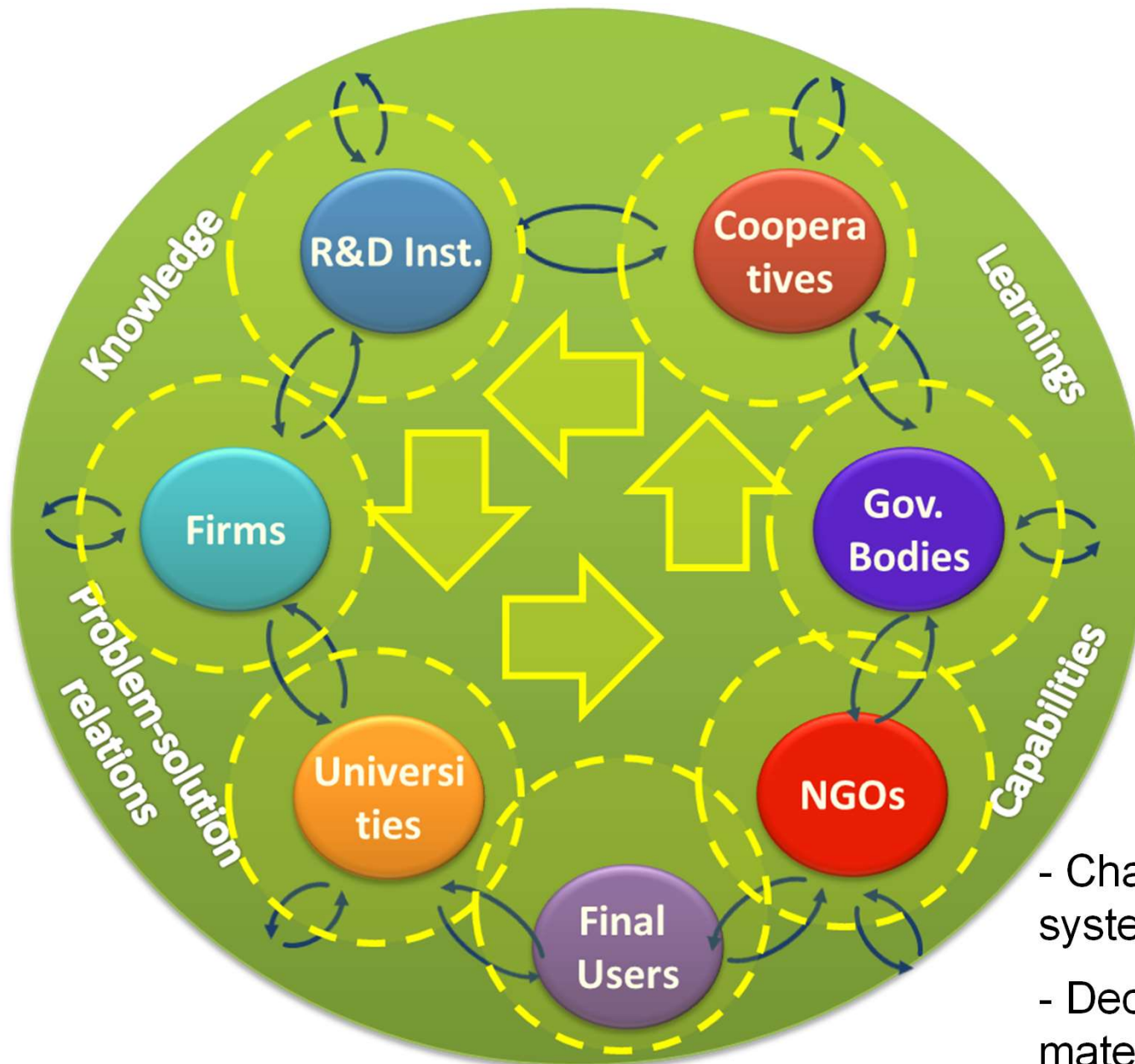
To understand Socio-Technical Change, we developed an analytical model: Socio-cognitive Interactive Model (SCIM). The model is based on the interaction of four main constitutive elements of technologies (problem-solution relations, knowledge, learnings and capabilities) and social groups.

Conceptual Framework

Socio-technical change (SCIM):

- **Main elements**

- How it works?

- What kind of research problems it is possible to analyze?

Socio-technical Change: Socio-cognitive Interactive Model (SCIM)

Knowledge

Learnings

Problem-solution relations

Capabilities

R&D Inst.

Cooperatives

Firms

Gov. Bodies

Universities

NGOs

Final Users

Key elements:

- Actor heterogeneity
- Systemic interactions
- Problem-solution relations
- Knowledge
- Learning

- Change and stabilization is a systemic and collective process

- Decentred analysis of the materiality of the artifact

Problem-solution relations:

Definition 1 (actor level):

Problems: restrictions, inconveniences, dysfunctions, incompatibilities, negative or counterproductive effects, immanent vacancies in artifacts and systems, meant by engineers, technologists, users.

Solutions: Overcoming restrictions, compatibility, techno-cognitive developments, defined by the actors as a response to problems in terms of construction of artifacts and technological systems.

The actors assume the existence of corresponding and logical correlations between the perceived problems and the constructed solutions. At this level it is possible to observe, survey, record and systematize the problem-solution relationship constructions generated by the actors.

Problem-solution relations:

Definition 2 (analyst level):

The problems are not "real", immanent to the artifacts or technological systems (objective problems) nor are they found in the minds of the actors (subjective problems). The problems are (re)constructions of relationships of meaning between actors and artifacts, irreducible to the singular components of this relationship.

The solutions are socio-technical constructions generated by different actors who assign the sense of technological solution.

In addition, it is necessary to reconstruct the relationship between problems and solutions that is neither a priori nor logical, neither corresponding nor necessary, but the result of successive operations -reciprocal and one-to-one- of a) constructions of meaning deployed by the actors on artifacts and systems and b) of exercise of the agency of artifacts and systems.

In this co-construction dynamic, different social groups and artifacts and technological systems define problems (and solutions) in different ways.

Some problem definitions (and solutions) stabilize and others neutralize or disappear. This is the result of the power dynamics that is constituted around the construction of problems and solutions.

Knowledge:

Definition 1 (actor level):

Knowledge is the result (a product) of the action of "knowing" or "learning" carried out by the actors. But at the same time, knowledge is an input for the generation of capacities that allow actors to solve problematic situations and build new knowledge.

Knowledge is also acquirable, to the extent that through formal education, trial and error, the reiteration of uses and customs, daily practices (among other possible mechanisms) the actors manage to incorporate it.

Knowledge is transferable, given that a singular actor or a group of actors can acquire knowledge from another singular or collective actor.

The actors can ascribe themselves and others within a specific disciplinary knowledge (biologists, economists, sociologists...) and within a differentiated epistemic sphere (experts, academics, laymen...)

By observing the practices of the actors, it is possible to survey, record and analyze the knowledge that is integrated into the generation of problem-solution relationships, the design and production of artifacts and systems, the construction of functioning and non-functioning, and to how existing knowledge allows the construction of new knowledge.

Knowlege:

Definition 2 (analyst level):

Knowledge is particular ideological constructions directly related (in an explanatory and causal way) to the set of actions (cognitive, artifactual and praxical) consciously carried out by humans to alter, prolong or parameterize the state of things with the aim of performing a use or function.

Knowledge (in socio-technical terms) refers to the different conceptualizations and definitions of what is and is not, what is good or bad, what is possible or not possible in technological terms: characterizations of artifacts or systems, inputs for the formulation of a problem or the identification of a solution, criteria to define parameters of operation or non-operation...

When actors mobilize knowledge (through their practices) they can do so tacitly or explicitly.

This definition does not imply any type of epistemic leap between different "forms of knowledge": scientific, religious, customary, ancestral, empirical. For this reason, it does not admit the exhaustive distinction between "knowledge" (scientific, technological, engineering, professional, academic) and "knowledge" (ancestral, customary, experiential, community): for the purposes of socio-technical analysis, all are -symmetrically- knowledge.

Learning:

Definition (analyst level):

In socio-technical terms, learning is a construction of the analyst. Learning is a process of generation (original creation, induction, deduction, adaptation, redefinition), and reproduction (externalization, objectification, and internalization: formal and non-formal teaching, ostension, modeling, demonstration, association, experimentation, reverse engineering) that produces and socializes knowledge, capacities and abilities in (and by) the subjects (actors, institutions, communities) of learning.

Learning is a relational socio-technical process: it occurs in the interaction between actors and artifacts, institutions and technological systems, and, obviously, between previously internalized knowledge, skills and abilities. It is, in this sense, a process of co-construction between actors and knowledge.

Learning is a situated socio-technical process: the generation and reproduction of knowledge, skills and abilities is carried out (in the sense proposed by historical materialism) in specific social configurations, within the framework of discrete socio-technical alliances.

Capabilities:

Definition 1 (actor level):

At this level, capacities refer to what an actor, an institution or a social group can do or believes they can do. From data analysis capabilities to production capabilities for goods and services, from producing new knowledge to developing new artifacts.

The actors, too, can define capacities such as the availability and access to artifacts: buildings, laboratories, equipment, infrastructure.

And, in general, the actors define their capacities as something that one has, not that is exercised in relation to other actors and in relation to artifacts and systems.

The capacities of an actor or a social group allow it to define a problem, mobilize existing knowledge, learn (generating new knowledge) and generate a defined range of possible solutions. The viability of these solutions responds to the capacities of the actors or social group that develop them.

By observing the practices of the actors, it is possible to survey, record and analyze the capacities that are integrated into the generation of problem-solution relationships, the design and production of artifacts and systems, the construction of working and non-working...

Capabilities:

Definition 2 (analyst level):

In socio-technical terms, capabilities are a set of conditions, qualities, and aptitudes that, in the practice of an actor, an institution, or a social group, allow solving problematic situations by parameterizing, designing, producing, and deploying solutions in terms of practices, knowledge, artifacts and technological systems.

Capabilities are not presented as the theoretical possibility of solving a problem, but in an effective way. The capacities, then, refer to the effective practices that an actor, an institution or a social group has in relation to a certain material configuration (artifacts, technological systems and even... what is called "nature").

Capabilities are the product (and input) of a relational socio-technical process: they are produced in the interaction between actors and artifacts, institutions and technological systems, and, obviously, between previously developed knowledge and capabilities. It is, in this sense, the result of a co-construction process.

Capabilities are not universal, it is only possible to dimension them as part of a situated socio-technical process: the generation and reproduction of knowledge, skills and learning is carried out in specific social configurations, within the framework of discrete socio-technical alliances.

Conceptual Framework

Socio-technical change:

- **Main elements**

- **How it works?**

- **What kind of research problems it is possible to analyze?**

Socio-technical change: development and emergence of new technologies

Research question:

Why and how does a new technological solution (artifact, process or organization) emerge?

Key methodological questions:

- Which groups of actors enter into interplay?
- What problems are defined? What solutions are proposed?
- What pre-existing knowledge, learning and skills come into play?
- Are new knowledge and capacities generated as a result of the learning dynamics? Which is it?
- How do P-S relations, knowledge and capacities circulate? Are there specialization processes? Which are they?
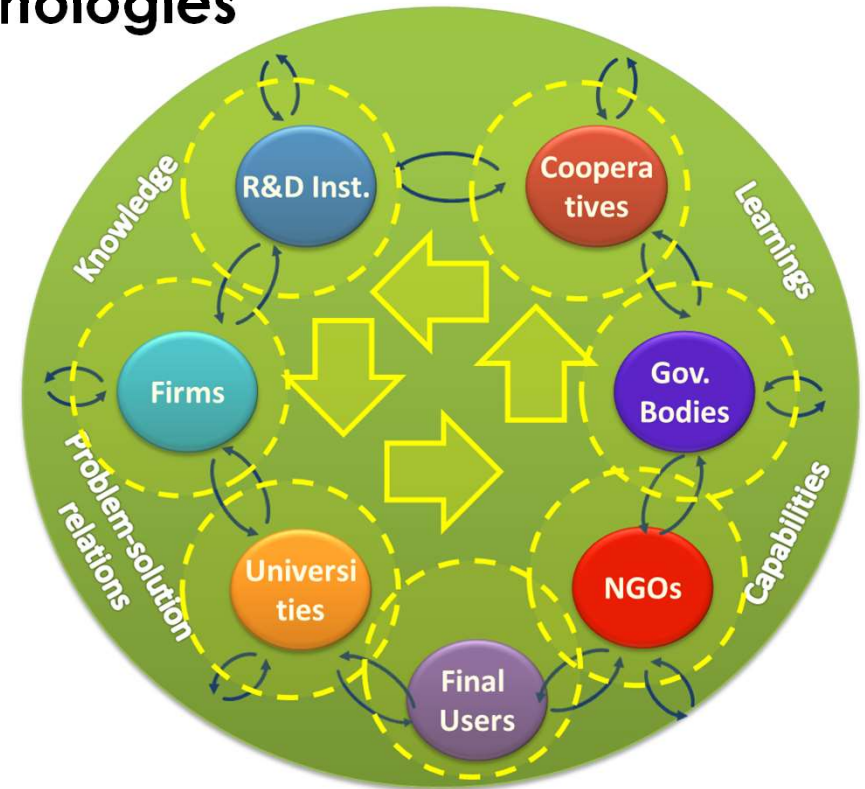
- Evidence-based analysis
- Case studies

The elements keep on movement even when the materialities remain identical to themselves.

Socio-technical change: Concentration dynamics of the system centered on the profit-maximizing company

Research question :
What is the process of governance and appropriation/socialization of socio-technical change like?

Key methodological questions:

- Which stakeholder group(s) govern the process of defining problems and solutions?
- Which group(s) of actor(s) legitimize (or disregard) knowledge, activate (or restrict) learning, develop (or inhibit) capacities?
- Which trajectories of new knowledge and skills are activated and which are cancelled?
- The stabilization of a certain artifact, which options (rival goods) did it displace?
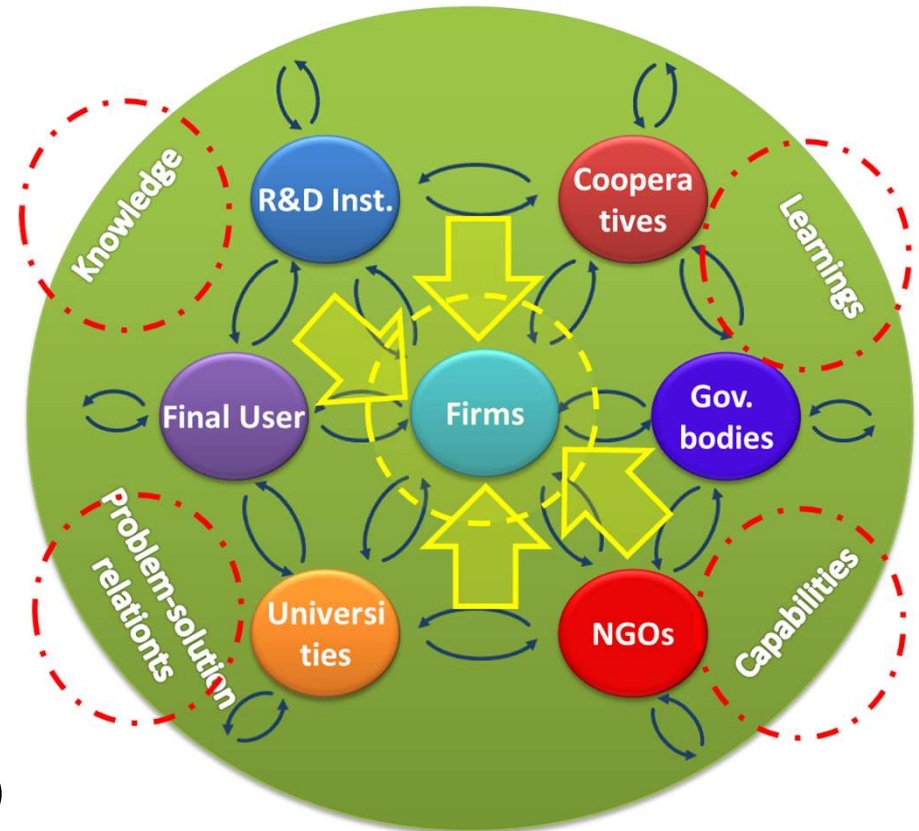
"Innovation" is a particular form, a style that the system takes, where a type of actor appropriates the collective production process.

- **Heterogeneity of problems, knowledge, learning and capacities**

Conceptual Framework

Socio-technical change:

- **Main elements**

- **How it works?**

- **What kind of research problems it is possible to analyze?**

The flat ontology of the notion of Socio-Technical Change (from the MISC) allows analytically capturing various objects of analysis:

➢It is possible to analyze the emergence of a new technology (product, process or organization) as the result of an interactive systemic process.

➢ It is possible to analyze how the development of a new knowledge or a new capacity alter the relationships with the other elements of the model and results in new artifacts and systems.

➢ It is possible to analyze how a new regulation, or a new perception of risk, or the empowerment of a particular social group reconfigures problem-solution relationships.

➢ It is possible to analyze trajectories of technological change and assess their inclusive/exclusive or sustainable/unsustainable bias.

➢ It is possible to analyze the style of a trajectory or dynamic of technological change based on the social group that governs (completely or partially) the elements of the model.

➢ It is possible to analyze how (apparently contradictory) technological solutions are the result of negotiation processes between social groups and artifacts and systems.

¡Thank you!

Mails: lucas.becerra@unq.edu.ar / thomas@unq.edu.ar

Instituto de Estudios sobre la Ciencia y la Tecnología IESCT

RedTISA
Tecnologías e Innovación para el Desarrollo Inclusivo Sustentable

Universidad Nacional de Quilmes

CONICET
Consejo Nacional de Investigaciones Científicas y Técnicas