NSEAD White Papers

Exploring a Model of Transdisciplinary Research Collaboration

based on Collective Action Theories

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Introduction

The objective of this paper is to develop the first schemes of a possible methodology based in the Theories of Collective Action to analyse and facilitate transdisciplinary dialog and collaboration between science, engineering, art and design. Such theories are usually applied to understand different kinds of collective actions (for example, regarding actions that appear in ecologist, feminist or pacifist movements, among others). We propose that these theories can also be pertinent to analyse, in a very structured way, the interaction between the main dimensions, agents, resources, contexts and strategies of transdisciplinary action. Therefore we will use these theories to frame a method for identifying the main elements that constitute this kind of action in general and in particular between art, science, design and engineering. This methodology could support action coordination towards transdisciplinary collaboration addressed to different stakeholders taking as reference the distinctions between 3 kinds of collaboration, introduced by Allen F. Repko (2012:20)[1].

The hypothesis is that collective collaboration in transdisciplinary research environments can be understood as a form of collective action according to the following definition:

> *"Collective action is the result of a social action (or collective challenge) carried out by the set of formal and informal interactions established between (1) a plurality of individuals, collectives and organized groups (who share, to a greater or lesser extent, a sense of belonging or collective identity among themselves) and (2) other social and*

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[1] According to Repko (2012:20) "multidisciplinarity studies a topic from the perspective of several disciplines at one time but makes no attempt to integrate their insights […]. Interdisciplinarity studies a complex problem […] by drawing on disciplinary insights (and sometimes stakeholder views) and integrating them […]. Transdisciplinarity concerns that which is at once between the disciplines, across different disciplines, and beyond all disciplines […] and seeking to integrate disciplinary and stakeholder views […]."

political actors with which they come into conflict. This conflict is triggered by the appropriation (of), participation (in), and transformation of relations of power to achieve social goals, and above all, through the mobilization of certain sectors of society" (Tejerina, 2010:19).

Repko's definition helps us to understand that despite the different forms in which transdisciplinary collaboration has historically developed there has been a constant core around which different ways, objectives, motivations and concerns spun towards its achievement. This core is the social need to deal with (1) topics, (2) complex problems or (3) knowledge about the world in a unified sense, that goes beyond the capacity of each discipline and implies a collective endeavour materialized in actions. Therefore it is crucial to understand how these collective actions are shaped by means of discussions, negotiation and re-negotiation processes according to specific historical and cultural circumstances.

The development of a typology of different categories of analysis to understand transdisciplinary collaboration actions can be crucial to fully support and ground such actions, making the most of possible resources and finding the right institutional, educative and social framework for their development. Transdisciplinary action is a dependent variable in relation to a few key elements that are categorized in the theory of collective action. The translation of these elements can serve to generate a specific action theory for collaboration between disciplines. These elements are:

(1) Why, where, when and in which way collective action happens (Theory of Collective Behaviour, Smelser, 1963). In the case of NSEAD action the same questions apply;
(2) The relationship between costs and benefits of collective action, that is to say, the dependence of collective action on available resources, group organization and opportunities and on the strategic and political factors involved (Theory of Resource Mobilization, McCarthy and Zald, 1977; Jenkins, 1983; Zald and McCarthy, 1987). In the case of NSEAD action the same is valid;
(3) Context interaction (Theory of Social Interaction, Turner and Killian, 1957), in the case of collective action, translates into the concept of NSEAD's context interaction;
(4) Political aspects (Theory of Structure of Political Opportunity, Kriesi, 1995; Tarrow, 1989, 1994; 1998), present in collective action, is also valid for NSEAD action.
(5) Collective sense and aims (Theory of Collective Identity, Melucci, 1995), as in collective actions, there is a blend of intentions, resources and limits. Collective actions imply intentional decisions and interaction structures inside a system of opportunities and restrictions. There is a need to build a sense of belonging to a collective, in relation to transdisciplinary action.

The concept of "interaction structure", that is central in the case of a social movement, frames the environment that "enables the existence of a series of interactions (Tilly), or the network of informal interactions between a plurality of individuals, groups or organizations (Diani, 1992), or that a group acts in a continuous way (Turner and Killian, 1957)" (Tejerina, 2010:20). In the analysis of these interaction structures, all dimensions in which an action takes place, micro, mezzo and macro, must be taken into consideration. In the case of transdisciplinary collaboration, the very researchers are those who produce face-to-face actions, negotiate strategies within organizations, coordinate their own actions in relation to other institutions, dialogue with decision-makers, have access to media and promote sensibilization actions to increase consciousness regarding this kind of collaboration. In our case, NSEAD can be an example of this thread of actions across many spheres and scales of activity that recommend actions to be taken according to different levels of agency.

The concept of interaction structure can also be essential to analyse how transdisciplinary research and creative work, learning and knowledge transmission processes develop (regarding

agents, ways, tools and environments) because transdisciplinary agencies (researchers, managers, decision-makers, funding institutions) interact in different degrees in all these spheres and scales. Therefore it is necessary to see how these interactions are produced and coordinated (either in a positive or in a conflictive way) and the effect of these actions on improving the conditions of transdisciplinary action and research across science, engineering, art and design.

According to the theories of action (Tejerina) the most important interaction structures that shape collective action happen in different spheres. Some happen in face-to-face situations particularly between peers inside each group or collective (Melucci, 1995; McAdam, 1982); some within each organization or institution (Klandermans, 1997; McCarthy and Zald, 1977); others emerge from the challenges that social actors (in our case, artists, designers, engineers and scientists) pose to elite decision and policy-makers (McAdam, Tarrow, Tilly, 2001) and those that spread and impregnate society in an invisible way. The processes of interaction that happen in each one of these structures and between themselves shape how successful action can be.

Having the broad matrix of these structures will improve our capacity to suggest the best actions to different stakeholders, especially to those in the position of making decisions; to identity and overcome obstacles and to enhance opportunities for collaborative action across science, engineering, arts and design.

The method: Nature, type and scale of stakerholders and type of action

The method is developed as a tridimensional matrix taking into consideration different kinds of actions, crossed with different kinds of agents and their spheres of interaction between each other. The aim is to explore opportunities and obstacles to develop transdisciplinary collaboration, analyse how it is emerging and plan future actions. Time will add a fourth dimension to the matrix.

The method can contribute to improve the vision on how transdisciplinary actions change knowledge production and how the aims, motivations, and interactions around transdisciplinary problems synchronize and find resonance (or not) in an environment of limited resources and changing opportunities in which there are collaborators and opponents that need to dialog.

In this sense each suggested action must be related to the big picture but addressed to each different stakeholder in its own sphere of action (for example: artists, designers, engineers, scientists, educators, funding agencies). We can differentiate between 4 kinds of stakeholders: individuals, communities, public institutions and private institutions.

Actions analysis should take into consideration basically two kinds of agents: sympathy and resistance agents. Sympathy agents are individuals, collectives and organized groups that work to facilitate transdisciplinary dialog and collaboration around similar or equal objectives. Resistance agents are other social and political actors with which they come into competence or conflict.

In addition to 6 kinds of actions, the analysis takes into consideration 4 types of stakeholders such as individual, communities (structured and formally organised, like professional associations, and *ad hoc* interest alliances, linked to disciplinary fields) and public and private institutions (not linked to disciplines like banks for example), acting in 4 scales (local L, regional R, national N and international I scales).[2]

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[2] There are associations that are difficult to classify in a definitive way. For such cases, it is necessary to add more specific criteria.

The actions that can be considered have been grouped into these 6 categories:

1) (AR) Actions for the increasing of resources (including advocating)
These actions aim at getting more access to funding, human and technological resources to research and collaboration across disciplinary borders.

2) (NA) Actions to support networking
The aim of this kind of actions is to foster engagement, participation, formal and informal actions for exchanging knowledge and networking actions. Resilience and solidarity actions for supporting networked projects (NSEAD can be a kind of big umbrella for different projects and institutions towards the aim of fostering networked achievements).

3) (EA) Education actions to prepare researchers to manage transdisciplinary collaboration
Education actions are aimed at preparing researchers to manage collaboration across disciplines, develop a common language and deal with differences. In particular, it is necessary to solve questions around methodological and theoretical dominance of one discipline on others and questions around theoretical and methodological integration and developing adequacy (Repko). As Repko said, multi-disciplinary approaches the 'home' discipline usually imposes the preferred method and theory, transdisciplinary approaches do not give preference to any disciplinary method or theory and trans-disciplinary approaches integrate all knowledge, disciplinary methods and stakeholder views on the basis of some overcharging theory.

4) (ARS) Actions to support research (for researchers)
These actions involve listening and follow up, to maintain a system of tracking opinion from researchers in the network. The purpose is to update the cartography of researchers on the network and their results of their collaborations, creating feedback between peers.

5) (DA) Diffusion, dissemination and sensitizing actions (to create visibility towards society and sensitizing different social groups)
Sensitizing actions aim at increasing awareness about transdisciplinary collaboration. They can be carried out in the form of dissemination actions (actions for increasing sensibility of different spheres regarding transdisciplinary collaboration).

6) (AIS) Actions to create an interaction structure
The interaction structure for transdisciplinary collaboration can be better realized within an institutional space from which all kinds of actions can be coordinated. This space can take form as an Observatory for Networked Science, Engineering, Art and Design.
The aim is to enable agents that support transdisciplinary approaches to be in positions of power in decision-making processes. This can be achieved by complementing the network of SEAD (The Network for Science, Engineering, Art and Design) with an International Observatory for NSEAD Knowledge, to fully protect transdisciplinary collaboration.
SEAD Observatory for Networked Science, Engineering, Art and Design should be able to plan, coordinate, implement and manage all aspects of transdisciplinary collaborations. The Observatory would be supported by social network and social media platforms (transmedia approach), and coordinate the implementation of all kinds of actions (AR, NA, EA, ARS, DA). The objectives of the SEAD Network Observatory can be:
(1) To situate NSEAD transdisciplinary collaboration in the main political objectives and institutional guideless of research at any level in order to accelerate the development of sustainable, innovative and inclusive transdisciplinary knowledge in society;

(2) To foster, implement and look for funding to network knowledge and collaboration in the NSEAD transdisciplinary field. The NSEAD Observatory can be supported in a network of observatories such as European NSEAD Observatory, National NSEAD Observatories. These observatories can also be created at lower levels;

(3) To overcome hurdles in the development of an transdisciplinary knowledge Society;

(4) To foster interoperability of solutions across countries; to treat transdisciplinary Knowledge on global and local scales;

(5) To generate awareness in different stakeholders about the research and knowledge sector in order to mobilize the needed financial and human resources to carry out actions;

(6) Stimulation actions for transdisciplinary research: Promote annual research grants for researcher groups with the requirement of the participation of at least 2 fields collaborating.

Each action must be described in relation to the scale of the problem addressed, the opportunity that it opens, the obstacles that can be found and the kind of stakeholders involved.

Opportunities and obstacles are identified according to different spheres of interaction: (1) on the scale of face-to-face interactions FFI (such as linguistic opportunities and problems, cross-communications misunderstandings, emotions and insights, etc.); (2) on the scale of transdisciplinary power synergies, struggles and competitions such as those that belong to authority and power elites inside each discipline (interest groups IG); (3) on the scale of institutional educational and research structures –ERS- that are discipline-based and can be seen as structures for new opportunities or threatens to any kind of transdisciplinary action; (4) on the scale of the social paradigm that is common in public political-administrative systems –PPAS- of funding at different levels like national, regional, European or international that are not adapted to transdisciplinary action. For instance, it is considered appropriate that a scholar follows a unique lineal disciplinary path during her/his academic trajectory and any break in this lineal path needs to be justified so that the carrier is considered adequate to academy, which reflects a Cartesian mode of thinking about academia and constitutes an obstacle for transdisciplinary fluidity. The following chart translates the elements taken from Theory of Action to structure the actions suggested to improve transdisciplinary collaboration.

Apart from these 4 spheres of interaction identified in this chart, we include activities to be carried out within the interest groups NSEAD and NSEAD Observatory (to be created). Both are interest groups that can house different interaction spheres and therefore they appear at a different level.

Table of suggested actions

1) (AR) Actions for the increasing of resources (including advocating)				
Type	**Temporal and Spatial Scale**	**Opportunity**	**Obstacle to action implemention**	**Sphere of interaction**
Transdisciplinary funding research programmes	Global, National, Regional and local; Continuous	To channel more access to funding, human and technological resources to collaboration across disciplinary borders	Resistance from funding institutions that still do not accept transdisciplinary approaches in research	FFI, IG, ERS, PPAS
Creation of politically	International, National,	These quotas should guaranty that a particular part of public budgets to	Resistance from funding	FFI, IG, ERS, PPAS

corrected Minimum Quotas for transdisciplinary Research	Regional	research, are oriented to the funding of NSEAD transdisciplinar research in the framework of networked knowledge. The effectiveness of these quotas will be followed-up by NSEAD Observatory.	institutions that still do not accept transdisciplinary approaches in research and from PPAS	Observatory NSEAD
Funding grant actions for transdisciplinary research	Global, National, Regional and local Continuous	Promote annual research grants for researcher groups with the requirement of the participation of at least 2 fields collaborating	Resistance from funding institutions to accept transdisciplinary research	IG, ERS, PPAS
Funding prize actions for transdisciplinary research	Global, National, Regional and local; Continuous	Promote periodical research prizes for researcher groups with the requirement of the participation of at least 2 fields collaborating. To create the space for a Nobel Prize section or Principe de Asturias section, for collaboration across disciplines)	Resistance from PPAS	FFI, IG, ERS, PPAS-Institutions linked to Nobel Prize and Prince of Asturias
Visibility actions	Global, National, Regional and local; Continuous	To make visible the results of transdisciplinary collaborations by using social network and social media platforms (trans-media approach), developing online and onsite workshops and conferences	Lack of support from institutions with resistance to fund transdisciplinary research	FF, IG, ERS, PPAS, NSEAD Observatory
Integration actions	Global, National, Regional and local; Continuous	To inscribe transdisciplinary research in all phases of decision making process of funding allotments	Lack of support from scientific politics at national, regional and local levels	FF, IG, ERS, PPAS, NSEAD Observatory

2) (NA) Actions to support networking: engagement, participation and networking actions				
Type	**Temporal and Spatial Scale**	**Opportunity**	**Obstacle to action implementation**	**Sphere of interaction**
Technical support Development of an online platform and system to support networking activities	Global accessibility Sustained by networked institutions	To develop an online platform and system to support networking activities, as an innovation ecosystem, an environment for social innovation, making full use of the Web 2.0, hybrid ontologies and the Internet of Things. Offer online support and visibility to transdisciplinary projects. Networks knowledge. Contact between peers	Maintenance sustainability Who pays for the service	FF, IG, ERS, PPAS

Creation of synergies with external partners and among observatories. Integration and fostering of knowledge sharing	Global, National, Regional and Local; Continuous	Creation of synergies with existing projects for the sustainability of the SEAD Network and Observatory and to intensify the networking processes with other initiatives such as Living Labs.[3] Sharing of best practices, finding partners, sharing of human and technological resources. To create synergies between NSEAD and a network of Observatories, particularly in areas like education, government, funding and administration structures	Lack of trust; lack of a common language	FFI, IG, ERS, PPAS
Creation of Research HotSpots	Global, National, Regional and Local Continuous	To foster interaction with research problems from other disciplines, other researchers and institutions. Research HotSpots would be the core around which researchers gather to search and offer collaboration	Lack of support from funding institutions	IG, ERS, PPAS
Matching around research problems	Global, National, Regional and Local; Continuous	To open a system in the network to match interests around complex research problems (that need the contribution from different disciplines). NSEAD Observatory would offer a service from the researchers' point of view. That means to offer a tool for interactivity and a bottom-up approach to information (inclusiveness) that can help researchers to plan their activities and participate in knowledge creation in the Web. Develop the network with extensive training and transdisciplinary seminars, forums and conferences	Lack of a common language to be able to dialog; lack of transdisciplinary protocols for sharing; lack of trust	Actions scope: FFI, IG, ERS, PPAS

3) (EA) Education actions to prepare researchers to manage transdisciplinary collaboration				
Type	**Temporal and Spatial Scale**	**Opportunity**	**Obstacle to action implemention**	**Sphere of interaction**
Transformation of power relations and complementary actions	Global, National, Regional and Local; Continuous	To enable agents that support transdisciplinary approaches to be in positions of power in decision making processes Transdisciplinary research should	Lack of political support or interest; lack of funding; lack of peer-to-peer support	FFI, IG, ERS, PPAS

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[3] Possible examples are (1) Innocentive (http://www.innocentive.com/), a platform for transdisciplinary collaboration and innovation; Fundation Garum (http://garumfundatio.org/redes/), an institution in the Basque Country that supports the creation of networks for business projects.

		be integrated in all phases of the decision making process for funding allotments		
Education actions	Global, European, Regional and Local; Continuous	To prepare researchers to manage transdisciplinary collaboration (development of academic and research methodologies to integrate different fields in research work, didactic guidelines for best practices) by using social network and social media tools and (transmedia approach), and developing online and onsite preparation workshops	Lack of interest on the part of researchers to change methodology; stress due to lack of a common language	FFI, IG, ERS, PPAS
Creation of methodologies to integrate different fields in research work	NSEAD	Methodologies are essential to enable dialog between disciplines to cover the lack of a common language	Peers resistance to incorporate and open space to other disciplines; language barriers	NSEAD

4) (ARS) Actions to support research (for researchers)				
Type	**Temporal and Spatial Scale**	**Opportunity**	**Obstacle to action implemention**	**Sphere of interaction**
Preparation of guidelines for best practices and a NSEAD Best Practices Database	NSEAD	The database will foster reflexion on results and extract periodical synthesis of best practices	Difficulties to retrieve information without the collaboration of researchers	NSEAD
Listening and follow up	Global, National, Regional and Local Continuous	To maintain a system of tracking opinion from researchers in the network. To update the cartography of researchers on the network and the results of their collaborations. Follow up in blog, social media tools	Lack of participation (need to stimulate participation)	FFI, IG, ERS, IPL
Creation of a "Best practices Database" for NSEAD	Global, National, Regional and Local; Continuous	To develop a database of transdisciplinary experiences for reflexion on results of networking knowledge and to extract serial synthesis of best practices. Transdisciplinary research should be integrated in all phases of decision making regarding funding	Lack of peer participation due to lack of trust	FFI, IG, ERS, NSEAD Network and Observatory
Creating synergies	Global, National, Regional and Local; Continuous	To create synergies between NSEAD and other institutions particularly between areas such as education, government, funding and administration structures	Need for paradigm shift to avoid resistance from institutions	FFI, IG, ERS, PPAS NSEAD Observatory

5) (DA) Diffusion, dissemination and sensitizing actions (to create visibility towards society and make sensible different spheres)				
Type	**Temporal and Spatial Scale**	**Opportunity**	**Obstacle to action implemention**	**Sphere of interaction**
Awareness increase actions aim at making pressure for changing policies and cosmovision	Global, National, Regional and Local; Continuous	To increase awareness about transdisciplinary collaboration using social network and media tools and (trans-media approach) and developing online and onsite workshops and campaigns	Lack of interest	IG, ERS, PPAS, NSEAD Observatory
Diffusion actions	Global, National, Regional and Local; Continuous	To increase awareness about transdisciplinary collaboration by publications, on paper, on Internet, in video regarding science and art	Lack of funding for publications, video documental films, etc.	Actions scope: FFI, IG, ERS, PPAS, NSEAD and Observatory

6) (AIS) Actions to create an interaction structure				
Type	**Temporal and Spatial Scale**	**Opportunity**	**Obstacle to action implemention**	**Sphere of interaction**
Creation of the NSEAD Observatory to complement SEAD Network	Global, European, Regional and Local Continuous	General institutional coordination of all kinds of actions of NSEAD to fully protect interdisciplinary collaboration and assure the attainment of NSEAD's objectives	Lack of sensibility and resistance of institutions to organize a network due to fixed paradigms	IG, ERS

Conclusions

The aim of this white paper is to offer a tridimensional stakeholder-centred matrix in which 6 kinds of transdisciplinary actions are situated according to 4 stakeholders' scales articulated around 4 spheres of interaction in order to explore opportunities and obstacles of each action.

The matrix opens the possibility to classify transdisciplinary action in a grid of 96 possible situations that can be useful for analysing how transdisciplinary action is being achieved and to plan the future action that needs to be developed by each stakeholder within the scope of their aims, possibilities and responsibilities to produce a qualitative change in transdisciplinary practices.

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